L. P. ZONENSHAIN MEMORIAL CONFERENCE ON PLATE TECTONICS

Moscow
November 17–20, 1993

Programme and Abstracts

L. P. Zonenshain Laboratory of Paleogeodynamics,
Institute of Oceanology, Russian Academy of Sciences

GEOMAR – Research Center for Marine Geosciences
Christian-Albrechts-University, Kiel, Germany

Scientific Council of Plate Tectonics

L. P. ZONENSHAIN MEMORIAL CONFERENCE ON PLATE TECTONICS

SCHEDULE

	Hotel "Aksakovskie zori" – Conference Hall – Oral Sessions	Hotel "Rus" – Conference Hall – Oral Sessions	Hotel "Rus" – Hall – Poster Sessions
Wednesday 17, November 1993			
9.30–13.30	**SYMPOSIUM 1** L. P. Zonenshain Memorial Symposium		
14.30–18.30	**SYMPOSIUM 2** Mid-oceanic ridges	**SYMPOSIUM 9** Sedimentary basins	**SYMPOSIUM 5, 11** Poster Sessions
Thursday 18, November 1993			
9.30–13.30	**SYMPOSIUM 4** Tectonics, volcanism and hydrothermal activity of marginal seas	**SYMPOSIUM 6** Geology and plate tectonics of the Arctic region	**SYMPOSIUM 2, 3** Poster Sessions
14.30–18.30	**SYMPOSIUM 3** Subduction zones and terrane accretion	**SYMPOSIUM 7** Regional geology of the former USSR territory	**SYMPOSIUM 8A + B** Poster Sessions
Friday 19, November 1993			
9.30–13.30	**SYMPOSIUM 5** Plate boundaries of the former USSR territory	**SYMPOSIUM 8A** Paleogeography and environment	**SYMPOSIUM 4, 6** Poster Sessions
14.30–18.30	**SYMPOSIUM 8B** Radiolaria	**SYMPOSIUM 11** Geodynamics of the earth's interior	**SYMPOSIUM 9, 10** Poster Sessions
Saturday 20, November 1993			
9.30–13.30	**SYMPOSIUM 10** Intraplate tectonics and magmatism	**PALEOMAGNETIC WORKSHOP**	**SYMPOSIUM 7** Poster Session
14.30–18.30	**DISCUSSION**		

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In memoriam

Lev Zonenshain (1929-1992)

Lev Zonenshain was a prominent representative of Russian geosciences and at the same time an internationally oriented scientist, rich in perspectives, who has made important contributions to the geosciences in general. After graduating at the University of Moscow (1952) he was occupied with field work in several areas of the former USSR, for example in the Altai, East Kasachstan, Central Asia and Sibiria. At an early stage of his career he began to publish geological maps and reconstructions. He has made important contributions to the understanding of structure and evolution of the central Asian fault belts (synthesized in a thesis for the Doctor of Sciences in the year 1970).

Lev P. Zonenshain in February 1992 on the occasion of the first meeting of the GEOMAR Scientific Advisory Board. From left to right: Jean Francheteau, ***Lev P. Zonenshain,*** *Edward Boyle, Michael Sarnthein, William W. Hay, Olav Eldholm, Keith Cox*

The scientific career of Lev Zonenshain can be subdivided into several phases. As one of the first geoscientists in the USSR he accepted the novel idea of plate tectonics which forced him to rethink a considerable number of his own hypotheses. He did this very rapidly and he was able to introduce his ideas into the marine geosciences of the former Soviet Union after he had accepted a new job at the P. P. Shirshov Institute of Oceanology of the USSR Academy of Sciences in the year 1974. It was a great advantage that he had so much experience in the continental geology of Asia and northern Europe and that he was able to build a bridge between continental and marine geosciences.

As part of his scientific activities at the Shirshov Institute he conducted far reaching expeditions to the Pacific, Atlantic and Indian oceans; he used the deep-diving submersibles PISCES and MIR for extensive investigations of the mid-ocean ridge systems, of hydrothermal vents in the deep ocean and of submarine volcanoes. Towards the end of his career he continued these "deep-sea investigations" with studies of the deep structure of Lake Baikal. Each time he succeeded to formulate important new ideas based on his own studies and to gain a new insight into important properties of the solid earth. He transferred the concepts of paleoceanology to the continental geology and he established a reconstruction of the Ural paleo-ocean; at the same time he applied these new insights to the history of the Tethys ocean. The illustration of geological situations in maps, whether as tectonic maps or as paleogeographic atlases occupied the scientific productivity of Lev Zonenshain for many years, but during the past years he was also involved in theoretical considerations of the forces which drive the tectonic movements close to the surface of our earth. He developed a comprehensive concept of the geodynamics of the earth's interior and he was ready to do the first steps to start a new important chapter of his investigations. This last chapter could not progress rapidly because of Lev Zonenshain's illness.

He was one of the most important organizers of many important workshops in the USSR, he played a role as the founder of the Scientific Advisory Board for Plate Tectonics in Russia and as chairman of many international scientific meetings. Many who knew Lev Zonenshain in Russia and his activities in the international network of geo-sciences will remember him as a friendly, magnanimous personality always willing to help and always open for new ideas and discussions. The untimely death of Lev Zonenshain is a great loss for the international science community.

PROGRAMME

L. P. ZONENSHAIN MEMORIAL CONFERENCE ON PLATE TECTONICS

OVERVIEW

SYMPOSIUM 1
L. P. Zonenshain Memorial Symposium

Oral session Wednesdy 17, November 1993, 09.30-13.30, Hotel "Aksakovskie zori"

SYMPOSIUM 2
Mid-oceanic ridges (structure, petrology, geophysical fields)

Oral session Wednesdy 17, November 1993, 14.30-18.30, Hotel "Aksakovskie zori"

Poster session Thursday 18, November 1993, 09.30-13.30, Hotel "Rus"

SYMPOSIUM 3
Processes in subduction zones and terrane accretion

Oral session Thursday 18, November 1993, 14.30-18.30, Hotel "Aksakovskie zori"

Poster session Thursday 18, November 1993, 09.30-13.30, Hotel "Rus"

SYMPOSIUM 4
Tectonics, volcanism and hydrothermal activity of marginal seas

Oral session Thursday 18, November 1993, 09.30-13.30, Hotel "Aksakovskie zori"

Poster session Friday 19, November 1993, 09.30-13.30, Hotel "Rus"

SYMPOSIUM 5
Seismicity and neotectonics at the plate boundaries of the former USSR territory

Oral session Friday 19, November 1993, 09.30-13.30, Hotel "Aksakovskie zori"

Poster session Wednesdy 17, November 1993, 14.30-18.30, Hotel "Rus"

SYMPOSIUM 6
Geology and plate tectonics of the Arctic region

Oral session Thursday 18, November 1993, 09.30-13.30, Hotel "Rus"

Poster session Friday 19, November 1993, 09.30-13.30, Hotel "Rus"

SYMPOSIUM 7
Regional geology of the former USSR territory (folded belts, suture zones and continental rifts)

Oral session Thursday 18, November 1993, 14.30-18.30, Hotel "Rus"

Poster session Saturday 20, November 1993, 09.30-13.30, Hotel "Rus"

SYMPOSIUM 8 A
Paleogeography and environment

Oral session Friday 19, November 1993, 09.30-13.30, Hotel "Rus"

Poster session Thursday 18, November 1993, 14.30-18.30, Hotel "Rus"

SYMPOSIUM 8 B
Radiolaria: application for stratigraphy, paleogeography and paleotectonics

Oral session Friday 19, November 1993, 14.30-18.30, Hotel "Aksakovskie zori"

Poster session Thursday 18, November 1993, 14.30-18.30, Hotel "Rus"

SYMPOSIUM 9
Sedimentary basins: data and geodynamic models

Oral session Wednesdy 17, November 1993, 14.30-18.30, Hotel "Rus"

Poster session Friday 19, November 1993, 14.30-18.30, Hotel "Rus"

SYMPOSIUM 10
Intraplate tectonics and magmatism

Oral session Saturday 20, November 1993, 09.30-13.30, Hotel "Aksakovskie zori"

Poster session Friday 19, November 1993, 14.30-18.30, Hotel "Rus"

SYMPOSIUM 11
Geodynamics of the earth's interior

Oral session Friday 19, November 1993, 14.30-18.30, Hotel "Rus"

Poster session Wednesdy 17, November 1993, 14.30-18.30, Hotel "Rus"

PALEOMAGNETIC WORKSHOP

Oral session Saturday 20, November 1993, 09.30-13.30, Hotel "Rus"

Discussion

Saturday 20, November 1993, 14.30-18.30, Hotel "Aksakovskie zori"

SYMPOSIUM 1
L. P. Zonenshain Memorial Symposium

Oral session Wednesdy 17, November 1993, 09.30-13.30, Hotel "Aksakovskie zori"

Conveners: V.E. Khain and J. Thiede

09:30 Opening of the Conference

09:45 V.G. Kazmin, M.I. Kuzmin, A.A. Mossakovsky, and L.M. Natapov: L.P. Zonenshain: his life and scientific activity

10:30 V.E. Khain: Deep Earth's interior dynamics: status and perspectives

11:00 L.A. Savostin: Paleogeodynamic reconstructions

11:30 COFFEE BREAK

12:00 L.P. Zonenshain and K.A.W. Crook: Tectonic setting and plate tectonic evolution of the North Melanesian seas

12:30 L.I. Lobkovsky: Geodynamic models and conceptions

13:00 Chr. Scotese: Phanerozoic and Late Proterozoic plate tectonic reconstructions

SYMPOSIUM 2
Mid-oceanic ridges (structure, petrology, geophysical fields)

Oral session Wednesdy 17, November 1993, 14.30-18.30, Hotel "Aksakovskie zori"

Conveners: L.V. Dmitriev and I.M. Sborshchikov

14:30 W.G. Melson: Understanding sea floor-spreading centers: a thirty-years petrologic perspective

14:50 E. Bonatti: Thermal structure of the upper mantle below the Mid-Atlantic Ridge from petrological and geophysical evidences

15:10 L.V. Dmitriev, A.V. Sobolev, L.V. Danyushevsky, and K.S. Akchmetov: Segmentation of the Mid-Atlantic Ridge and its relation with pressure and water content of TOR (MORB) fractionation

15:30 F. Tessensohn: Geodynamic development of the Ross Sea Rift, Antarctica

15:50 J.F. Casey, S.A. Silantiev, W. Bryan, L.V. Dmitriev, and B. Basilev: Geochemical variations in basalts and residual peridotites along the Mid-Atlantic Ridge (0°-55°N): tectonic implication for ridge processes

16:10 A.V. Sobolev and N. Shimizu: Dynamics of the oceanic mantle melting: data on the primary melts investigation

16:30 COFFEE BREAK

17:00 N.L. Dobretsov, V.A. Simonov, V.Yu. Kolobov, and S.V. Kovyazin: Oceanic lithosphere formation in slow spreading ridges of the Central Atlantic

17:20 H. Bougault: Mantle exposures and methane outputs along the Mid-Atlantic Ridge

17:40 S.V. Aplonov, and A. Trunin: Sub-axial asthenospheric flow as a cause of diverging plate boundaries activity migration

18:00 A.A. Bulichev, A.G. Gainanov, T.P. Fedorova, and E.L. Mazo: Structural pattern of the geoid anomaly of MAR between Ascention and St. Helena transform zones

18:15 I.M. Poroshina, D.S. Rozhdestvensky, and V.I. Timofeev: Tectonics of the axial part of the Mid-Atlantic Ridge between 15°20'N and 19°50'N

Poster session Thursday 18, November 1993, 09.30-13.30, Hotel "Rus"

P. Passerini: Rift parallel strike-slip faulting in Iceland

Yu.G. Zorina, E.G. Mirlin, Yu.V. Mironov, and I.A. Pshenina: Sea floor-spreading on mid-ocean ridges and in marginal basins: a comparative analysis

A.K. Bogolepov, D.V. Kolos, I.J. Frantsuzov, and S.I. Shkarubo: Tectonics of the North-Atlantic Ridge: results of research from the Canary-Bahama geotraverse

S.P. Maschenkov: Tectonics of the western MAR flank and Kane fracture zone intersection based on geophysical data interpretation

N. Sochevanova, S. Mercouriev, and Ph. Patriat: Which model for the evolution of the Carlsberg Ridge between 20 and 45 Ma (anomalies 6 to 22)?

E.G. Zhemchuzhnikov: Mechanism of short-period pulsation of oceanic spreading

E.I. Suetnova and T.M. Fedorova: Upper mantle density inhomogeneities along the crest of East Pacific Rise: thermal consequences

O.I. Komarova: Morphotectonics and magnetic heterogeneities of oceanic lithosphere of the Mid-Atlantic Ridge in the area of the Angolo-Brasilian geotransect

N.M. Sushchevskaya and L.P. Volokitina: The Mid-Atlantic Ridge (0°-15°N): tectonic, petrochemical and geochemical aspects of its segmentation

T.I. Tsekhonya and N.M. Sushchevskaya: Computer simulations of isobaric crystallization processes of tholeiitic melts: South Mid-Atlantic Ridge

R. Magakyan, O.P. Tsameryan, and N.N. Kononkova: Petrology and geochemistry of the Hayes and Petrov fracture zones magmatism (North Atlantic)

E.P. Dubinin and Yu.I. Galushkin: Formation and evolution of magma chambers in the mid-oceanic ridge rift zones

V.V. Nikulin and N.M. Sushchevskaya: Postrifting magmatic activization in the eastern part of Indian Ocean: petrogeochemical confirmation

A.V. Sobolev and M. Chaussidon: H_2O in primary mantle derived magmas and in their sources: geodynamic consequences

M. Chaussidon and A.V. Sobolev: Boron isotopy in the primitive mantle derived magmas: geodynamic consequences

V.I. Bagin, T.S. Gendler, and O.B. Polischook: Magnetic properties of metalliferous sediments from the East Pacific Rise axial zone (20°30'-22°00'S)

T.S. Gendler, D.M. Pechersky, and Z.V. Sharova: Magnetic properties of massive sulphide deposits (Holes 856 G, 856 H)

K.V. Popov: Comparative analysis of the magnetic properties of basalts from the Mid-Atlantic and Juan de Fuca Ridges

A.O. Mazarovich: Segmentation of the tropical Atlantic ocean crust and the structure of transform faults

SYMPOSIUM 3
Processes in subduction zones and terrane accretion

Oral session Thursday 18, November 1993, 14:30-18:30, Hotel "Aksakovskie zori"

Conveners: B.V. Baranov and R. von Huene

14:30	W.W. Hay, C.N. Wold, and K.M. Wilson: Kinematic relations between terranes of Western North America and Siberia
14:50	B.V. Baranov, N.I. Seliverstov, and E.I. Pristavakina: Kurile-Kamchatka subduction zone: some aspects of its structure, seismicity and geodynamics
15:10	S.A. Fedotov, L.S. Shumilina, and G.V. Chernyshova: Seismicity pattern of the Kamchatka and Komandorsky Islands according to detailed investigations during 1962-1990.
15:30	V.P. Zinkenich and N.V. Tsukanov: Accretionary tectonics and geodynamics of Kamchatka
15:50	G.P. Avdeiko and O.N. Volynetz: Fluids in the Kurile Island Arc subduction zone: estimates from magma genesis models
16.10	D. Klaeschen, R. von Huene, I. Belykh, H. Gnibidenko, and S. Patrikeyev: Structure of the Kurile Trench from seismic reflection records
16:30	COFFEE BREAK
17.00	R. von Huene and D. Klaeschen: Structure of the Japan Trench convergent margin
17.20	L.M. Parfenov: Accretion tectonics of Northeast Asia: main trends in its tectonic evolution
17:40	R. Oberhänsli, M. Michard and B. Goffe: High pressure rocks in Oman: a metamorphic core complex after obduction and island arc collision?

S.M. Tillman and V.D. Chekhovich: Distribution and development of accretionary systems in the northwestern margin of the Pacific Ocean

V.P. Pan and Yu.P. Zmievsky: Geodynamics of the junction zones of the Pacific plate and the continental margin

H. Aoki: The palaeo-Benioff zone of the Izu-Bonin-Mariana Island Arc

N.I. Seliverstov and B.V. Baranov: Extensional tectonics of the far West Aleutian Arc

V.N. Patrikeev and V.L. Lomtev: New data on the structure of the Cenozoic sediment cover on the Northwest Pacific plate near the Kuril Trench

V.A. Ermakov: Formation and evolution of the Kurile Arc

A.Yu. Antonov: Geochemistry of Cretaceous-Paleogene magmatic rocks from the Lesser Kurile Islands Ridge and the dynamics of their formation

B.G. Golionko and M.V. Kononov: Evolution of the stress field of the Lesser Kurile Islands

B.G. Golionko and M.V. Kononov: Composition and structural position of the chaotic complex on the Shikotan Island (Lesser Kurile Islands)

N.V. Tsukanov and V.P. Zinkevich: Tectonic structure and origin of the Vetlovsky complex of Eastern Kamchatka

G.I. Bondarenko, S.J. Sokolov, and N.B. Kuznetsov: Transformation of mafic to sialic crust at convergent plate margins (an example from Kamchatka)

N.I. Filatova and V.S. Vishnevskaya: Structure of Mesozoic terranes from the West Kamchatka-Koryak accretional orogenic belt: undisturbed paleostructures or nappe systems?

O.V. Astrakhantsev and V.G. Batanova: Intrusive magmatism of the intraoceanic underthrusting zone: evidence from mafic-ultramafic plutons of the Olyutor accretionary terrane

A.K. Khudoley and S.D. Sokolov: Geometry and evolution of the West Koryakia accretionary structures

A.V. Fedorchuk: High-grade metamorphic terrane of Eastern Kamchatka: possible evidence for island arc collision

A.V. Fedorchuk: Pre-Cretaceous and Cretaceous oceanic fragments of Kamchatka: basalt geochemistry evidence for their possible origin from DUPAL area

A.A. Kovaljev and E.I. Leonenko: Accretion prism and heaping zones of the oceanic crust

V.A. Simonov, S.V. Kovyazin, and V.Yu. Kolobov: Petrogenesis conditions in supra-subduction zones

O.Yu. Khodyrev: Subduction process of serpentinites: stability of hydrous minerals in a sinking slab (based on experimental data)

K.A. Krylov, S.D. Sokolov, V.N. Grigoriev, V.G. Batanova, and A.A. Peyve: Ophiolites (serpentinite) melange in the structure of the Koryak Highland

P.I. Fedorov: Geochemistry and origin of Cenozoic volcanic rocks from the Eastern Koryak highland

SYMPOSIUM 4

Tectonics, volcanism and hydrothermal activity of marginal seas

Oral session Thursday 18, November 1993, 09.30-13.30, Hotel "Aksakovskie zori"

Conveners: N.A. Bogdanov, A.P. Lisitzin, and A. Malahoff

09:30	A.P. Lisitzin: Endogenic matter in modern and old oceans
09:50	Yu.V. Mironov, E.G. Mirlin, Yu.G. Zorina, T.M. Papesko, and A.L. Kotljar: Evolution of volcanic and sulfide ore formation in modern and ancient marginal seas
10:10	E.G. Gurvich: Problems and study of recent and ancient metalliferous sediments of the world ocean
10:30	Yu.A. Bogdanov, A.P. Lisitzin, K.G. Muraviov, K.A.W. Crook, R.A. Burns, and A. Malahoff: Ore formation in the back-arc spreading zone of the western part of the Pacific Ocean
10:50	B.Ya. Karp, V.N. Karnaukh, E.P. Lelikov, and V.T. S'edin: Tectonics of the Urdaneta Plateau, West Philippine Basin
11:10	G.M. Valyashko and G.E. Cherniawsky: Evolution and tectonics of the Komandorsky Basin (Bering Sea) based on the study of magnetic anomalies
11:30	COFFEE BREAK
12:00	N.A. Bogdanov: Tectonic map of the Mediterranean Sea
12:20	K. Kaleda and K. Krylov: Composition, geodynamic setting and origin of the Cyprus umbers
12:40	M. Lordkipanidze, K. Buadze, and L. Kvalishvili: Types and volcanic evolution of back arc basins
13:00	S.K. Zlobin, I.K. Pustchin, I.A. Tatarin, and Yu.A. Konovalov: New data on the magmatic geology of the South New Hebrides Arc (Hunter Fracture Zone) and the adjacent North Fiji Basin
13:15	A.G. Ryabukhin: Rift structures of small lithospheric plates from the Circum-Pacific Ring

Poster session Friday 19, November 1993, 09.30-13.30, Hotel "Rus"

D.V. Rundkvist and A.P. Lisitzin: Sulfide ores in recent and ancient basins

V.M. Kuptsov: Geochemical indicators in geodynamics

A.A. Kovaljev and E.I. Leonenko: Exhalative processes at the oceanic bottom

V.N. Karnaukh and B.Ya. Karp: Tectonic evolution of the Western Japan Sea

P.P. Loyter, S.K. Zlobin, I.K. Pustchin, and A.N. Golovan: Geological structure of the South New Hebrides Arc (Hunter Fracture Zone) as evidenced from joint interpretation of magnetic and petrological data

M. Lordkipanidze and A. Tvalchrelidze: Volcanism, hydrothermal activity and metallogeny of the back arc basins of the Mediterranean Belt

E.A. Starshinova: Inhomogeneities in the deep structure of the Philippine Sea

E.V. Verzhbitsky: A diffuse spreading rate and lithospheric composition in a back-arc basin interpreted from geothermal data (Tyrrhenian Sea)

V.V. Maslennikov: Reconstructions of rift valleys in volcanogenic arcs of the Uralian paleocean

K.G. Muraviov, E.V. Bibikova, V.V. Serova, and S.T. Yakimenko: Comparison of the material composition of oceanic ores from different geodynamic settings and their relation to the composition of rocks from the 1st and 2nd layer of the oceanic crust

Yu.P. Neprochnov, G.M. Valyashko, O.V. Levchenko, G.A. Semenov, and G.E. Cherniawsky: Inhomogeneity of the earth's crust and back-arc spreading in the Komandorsky Basin (Bering Sea)

V.V. Zaykov, V.V. Maslennikov, and E.V. Zajkova: Criterions for establishing regularities in the distribution of paleohydrothermal fields for Paleozoic marginal seas from the Urals and Siberia

E.P. Shirai and S.T. Ageeva: Paleobasins of spreading interarc zones and double island arcs (evolution and metallogeny)

E.I. Filatov and E.P. Shirai: Metallogenic zonality of marginal seas and island arcs

S.G. Tesalina and V.V. Maslennikov: Complete clastation of some sulfide mounds on the bottom of the Urals paleocean

SYMPOSIUM 5

Seismicity and neotectonics at the plate boundaries of the former USSR territory

Oral session Friday 19, November 1993, 09.30-13.30, Hotel "Aksakovskie zori"

Conveners: Yu.K. Shchukin and A.V. Lander

09:30	Yu.K. Shchukin: New ideas about seismotectonics of Northern Eurasia
09:50	V.I. Makarov: Modern geodynamics of Northern Eurasia
10:10	V.G. Trifonov: Active faults of Eurasia
10:30	L.M. Rastsvetaev: The greatest shear zones of Central Eurasia: geodynamic origin and seismotectonic importance
10:50	S.I. Sherman: Faulting at interplate boundaries and morphology of seismic belts
11:10	M.A. Baer: On the geodynamics of the Alpine-Carpathian-Dinarides region
11:30	COFFEE BREAK
12:00	Sh.A. Adamia, S.I. Kuloshvili, and G.Sh. Shengelaia: Seismicity of the Caucasus and its relation to plate margins
12:20	F.N. Yudakhin and T.Ya. Belenovich: Recent geodynamics of Tien-Shan's lithosphere
12:40	A.V. Lander and B.G. Bukchin: Tectonic position and source parameters of the Koryakiya (Khailino) earthquake, March 8, 1991, and its relation to the problem of the present day existence of the Beringia plate
13:00	I.V. Ananin: Seismicity of the platform regions of the former USSR territory

Poster session Wednesdy 17, November 1993, 14.30-18.30, Hotel "Rus"

L.M. Rastsvetaev, L.A. Sim, T.Y. Tveritinova, M.Y. Nikitin, and K.M. Bahor: Tectodynamic and seismotectonic conditions of the formation of the Crimea Mountains structure

V.V. Yudin: Structural-geodynamical model of the Crimea and its seismicity

N.V. Koronovsky and V.N. Vadkovsky: Seismicity model of the Aegean-Anatolian-Caucasus region

A.L. Aleinikov, O.W. Bellavin, W.S. Druzhinin, B.P. Rizhiy, G.P. Parigin, and F.F. Yunusov: Seismicity and Neogene-Quaternary tectonics of the linked zone of the Urals and the East-European Platform

V.Yu. Timofeev, D.G. Gridnev, Yu.K. Sarycheva, L.V. Anisimova, and S.F. Panin: Observed strains and tilts at the Baikal rift zone (from observations with extensometers and tiltmeters)

B.I. Kim: Seismic zones of the Laptev margin plate and their continental and ocean projection

V.A. Basisty: The role of neotectonic environment in the development of thick frozen rocks

A.V. Vikulin and A.G.Ivanchin: A model of inertial earthquake's source

SYMPOSIUM 6

Geology and plate tectonics of the Arctic region

Oral session Thursday 18, November 1993, 09.30-13.30, Hotel "Rus"

Conveners: L.A. Savostin and J. Thiede

09:30 J. Thiede, A. Myhre, and ODP Leg 151 Shipboard Scientific Party: Recent advances in Arctic deep-sea drilling (ODP Leg 151)

09:50 L.A. Savostin and S.S. Drachev: Tectonic structure and evolution of the Laptev Sea shelf

10:10 S.S. Drachev, L. Johnson, L.A. Savostin, and J. Thiede: Laptev Sea drilling plans

10:30 C.N. Wold, W.W. Hay, W.-Chr. Dullo, and J. Thiede: Origin and controls of high late Cenozoic global ocean sediment fluxes

10:50 L.A. Lawver: The Iceland hotspot: tail for the Siberian traps?

11:10 V.J. Glebovsky and L.C. Kovacs: The adjustment of aeromagnetic data in the deep Amerasian Basin for mapping and geological interpretation

11:30 COFFEE BREAK

12:00 L.A. Savostin, L.I. Lobkovsky, and I.A. Melnikov: Institute of Oceanology Arctic program presentation

12:20 R.A. Stephenson: Implications for Canada Basin development from the crustal structure of the Southern Beaufort Sea-McKenzie Delta area

12:40 A. Grantz, S.D. May, M.W. Mullen, L.B. Gray, and J.S. Lull: Northwind Ridge: a continental fragment isolated by Tertiary rifting in the Amerasian Basin, Arctic Ocean

13:00 S.B. Sekretov: The junction of Gakkel oceanic ridge and the Laptev Sea continental margin: general tectonic features according to multichannel seismic profiling data

13:15 Y. Kristoffersen, W. Jokat, and E. Weigel: Seismic reflection profiles from the Eastern Arctic deep-sea and from Lomonosov Ridge

Poster session Friday 19, November 1993, 09.30-13.30, Hotel "Rus"

S.P. Price and A.G. Whitham: The Mols Bjerge fault block, East Greenland - an exhumed hydrocarbon trap

D.G. Baturin: Fram Strait area

S.B. Sekretov: The continental margin north of the East Siberian Sea: some geological results and conclusions based on CDP seismic-reflection data

V.R. Tumanov, Yu.V. Safonov, V.D. Gabyshev, and V.A. Namolov: Geological interpretation of geophysical data for the Siberian platform, Laptev continental-marginal plate, and Verkhoyansk-Kolyma fold system

A.P. Simonov: Geodynamics of the Laptev Sea shelf

A.P. Simonov: Geodynamic model for the formation of the South Kara basin

A.P. Simonov: Geodynamic model for the formation of the South Barents basin

A.L. Piskarev, A.V. Manukhova, and M.Yu.Chernishev: Petrophysical models of the Arctic Sea basins as a key to the geophysical field interpretations and paleogeodynamical study of the region

M.K. Kos'ko: Geology of the New Siberian Islands: constraints on paleogeodynamic reconstructions

Yu. Malyutin and M. Kavoun: New data from the Shtokman gas field based on detailed gravity and magnetic surveys

S.V. Aplonov: Determination of the age of paleo-oceanic crust based on magnetic and paleomagnetic data: new examples from the deep sedimentary basins of the Russian Arctic shelf

SYMPOSIUM 7

Regional geology of the former USSR territory (folded belts, suture zones and continental rifts)

Oral session - Thursday 18, November 1993, 14.30-18.30, Hotel "Rus"

Convener: N.V. Koronovsky

14:30	M.G. Lomize: Origin, evolution and interplay of the main suture zones in the Tien-Shan
14:50	G.S. Gusev and A.I. Peskov: East Transbaikalia ophiolites
15:10	S.L. Kostiuchenko: A continental plate tectonic model of the Timan-Pechora province based on an integrated deep geophysical study
15:30	V.S. Fedorovsky, D.A. Ryabukhin, and K.H. Avakyan: Tectonics of the Yona collision zone (North-Western Belomorian)
15:50	J. McCall: Mesozoic to Eocene inner ocean of South and Central Iran and the associated microcontinents: a new insight
16:10	R.G. Garetsky and G.V. Zinovevko: Paleotectonics of the East European craton in the context of geodynamic processes in the Teisseyre-Tornquist suture zone
16:30	COFFEE BREAK
17:00	A.M.C. Sengor, B.A. Natal'in, and V.S. Burtman: Collage assembly and crustal growth in the Altaids
17:20	G.S. Gusev and V.E. Khain: On relationships between three composite terranes of Transbaikalia: Baikal-Vitim, Aldan-Stanovoy and Mongolo-Okhotsk
17:40	V.A. Koroteev and V.M. Necheukhin: Subduction and accretion paleogeodynamic systems of the Urals orogen
18:00	A.K. Sokolowsky, V.Ya. Fedchuk, and A.K. Korsakov: Geodynamic reconstruction of the Early Proterozoic Unahinsky greenstone belt (Stanovoy region of the Aldan shield)
18:15	Sh.A. Adamia, A.O. Chabukiani and Z.A. Kutelia: Accretionary tectonics along present subduction zones and their paleoanalogues

Poster session - Saturday 20, November 1993, 09.30-13.30, Hotel "Rus"

V.M. Grannik: Evolution of magmatic and tectonic processes during the Mesozoic formation of the Sakhalin geologic structure

M.I. Grudinin, A.M. Mazukabzov, and I.A. Demin: Ophiolites surrounding the Muya block

A.M. Mazukabzov, M.I. Grudinin, and I.A. Demin: Riphean ophiolite belt in the folded margin of the Siberian platform

R.M. Yurkova and B.I. Voronin: Bimetasomatosis and ophiolite geodynamics in the northwestern Pacific margin

V.D. Brezhnev: Variscan terranes and sutures in Europe

D.V. Alexeiev: The Caledonian thrust-folded structure of Karatau (South Kazakhstan) as a result of the collision of two sialic terranes

S.V. Rasskazov: Space-time variations of tectonic paleostress in the volcanic fields of the Baikal rift system: A reflection of compression in plate boundaries?

V.N. Gubin: Neogeodynamic model of the western Russian platform

E.V. Sklyarov, V.G. Belichenko, A.M. Mazukabzov, A.I. Mel'nikov, and T.V. Donskaya: Indicators of postcollisional extensional processes in folded systems of southern Siberia

V.N. Sharov: Geodynamic setting of Precambrian sedimentation during the formation of Bodaibo trough

S.G. Rudakov: Adjacent tectonic boundaries in the Late Proterozoic-Early Paleozoic evolution of the North Atlantic, Mediterranean and Urals-Okhotsk mobile belts

N.B. Kuznetsov: Late Mesozoic/Early Cenozoic evolution of the NW Pacific margin

V.G. Pastukhov and S.D. Lepki: The Proterozoic paleoceanic peripheral belt of the western East-European platform: structural peculiarities and geodynamic history

D.I. Garbar: Geodynamics of the Svecofennides (Baltic shield)

D.I. Garbar: Evolution of the north-western part of the East-European platform (Baltic shield and its surrounding structures)

I.V. Kozyreva: Ancient sutures in East Siberia: petrological aspects

A.M. Kourtchavov: Transform faults in orogenic volcanic belts

K.O. Sobornov: Structure of the Dagestan thrust belt (north-eastern Caucasus, Russia)

L.A. Sim, A.N. Sysoev, A.B. Volkov, and V.A. Petrov: Postcollisional development of the geology and geodynamics of the Urals

M.E. Kazimirov: Transbaikalian lateral-temporal regularities of evolution and geochemistry of magmatic rocks (Nercha-Ingoda rift zone)

L.I. Krasnyi: Tectonics of the Amur region according to Russian-Chinese investigations

E.V. Khain and A.S. Gibsher: Obduction zones of ophiolites and sutures of the Southern Siberian platform

M.V. Mints: The integrated pattern of the Early Precambrian evolution of the northeastern Baltic shield

S.V. Aplonov and G. Shmelev: Geophysical diagnosis of the sutures in the Timan Pechora basement

V.G. Pastukhov, S.S. Kruglov, and S.D. Lepki: Geodynamic evolution of the Ukrainian Carpathians

L.M. Natapov, G.M. Dobrov, N.S. Pososhkova, and N.A. Yablonskaya: Geodynamic map of the Pamirs and Tien Shan at the scale 1:1.000.000

N.A. Yablonskaya: Cenozoic structure of Tien Shan, Central Kyzyl-Kum and the Pamirs

T.N. Surin: Geodynamics and paleovolcanic activity of the Magnitogorsk paleovolcanic belt (South Urals)

A.S. Baluev, B.V. Malkin, A.A. Murav'ev, V.I. Fomin, and V.G. Kazmin: Some aspects of the geodynamics of the Baikal Rift zone: results from remote sensing studies

G.L. Kirillova: Mesozoic-Cenozoic intracontinental rift basins of East Asia: their structure and evolution

V.S. Oxman and A.V. Prokopiev: Transpressional and collisional structures of the Chersky Range

M.H. Gagiev, G.E. Bondarenko, O.L. Morozov, and A.P. Stavsky: Median massifs on the eastern side of the Verkhoyano-Chukotska fold-area: terranes or fragments of Asia?

V.V. Yudin and M.E. Gerasimov: Geodynamics of the Crimea and adjacent seas

M.E. Gerasimov: Geodynamic reconstructions of the Black Sea region based on seismic stratigraphy

Yu.V. Arkhipov, K.A. Visotsky, E.K. Elistratova, A.T. Kalinin, and V.A. Philipova: Deformations of the continental lithosphere of the East-European platform

N.T. Romanov: Geodynamical conditions for the formation of the diabase belt of the Greater Caucasus

K.A. Krylov, K.G. Kaleda, and N.Yu. Bragin: Structure of South-Western Cyprus

M.N. Zakharov, V.V. Konusova, and E.V. Smirnova: Geochemical features of Cenozoic volcanics from the Anadyr depression

A.A. Bukharov, N.L. Dobretsov, L.P. Zonenshain, and V.A. Fialkov: Geological structure of the bottom of Lake Baikal based on underwater investigations

Yu.A. Zorin, V.G. Belichenko, E.Kh. Turutanov, P. Khosbayar, O. Tomurtogoo, and N. Arvisbaatar: Baikal-Mongolia transect and accretion of the Asiatic continent in the Paleozoic

V. Segalovich: Integrated geophysical and geodynamical interpretation of the Urals and adjacent basins using superdeep boreholes

A.T. Korolkov, S.N. Kovalenko, and V.G. Gladkov: Collisional structural paragenesis of the Muya region (North-Baikal Upland)

V.G. Stepanets: Geology and geodynamics of ophiolites from north-east Central Kazakhstan

A.S. Yakubchuk, K.E. Degtyarev, and A.F. Chitalin: Traces of Caledonian strike-slip faults in central Kazakhstan

S.M. Aleksandrov: Morphostructural evolution of continental-oceanic and intra-continental sutural zones

E.B. Glevassky: Precambrian sutural zones of the southwest segment of the East European platform

A.V. Ryazantsev: Relicts of a divergent margin in the Caledonides of the Bayankhongor zone, Mongolia

A.N. Demin: Suture zones in continental crust of Central Asia

S.S. Schultz jr.: Connection between genesis of granites and metallogenesis in the Urals - Tien Shan Variscan orogen

A.I. Rusin: Continental rift metamorphism

I.I. Abramovich: Genetic systematics of collision magmatism

K.A. Krylov, V.N. Grigoriev, P. Layer, A.M. Heiphets, and W.P. Harbert: A record of two geodynamic situations in a single ophiolite sequence (Gankuvayam nappe, Kuyul ophiolite terrane, Northern Kamchatka)

M.E. Artemjev, V.A. Kucherinenko, and V.M. Gordin: Gravity field structure, isostasy and subcrustal density inhomogeneities in Northern and Central Eurasia

SYMPOSIUM 8 A
Paleogeography and environment

Oral session Friday 19, November 1993, 09.30-13.30, Hotel "Rus"

Conveners: V.G. Kazmin and L.M. Natapov

09:30 V.G. Kazmin and L.M. Natapov: A new paleogeographic project in Russia

09:50 N.A. Yasamanov: Geochronology and cyclicity of tectonic events in connection with astronomic data

10:10 V.G. Kazmin, A.A. Shreider, and V.A. Luigin: Tectonic history of the Black Sea

10:30 G.S. Zakariadze, O.G. Bogdanovsky, S.F. Karpenko, A.L. Knipper, E. Yagotz, and V.S. Vishnevskaya: Accretional structure of the Lesser Caucasus ophiolite zone based on geochemical and geochronological data

10:50 S.V. Popov, I.G. Scherba, and A.S. Stolyarov: Paleogeographical maps of of the Paratethys (late Eocene-Pliocene)

11:10 V.N. Puchkov: Main paleogeographic features of the Urals and the adjacent areas of the East European platform in the Late Proterozoic and Phanerozoic

11:30 COFFEE BREAK

12:00 L.F. Volchegursky, T.V. Vladimirova, I.N. Kapustin, and L.M. Natapov: Paleozoic history of the North Caspian Depression

12:15 A.Yu. Egorov: Triassic paleogeography of North-East Asia

12:30 K.L. Kleshevich and A.N. Khramov: Paleozoic paleogeodynamic reconstructions of Tien-Shan

12:45 V.G. Belichenko, He Guogi, L.P. Karsakov, Maosong Li, B.A. Natal'in, E.V. Sklyarov, and O. Tomurtogoo: Geodynamic map of the paleo-Asian Ocean (eastern part)

13:00 V.S. Vishnevskaya: A new version of the sedimentary basin model for the Domanik-type deposits:

13:15 L.P. Zonenshain, A.N. Balukhovsky, M.Yu. Lebedeva: Impulses of absolute plate motions during the last 150 m.y. and their correlation with changes in global sedimentation rates

SYMPOSIUM 8 B

Radiolaria: application for stratigraphy, paleogeography and paleotectonics

Oral session Friday 19, November 1993, 14.30-18.30, Hotel "Aksakovskie zori"

Conveners: P. De Wever, V.S. Vishnevskaya, and S.B. Kruglikova

14:30	P. De Wever, J. Azema, and E. Fourcade: Radiolarians and radiolarites: from primary production to paleogeography
14:50	J.C. Aitchison: Radiolarians, a key to contrasting the tectonic evolution of orogenic zones worldwide: examples of their application and suggestions of future potentials
15:10	V.S. Vishnevskaya: Important radiolarian events of the north-western Pacific region
15:30	N.Yu. Bragin: Boreal radiolarian assemblages of the Triassic and Jurassic and their significance for tectonic and paleogeographic interpretations
15:50	I.E. Khokhlova: Paleogene radiolaria of the North Tethys: taxonomic composition and paleoecological reconstructions
16:10	S.B. Kruglikova: High-rank taxa of Radiolaria as an indicator of paleoenvironment
16:30	COFFE BREAK
17:00	M. Marcucci: Jurassic radiolarian cherts in the Northern Apennines
17:20	M.S. Afanasieva: Possible reasons for the appearance, biomineralization and fossilization of radiolarian siliceous skeletons and paleobiogeographic reconstruction for the Early Permian
17:40	A. Ormiston: Using Paleozoic radiolarians to define paleolatitudes and identify allochthonous terranes
18:00	A. Matul: Paleoceanographic changes in the northern North Atlantic for the last 13 Ka interpreted from radiolarian data (core MK-340, Reykjanes Ridge)
18:15	S.V. Tochilina: Comparative characteristics of a Middle Miocene hiatus in the Philippine Sea based on DSDP data, Leg 59, Site 126

SYMPOSIUM 8 A, 8 B

Poster sessions Thursday 18, November 1993, 14.30-18.30, Hotel "Rus"

I.B. Philippova, L.I. Kulikova, O. Suetenko, S.M. Kalimulin: First set of maps for the Paleogeographic Atlas of Northern Eurasia

A.A. Fedotova: Carbonate shelf destruction related to the closure of marginal basins (southeastern part of Eastern Sayan)

B.V. Malkin: Geodynamic nature of geomorphological cycles

D.I. Vitukhin: Radiolarians and their paleoenvironments in the Cenozoic deposits of far eastern Russia

V.S. Vishnevskaya: Late Cretaceous radiolaria of the Russian platform and comparison with the same faunas from Tethyan and Pacific regions

V.T. Krimsalova: Radiolarian assemblages from the Raritkin Ridge (North Eastern Russia) and their paleogeographic affinity

N.Yu. Bragin and L.G. Bragina: Radiolarian biostratigraphy of Upper Cretaceous deposits in southwestern Cyprus

S.B. Kruglikova and M.S. Barash: The stratigraphy of Cenozoic sediments and the age of manganese nodules in two areas of the Clarion-Clipperton province in the Pacific Ocean

T.N. Shikova and V.S. Vishnevskaya: Campanian to early Maastrichtian radiolaria from carbonaceous lenses of the Olyutor Ridge (Koryak Upland, Russia)

L. Oleinik: Some assemblages of Jurassic radiolaria from Primorye (far eastern Russia)

O.L. Smirnova: Lower and Middle Jurassic radiolaria of the South Sikhote-Alin

L.B. Tikhomirova: New siliceous biostratigraphy of the Gorinsky synclinorium (far eastern Russia) based on radiolarian data

L.I. Kasintsova: Radiolaria from Albian terrigeneous-carbonate rocks of eastern Europe

R.Kh. Lipman: The first Russian investigation of radiolarians from deepwater sediments of the NW Pacific and their significance

E.V. Ivanova, A.A. Ivanova: Neogene paleogeodynamic reconstructions and climatic zonation of the Indian Ocean: New results based on ODP data

V.A. Krasheninnikov, G.Kh. Kazarina, S.B. Kruglikova, V.V. Mikhina, and M.G. Ushakova: Use of planktonic microfossils for the study of stratigraphy of deposits and paleoenvironment of the East Pacific Rise and the Galapagos spreading zone in Pliocene-Quaternary time

I.G. Scherba: Paleogeography and tectonics of the Paleogene basin of the Caucasus

L.P. Volokitina and A.P. Sedov: Main morphological features of paleocean relief

O.S. Stupka: A model for the Early Mesozoic evolution of the Carpathian - Black Sea segment of the continental margin of the Tethys ocean

I.G. Pralnikova: Jurassic radiolarians from the Kingiveem volcano-sedimentary complex (Kuyul ophiolites, Talovka-Pekulney zone, NE Russia) as an indicator of palaeolatitude

E.B. Glevassky and G.I. Kalyaev: Iron-cherty formations as indicators of geodynamic situations

V.P. Aparin and O.P. Zolotova: Analysis of time series data for geodynamic processes

S.S. Schultz jr.: Remote sensing information for the study of recent crustal movements

M. Antadze: Jurassic - Early Cretaceous radiolaria in alkali volcano-sedimentary series of the Lesser Caucasus and Eastern Pontides

Yu.V. Agarkov: Radiolarian potential of the Pre-Caucasus

I.A. Basov and A.Yu. Gladenkov: Cenozoic biostratigraphy of the Subarctic Pacific (ODP, Leg 145)

SYMPOSIUM 9
Sedimentary basins: data and geodynamic models

Oral session Wednesdy 17, November 1993, 14:30-18.30, Hotel "Rus"

Conveners: L.I. Lobkovsky and R. Stephenson

14:30 A.M. Nikishin, E.E. Milanovsky, P.A. Ziegler, L.I. Lobkovsky, S. Cloetingh, and P.A. Fokin: Devonian rifting along the eastern and south-eastern margins of the European paleocontinent

14:50 R.G. Garetsky, R.Ye. Aizberg, G.V. Zinovenko, and K.N. Monkevich: Post-Variscan sedimentary basins in the East-European Craton West and their connection with global geodynamic events

15:10 V.A. Koroteev, K.S. Ivanov, and A.V. Maslov: Riphean and Early Paleozoic sedimentary basins of the eastern margin of the Russian platform and the Urals

15:30 M.A. Baer and Yu.K. Schukin: Conditions of formation of sedimentary basins on the East and West European platforms

15:50 B.A. Sokolov and A.I. Konyukhov: Sedimentary basins of continental margins: sedimentary processes, deformation and petroleum potential

16:10 B.M. Naimark, A.T. Ismail-zadeh, and L.I. Lobkovsky: A quantitative model of subsidence mechanism in intracratonic basins: its application to North American examples

16:30 COFFEE BREAK

17:00 N.V. Lopatin and Yu.I. Galushkin: Models of oil and gas generation in the northern subbasin of West Siberia

17:20 I.A. Garagash, V.N. Nikolaevski, and V.N. Shacilov: Anomaly stresses in zones of hydrocarbon deposits of the North Caspian region

17:35 N.V. Koronovsky, L.V. Panina, A.I. Guschin, A.N. Stafeev, and V.O. Mikhailov: History of formation and geodynamics of the Tersko-Caspian foredeep (North Caucasus)

17:55 V.S. Shein, D.A. Astafyev, and A.G. Kuznetsov: Geodynamic criteria of oil-gas potential evaluation

18:15 L.E. Levin: Plate tectonics and evolution of the sedimentary basins of the marginal seas of Asia

D.L. Fedorov, V.B. Svalova, A.V. Lobusev, and Yu.B. Silantyev: Sedimentary basins of the Russian platform and forecasting their petroleum potential

V.A. Ignatova: Geodynamic and paleogeothermic conditions of formation and prediction of oil and gas accumulations in the Amu-Daria Basin

O.V. Levchenko: Thickness and structure of the distal Bengal fan sediments: tectonic implications

E.A. Levkov, R.G. Garetsky, A.K. Karabanov, and R.Ye. Aizberg: Genesis of the Baltic basin: exaration or tectonics?

E.E. Milanovsky, A.V. Furne, A.M. Nikishin, L.I. Lobkovsky, and S. Cloetingh: East European platform: history and geodynamics of the Riphean rifting

A.M. Nikishin, S.N. Bolotov, S. Cloetingh, A.V. Ershov, V.E. Khain, N.N. Kurdin, L.I. Lobkovsky, E.E. Milanovslky, B.P. Nazarevich, D.I. Panov, L.M. Rastsvetaev, and K.O. Sobornov: The North Caucasus sedimentary basin: stages of its development and geodynamical history

A.M. Nikishin, L.I. Lobkovsky, S. Cloetingh, and O.A. Egorshin: Triassic West Siberia - South Kara Sea - Pyasina-Khatanga rift megasystem: a geodynamical approach

I.N. Peshkova: Sedimentation and oil and gas accumulation conditions in the Fergana Basin during the Paleozoic and Mesozoic-Cenozoic cycles of geodynamic evolution

I.V. Puzanova: Plate-tectonic zonation and oil and gas potential of the Turgay basin

K.S. Kaziev, E.V. Savona, and S.Ya. Askerov: Geodynamic models of the Caucasian foredeep

V.S. Shein and A.V. Khortov: Structure of the southern Pre-Caspian and Scythian-Turan platform joint zone

O.E. Skira and F.S. Ulmasvay: Geodynamic model of the modern structure of the Rjazan-Saratov basin

B.A. Solovyev, T.D. Ivanova, I.N. Komissarova, and S.B. Kocharyantz: Geodynamic model of the evolution of the Pre-Caspian sedimentary basin

V.B. Svalova: Geodynamics and oil potential of Pre-Caspian depression

A.N. Yacobson: Earthquake Rayleigh-wave-spectroscopy of the South Caspian lithosphere

V.V. Yutsis, V.V. Smirnov, and O.A. Smoilovsky: The Pliocene-Quaternary basins of the Eastern Mediterranean: seismostratigraphy, structure and geodynamics

A.A. Geodekyan and A. Zabanbark: Regularities of hydrocarbon distribution in the sedimentary basins of the Laurasian and Gondwanian megablock margins

I.E. Balanyuk and L.Sh. Dongaryan: Oil and gas accumulation and plate motions

SYMPOSIUM 10
Intraplate tectonics and magmatism

Oral session Saturday 20, November 1993, 09.30-13.30, Hotel "Aksakovskie zori"

Convener: M.I. Kuzmin

09:30 L.P. Zonenshain and M.I. Kuzmin: Hot fields and deep geodynamics of the Earth
09:50 I.V. Ashchepkov and L. Andre: Polybaric crystallization of deep-seated mixed fluids below the Vitim plate
10:10 A.N. Zhidkov: Kimberlite fields of the Siberian platform: hot spot traces
10:30 M.Z. Glukhovsky, V.M. Moralev, and M.I. Kuzmin: The "hot belt" of the early Earth and its evolution
10:50 S.V. Rasskazov: Intracontinental Yellowstone and East Sayan hot spots: comparisons of volcanism and neotectonic structure
11:10 V.S. Zubkov and I.K. Karpov: Impulse sources of energy in hot fields
11:30 COFFEE BREAK
12:00 L.I. Krasny: Heterogeneous tectogenesis and its mineralogenic consequences
12:20 L.I. Kogan, Yu.A. Byakov, I.F. Glumov, and R.R. Murzin: Results of wide aperture deep seismic profiling (WADSP): the Earth's crust internal structure in the Indian and Atlantic Oceans
12:40 E.G. Mirlin and B.D. Uglov: Dynamics of the oceanic lithosphere (in accordance with new data from transocean geotransects)
13:00 G.S. Gnibidenko: Tectonics and geodynamics of the Mapmaker plate (NW Pacific)
13:15 S.P. Maschenkov, E.G. Astafurova, M.S. Belousov, L.A. Daragan-Suschova, A.D. Pavlenkin, and S.V. Stepanov: The complicated structure of old oceanic crust at the western end of the Canary - Bahamas geotransect (23°N-29°N, North Central Atlantic)

Poster session Friday 19, November 1993, 14.30-18.30, Hotel "Rus"

S.I. Andreyev and L.I. Anikeyeva: Tectonics and metallogeny of the world ocean (based on compilation experience of the "Metallogenic Map of the World Ocean", scale 1:10,000,000)

Yu.A. Bogdanov: Cobalt-rich ferromanganese crusts and lithospheric plate motion

H. Aoki: Distribution of elements in the marine mineral resources of the Western Pacific

M.L. Kopp and Yu.G.Leonov: Intraplate deformation of the West Arabian plate as a result of a heterogeneous strike-slip along the Levant fault

E.G. Astafurova, V.Yu. Glebovsky, and S.P. Maschenkov: The nature of magnetic anomalies and composition of the Earth's crust along the Canary - Bahamas geotransect (North Central Atlantic)

A.A. Andreev and A.S. Svarichevsky: Fracture zones in the north-western part of the Pacific

V.N. Patrikeyev and H.S. Gnibidenko: "Normal" oceanic crust structure of the North-west Pacific plate according to MCS data

L. Khankishieva: Structure and geological evolution of the Shatsky Rise

N.A. Marova: General regularities in the distribution of Atlantic and Pacific volcanic seamounts

Yu.P. Neprochnov and A.A. Buravtsev: Northern boundary of the Central Indian Ocean intraplate deformation: analysis of new seismic reflection-refraction data

A.I. Al'mukhamedov: Rifting and flood basalts in the formation of Permian-Triassic traps, Eastern Siberia

R. Clocciatti: Petrology and geochemistry of the Etna volcano

R. Magakyan, S.Ya. Kuznetsova, and V.G. Senin: Evolution of silicate and sulphide components in intraplate magmas (N Syria, SW Cyprus)

A.Y. Borisova and M.V. Portnyagin: Petrological constraints on the origin of subalkalic basalts from the Aphanasi Nikitin Rise (Indian Ocean)

I.V. Ashchepkov, S.V. Esin, Yu.D. Litasov, and A.I.Turkin: Models for the differentiation of deep seated melts in continental rift zones

SYMPOSIUM 11
Geodynamics of the earth's interior

Oral session Friday 19, November 1993, 14.30-18.30, Hotel "Rus"

Conveners: V.P. Trubitsyn and A.G. Kirdyashkin

14:30 N.L. Dobretsov, A.G. Kirdyashkin, and I.N. Gladkov: Problems of deep geodynamics and modelling of mantle plumes

14:50 A.G. Kirdyashkin: Unsteady regimes of heat gravitation flows in the mantle

15:10 S.A. Tychkov and T.L. Zakharova: Manifestation of induced slab mantle flow in surface movements and its role in collisional processes

15:30 V.P. Trubitsyn and V.V. Rykov: Origin and evolution of mid-oceanic ridges, subduction zones and marginal seas based on numerical modelling

16:10 V.P. Trubitsyn, A.M. Bobrov, and V.V. Rykov: 2-D model of mantle convection with moving continents

16:30 COFFEE BREAK

17:00 S.N. Ivanov and K.S. Ivanov: Rheological principles of the geodynamics of the Earth's crust

17:20 O.A. Hachay and Yu.V. Khachay: A numerical experiment of mantle convection mechanism identification using the inverse problem method

17:40 B.I. Birger: A thermoconvective mechanism for oscillatory vertical crustal movements in sedimentary basins

18:00 A.N. Dmitrievsky and I.A. Volodin: Geodynamics from the standpoint of system-vacuum view

18:15 O.G. Sorokhtin and S.A. Ushakov: Proterozoic reconstructions of continental drift

Poster session Wednesdy 17, November 1993, 14.30-18.30, Hotel "Rus"

O.G. Sorokhtin, F.P. Mitrofanov, and N.O. Sorokhtin: Origin and prediction of diamonds on the Kola peninsula

N.A. Bozhko: Global geodynamic polarity and reversals in the system of the Earth's hemispheres

V.P. Trubitsyn, U.F. Belavina, and V.V. Rykov: Interaction of mantle convection with continental and oceanic plates

N.A. Bozhko and M.A. Goncharov: A globally balanced arrangement of the geodynamic polarity of the Earth's southern and northern hemispheres

M.A. Goncharov: Range arrangement of geodynamic systems and cells

I.A. Volodin: Quantum geodynamics and new mechanisms of plate tectonics

L.A. Abukova and I.A. Volodin: Tectonic aspects of wave nonlinear geodynamics

A.A. Barenbaum: Geodynamic revolution of the Earth in a cosmogenic model of an "open" solar system

A.G. Rodnikov: Deep structure of the transition zone between the Asian continent and the Pacific based on a system of geotraverses

A.A. Kovaljev: New paradigms of endogenic ore formation

V.Yu. Timofeev, Yu.K. Sarycheva, L.V. Anisimova, and S.F. Panin: Fluid core resonance measured by observations of the earth tides in Siberian stations

S.Yu. Gertsenshtein, I.V. Nekrasov, and A.V. Vikulin: Phenomenological model of the Pacific Ocean plate tectonics

N.I. Medvedev: Tectonic processes as a consequence of superposition of gravitational and thermochemical factors

Yu.V. Khachay and V.S. Drujinin: Thermal model of the Ural folded system as an indicator of its geodynamical evolution

V.B. Svalova: Geodynamics of the Alpine and Pacific belts:. mechanical-mathematical modelling

A.G. Simakin and V.P. Trubitsyn: Dynamics of crystallization near the roof of a magma chamber taking into account crystal settling

V.A. Kirkinsky: An alternative model for the mechanism of plate tectonics

V.A. Kirkinsky and Ju.S. Kusner: Criteria for employment of the Boussinesq approximation to describe convection in the Earth's mantle

S.A. Tychkov and V.V. Chervov: Thinning of the continental lithosphere by upper mantle convection

I.Yu. Kulakov, S.A. Tychkov, and S.I. Keselman: Three-dimensional structure of lateral heterogeneities in P-velocities in the upper mantle of the southern margin of Siberia and their preliminary geodynamic interpretation

PALEOMAGNETIC WORKSHOP

Oral session Saturday 20 November 1993, 09.30-13.30, Hotel "Rus"

Convener: A.N. Khramov

09:30	A. Didenko and D. Pechersky: Revised Paleozoic apparent polar wander paths for the E Europe, Siberia, N China and Tarim plates
09:50	A.N. Zhidkov, V.A. Kravchinsky, and K.M. Konstantinov: The history of the convergent East Siberian and North China plates (based on paleomagnetic data)
10:10	V.P. Aparin and O.P. Zolotova: Change of the geomagnetic reversal rate as indicator of plate kinematics activity
10:30	I.A. Svyazhina and R.A. Koptera: Paleomagnetic evidence for the Ural ocean in the Paleozoic
10:50	M.L. Bazhenov and V.S.Burtman: Upper Cretaceous paleomagnetism of the Shikotan Island: a kinematic enigma
11:10	V.A. Kravchinsky: Paleomagnetism of the Amuria Block (preliminary data)
11:30	E.V. Shevljagin and G.Chth. Aminova: Obtaining specific information on the geodynamics of the Northern Caucasus from paleomagnetic data

ABSTRACTS

IN ALPHABETICAL ORDER
OF FIRST AUTHORS' NAME

GENETIC SYSTEMATICS OF COLLISION MAGMATISM

I.I. Abramovich
VSEGEI

The collision magmatism is characterized by different genetic types with a wide variety of mineral and chemical composition. We are now in a position to recognize at least seven types of magma-generation systems:

1. The generation of magma predominantly within the asthenosphere which a partially melting of downgoing slab and mantle wedge. The melt which contains water and volatile components redistributes by the action of lateral temperature and pressure gradients. The magma-generation systems of this type are associated directly to residual subduction and amount to an extension of preceeding subduction processes.
2. The magma generation systems within the asthenosphere traps which is located at the rear of previously existing subduction zones.
3. The decompression melting at asthenosphere within syncollision rifts.
4. The decompression melting within transcurrent faults or local transtention zones.
5. Anatectic magmatism within Earth's crust (most commonly at top-crust level); granites intrude into the cavities which are caused by the predominate compression during A-subduction conditions.
6. Melting predominantly at lower crust level within subfluxion zones. It is typical for tectonic areas.
7. Decompression melting within local transtension zones (sphenochasms, transcurrent faults, rifts and so on) at crust level within tectonic areas.

There is a high variability at each genetic type of magmatism that depends upon the joint action of some factors, among which are type of colliding structures, absolute velocities of plate configuration, of plate boundaries, physical conditions within upper mantle and so on.

TECTONIC ASPECTS OF WAVE NONLINEAR GEODYNAMICS

L.A. Abukova, I.A. Volodin
OGRI RAS

To present time autowave nature of the Earth geodynamical fields was recongnized obviously. It was achieved by the understanding of the essence of energy structure of earth bowels as complicate organized system of interaction of physical fields differed on appearance manner and homogenous on formation source - inertia field. The ability of selfdevelopment and selfexistence through weak external and internal influences was also proven. Using recent researches performed on the base of geological and geophysical materials of the southern Turan Plate it was detailed ideas about appearance of geodynamical field around point sources of its excitation. In this region it was chosen the number of point generation sources of geodynamical field giving energy connected systems similar to shell model of atomic core.

Geological and tectonic conditions of generation sources can be considered as instability zones and concentrate as a rule in joint zones of plate elements of different order as compared to the territory for which wave fronts are propagated. Such zones correspond to the fields of geodynamical instability of large scale. So one of them is situated on Sultan-Uvai mountain-mass territory where rocks make the foundation go out on the surface. Here a large north and north-west lineament zone is formed which has numerous intersections and complications by tectonic deformations. It shows that there is a powerful focus of geodynamical wave fields. Note that secondary excitation centers correspond to interfaces or intersections of regional tectonic fractures and one of the interacting fracture waves west and north-west direction perculiar to main structures of Turan Plate zones.

Presented materials show dependence of tectonic fractures on wave barrier direction of geodynamical fields. It allows to consider that fracture systems in different Earth shells are the portraits of phase trajectories of wave geodynamical processes.

Suggested geodynamical field model realizes the conception of macro- and microcosm unity, the universality of management laws by natural systems of different order. Obtained topological pictures of geodynamical field and petroleum objects connection allow to solve practical porblems in particular to forecast local area perspectives for exploration works.

THE ACCRETIONARY TECTONICS AT THE PRESENT SUBDUCTION ZONES AND THEIR PALEOANALOGUES

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The data from present subduction zones of the active margins of the Pacific (American in the East and Asian in the West) points to the intense submarine deformations (folding, faulting) and dynamic and thermal metamorphism in these regions. These events are proceeding without basin closing (collision) and formation of folded montainous systems.

The example of similar processes which took place in the geological past is the Late Paleozoic-Early Mesozoic Dizi series (Svanetian Devonian-Triassic section represented by turbiditic sediments, sandstones, slates with lenses of limestones, conglomerates, gravelstones, volcanogenic (calc-alkaline, active-margin type) rocks, chert interbeds and olistostromes (with marks of submarine slumping) on several levels of the section. The Lower Jurassic slates (similar to Triassic) in some places with conglomerate in the bottom unconformably rest on this Late Paleozoic-Early Mesozoic unit.

Deformation and incipient metamorphism of this Devonian-Triassic formation proceeded in sumarine condition at the boundary of the Caucasian Small Oceanic Basin and the Caucasian Island Arc without complete closing of the basin by the end of Triassic-beginning of the Jurassic period. Liassic conglomerates were connected with the appearance of small islands which are the result of these processes.

SEISMICITY OF THE CAUCASUS AND ITS RELATION TO PLATE MARGINS

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**** Geological Institute, Georgian Academy of Sciences, Tbilisi***
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The complex geological-geophysical investigations together with the remote sensing data in the Caucasus and the adjoining regions of E Turkey and NW Iran allow to distinguish the several relatively small microplates located between the Arabian and Eurasian plates. Although the existing plate tectonics models may differ in some details the basic microplates are well defined. The boundaries between the microplates represent the main zones of recent geodynamic activity where faulting, folding and volcanic activity are manifested most intensely. Within these boundary belts a great amount of seismic energy is being released.

Seismicity of these regions has been characterized using epicenter location, their depth, configuration of the pleistoceistal areas (areas of maximum ground shaking), spatial-temporal distribution of aftershocks, the focal mechanisms. The general analysis of a great amount of the earthquake source parameters allows to estimate strained-deformational state of the region and character fo displacement of the microplates which is the direct cause of seismicity.

The neotectonic regime started in the Late Miocene by NNE-SSW compression (azimuth ~ 20°) which resulted in the NW-SE or WE trending faults, thrusts and reversed folds, accompanied by right-lateral strike-slip along the NW-SE trending faults and left-lateral slip along NE-SW faults. The fault-plane solutions are in good agreement with macrotectonics.

In the Caucasus there are three NW-SE trending plate margins, characterized by a significant seismic activity: (i) Sevan-Akera ophiolitic suture zone (boundary between the Transcaucasian and South-Armenian blocks; (ii) the junction between the Transcaucasian block and the folded system of the Greater Caucasus; and (iii) the Greater Caucasian Main Thrust (Southern limit of the Eurasian plate). One more zone of higher seismicity extending NE-SW along Chorukh-Kura-Kazbek lineament coincides with the Caucasian transversal uplift.

THE POSSIBLE REASONS OF APPEARING, BIOMINERALIZATION AND FOSSILIZATION OF RADIOLARIAN SILICEOUS SKELETONS AND THE PALEOBIOGEOGRAPHIC RECONSTRUCTION IN EARLY PERMIAN TIME

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The original synthesis of nucleic-proteids complex was realized on the abiogenic mineral matrixes: apatite, calcite, opal. The apatite and calcite skeletons proper are salts of according acides but opal tests were built from the solid colloidal particles of orthosilicic acid. Radiolarians utilized silica for test building (and not other chemical elements like many other Eukaryotes) due to paleosea-waters were highly saturated with silica ions. Utilization of silica: (1) defended radiolarians from solar radiation, (2) allowed them to create a light delicate skeleton, (3) let them be the first to assimilate the paleopelagic aquatic zones.

The detailed study of the morphology of radiolarian skeletons and ultrastructure of their shell wall is required for clarifying closer relations between the structure of skeleton and degree of its preservation and peculiarities test destruction in geological history. The formation of skeleton appears to initiate with appearance, on the hexagonal plates of the organic matrix of the future test, of amorphous opal primary globules grouping into progressively larger ultrastructural skeleton elements each of which is surrounded with organic lamella. The destruction of organic lamellae impeding fossilization of living organisms tests is favourable for the silica realization. The crystallization of fossilized radiolarian tests could take place through successive series: opal - opal-tridymite - low-temperature tridymite - low-temperature quartz. These events are very important for the diagnosis of post-sedimentational processes which proceeded in older rocks during lithogenesis. In this instance, globular amorphous opal and opal-tridymite of radiolarian tests correspond to the sedimentogenesis and diagenesis stages accordingly. The prismatic tablets of low-temperature tridymite appear to be formed within the structure of radiolarian tests possibly under early catagenesis condition. The prolonged dipyramidal-prismatic crystals of more perfectly low-temperature quartz could be formed in radiolarian tests only at high temperatures associated with the late stage of catagenesis.

A close relation between taxonomical and quantitative composition of radiolarians and their environment, that makes it possible to consider them as the most sensitive paleobiotope indicator. Comparative analysis of the distribution of radiolarian complexes which were encountered has revealed a dependence of their community compositons on confinement to one or another paleobiogeographic zone of the Uralian and Precaspian paleosea. The paleoecologic reconstruction has identified unfavourable conditions for habitation in the central zone and has shown the existence of rich radiolarians associations in the side zones of the ancient basin. The reduction of the taxonomic diversity and the decrease in number of individuals which were observed at the transition from Aktastinian to Baigendzhinian strata (Lower Permian) reflect a general tendency in the development of the basin produced by the reduction of the area they inhabited with the concurrent progressive elevation of the salinity of the water. Studies of the facio-plaeoecologic conditions of the Early Permian basin subject as a whole, attest to the fact that the deposition of strata took place under the conditions of a shallow-water epicontinental sea.

RADIOLARIANS, A KEY TO CONSTRAINING THE TECTONIC EVOLUTION OF OROGENIC ZONES WORLDWIDE: EXAMPLES OF THEIR APPLICATION AND SUGGESTIONS OF FUTURE POTENTIAL

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Over the past decade a revolution in the understanding of many of the world's orogenic zones has resulted from the development of radiolarian biostratigraphy and its application to otherwise sparsely fossiliferous rocks which have been tectonically accumulated along convergent margins. The provision of radiolarian age constraints has been crucial to the understanding of the relative significance of large and small scale structures and even the recognition of previously undiscovered, but major, "cryptic" structures.

Illustrations of the utility of radiolarians are found throughout the literature. Over the past five years understanding of the tectonic evolution of eastern Australia and the Paleozoic margin of East Gondwana has been markedly advanced through the radiolarian dating of large scale subduction complexes of previously imprecise age. Perceptions of the nature of this zone continue to change with ongoing work and new discoveries and a much better understanding has now been achieved.

In New Caledonia the amalgamation of Mesozoic arc successions to the Gondwana margin, their Cretaceous disruption through rifting and Cenozoic collision and overthrusting by a major arc ophiolite followed by extensional collapse and core complex development can be better constrained using radiolarians.

Much of Japan was though to be of Permian on the basis of fusulinid foraminifers present in limestone lenses. Radiolarians have been used to demonstrate that these rocks comprise merely a small proportion of large scale Late Jurassic accretionary complexes. Radiolarian age constraints now elucidate the history fo travel of Permo-Triassic oceanic crust from equatorial latitudes towards the Eurasian margin. These subduction complexes have now been traced from the Philippines through Japan to the Russian Far East throughout the Tethyan realm radiolarians have also been used to finetune biostratigraphy and provide constraints on the timing of plate interactions.

In western North America radiolarians have facilitated the recognition of numerous terrane and resolution of their tectonic evolution. Notable examples of this include the Golconda, Cache Creek and Franciscan terranes. Mesozoic radiolarian biostratigraphy is now sufficiently detailed that various North American workers have suggested they can make useful paleolatitude estimates on the basis of radiolarian faunal contents through time. Recent developments include detection of the complete subduction of no longer existent plates using relative age differences between accreted material and trench fill in subduction complexes.

To date advances in the understanding of complex tectonic collages using radiolarians have been restricted to late Paleozoic and younger orogens because of the lack of a detailed biostratigraphy back beyond the Late Devonian. However, work is currently in progress on the development of an Early Paleozoic radiolarian zonation sufficiently precise to be of use to tectonostratigraphers working in ancient orogens. The Silurian and Devonian now have diagnostic several assemblage zones and initial work suggests that similar results will be possible for the Ordovician. The potential for study of ancient tectonic collages such as those in Central Asia and Australia now exists. Other younger zones such as the Russian Far East also await widespread intensive study using radiolarian age constraints. Exploration for economic mineral deposits is in many cases dependant on the accuracy of predictive plate tectonic models for ore genesis in target areas. If models are incorrect due the absence of reliable age constraints then exploration strategies are flawed. Radiolarians hold the key, not only to the academic understanding of orogenic zones, but also to their commercial exploitation.

MORPHOSTRUCTURAL EVOLUTION OF CONTINENTAL OCEANIC AND INTRACONTINENTAL SUTURAL ZONES

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Morphostructural evolution of inter-plate - sutural - zones is discussed, island arcs and mountain uplifts being compared and likeliness and differences in their evolution being traced for 3 stages, i.e. Pre - Late Mesozoic, Late Mesozoic - Early Cenozoic and Late Cenozoic. Evolution of island arcs proceeds in cycles mostly under oceanic conditions, orogenous uplifts grow continuously mostly within limits of the continents. Both kinds of sutural zones are characterized by migration of island arcs replaced by orogenous structures from the Eurasian continent towards the Pacific and Indian Ocean, linear block morphostructures to replace microcontinents, mantle and folded arcuate structures to be formed at the places of deep troughs marked by ophiolitic belts.

THE CALEDONIAN THRUST-FOLDED STRUCTURE OF KARATAU (SOUTH KAZAKHSTAN) AS A RESULT OF TWO SIALIC TERRANES COLLISION

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The Caledonian structure of the Karatau Ridge is a thrust-folded complex, that was formed at the Syrdaria microcontinent passive margin as a result of its collision along the Ishim-Naryn suture, with the Stepniak-Northern Tian Shan ensialic volcanic arc in the Caradocian-Ashgillian after the closing of the back-arc sea north-east of the Karatau.

The north-eastern Karatau (Malyi Karatau) structure is a package of six thrust sheets, bounded by thrusts subparallel to the bedding planes, oriented toward south-west and dipping to north-east. Thickness of the individual thrust sheets varies from 0.5 to 4.5 km, the horizontal displacements along individual thrusts are from 5 to 30 km, the total shortening is estimated as 80-100 km. Thrust sheets are deformed as longitudinal folds with north-eastern vergence (opposite to the direction of thrusts), altered by longitudinal reverse faults, diagonal strike-slip faults and cut by granites. The thrusts are of the Caradocian age, verified by the Llandeilian-Early Caradocian age of the youngest rocks in the thrust sheets and by the age of granites, cutting the thrust sheet package which is 447 ± 4 Ma (Rb-Sr isochrone), corresponding to Late Caradocian - Early Ashgillian time. The age of the folds is close to that of the granites.

In the south-western Karatau (Bolshoi Karatau) large thrusts are unknown; the time of the Malyi Karatau thrusts corresponds there to a period of flysh accumulation. The Bolshoi Karatau structure is a complex of compressed linear folds, formed in Early Ashgillian time almost simultaneously with the fold formation of the Malyi Karatau. All folds of Malyi and Bolshoi Karatau form a divergent folded fan with anticlinal morphology with the axis near the Malyi-Bolshoi Karatau boundary. The overlapping of the back part of the Late Ordovician divergent folded fan upon the frontal part of the Caradocian thrust complex changed the structural vergence to the opposite within the Malyi Karatau.

The migration of deformations to south-west, toward the Syrdaria microcontinent foreland, is a result of back arc compression during the time of active subduction from north-east beneath the Stepniak - Northern Tian-Shan arc in the Caradocian and Ashgillian.

RIFTING AND FLOOD BASALTS IN THE FORMATION OF PERMIAN-TRIASSIC TRAPS, EASTERN SIBERIA

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1. Two volcanic series are revealed in the Permian-Triassic formation of the Siberian traps. One series is represented by low potassium tholeiites (enriched with incompatible elements as opposed to MORB ones) and occurs within the Tunguska basin and forms the sequence of flood basalts. Another one, which is more alkaline, is locally observed in the linear zones in the north-west (Norilisk-Kharaelakhsk province) and north-east (Maimecha-Kotui province) of the platform.

2. As examplified by the Norilsk-Kharaelakhsk province, where the lava sequence is best studied, it is evident that the alkaline basalts occupy the lower and mean locations in the cross-section and are younger as compared to tholeiites. The available data permit to presume the similar dependence for the Maimecha-Kotui province as well.

3. The pattern of spatial distributions and temporal relationships for the revealed types of the basalts result from different geodynamic settings. The youngest alkaline volcanics correspond to the magmatism of rifting structures, which are associated with formation of the Upper Paleozoic Paleobsk ocean and its prolongation as a rift structure, located under the recent Near-Taimyr depression. Flood basalts of intraplate nature result from the processes of area fragile deformations of the lithosphere of the platform under the change of kinematics.

4. The genetic relations between two stages of magmatism (rifting and flood proper) is still a problem. There is only a supposition that the close age is determined by the presence of wide mantle plume under the Paleobsk ocean, which was still active under the formation of fragile deformation in the lithosphere of the East Siberian region.

THE FRACTURE ZONES IN THE NORTH-WESTERN PART OF THE PACIFIC

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Insufficient account of magnetic, seismic and morphological data are cause of well known variety structural plans and also kinematic, geodynamic retrospective models of the northwestern part of the Pacific.

We present unpublished magnetic and bathymetric data collected during cruises of R.V. of the Far East Center of the Russian Academy of Sciences until 1991.

This enables us to study in more detail: the south-east border of a magnetically quiet zone, positions and structure fracture zones (FZ). Some of those FZ determined by us were unknown before.

Lineations of FZ have some interesting features. This is like a diagonal net. The northwestern lineations of this net are well known not active traces of transform FZ orthogonal to those are graben like features, its lineation are parallel to the Kurile trench. Among others these features are the Hokkaido FZ, structural rupture at the N-E Shatsky Rise, small elongated ridges not far from the east border of the Shatsky Rise. These features can be considered as second-rate features appeared on the board of paleo-spreading ridge.

Unusual curve form of the Stalemate FZ traced along the Stalemate ridge may be explained by counter-clockwise rotation of the Kula plate when Eocene magnetic lineation was formed.

TECTONICS AND METALLOGENY OF THE WORLD OCEAN (COMPILATION EXPERIENCE OF "METALLOGENIC MAP OF THE WORLD OCEAN", SCALE 1:10,000,000)

S.I. Andreyev, L.I. Anikeyeva

1. "Metallogenic Map of the World Ocean" (1:10,000,000) has been compiled at VNIIOkeangeologiya to show the mode of occurrence and distribution regularities of ferromanganese nodules, cobalt-bearing crusts, deep-water polymetallic sulphides and metalliferous sediments, phosphorites, placer deposits and other solid minerals of the ocean.

2. The geologic-tectonic base involves materials intergrated for the whole ocean as to the anomalous magnetic field, seismic data on the sedimentary cover thickness and depth of occurrence of the oceanic basement, information on the heat flow and seismic activity. Utilization of the map has allowed to apply chrono-structural-formational (facies) approach to solve metallogenic tasks and look in other respects at the evolution of the oceanic ore genesis in connection with peculiarities of the geological formation history of the world tholassogenic system.

3. The advanced novel tectonic concept considers the "ocean formation" as a powerful and prolonged volcanic-plutonic pulse of the basic magmatism. As a result of the latter the new - oceanic crustal type has been formed for the last 170 My years to cover 2/3 of the planet surface.

4. Development of the world's tholassogenic system shows a stage-by-stage oriented pattern expressed in the sequential change of formation regimes of the oceanic basement. The formation time of the tholassogenic system corresponds to the Alpine geotectonic cycle while some of its stages - to Cimmerian and Laramian geotectonic epochs terminated in the Neogene-Quaternary by the orogenic stage resulted in an appearance of tholassides - a system of isolated chains of mid-oceanic ridges.

5. The geophysical data analysis allows to establish a rigorous connection between the oceanic ore genesis and geotectonic development stages of the world tholassogenic system, to reveal the main distribution regularities of the known solid minerals and to predict discoveries of new ore species of mineral raw in the world ocean.

ON PALAEO-BENIOFF ZONE IN THE IZU-BONIN-MARIANA ISLANDS ARC

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Based on the petrochemical character of volcanics dredged and collected from submarine slopes and subaerial islands of the Izu-Bonin-Mariana Islands Arc respectively, it is safe to conclude that the angles of Palaeo-Benioff Zone do not seem to be consistent, but to be changeable.

ON THE DISTRIBUTION OF ELEMENTS IN MARINE MINERAL RESOURCES OF THE WESTERN PACIFIC

H. Aoki
Tokai University, Shimizu, Japan

The problems of the formation of cobalt-rich manganese crusts, hydrothermal deposits and manganese nodules are discussed on the stand-points of the distribution of elements shown by color map chart carried out by the computer-aided X-ray micro-analyzer.

ANALYSIS OF THE TIME SERIES DATA OF GEODYNAMIC PROCESSES IN PHANEROZOIC

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Investigation of the age series data of the geological phenomena by spectral analysis methods forms a true notion about development and hidden periodicity. It is important for the evaluation of time characteristics for the geodynamic models.

Our approach is based on the model of stationary random process. We have investigated different kinds of Phanerozoic age curves. Several global curves of geochemical cycles are: $\partial\,^{34}S$, $\partial\,^{13}C$, $^{87}Sr/^{86}Sr$, C_{org}. The paleomagnetic curves have been computed from bank paleomagnetic data for different continents, depicted evolution of its positions relatively to the Earth's axis rotation (Aparin, 1983-88). Phanerozoic volumes and squares of lithological formations curves of the continents (Ronov, 1980) were investigated together. Variation of curve parameters were approximated by polyharmonic processes, characteristic periods were determined by combining two methods: maximal entropy and elements of the Fourier spectral analysis.

As result we have determined hidden periods with different spectral densities in all analysed curves and phases of harmonic time-scale. Most representative periods are 550-570, 205-210, 140-90 and 45 Myr. The period 205-210 Myr is common for all curves. Extremums of harmonics for separated periods coincide on time-scale with boundaries of the paleogeographical evolution stages, such as a continental collision or opening of the paleoocean. Coincidence of the durations of some periods for different phenomena have indicated on external factor with period 200 Myr obviously connected with the plate kinematics.

It gives arguments for interpretation of the correlation of the geochemical cycles age-curves and eustatic curve (Vail, 1979) in Phanerozoic from plates kinematics changes of paleogeography, which provide interaction between geochemical reservoirs of the oceans and continents.

Global process of continental and oceanic crust history, generated by a plate kinematics and the mantle influence, formed the common shape of long-term periodicity in the all examined curves. Local deviations from the common trend of curves which are probably connected with peculiarity of geodynamic developments of different continents. The plates movement changes, the long-term sea-level variations, caused by change sea-floor spreading rate, a continental paleo-relief evolution, the geochemical cycles S, C, Sr, the sedimental megacycles in Phanerozoic are common processes with indivisible regularity.

DETERMINATION OF THE PALEO-OCEANIC CRUST AGE ON THE BASE OF MAGNETIC AND PALEOMAGNETIC DATA: NEW EXAMPLES FROM THE DEEP SEDIMENTARY BASINS OF THE RUSSIAN ARCTIC SHELF

S. Aplonov
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The striped medium-wave (MW) magnetic anomalies probably connected with ancient sea-floor spreading have been discovered and separated by the adaptive band-pass filter over the deep sedimentary basins of the Kara Shelf: Uyedineniya, North Novaya Zemlya and South Kara.

Considering that the Paleozoic magnetic field reversals have now been investigated (Khramov et al., 1982), it was always tempting to determine the age of linear anomalies, separated from the total magnetic field over the deep sedimentary basins.

The probable interval of sea-floor spreading was searched for in Magnetic polarity scales and transformed into magnetically active layer model taking into consideration the basement surface relief and chosen spreading half-rate. Calculated magnetic field was compared with MW-anomalies separated from the total magnetic field. The optimal model was that having the strongest correlation between the calculated and separated MW-anomalies. The optimal field inclination chosen during the modelling was re-calculated into latitude; the latter was treated as a latitude of a paleo-oceanic block formation.

The determined spreading intervals, half-rates and latitudes are as follows:

- for the Uyedineniya Basin: 388-382 Ma (Early-Middle Devonian), 4 cm/year, and 5 degrees;
- for the North Novaya Zemlya Basin: 370-363 Ma (Late Devonian), 3 cm/year, and 10 degrees;
- for the South Kara Basin: 320-305 Ma interval (Late Carboniferous), 2 cm/year, and 30 degrees.

Performed evaluations have confirmed similarity of the Uyedineniya and North Novaya Zemlya Basins. The lithosphere imprinted in their basement is of similar origin (both in spreading rate and in paleo-latitude of formation). Apparently, this lithosphere is related to the northern branch of the Early Paleozoic Yapetus.

Most likely, the lithosphere imprinted in the South Kara Basin is related to the Uralian Ocean, which separated Europe, Siberia and Kazakhstan in Paleozoic.

These suggestions are confirmed by their comparison with global reconstructions of the Paleozoic oceans (Zonenshain et al. 1984).

During Devonian the spreading rate of the Yapetus was rather high - about 8 cm/year, that corresponds to calculated values (half-rate is 3-4 cm/year). Latitudinal location of the northern branch of the Yapetus in global reconstructions (near equator) is also close to that we have obtained.

During 340-319 Ma Siberia rotated about Europe around 45°N; 135°E pole with angular rate of about 0.2 degree/Ma. The northern branch of the Uralian Ocean situated then near 15°N; 60°E. These data allow to calculate linear spreading rate of the region which was later transformed to the South Kara Basin: it is about 2.8 cm/year. This independent assessment is quite close to that we have obtained.

SUB-AXIAL ASTHENOSPHERIC FLOW AS A CAUSE OF DIVERGING PLATE BOUNDARIES ACTIVITY MIGRATION

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*** Geodynamical Research Center "TETHYS", St. Petersburg, Russia)*

The diverging plate boundary activity migration in space and time manifests itself in local spreading instability, i.e. frequent jumping, overlapping and propagating of the "instantaneous" spreading centers. The processes have been investigated in detail on the base of magnetic and bathymetric data over two Mid-Atlantic Ridge (MAR) segments: 1) to the south from the Kane Fracture Zone (MARK area, 21°-24°N), and 2) between the Marathon and Fifteen Twenty Fracture Zones (12°-15°N).

The most probable cause of the activity migration is the influence of the sub-axial asthenospheric flow. In some segments of MAR it affects rather autonomously, causing local distinctions of spreading.

The cycle of asthenospheric flow migration influence consists of two main phases: 1) centrifugal motion of magma from the former local center of mantle upwelling, and 2) centripetal motion back to the center of segment.

According to our data, the latest mantle upwelling within the MARK area took place at about 1.5 Ma ago. Only the first phase of asthenospheric flow migration cycle can be observed here - its centrifugal motion from the former upwelling center toward the segment boundaries.

Over 12°-15°N MAR segment the more advanced phase of the same process can be observed. The latest mantle upwelling took place near 14°N at about 3 Ma ago. During 3-1 Ma asthenospheric flow has been migrating centrifugally toward the segment boundaries. Having met an obstacle (the Marathon and Fifteen Twenty Fracture Zones) the flow began to move back centripetally toward 12°-15°N segment.

The sub-axial asthenospheric flow reconstruction based on detailed magnetic and bathymetric data allows to evaluate the activity of different parts of spreading cells, which makes it possible to forecast the hydrothermal activity of MAR spreading centers.

GEOPHYSICAL DIAGNOSIS OF THE SUTURES IN THE TIMAN-PECHORA BASEMENT

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The original methods of gravity, magnetics and seismic interpreting were used for investigations of the Timan-Pechora basement inner structure. The convergent and divergent sutures between the blocks of different tectonic nature have been investigated in detail.

Three blocks of ancient (Pre-Riphean?) continental crust are "imprinted" in the Timan-Pechora basement, namely the East Timan, Bolshezemelsk and Malozemelsk. These blocks correspond to a thick (up tp 44-46 km) and relatively low-density (up to 2.6 g/cc) crust with a thin (0.5-4 km) sedimentary cover. We classified these blocks as microcontinents.

The foredeep basins of the Polar Urals and Pay-Khoy (Upper Pechora, Kosyu Rogov and Korotaikha) are located in the eastern and north-eastern areas of Timan-Pechora. Their crust is thick (up to 44 km) but of very high density (up to 2.9 g/cc). The basement of the foredeep troughs is depressed up to the depth 12-14 km.

Pechora-Kolva Aulacogen ist the axial suture of the Timan Pechora Basin. It corresponds with a zone of reduced crustal thickness (36-38 km) and high crustal density (up to 2.9 g/cc). In the north the Pechora-Kolva Aulacogen extends into the South Barents Depression narrowing between the edges of the Malozemelsk and Bolshezemelsk microcontinents.

According to our data, the north-eastern edge of the East European (Russian) craton is traced under the western part of Timan-Pechora at a distance of 250-300 km and is covered by the allochtone complexes representing the basement over the Izhma-Pechora Depression. The continuations of the largest Riphean aulacogens of the Russian Platform (Sredne-Russky, Mezensk and Kazhimsk) are distinct under Timan and Izhma-Pechora Depression. The giant thrusts deepening from the SW to NE were mapped over the Sorokin, Gamburtsev and Pre Pay-Khoy Rises.

The investigated sutures originated during the consecutive stages of the Timan-Pechora tectonic evolution: (1) Riphean rifting of the Russian Platform NE margin causing the mircrocontinents splitting, (2) Late Precambrian collision over the Timan Rise and the main part of Timan-Pechora, and (3) repeated splitting along the Pechora-Kolva and Varandey Adz'va Zones during Middle-Late Devonian.

DEFORMATIONS OF THE CONTINENTAL LITHOSPHERE OF THE EAST-EUROPEAN PLATFORM

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The analysis of geologic-geophysical materials on the eastern part of the East-European platform proved that the deformations of its continental lithosphere has no qualitative differences to many folding regions of the world.

Only within a sedimentary cover you can find overthrusting structures (duplexes and scaled fans) and stipulated them folds, tectonic melanges, olistostroms, etc. of different ages and types. The above elements form structural paragenesis, which conformably localized against the bordering limits of the platform. Their main difference to the structural forms of the same family in the folding buildings consists of smaller dimensions and contrasts, lower distributions. The above mentioned gives us the right to regard a tectonic regional division from a new angle with differentiation here between Totminskaya, Kotelnichesko-Kostromskaya, Saranskaya, Tatarskaya, Sarapulskaya, Samarskaya structural zones, that include over 40 segments and a great number of local structures of different types.

The formation of deformations of the sedimentary cover of the eastern part of the East-European platform underwent 8 stages: R-V, P_2-T_1, K-P and others, correlated in time with the same ones in Alpine fold belts.

STRUCTURE OF GRAVITY FIELD, ISOSTASY AND SUBCRUSTAL DENSITY INHOMOGENEITIES OF THE NORTHERN AND CENTRAL EURASIA

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Various geophysical investigations reveal the existence of the subcrustal density inhomogeneities. In the present paper we give a method of their estimation based on the classical principle of the lithospheric isostasy. The procedure consists in the construction of the isostatic density models of the lithosphere following the separation of isostatic anomalies to the short- and long-wave components based on the spectral - statistical analysis of the anomalous field. In result we tried to reveal the gravity effects of main groups of deep density sources and estimate the depths of their position.

The experimental bases of our investigations are the average 1° x 1° topographic, free-air gravity, Moho depth, thickness of the sediment cover and the mean density of sediments values.

The relation between the depth of Moho boundary M and adjusted topography (or outer load P) leads us to such a isostatic model: the outer load P is compensated by two types of masses - first - the main compensating masses (connected with Moho boundary undulations and second - additional ones, which are distributed in equal parts both into the consolidated crust and in the subcrustal layer down to the depth 100 km.

The map of isostatic gravity anomalies, calculated in accordance with this scheme, reveals some interesting features. Large extensive positive and negative free-air anomalies of Central Asia have practically disappeared.

Therefore we can conclude the great mountain system of Central Asia to be isostatically compensated and explained by our density model which corresponds to reality for many regions of area under study. At the same time we can see rather intensive isostatic values, such as negative anomalies of Japan-Kurile-Aleutian and Hellenian trenches, the Southern Caspian anomaly and positive anomalies corresponded to the active tectonic areas Alpine belt and island arcs.

The resulting isostatic map seems to contain the influence of mainly two types of sources: uppermost (crustal) and deep (situated probably under the lithosphere). Consequently, the idea comes to separate these effects because they should differ in frequency.

For this aim the spectral-statistical procedure has been worked out. The procedure is based on the analysis of spectral density intensity (SDI) of the system of latitudinal and longitudinal profiles of free-air and isostatic anomalies as well as topographic-isostatic correction and adjusted topography values. According to distinct sharp crook of SDI curve which divides all graphs into two parts, low-frequency and high-frequency, the simulation of SDI experimental points was carried out.

Judging by the SDI modeling results in the anomalous sources seemed to be concentrated in the two structurally isolated graviactive horizons (layers). The upper horizon is located at a depth of 10 km and is 100 km thick, i. e. it includes the consolidated Earth's crust and also the lithospheric part of the mantle. The lower horizon is within an interval of depths 400 - 1000 km, it may correspond to the modern concepts on zones of phased transition.

MODELS OF THE DEEP SEATED MELTS DIFFERENTIATION IN CONTINENTAL RIFT ZONES

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Lherzolite and pyroxenite xenoliths from the Cenozoic rift basalts show the rapid temporal changes of their mineralogical and structural features. The only one reason that can be responsible for these phenomena. This is the migration of enriched in volatiles melts through the upper mantle section.

Detailed study of the cumulative xenoliths from Cenozoic basalts reveals that in the mantle the following magmatic system should be evaluated:

1) Large magmatic bodies similar to layer magma chambers where coarse grained mantle rocks somewhat alike mantle pegmatites are supposed to be formed. Mean grained polymineral pyroxenites probably represent their contact zones. Contact lherzolites with pyroxenites revealing rough diffusion zonation suggested to be vertical magma channels connecting magma reservoirs. Usually basalt magmas restrict its influence on mantle lherzolites forming only some reaction zones. Basalt system is practically closed.

2) Hybrid reaction rocks determined as impregnated lherzolites can be formed in case of very high heat flow or high concentration of fluid when basaltic melts can pass directly through the mantle lherzolites without tectonic conduits. This phenomenon in mantle is usually concentrated in fractured zones most permeable for the melts. Process can be determined as magmatic substitution. Magmatic system is opened or semiopened.

3) Fluid flow produced by crystallising basalts course the partial melting of country lherzolites and migration of anatectic melts that due to filter pressing occur the layers of Cr-diopside pyroxenites.

Basaltic and any other mantle magmatism in continental zones is a process of stepped rising up of the deep seated melts. Intruding basalts are crystallising and produce secondary fluid flow with melting. Acquiring the buoyancy after increasing of volatiles or due to tectonic fracturing this process is repeated again. Mantle xenoliths material evidences that melts simultaneously exist on some separate depth levels (not less than two).

The ratio of the melts concentrated in these three systems depends on tectonic conditions, the nature of the intruding melts and previous history of host mantle lherzolites mainly determined by degree of ancient metasomatism.

The periodicity of volcanism in the Baikal rift and trough over the world divulges close relationships with tectonics. Under the tectonic fracturing all melts in the three systems should mix together. This is the reason why the composition of basalt melts usually correlates with the depths of their last stop and some specific features of host mantle peridotites.

In Baikal rift trends of the chemical mineral compositions together with oxygen state as functions of T (P) show the position and characteristics of the melts passing through the mantle column. Obtained diagrams for the different time interval at the same volcanic region show that in some cases one wave of interstitial melt in mantle lherzolite runs down another one.

The good temporal correlation of the petrochemical features of xenotliths between different volcanic regions suggests that there are some world-wide pulsation of the fluid and related melts passing through the mantle.

POLYBARIC CRYSTALLISATION OF THE DEEP SEATED MELTS UNDER VITIM PLATEAU

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Cumulative deep seated inclusions from Cenozoic rift basalts were studied using the microprobe for major components and ICP MS for trace elements to induce the temporal and spatial variations of deep seated magmas in Baikal Rift.

In Vitim volcanic region xenoltihs from picrite basalt tuffs reveal those groups of culumative deep seated rocks.
1) Black coarse grained pyroxenites form in variation diagrams of three separated groups joined by changes of figurative points. They seem to be the products of magma differentiation in several magma chambers in different depth levels. Rare mean-grained polymineral pyroxenites with adcumulative structure probably from the contact zones of magma chambers correspond to the three pressure intervals 25-27 kbar, 20-22 kbar and 14-17 kbar. The upper cumulates in crust-mantle transititonal zone are represented by Pl-Ga-fine grained websterites at pressure 10-12 kbar. Most of the high-T varieties (1350-1250°C) in first chamber contain interstitial garnet. Cpx reveal the crossing for the heavy REE-elements due to crystallization of Ga. In the next magma chamber (1000-1150°C) precipitation of the Cpx only produces the enrichment and parallel REE distribution. In the third magma body (900-950°C) porous Cpx crystallized under the high concentration of relatively oxidized fluid formed secondary Cpx and oxide rims on the primary pyroxenes. The transitional crust mantle zone is suggested to be formed by the repeated intrusions of some portions revealing various trace element behavior also can be reconstructed. About 80-70% remaining liquid was calculated for first magma chamber, 50-60% for the next, and 50-40% for the third one. Upper intrusions were produced by melts remaining less than 10% of starting magma composition.
2) Cr-poor green pyroxenites probably derived from picritic melts have the most flattened REE pattern for Cpx. They form some trends and in most of the high-T part of diagrams they are similar in composition with black pyroxenes.
3) Transitional Al-rich coarse grained clinopyroxenites having moderate temperature reveal combination of typical magmatic REE distribution for Cpx with superimposed U-shaped pattern characteristic for the magmas precipitated Amph. These rocks should be formed by hybrid melt resulting from the contamination of hydrous picrite-basalts with host rock mantle peridotites. In respect to Cpx major components this group is close to the thin Amph-Phl-bearing veinlets in mantle lherzolites but probably it was a separate portion of magma evaluated in a large magmatic system.
4) Cromious green websterites and garnet websterites are in our opinion the result of a hydrous partial melting of mantle lherzolites. The filter pressing structures are evidently seen in peridotites. Trace element features show a rather complex evolution of such melts due to the precipitation of Ga, Cpx, Opx, Amph and Phl in various proportions.
5) Cpx from lherzolites also have the typical magmatic distribution of REE which coincides with the hypothesis of the melt percolation through the mantle column. Cpx REE abidance in lherzolite xenoliths usually similar or exceed those of cumulative xenoliths demonstrating enrichment of melts passing through peridotites in moderate incompatible elements. Lherzolites from Quaternary lavas more enirched in REE which may be referred to as relic nature of Quaternary asthenosphere.

MAGNETIC ANOMALIES NATURE AND EARTH CRUST COMPOSITION AT THE CANARY-BAHAMAS GEOTRANSECT (NORTH CENTRAL ATLANTIC)

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We report new results of magnetic modeling of the bearing profile along latitude 23°30'N accomplished on the basis of systematic geophysical surveys carried out by SEVMORGEOLOGIA Association under the umbrella of Canary-Bahamas Geotransect Project complemented with detailed magnetic data and petromagnetic measurements collected by P.P. Shirshov Institute of Oceanology in the Mid-Atlantic Ridge area.

The modeling purpose is to understand the nature of lateral changing of linear magnetic anomalies amplitude characteristics and their relation with the oceanic crust structure. An original procedure of direct magnetic modeling and inversion technique was used on the basis of adaptive filtration and partial reparametrization of the model reducing the invariance of the solutions. Crustal layers geometry was determined from the deep seismic reflection profiling but the estimations of the effective magnetization have been controlled with the petromagnetic measurements of the bedrocks, dragged or collected by the habitable deep-water vehicles.

Due to the modeling results estimated mean magnetization of the basaltic layer for its real thickness significantly exceeds the values of experimental petromagnetic measurements. Correlation between these two groups of independent data is achievable at the thickness of the magnetic layer which corresponds to the full crustal section. Anomalous increases of the effective magnetization correlate with the thickening of the seismic layer of 3 units and integral negative density variations acquired by the gravity modeling. This pattern also correlates with the disturbed topography symmetry in the MAR area.

The reported results complemented with the detailed petromagnetic measurements in the TAG area and near the transformations correspond to the complicated and almost bilayer structure of the magnetic crust units in the slow spreading regions. The deepest magnetic layer is given by serpentinites created at the ridge flank as a result of frontal serpentinization and also in the spreading center under the conditions of the discreteness of eruptive phases at the slow spreading rate regime.

INTRUSIVE MAGMATISM OF THE INTRAOCEANIC UNDERTHRUSTING ZONE: EVIDENCE FROM MAFIC-ULTRAMAFIC PLUTONS OF THE OLYUTOR ACCRETIONARY TERRANE

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The Koryak Highland represents a combination of accretionary terranes which were amalgamated at the margin of Asia. The Late Paleozoic to Cenozoic deposits of different structures of the transitional ocean-continent zone are recognized in their composition. The peridotites to gabbroic massifs are widespread. Most of them are identified as basal part of ophiolite sequences. Olyutor mafic-ultramafic plutonic complexes for a long time were considered as ophiolite hypabyssal rocks, too. Our new geological, mineralogical and geochemical data show that the origin of the Olyutor zone plutons has been connected with the magmatic processes that operated within the root part of the Late Cretaceous to Paleogen intraoceanic island arc.

1. Olyutor terrane occupies the southern part of Koryak Highland. It represents the pile of nappes of oceanic (K_1al-K_2cp) and island-arc (K_2m-P_2) deposits which has been thrust over the Ukelayat marginal sea flysch (K_2-P_2). Four nappes were identified and their mutual disposition at the Cretaceous-Paleocene boundary was reconstructed. The basal unit of each nappe was composed of the different litho-facial type of the oceanic rocks, which reflected Cretaceous structural zoning of the region.

2. Mafic-ultramafic plutons are included in the nappes which basal part is composed of slope deposits of oceanic seamountains. Intrusive bodies form an elongated belt parallel to the facial zoning within the nappes. They intrude all oceanic and lower parts of island-arc deposits.

3. Mafic-ultramafic plutonic complexes composed predominantly of ultramafic cumulates (dunites, wherlites, olivine clinopyroxenites) and a small amount of gabbro. Ultramafic - mafic cumulates are genetically related and were formed through crystal fractionation of primitive melts in long-lived magmatic chambers. The parental melts have been characterized by high MgO, FeO contents, high LILE and H_2O concentrations, high LILE/HFSE and Ca/Al ratios. This type of primitive melt was generated at the early stage of evolution of intraoceanic island arc.

4. The emplacement of Olyutor mafic-ultramafic plutons heralds the change from an oceanic tectonic setting to an island arc setting.

FLUIDS OF SUBDUCTION ZONE IN KURILE ISLAND ARC: ESTIMATES OF MAGMA GENESIS MODELS

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Previously we have identified two volcanic zones in the Kurile Island Arc: the frontal and rear one, with the zone of decreased volcanic activity between them. These zones distinctly vary in petrologic, geological, mineral and isotopic characteristics. Concentrations of K, Rb, Ba, Sr, U, Th, La, Ce, Nb, Be, Ni, Cr in basalts of the rear zone are twice and more as high as those of the frontal zone. The average 87/86 Sr ratios in lavas from the frontal and rear zones are 0.70324 and 0.70302, and Nd are 9-10 and 7-8, respectively. Intermediate and acid lavas from the volcanic front are characterized by two-pyroxene phenocryst associations, while similar lavas and even some basalts from the rear zone have amphibole- and biotite-bearing associations. Discrete variations of many characteristics from the frontal to rear zone testify to the existence of two zones of magma generation.

The quantitative estimate of the mantle matter participating in magma genesis, according to the temperature structure beneath the Kurile Island Arc after the model by Honda & Uyeda (1983), along with geochemical parameters, indicate that the process of magma genesis apparently takes place in the convecting mantle wedge under the influence of the fluid. Two zones of magma genesis result from two different levels of volatile separation from the subducted slab: dehydration of tremolite, 7A-clinochlore and other hydrous minerals from the layers 1-3A takes place beneath the frontal zone, while dehydration of serpentine from the layer 3B occurs beneath the rear zone. Besides, dehydration of the dredged basement beneath the frontal zone of the mantle wedge takes place. There are no real H_2O sources under the intermediate zone. About 66 million kg/km x yr of H_2O and 16 million kg/km x yr of CO_2 are subducted in the Kurile Island Arc. These are 10 and 50 times more, respectively, than their amount in the island arc lavas. H_2O release from the descending slab in the frontal zone is twice more than that under the rear zone. The levels of CO_2 extraction from the descending slab are unknown.

Correlation between the mobile incompatible elements (Rb, K, Ba, Sr, U, Th, Pb a. o.) and non-mobile elements (Nb, Ta, Ti, Zr, Yb a. o.) in the frontal and the rear zones and comparison of these with those of MORB, the depleted, and enriched mantle sources allow us to estimate the role of various factors in the development of specifical geochemical characteristics of island arc lavas. Comparison of modal and calculated basalt compositions gives an evidence that the geochemical specifity of island arc lavas and differences between frontal and rear arc lavas are caused by the fluid composition, by their amount and to a less degree by a fraction of melting. Contamination by continental crust is negligible. Some other T-structure causes the different sequence of mineral dehydration and consequently, the different picture of structural and geochemical zonation, for example, as in the Mariana Island Arc.

ON THE GEODYNAMICS OF THE ALPINE-CARPATHIAN-DINARIDES REGION

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The development of this region includes three basic phenomena: 1) the formation of deep basins on oceanic and continental crust,
2) an intense compression of the crust and
3) the formation of high mountain ranges. The concept of plate tectonics explains both horizontal movements (sea-floor spreading and compression of the crust) and vertical movements (formation of deep basins and high mountains) in fold belts in terms of horizontal plate motion.

Our analysis of the structures of this segment of the Alpine belt has revealed that its development took place in a considerably different way.

Since the Triassic the numerous deep basins on continental crust have been formed there by rapid subsidence without significant stretching or thrust loading. They were produced by contraction of the rocks in the lower crust under asthenospheric upwelling. Two oceanic basins were produced by sea-floor spreading in the Jurassic.

The deep basins on oceanic and attenuated continental crust were underlain by a thin lithosphere. From the Late Jurassic and until the Pliocene they were intensely compressed, with formation of the Alps, Carpathians and Dinarides. Compression began in the deepest basins and then covered the basins of moderate depth. No compression occurred in adjacent cratonic regions with a thick lithosphere. The present fold belts follow the boundary between the past deep basins and the surrounding stable regions. The nappe emplacement was associated with no significant subsidence in the adjacent cratonic region.

After the termination of compression of the crust in each region the crustal surface emerged only by several hundreds of meters above sea level, because of the contraction of rocks in the lithosphere due to grabbo - garnet granulite - eclogite transformation in the lower crust. This permits estimating the force that produced the compression. The high mountains in the folded regions were formed long after the termination of compression. They could have been produced by upwelling of a hot asthenosphere and an inverse phase of transformation in the lower crust.

ON THE CONDITION OF FORMATION OF SEDIMENTARY BASINS ON THE EAST- AND WEST-EUROPEAN PLATFORMS

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The sedimentary basins of these platforms pertain to two main basin types: cratonic basins produced by slow sediment-loaded subsidence (10-100 m/Ma) and deep basins where rapid water-loaded subsidence (~ 1 km/Ma) took place. The Moscowian and Mezen basins pertain to the first basin type, the Timan-Pechora, Volga-Urals, Pre-Caspian, Dniepr-Prypyat, South Barents Sea, North Sea, North Germany basins and others pertain to the second basin type.

Rapid subsidence of continental crust took place on the East European platform in O_3-S_1, D_3, C_2 and C_3-P_1, on the West European platform in P_2, T, J_1, J_3, P_1 and N. Rapid subsidence formed mainly along passive margins of ancient or recent oceanic basins - Uralian and North Atlantic.

In the basins of the first type the heat flow and the intensity of local tectonics are low. These basins do not include giant hydrocarbon fields. The basins of the second type are characterized by high heat flow, intense local tectonics and the occurrence of good source rocks of domanic type, reservoirs and seals. The main hydrocarbon basins of East and West Europe pertain to this basin type.

All sedimentary basins of both platforms formed without thrust loading. In many basins (Timan-Pechora, Volga-Urals, Pre-Caspian, South Barents Sea, North Germany) crustal extension is absent or amounts to only a few percent and is unable to explain their rapid subsidence. Large discrepancy between upper crust stretching (5-15%) and lower crustal attenuation (from several ten percents to two hundred percent) is seen in the Dniepr-Pyrpyat graben, Viking and Central graben of the North Sea. In the West European passive margin upper crustal extension ranges between 15 and 50%, whereas the lower crust is attenuated by 2-3 times (e. g., the North Biscay margin, Western Approaches margin, West Scotland margin).

The observed discrepancy between upper extension and crustal thinning suggests that crustal stretching alone cannot account for the subsidence of these basins. Phase transformation in the lower crust under upwelling of the anomalous mantle probably facilitated by presence of hydrous fluids, can cause rapid (~ 1 Ma) as well as long-term (200-1500 Ma) upward displacements of the Moho discontinuity, resulting in high amplitude subsidence of the crust.

MAGNETIC PROPERTIES OF METALLIFEROUS SEDIMENTS FROM THE EAST PACIFIC RISE AXIAL ZONE

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Detailed magnetic properties, element contents and Mössbauer spectra of metalliferous sediments (mfs) from ultra-fast spreading center axial zone in the south part of the East Pacific Rise (EPR) were studied (4th cruise of R/V "Geolog Fersman". The mfs cores were taken from three profiles: 10, 20 and 40 km along the spreading axis. Surface mfs from 20 cores and mfs down 9 cores were studied (in initial and carbonate-free state; at 20°C and after heating at 700°C). A complex of methods made it possible to identify Fe (Mn) minerals. The ore part of these mfs consists of two genetically unconnected components:

1) Partly oxidized magnetite (T_b ~600°C) and titanomagnetite (T_b ~ 300 - 400°C) are the magnetic minerals of basaltic components. Their part in mfs is negligible ($J_{rs} \sim 10^{-3}$ Am^2/kg) and decreases away from the rise crest.

2) X-ray amorphous and fine-dispersed Fe (Mn) para- and superparamagnetic oxyhydroxides (hydrogoethite d<100 Å and Mn-ferroxyhite) are the main hydrothermal part of mfs.

Some new tendency was found in changes of surface mfs magnetic properties. Away from the spreading axis saturation magnetization J_{so} increases (from 5 to $20x10^{-2}$ Am^2/kg), the form of thermomagnetic curves changes from pure paramagnetic (median temperature $T_{1/2}$ ~ 230-250°C) for mfs from 10-20 km profiles to strong concave ($T_{1/2}$ ~ 150°C) for mfs from the 40km profile with T_C ~ 250°C; relations J_{S1}/J_{SO} decrease from 7-8 to <1. Similar changes are observed after laboratory heating of mfs. That is connected with partial crystallization from initial precipitates of a new and stronger magnetic phase with $T_C \sim 250°C$ during the transport from the rise crest. This process is also observed for mfs down the 40km profile cores (meaning the spreading rate). The value of J_{SO} has a negative correlation with the relation J_{SI}/J_{SO} and Fe and Mn contents. These peculiarities are observed only in the area of hydrothermal influence. Thus the observed changes of mfs magnetic properties away from the rise crest mark the zones of hydrothermal discharging. Fine-dispersed initial precipitates formed near the hydrothermal vents stay unchanged up to the 20km profile and partly crystallize during the transport to the 40km profile.

OIL AND GAS ACCUMULATION AND THE PLATE MOTION

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Some considerations on the hydrocarbon (HC) formation in subduction zones on the base of plate tectonics theory are developed. It is shown that some individual petroleum provinces provide the possibility of oil and gas formation in subduction zones. An exclusive intensity of processes of HC generation and migration is regarded as a factor able not only to compensate for the HC loss, but to form unique provinces as well.

Great attention is paid to the possibility of gas generation due to the transformation of geologic beds in subduction zones containing the organic matter or coal. Some examples are given showing the intensity of gas generation processes that, as a rule, cause lateral zonality of the HC phase distribution in the marginal basin, i.e. gas deposits concentrate in the overthrust part while liquid HC are shifted towards its platform side.

SOME ASPECTS OF GEODYNAMICS OF THE BAIKAL RIFT ZONE: RESULTS OF THE REMOTE SENSING STUDIES

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1. The Baikal Rift Zone (BRZ) is controlled by the pre-rift basement structures. The Baikal Rift itself follows the contact between the Siberia craton and Precambrian to Early Paleozoic fold belt with a relatively thin lithosphere and wide development of asthenospheric uprises. Massive uplifted blocks of the relief, bounded by seismically active faults develop along the ancient overthrusts and strike-slip faults.

2. Remote sensing data indicate that kinematics of the rift zone opening changed in time. Instantaneous kinematics is reflected in the normal fault focal mechanisms of earthquakes with horizontal extension perpendicular to fault planes (Zonenshain et al. 1981). However, the structural pattern of rift depressions suggests that in the past strike slip along east-north-east trending transfer faults was important. The major transfer zones were bounding the Baikal Rift from north and south, as suggested by Piragov (1971), Sherman and Levi (1976).

3. We speculate, that different kinematics correspond to changes in geodynamic conditions. At an early stage (Miocene- Middle Pliocene?) passive extension and opening were caused entirely by an external cause: the Indian-Eurasia collision, fragmentation of SE Asia and relative motion of formed subplates. Later, in the Late Pliocene-Anthropogene, tensional forces created by the lateral flow of the material due to gravitational instability of the asthenospheric rise became important. Thus rifting became at least partially "active", with extension concentrated in the rift zone. The present structural pattern fixed by remote sensing data has a complex genesis and we can see the marks of two or more kinematic situations.

4. An individual topographic swell about 250 km in diameter corresponds to the Darkhat-Khubsugul segment of the BRZ. This swell is presumably related to a separate asthenospheric rise and may has its own geodynamic history.

GEODYNAMIC EVOLUTION OF THE EARTH IN COSMOGENIC MODEL OF THE "OPEN" SOLAR SYSTEM

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An original cosmogenic model of planets'evolution based on the new idea of jet outflow of substance from the center of spiral galaxies is proposed. According to the model all objects of the solar system since its birth moment are subject to quasi-periodically strong influence of stars and comets which are composite parts of the jet of the Galaxy. One of such influences forced the destruction of the Faeton planet 4.7 billion years ago generating asteroid ring which became the main reason of appearance in Solar system the second cycle of planet formation.

Calculations show at that moment that a surface layer with 240 ± 10 km depth was torn away from the Earth as result of Earth's bombarding by Faeton fragments. One part of this substance (~ 18.4%) accumulated in the Moon, the other was lost. At the same time the Earth lost ~ 4/5 of its initial Earth-crust substance and the remaining part was completely melted and mixed with Earth-mantle substance. The depth of melting layer of new Earth-surface could be hundreds of kilometers.

The following geological evolution of Earth was caused by cooling and separation of surface rocks and developing of convective motion. During cooling the main physical mechanism of heat transfer to the Earth surface as well as the geodynamic regime were changing. Being convective in Katarchaic it became plumotectonic in Archaic and beginning from Proterozoic transformed into the modern plate tectonic style.

A model is proposed which could estimate the maximum thickness of modern lithosphere plates as soon as observed depth and thickness of heated asthenosphere layer. In the Earth history the thickness of tectonosphere often changed under the influence of cosmic energy impulses.

THE ROLE OF NEOTECTONIC ENVIRONMENT IN THE DEVELOPMENT OF THICK FROZEN ROCKS

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Structurally, the Yana-Chukchi mountain system includes intermontane depressions, which resulted from neotectonic continental rifting, and fault-related grabens of a complex structure. These depressions are mainly infilled with alluvial, glaciofluvial, proluvial, lake and diluvial deposits of Pleistocene. The basement has a block structure. Under an intense neotectonic regime, the blocks of the basement are subject to vertical movements, which are relatively rapid and may differ in amplitudes.

Within the cryolithic (frozen soil) zone, the subsidence rate of some blocks may be significant up to 3 cm/year, and the frozen rocks are accreted from below. Permafrost layers (PL) of great thickness are developed when the rate of permafrost melting caused by heat flows from the Earth's interior is less than the rate of subsidence.

An example of it is the Olskaya depression located within the area where PL occur in patches. Here, the thickness of permafrost is usually not more than 180 m, and in some depressional blocks it is up to 350 m.

Thus, the neotectonic environment pertinent to intermontane depressions of the Yana-Chukchi mountain system can be understood as a regulating factor for the distribution of the lower limits of PL zone.

UPPER CRETACEOUS PALEOMAGNETISM OF THE SHIKOTAN ISLAND: A KINEMATIC ENIGMA

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Maastrichtian tuffaceous sandstones and siltstones were sampled from four sections in the northern part of the Shikotan Island, Lesser Kurile Islands. A characteristic component (ChRM) readily isolated from most samples passes the reversal and fold tests and is most probably a primary remanence. It is shown that the ChRM mean direction (D = 334°, I = 56°, k = 36, alpha95 = 3.2°) is by 14° ± 3.5° steeper than the Pacific reference direction. This discrepancy may be accounted for by the Shikotan welding to the Pacific plate in the Eocene and drifting together with this plate further on. In contrast, the large inclination misfit of 13° ± 3.5° between Shikotan and Eurasia (or

North America) remains an enigma since no structures able to consume the intervening space are known in the area. Other paleomagnetic data from the North West Pacific periphery also reveal similar inclination pattern thus implying that the above inclination misfit is related to Eurasia-Pacific kinematics.

GEODYNAMIC MAP OF THE PALEO-ASIAN OCEAN (EASTERN PART)

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The eastern transect of the geodynamic map of the Paleo-Asian ocean of 1:2,000,000 scale is compiled as a result of work on the project IGCP 283 "Geodynamic evolution and main sutures of the Paleo-Asian ocean". The map comprises a wide area, including the marginal part of the Siberian craton and folded systems, formed during the evolution of the Paleo-Asian ocean (Pt_2-Pz_3), the Mongol-Okhotsk ocean or oceanic gulf (Pz_2-Mz_2) and the Paleo-Pacific ocean (Pz_3-Cz).

The Paleo-Asian ocean history may be divided into three periods - PR_2-PZ_1, PZ_{1-2} and PZ_{2-3}. Complexes of the first period differ in the marginal part of the Siberian plate and in the Tuva-Mongol, Barguzin and Burea composite terranes, regarded as microcontinents. Marginal parts of the Siberian craton consist of volcanic-sedimentary series of active continental margins (PR_2) and carbonate-sedimentary series of passive margins (PR_{2-3}). The composite terranes include fragments of the Early Precambrian metamorphic basement, Precambrian ophiolites (PR_{2-3}), island arc or accretionary wedges volcanic-sedimentary series sometimes with ophiolites and blueschists (PR_{2-3}), limestone-dolomite sequences of passive margins (V-Cm_1). PZ_{1-2} is a time of collision of terranes with the margin of the Siberian plate, resulting in the formation of high grade zonal metamorphism (Cm-O) and formation of the large Angara-Vitim batholith (O-S). Devonian A-type granites impregnate all rock series. PZ_{2-3} plutonic and comagmatic volcanic complexes with associated clastic rocks of active continental margins are widespread all over the southern margin of the Siberian plate.

The history of the Mongol-Okhotsk ocean begins in the Middle Paleozoic. This ocean related complexes include essentially terrigenous series of accretionary wedges with ophiolites and blueschists (S-D) and sedimentary series of back arc or marginal seas (D-C). Closure of the basin, accompanied by collision of the Burea composite terrane begins in PZ_3 in the west and terminates in MZ_{1-2} in the east. Collision related complexes are S-type granites (J) widespread all over the area, mollasse-like sediments of foredeep basins (T-J) and linear granite-gneiss domes, regarded as metamorphic core complexes (T-J).

Complexes related to Paleopacifica are situated only in the eastern part of the territory and include accretionary wedges with fragments of ophiolites (C-J), island arc volcanic and clastic rocks (K_1), essentially sedimentary series of collisional foredeep basins (K_1), and volcanic and co-magmatic intrusive rocks of active continental margins (K_2-Cz).

ON A THERMOCONVECTIVE MECHANISM FOR OSCILLATORY VERTICAL CRUSTAL MOVEMENTS IN SEDIMENTARY BASINS

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The sedimentary record testifies that one of the main peculiarities of vertical crustal movements is their rhythmic behavior which consists of a periodic change in sign of movements. The long history of deposition in sedimentary basins is inevitably interrupted by episodes of erosion that indicate elevations. The vertical crustal movement in sedimentary basins can be considered as a slow subsidence on which a small-amplitude oscilliation (period of about 80 Ma and amplitude of the order of 100 m) is superimposed. In the present paper oscillatory crustal movements are related to thermoconvective oscillation of the upper thermal boundary layer formed by the large-scale convection in the earth's mantle. The instability of the boundary layer was analyzed by many researchers who used a Newtonian fluid rheological model or a power law non-Newtonian fluid model for the earth's mantle. However, a real material has a memory in contrast to Newtonian and power law fluids. The author proposed recently a nonlinear integral model consistent with general creep theory and laboratory studies of rock creep to decribe the earth's mantle rheology. To investigate the boundary layer instability we use this rheological model having a memory for the mantle and the crust but distinguish a thin uppermost layer which may be considered to be purely elastic at geological timescales. The upper boundary of the layer is considered as a surface loaded by sediments which thickness changes with time. We show that the boundary layer instability is oscillatory and the period of thermoconvective oscillation is of the order of 100 Ma.

TECTONICS OF THE NORTH-ATLANTIC RIDGE: RESULTS OF RESEARCH IN THE CANARY-BAHAMA GEOTRAVERSE

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Gravity and magnetic surveys complemented by multichannel seismic profiles, carried out by MAGE during 1987-1990 in the Mid-Atlantic ridge between 23°-29°N, form the basis for a structural model of the oceanic lithosphere.

From gravimetric modelling the thickness of the lithosphere changes from 11-13 km in the axial rift to 30-40 km at the flanks of the ridge. A sharp variation of the oceanic crust thickness (from 7.0 to 2.5 km) is determined by its block-faulting structure. The thinnest crust is in the central rift valley and at the fault zone axes, where the Moho's rise is assumed.

The area of this ridge segment is characterized by a complex spatial pattern of fault zones. The transcurrent fault zones show bends and step displacements similar to the axial rift. Locally wedge-shaped fault zones distensions are observed. A change in the character of the fault-block structure is observed both transverse and along the strike of the ridge. The axial zone of the ridge is characterized by linear relief and mainly perpendicular trend of the faults, whereas the ridge flanks' block-faulting pattern is more irregular.

Along the axis of the ridge there are three sublatitudinal areas different by structure and terminated by general fracture zones (Kane F.Z., Kap-Blanc F.Z., Atlantis F.Z.). These distinctions are clearly expressed in the relief of the oceanic basement as well as in gravity and magnetic fields. The axial zone, bounded by magnetic anomaly 5, is characterized by a magnetic high (from 200-400 to 400-600 nT) and the Bouguer low (from 260 to 220 mGal). This gravity minimum is associated with less dense partly melted upper mantle rocks. Toward the ridge flanks, bounded by magnetic anomaly 13, the gravity field values increase from 260 to 350 mGal while the amplitudes of magnetic anomalies decrease to 150-50 nT. The fracture zones are traced by the breaks of the geophysical field pattern (magnetic and Bouguer anomalies) or by the elongate free-air gravity anomalies lows. Within this region residual Bouguer anomalies trend sublatitudinally; positive anomalies characterize fault valleys and depressions at the ridge-transform intersections whereas the negative anomalies reflect the adjacent ridges.

Structural complication and magnetization lowering toward the flanks of the Ridge may reflect the second process of metamorphic and tectonic alteration of the oceanic crust. These structural features may be evidence for irregular spreading of the different sea-floor areas. Possibly, an extension component takes place along the ridge axis. This expanding was realized in the transcurrent fault zones, where the crust thinning and mantle rise have been observed by geophysical methods.

TRANSFORMATION THE MAFIC CRUST TO SIALIC ONE AT PLATES CONVERGENT BORDERS (FOR EXAMPLE OF KAMCHATKA)

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According to traditional opinion the accretion of continental margins takes place along the convergent plates borders. Kamchatka peninsula is one of the unique regions where these processes can be investigated in detail.

The ledge of metamorphic rocks (LMR) at the southern part of Kamchatka has traditionally been interpreted as the block of pre-Cambrian age or as result of different nature complexes of Pr-Mz age metamorphism at Cretaceous.

The new authors data permits to recognize at LMR complexes of Pz1-Mz age that is formed at ocean (Pz-T) and at ensimatic volcanic island-arc and back-arc basins (J-K1 and K2). These complexes are exposed by several stages of deformation and metamorphism.

1) Pz1 (near 400 m.y., Rb/Sr) - metamorphism affected only one tectonic block with protolites age 550 m.y., Rb/Sr and occurred at ocean (PaleoPacific). The nature of protolites (plagiognisses, amphibolites and calcifires) is problematical but probably oceanic.

2) Mz1 (180-120 m.y., Rb/Sr) - metamorphism took place at ophiolitic basement of D-T age of ensimatic volcanic island-arc.

3) K2 (60-70 m.y., Rb/Sr and K/Ar) - metamorphism was connected with obduction of K2 age ensimatic volcanic-arc to complexes Pz-Mz age of Asia margin. These metamorphism events reconstructed at all older complexes of Southern Kamchatka. As the result of this obduction is Ganalsko-Andrianovskaja suture zone of K2 age (65 m.y., Rb/Sr).

4) Early Paleogene (55-60 m.y., Rb/Sr and K/Ar) - metamorphism took place as result of uplift of thermal front over the Cenonian-Paleocene subduction zone and affected all older complexes too.

As result of polymetamorphism that accompanied the continental accretion of Asia the first-mafic nature complexes were transformed to sialic. The metamorphism stages coincided with main stages of continental accretion.

PETROLOGICAL CONSTRAINTS ON THE ORIGIN OF SUBALKALIC BASALTS FROM APHANASEY NIKITIN RISE (INDIAN OCEAN)

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The Aphanasey Nikitin Rise (ANR) is located in the central basin of the Indian Ocean. The ANR was discovered on a cruise of research vessel "Vityaz" in 1961. The ANR includes basement and the Aph. Nikitin Seamount (ANS) located in the northern part of the basement.

The previous study on ANR (Matveenkov et al., 1991 and Sborshikov et al., 1991) suggested that the ANR originated near the spreading axis. The age of ANR is estimated as - 75-80 m.y. Matveenkov et al. (1991) and Kashinzev (1992) pointed out that tholeiite suite which is represented by plagioclase basalts and diorites have been erupted during the fracture stage of ANR. Basalts and andesites of the ANS have been erupted during stratovolcano stage of the ANR. They were referred to subalkalic suite by Matveenkov et al. (1991).

In our studies the high-magnesium (MgO=9-10%) basalts of the volcano basement, which were collected on 20 cruises of "Keldysh" by submersibles "MIR" have been investigated.

The main results are following: 1. Basalts consist of microphenocrysts of olivine Fo 87.5 containing small inclusions of Cr-spinel (Cr/Cr+Al 0.52 mol%, TiO_2=0.8-1.1 wt%). The TiO_2 content of the spinel inclusions (0.8-1.1 mol %) is lower than that content of spinel of subalkalic basalts of typical "hot spot" (the Reunion, the Hawaii islands) (Nikogosyan 1990). It corresponds to the maximum value for the spinel of oceanic tholeiite (Dick and Bullen 1984).

2. As the results of the melt inclusion studies it has been proven that parental melt of the basalts was relatively enriched in K_2O=(1.0 %) content. The melt is characterized by SiO_2 (51 wt. %) and TiO_2 (1.1-1.2 wt. %) contents. The water content of the melt is as high as 1.0 wt % (calculated by difference in temperature of homogenization and termperature of "dry" liquidus of olivine). We suppose that these basalts are referred to as subalkaline suite.

3. Crystallization of basaltic melt proceeds during acsent to the surface to the maximum temperature of 1240° and buffer QFM. Further differentiation of the melt (fractional crystallization of olivine, plagioclase and clinopyroxene) could result in the origin of low magnesium subalkalic basalts and andesites of ANS.

4. The possible primary melt was calculated by approach of "back" fractional crystallization of olivine until equilibrium of the liquid with olivine Fo_{90} and Fo_{91} mol%. The composition of the co-existing crystals and melt were calculated using equations of Ford et al. (1983). Calculated composition of the primary melt is picrite. It is characterized by high MgO content (13-15 wt.%) and it is distinguished from primary melts of the subalkaline basalts from the Reunion and the Hawaii islands by relatively higher K_2O (0.9-1.0%), SiO_2 (50.1-50.6%) contents and lower FeO (9.7-9.8), TiO_2 (1.0-1.1) contents.

5. Origin of the ANR was thought to be connected either with "hot spot" (Singh 1986-1987) or transform fault (Matveenkov et al. 1991) and (Sborshikov et al. 1991). We suggest that the conditions of the origin of primary melt were similar ones deep ocean tholeiite (Dimitriev et al., 1985) and were distinguished from the conditions of the origin for typical "hot spot" related magmas (e.g. the Reunion and the Hawaii Islands).

GLOBAL GEODYNAMIC POLARITY AND REVERSALS IN THE SYSTEM OF EARTH'S HEMISPHERES

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1. Tectonic asymmetry of Northern and Southern hemispheres of the Earth can be followed all through the geological history, clearly increasing since the Upper Precambrian after the first fragmentation of the Pangea supercontinent into Gondwana and Laurasia.

Distinctions in the Early Precambrian evolution of two hemispheres are displayed in greenstone belts peculiarities, distribution of protoplatform covers, gigantic dyke-like complexes, repakivi-anorhtozites and ophiolites.

In the Late Precambrian - Early Paleozoic Laurasia underwent the destruction of continental crust which resulted in the generation of large oceans (Yapetus, Protothetys, Paleoasian) and separation of continents. This epoch was marked in Gondwana by folding within intracratonic troughs, development of subduction along supercontinent's margins and enormous manifestation of tectono-thermal reworking of ancient crust.

In the Phanerozoic fragmentation of Gondwana and coalescence of Eurasian continental blocks took place.

2. A reversal character of the polarity has been discovered. Epoches of geodynamic reversals of 370-350 Ma alternate in time reflecting changes of predominant compression in one hemisphere and extension in another one into the opposite pattern. The peak of reversals is expressed by comparatively short-term convergence of geodynamic tendencies resulting in global coalescence of continental plates into Pangeas.

3. The spatial and temporal regularity set up controls rifting and orogenies' distribution and effects a rearrangement of lithospheric plates.

4. Evidently, similar geodynamic polarity can be observed between Western and Eastern hemispheres. It is displayed in the opposite pattern of modern island arcs' distribution along the Pacific as compared with Mezozoic ones, different evolutionary features of Western and Eastern Gondwana etc.

5. The nature of this phenomenon fixed empirically is not clear. It seems plausible that it is connected with the geodynamics of the core-mantle boundary, when a similarity between geodynamic and geomagnetic reversals is considered.

GLOBAL BALANCED ARRANGEMENT OF THE GEODYNAMIC POLARITY OF EARTH'S SOUTHERN AND NORTHERN HEMISPHERES

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This paper is the first attempt to examine two recently created concepts with a common approach: (1) Geodynamic polarity and reversals between Southern and Northern hemispheres (Bozhko, 1991) and (2) Balanced arrangement of tectonic flow (Gonacharov, 1987, 1993).

According to the first concept, the known asymmetry between Northern and Southern hemispheres took place in the geological past within the Gondwana-Laurasia system. Geodynamic reversals expressed by regular changes (in 350-390 Ma) of a lateral strain character (extension in the Northern hemisphere - compression in the Southern hemisphere and vice versa), which correspond to long-term (350 Ma) geomagnetic fluctuations, have been discovered.

The second concept is based on the fundamental feature - the continuity - of the geological medium and the interpretation of tectonic flow (F) as combination of translational movement (M), rotation (R), and strain (S) of medium elements. Vertical and horizontal M and S in the combination with R are always balanced. Hence, TF is arranged in the form of convection cells independently on sources.

Common implication of both concepts leads to the idea of the global cell of balanced arrangement of TF (BATF). A rising vertical flow occurs near the Earth's pole which is a center of "expanding geosphere". Downstreaming flow takes place correspondingly near "the pole of compression". A superficial lateral flow moves along meridians from the pole of extension to the pole of compression. A deep-seated balancing horizontal flow moves also longitudinally, but in the opposite direction and at the level of the external core. The simplest (expressed by some elementary functions) model of global BATF has been elaborated.

The analysis of this model showed the following: (1) Horizontal S (extension in some geosphere and compression in another one) are equilateral, without a predominant direction of extension or compression. (2) Maximal value of M along any meridian takes place at low latitudes. (3) While crossing the equator, geodynamic conditions within each element are changed: extension is replaced by compression. (4) The geodynamic reversals occur simultaneously with a change of TF direction in the global convection cell. (5) Alongside the value of TF is changed increasing from the Early Precambrian to the Mesozoic-Cenozoic. Evolution of this process can be compared with the increasing swing of pendulum.

The described global convection cell of BATF interacts with other cells of the same scale (causing the polarity between Pacific and Indo-Atlantic segments of the Earth and regular drift of northern continents towards the west) as well as of higher scale (causing minor lithospheric plates and microplates movements etc.). So the effect of the global "polar" BATF described is considerably masked.

BOREAL RADIOLARIAN ASSEMBLAGES OF THE TRIASSIC AND JURASSIC AND THEIR SIGNIFICANCE FOR TECTONIC AND PALEOGEOGRAPHIC INTERPRETATIONS

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Despite the great progress in paleobiology of the tropical Mesozoic radiolarians their boreal assemblages are relatively poorly known, especially those from the Lower Mesozoic. The numerous radiolarian assemblages of the Lower Mesozoic from such regions as the Koryak Upland were interpreted as tropical and subtropical ones because of their similarity to those from the Mediterranean area and this interpretation was often used in paleotectonic reconstructions of the North Pacific region. The value of such speculations can be estimated only by the direct comparison of concrete low- and high-latitude assemblages.

In the Omolon massif, not far from the Koryak Upland, there are subcratonic sequences of the Triassic with typical boreal malacofauna (ammonites, bivalves, etc.). The Middle Triassic of this region is characterized by a peculiar radiolarian fauna represented by numerous Actinommidae with very simple external features, Entactiniidae, similar to the Paleozoic forms, rare *Pseudostylosphaera* and very rare nassellarians such as peculiar *Napora* and *Triassocampe*. Typical for the Triassic fauna of the Koryak Upland taxa as Eptingiidae and Muelleritortiidae were completely absent in the Omolon massif. The poor taxonomic composition and archaic type of the Omolon assemblages are very distinctive providing a good support to the idea that abundant and taxonomically diverse Triassic fauna of the Koryak Upland has a low-latitude origin.

In the central part of the East European platform there are very well known sequences of the boreal Upper Jurassic. They contain well preserved radiolarians (especially in the Upper Oxfordian and Kimmeridgian). This fauna is characterized by the abundance of various *Parvicingula* and Pantanelliinae. *Praeconocaryomma*, *Hsuum*, and *Paronaella* are common, but not diverse. *Geuyxella* is very rare. *Mirifusus*, *Ristola*, *Podobursa* and Williriedellidae, typical for the Mediterranean, were absent here. This assemblage has some similarities to those of the central Koryak Upland. These data allow to suggest that the Jurassic assemblages of the central Koryak Upland are subtropical or southern boreal.

In general, the boreal radiolarian assemblages of the Triassic and Jurassic have relatively poor taxonomic composition, numerous taxa with simple morphology and monotonous habitus. The differences between tropical and boreal radiolarian assemblages at genus or family level are very distinctive and can be used for paleogeographic and paleotectonic reconstructions.

RADIOLARIAN BIOSTRATIGRAPHY OF UPPER CRETACEOUS DEPOSITS IN THE SOUTHERWESTERN CYPRUS

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The Upper Cretaceous deposits of Cyprus lie on the allochthonous Mamonia Complex and Troodos ophiolites. This provoked a great interest in the geology and biostratigraphy of these deposits. Nevertheless, the paleontological data of this time interval is very poor and limits complex analysis of Cyprus geological history in the Late Cretaceous. Radiolarians are very abundant in these deposits being of major importance for biostratigraphy. This microfauna was studied in several key sequences.

The lowermost unit is the Perapedi Formation, which lies directly on pillow lavas of the Troodos massif. This formation is composed mainly of umbers (metalliferous sediments) with chert interlayers. Their radiolarian assemblage is of Santonian to Lower Campanian age (*Theocampe urna* Zone) and includes *Alievium gallowayi, Archaeospongoprunum bipartitum, Patulibrachium dickinsoni, Phaseliforma carinata, Spongosaturnalis hueyi, Amphipyndax stocki, Hemicryptocapsa conara*, and *Theocampe urna*. Thickness of the Perapedi Formation in the southwestern Cyprus ranges from 0 to 30-40 m. In the central part of Cyprus it is thicker and contains radiolarians of Turonian age.

The following Kannoviou Formation, consists of benthonite clays (30-150 m) with tuffaceous sandstones and acid tuffs. In the lowermost part of the section they contain radiolarians *Alievium superbum, Praeconocaryomma californica, Pseudoaulophacus praefloresensis, Afens lirioides, Amphipyndax pseudoconulus, Dictyomitra koslovae* etc. (Campanian, *Amphipyndax pseudoconulus* Zone). The Middle and upper parts of the Kannaviou Formation bear *Amphipynax tylotus* (Upper Campanian to Maastrichtian, *A. tylotus* Zone). Similar radiolarians are also recognized in the lower part of the overlaying Kathikas Formation (olistostrome with clay matrix, up to 100 m thick).

All these data are valuable for tectonic interpretations. First, the age of the base of Perapedi Formation is younger in western regions than in central ones and it may be reflected by differences in the geological history of relevant parts of the Troodos massif. Second, the thrusting of the Mamonia allochthonous complex and the beginning of its erosion could have started in the Late Campanian (not strictly in the Maastrichtian).

GEOLOGICAL STRUCTURE OF BAIKAL LAKE BOTTOM BASED ON THE UNDERWATER INVESTIGATIONS

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Underwater investigations from submersibles "Pisces" were conducted on Lake Baikal in 1990-1992. Dr. L.P. Zonenshain initiated these studies of Lake Baikal. The investigations were performed by several scientific institutions: Institute of Oceanology, Moscow (RAS), Institute of Geology and Geophysics (Novosibirsk), Limnology Institute of the Earth's Crust, Institute of Geochemistry, Irkutsk (RAS).

More than 20 divings to the bottom of Lake Baikal provided data of geological structure, neotectonics and geomorphology. The investigations from submersibles "Pisces" provided new data of the geological structure of the underwater slopes and the basement of the Baikal depression.

New data of geological cross-sections and the stratigraphic sequence of the basement rocks of the Baikal depression were obtained. The cross-section of the Quaternary sediments and the underwater Baikal paleolevels were revealed. The investigations contribute valuable additions to the database on neotectonics and active movements of the underwater slopes. These investigations indicate active neotectonic propagation of the depression towards the west. These data permit the morphostructural outlines of the recent seismic underwater faults to be revealed. The deepest diving (1637.0) took place near the Olkon island. It provided significant data of the geological structure of the island. The geological map of the middle part of the lake, compiled for the first time, shows the area of collision between the Precambrian Siberian plate and Vitim-Barguzin microcontinent, which happened about 520-400 Ma ago. The ferrous-manganese concretions are to some extent similar to the oceanic and sea concretions, they possess great genetic difference.

At present the investigations in terms of the programme "Deep-water investigations of Lake Baikal", proposed by the Institute of the Earth's Crust, are supported by the Russian fund of fundamental investigations.

STRUCTURAL PATTERN OF THE GEOID ANOMALY OF THE MID ATLANTIC RIDGE BETWEEN ASCENSION AND ST. HELENA TRANSFORM ZONES

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New altimeter data give us the possibility of using not only gravity anomaly but also geoid anomalies (analogue of the gravity potential) for density modeling of the lithosphere. Influence of the water-slab on the geoid anomaly was estimated. It was shown that influence of the 1° zone on the potential data is the greatest. Using relief bottom data (bathymetric map of the Angolo-Brazil geotransect, 1:2,000,000 scale, editor G.B. Narishkin, 1987) we have calculated water-slab correction for points within the area 8-18°S and 10-18°W. This map of corrections for geoid anomaly reveals three different patterns for northern, central and southern segments separated by linear zones of main transform faults.

There is an asymmetry of water-slab correction in each segment of the ridge. It may prove as result of correlation between ocean depths and water-slab corrections that this asymmetry has a connection with different depths on both flanks of the ridge.

Corrected for water-slab influence geoid anomalies reveal simple patterns located over central parts of each segments. These residual geoid anomalies suggest the connection with anomaly mass in the lithosphere and the lithosphere-asthenosphere boundary.

SUTURE ZONES OF CONTINENTAL CRUST OF CENTRAL ASIA

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Suture zones of Central Asia have been subdivided into two groups: transregional and global. They differ from each other by structural-composition complexes, dynamic structures and physical parameters (length, width, depth of penetration). The transregional zones are boundary structures of fold systems, and the global ones are those of fold belts. In Central Asia there are such transregional zones like Dzhida-Vitimskaya, Sayano-Tuvinskaya, Kandatskaya and Kurtushibinskaya, and such global zones like Glavnaya Sayanskaya, Baikalo-Vitimskaya, Tsagan-Shibetinskaya, Stanovaya, Mongolo-Ohotskaya and Bulgano-Irtyshskaya. The suture zones are characterized by active dynamo-metaphorism with wide areas of dynamoclastites, blastodynamoclastites, micstites and diaphtorites. In some of them (Biakalo-Muyskaya, Mongolo-Ohotskaya, Sayano-Tuvinskaya, Kandatskaya, Kurtushibinskaya) there are eclogites and glaucophane schists (Dobretsov a.o. 1988).

Suture zones are characterized by a high degree of uplift, which is typical of rocks formed under conditions of greenschist and epidote-amphibolite facies metamorphism. Also the rocks are accompanied by laminar flow structures, cataclastic and ptygmatic types, as well as a high degree of recrystallization and boudinage with rotation of rock fragments and active schistosity. The formation of the different structural forms is a result of transformation and differentiation of a solid mineral substance under conditions of strike-slip faulting and overthrusting with processes of laminar sliding, cataclastic and plastic flow.

The suture zones have typical structure-composition associations dependent on pressure, temperature and depth of formation. Generally the mineral associations are subdivided depending on depth of formation: epizonal, mesozonal and catazonal. However, the degree of transformation of composition in the zones can reach the same level as depths less than catazonal under the conditions of strike-slip stress or conditions of definite level of the all-round and directional pressures in the earth's crust, but this degree depends less on the temperature influence. It has been established that suture zone rocks, like the catazonal formation under the conditions of strike-slip are accompanied by the blastodynamoclastites and are metamorphosed under greenschist facies conditions to epidote-amphibolite facies conditions, and active pressure structural-composition complexes are metamorphosed under blueschist facies conditions, typical in the subduction zones.

REVISED PALEOZOIC APPARENT POLAR WANDER PATHS FOR E EUROPE, SIBERIA, N CHINA AND TARIM PLATES

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For the reconstruction of the Paleozoic history for the Paleoasia ocean and the areas which surrounded this basin, more reliable apparent polar wander paths (APWP) for major continental plates of Eurasia are needed. The work has been compiled from main sources - Global Paleomagnetic Database (McElhinny), and the latest published data. All data were classified by seven indices of paleo-magnetic reliability (IPR) from zero (completely unreliable: rocks remagnetized and age of remagnetization is unknown) to six (the highest variability) step by step. Higher than zero there are the following six reliability indices: 1) age of rock unit or overprint magnetization is known within a period; 2) there is a structural control; 3) if the statistical level is enough; 4) there are positive field tests (baked contact, fold, conglomerate, reversal); 5) with accurate magnetic cleaning and processing data; 6) comparison of the similarity for different rock types.

The data set of each plate was calculated by weight least square method to find out the regressions of F= f (t)*w, L=*f* (t) *w and L =*f* (F) *w, F =*f* (L) *w, where *f* - co-latitude, L- longitude, t-time and w= IPR/a95. The comparison of the above two types of curves allowed to exclude some effects of remagnetization and to mark the intervals of APWP with either high or low reliability.

time	E Europe			Sibiria			N China			Tarim		
	Plt	Plg	A95	Plt	Plg	A95	Plt	Plg	A95	Plt	Plg	A95
240	48	154	2	52	155	8	54	360	5	71	188	5
260	43	166	2	46	161	9	44	358	6	64	180	5
280	38	170	3	42	158	9	40	4	13	56	176	6
300	35	165	5	35	160	8	36	16	9	51	174	8
320	28	158	6	29	158	8	32	14	9	42	167	9
340	15	150	7	22	151	7	33	12	10	30	164	10
360	8	144	5	14	141	4	34	9	9	14	166	11
380	-2	138	4	6	136	4	35	6	9	-8	154	13
400	-5	154	5	-2	130	6	35	3	9			
420	-4	161	6	-10	120	9	36	358	10			
440	4	185	7	-18	117	10	36	353	10			
460	17	221	7	-25	116	9	35	348	12			
480	24	243	8	-32	120	7	33	342	14			
500	25	257	12	-36	129	8	29	335	16			
520	22	264	15	-37	139	11	25	326	17			
540	14	268	17	-36	152	12	20	315	18			
560	-2	272	26	-28	175	13	19	300	19			
580	-12	280	31	-7	209	17						

THE SEGMENTATION OF MID-ATLANTIC RIDGE AND ITS RELATION WITH PRESSURE AND WATER CONTENT OF TOR (MORB) FRACTIONATION

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The method of determination of pressure (CP) and water content (CH_2O) of the final stage of TOR tripple cotectic fractionation by mineral-melt geothermometers at 1 atm. has been modernized for quinched glasses. It permits to estimate pressure and water content regime with accuracy 2 kbar and H_2O - 0.3% for the axial zone of MAR under statistical level (3811 microprobe analyses of Smithsonian Catalog with our additional data).

Parameters CP and CH_2O have been interpreted as indicators of the critical geodynamic conditions which correspond to the fracturing of the oceanic lithosphere during its accretion and formation of channels for magma transport to the surface.

The main results include the following:

1) CP and CH_2O have a strong negative correlation. It should be explained as a result of the magma density decreasing with water content and affecting the ability of magma to uprise into upper levels of the lithosphere.

2) The distribution of CP and CH_2O along the MAR axial zone manifests its heterogeneity and permits to select the segments of various hierarchy within its space.

3) The boundaries between segments of the first order coincide well with the boundaries of petrological and geophysical provinces which have been determined formerly by the independent methods. This coincidence is considered as a new evidence of the strong interrelations between all geological processes at the moment of the new oceanic lithosphere creation in the system of Mid-Ocean ridges.

It is concluded that the segmentation of MAR reflects the thermodynamic desequilibrium of endogenetic processes.

GEODYNAMICS FROM THE STANDPOINT OF SYSTEM VACUUM APPROACH

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1. In literature the concept of matter system movement is described that connects the hierarchical construction of natural systems with matter states making up its initiative essence-vaccum at sequence appearance; also the geometrical base of these states is described specifying a so-called vacuum field.

2. The concept of matter equilibrium instability was developed connected with its states in which the structure change occurs (critical phenomena and phase transitions, degenerated vacuum of Goldstone-Huggs, coherent exiton excitations in semiconductors and lasers etc.).

Such states permit the classification on levels (for example, double, threefold and fourfold point of phase transitions) and its dynamics is defined by equations as quantum for some universal field-inertia field.

Levels of vacuum appearance are conform to levels of the matter instability equilibrium.

3. Research into the physical, physical-chemical and other nonlinear processes in geological media allowed to form the principle by which the system equilibrium of geological medium is realized as multilevels medium instability. It allowed to project the concept of system matter movement on geodynamical processes to describe the geodynamics as states network of equilibrium instability of geological media, dynamics of transitions is predetermined by vacuum and macroquantum equations for different space-time scales. Here different scaled dissipative autowave structures are explained (reverberators, fronts, grids etc.).

4. Lately with N. Flavitsky (France) it was possible to find new approaches to describe the mechanism of system matter movement. This approach using modern achievements in mathematics, physics, systems of artificial intelligence pretends on universal algorithm of selforganization and describes the process of system organization of forming structures.

5. The application of new system methodology connected with selforganization algorithm allows to approach to the new problem: to construct the classification of organization of natural system levels as stages of system equilibrium. The solution of this problem can be effective development of the system approach in which each natural system acquires matrix structure where one coordinate is stage of system matter movement (SNN) and the other one is type of SMM predeterminated of selforganization algorithm.

THE PROBLEMS OF DEEP GEODYNAMICS AND MODELLING OF MANTLE PLUMES

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Using available geophysical and geological data we have analyzed the effect of plumes on the structure of convection currents in the mantle. Correlation of the intensity of magmatic processes with inversions of the Earth's magnetic field and the analogy of lateral migration of Earth's hot-spots and Sun spots suggest a relation between magmatism and the processes taking place in the Earth's core.

We have studied experimentally the thermal and the hydrodynamical structure of plumes. They result from melting provoked by local sources. The height of these plumes should be much more than horizontal extent of the source. According to medium parameters, heat source dimension and temperature within the vertical channel of a melt, regimes of heat conductivity and boundary layer exist. The different periods of channel melting are fixed by a change of current regimes.

In the exreme case, when the whole heat is absorbed by crystalline mass and channel height is constant (i.e. when there is no melting) heat conductivity regime dominated in the lower part of channel and boundary regime in the upper part of the channel. In this case, the boundary layer is unstable appearing as migrating wave and the melt channel rotates relative to an axis which is parallel to gravity force vector and which passes through the heat source. Temperature profiles in a melt across the channel were compiled. Various stratification patterns were found: unstable stratification takes place in ascending current flow, stable stratification takes place in stagnant zone between current flow and the boundary layer.

Theoretically we analyzed an extreme case (height - L=const) when the entire heat of the source is absorbed by the solid mass: 1) an equation for relation between maximum height of channel and source energy and medium parameters was deduced; 2) dependence between the source energy and its temperature and horizontal extent was outlined; 3) equation for time of channel melting and its height, medium parameters and heat source was deduced.

Using geophysical and geological data and carried out investigations we analyzed the power of hot spot sources and estimated the time of channel melting from core/mantle boundary and from 670 km to Earth's surface. This time is less than the typical periods of magmatic processes. Energetically ($N<5*10^7$ kw) the existence of heat mantle plumes is corroborated. The problem is in the possibility of existence of local heat source with temperature exceeding the melting temperature of solid mass at 25°C-100°C.

OCEANIC LITHOSPHERE FORMATION IN SLOW SPREADING RIDGES OF THE CENTRAL ATLANTIC

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Results of detailed investigations of modern (Fracture Zone 15°20') and Eocene (King's Trough) oceanic lithosphere of the Central Atlantic are cited. Analysis of about 3000 samples, collected during 19th cruise of RV "Ak. M. Keldysh" (1989), 9th cruise of RV "Antares" (1990-1991I, 15th cruise of RV "Ak. Strakhov" (1992), shows the stable interrelations of the main rock types in the oceanic crust: basalts - 48%, ultramafics - 40%, gabbro - 10%, dyke rocks - 2%. Such studies and the geological situation in regions investigated in detail prove the eruption of basaltic magmas just onto the ultramafic mantle uplifted practically at the oceanic bottom surface. The major part of basaltic melts passed through the reduced lithosphere, and only a little share of them remain within the ultramafic matrix with further formation of small grabbo bodies.

Comparison of clinopyroxene compositions from magmatic rocks of the Fracture Zone 15°20'and King's Trough show resembling features of magmatic systems, which formed these morphostructures. Clinopyroxene compositions (low TiO_2 and FeO, and high MgO) confirm the prevailing formation of small magma chambers without essential development of differentiation processes within the studied areas of the Atlantic Ocean. However, the magma differentiation is more significant in the ancient lithosphere of the Atlantic Ocean (King's Trough). It is confirmed by wider variations of mineral compositions of dyke series rocks developed in King's Trough compared with reduced gabbro, which were transformed into flazzer-gabbro associated with ultramafic blocks.

Data on the compositions of homogenized primary melt inclusions in clinopyroxenes and in olivines testify that magmatic systems in the Mid-Atlantic Ridge at north and south sides of the Fracture Zone 15°20' are different. Compositions of homogenized melt inclusions are the same as corresponding rocks and magmatic glasses, and show wide development E-MORB melts with enrichment of K_2O and others in this region. These facts confirm the previous results of the melt inclusions investigations (Sobolev et al. 1991). Geochemical studies together with melt inclusions data help us to distinguish different types of basaltic magmas in the Fracture Zone 15°20'.

Considered in complete sections of oceanic crust in slow spreading zones of the Atlantic are compared with ophiolites of South Siberia.

LAPTEV SEA DRILLING PLANS

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A major international research effort, the Nansen Arctic Drilling Program (NAD), is designated to understand the environmental changes in the Arctic and its geologic evolution. By obtaining samples of the rocks beneath the Arctic, scientists can unlock the natural history of the region and better predict the future of the Arctic basin and its effect on the global climate, the biosphere and the dynamics of the world ocean and atmosphere. Included in these studies will be the determination of:

- detailed history of sea ice cover;
- detailed history of changes in ice sheets;
- detailed history of organic carbon flux, productivity and CO;
- history of river influx;
-establishment of the relationship between high-resolution seismic records, physical properties and paleoenvironmental parameters;
- tectonic conditions and rates of sediment accumulation, preservation and diagenesis;
- role of the Arctic in the global transition from the Eocene "greenhouse world" to present day "icehouse world";
- improving drill techniques and scientific equipment for the nature experiments in this complicated environment;
- study gas hydrate areas to better understand the gas hydrate formation process.

The Laptev Sea Shelf (LSS) plays a key role for recognition and explanation of the oceanographic conditions, climate, ecology, geology and paleoenvironments of the Arctic. It is a promising area for the drill sites.

The available geologic and geophyisic data show that LSS continental margin was formed under the influence of the Eurasia basin opening and penetration of the Gakkel Spreading Ridge into a continental area. Namely these processes caused recent geographic features and oceanologic conditions of the Arctic ocean. The major stages of Arctic history were imprinted in LSS sedimentary record. It is possible here to find the areas of very high sedimentation rate that will allow the examination of Arctic variability at time scales of 10s and 1000s of years.

The available seismic reflection data collected by Murmansk Arctic Geological Expedition (MAGE) and Moscow Laboratory of Regional Geodynamics (LARGE) supplemented by other geologic, geophysic and oceanologic data by VNIIOkeangeologia (St. Petersburg), Arctic and Antarctic Research Institute (St. Petersburg), and P.P. Shirshov Institute of Oceanology (Moscow) allow to determine such prospective drilling areas within major structural elements of LSS rift system. These are Omoloi and Belkov-Svyatoi Nos rifts subsided continuously during Cenozoic. Besides, there is no contradiction in opinions on seismic stratigraphy models of eastern parts of the LSS. Taking into account 100 m maximum drill penetration and considering Eocene to Quaternary intervals of Arctic history, the side parts of those rifts are more prospective for drill sites. The various variants of the drill sites depend on the weather conditions proposed.

STRUCTURE AND PLATE TECTONICS OF LAPTEV SEA SHELF

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The Laptev Sea Shelf (LSS) is a key region to understand tectonics and evolution of the Eastern Arctic. On one hand, it occupies joint areas between the Siberian craton, Early Mesozoic Taimyr fold belt and Late Mesozoic Novosibirsk-Chukchi and Verfhoyansk-Kolyma fold belts. This poorly known structural ensemble underlying LSS sedimentary basin was formed in Late Mesozoic orogenic event. On the other, a unique situation of the direct penetration of the oceanic spreading axis (Gakkel Ridge) into continental passive margin is having here. The spreading of oceanic lithosphere is transforming into the stretch of the continental one. This process caused the origin and development of LSS Cenozoic rift system which is a perfect object to study an initial break-up of the continent.

The present-day knowledge of LSS geology is based on the seismic reflection and gravity data by LARGE (Laboratory of Regional Geodynamics) and MAGE (Murmansk Arctic Geologic Expedition). LSS can be divided into two large structural and seismic stratigraphy provinces.

One of them that occupies the central and eastern parts of LSS was studied more completely. The Cenozoic rift system comprises from the west to the east Ust-Lena graben, Central uplift, Omoloi graben, East-Laptev uplift and Bel'kov-Svyatoi Nos graben. We suppose that the entire rift system was formed mainly during Late Cretaceous to

Eocene and underlain by the Late Mesozoides. The age of the basement was well-demonstrated for East-Laptev uplift by geologic data on Stolbovoi I., but is more questionable for the elements located to the west. The MAGE's scientists believe that the western side of the rift system is underlain by Laptev cratonic block and a graben-filling that consists of the Riphean and Phanerozoic sequences including Cenozoic ones. The total cover thicknesses are 0.5-2.5 km on the uplifts and 5-10 km within axial parts of the grabens.

Another structural province is located between the Lena River Delta and Taimyr Peninsula. It was intersected by three MAGE's seismic lines only and comprises the graben-like South-Laptev basin which is separated from LSS rift system by the Trofimov linear uplift and from Siberian craton by the Lena-Taimyr fold zone. The thickness of sediment cover is 7-12 km. The higher seismic velocities into lower horizons of cover (5.5-6.2 km/s) can characterize Riphean and Lower Paleozoic carbonate rocks. Possibly this province is the northeastern edge of Siberian craton. Therefore the South-Laptev basin can be considered as foredeep basin in front of Late Mesozoic fold belt.

The proposed seismic stratigraphy model of LSS sedimentary basin is supported by detailed geologic and paleogeographic data on continental and islands frame. The structure and evolution of LSS are illustrated by several structural maps and plate tectonics reconstructions.

FORMATION AND EVOLUTION OF MAGMA CHAMBER IN THE MID-OCEANIC RIDGE RIFT ZONES

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Formation and evolution of axial magma chamber (AMC) in rift zones of Mid-Oceanic Ridges (MOR) were simulated numerically within the framework of the discrete-continuous spreading model. The model is based on the three main principals inferred from geological and geophysical studies of axial zones of MOR: 1) the roof of asthenosphere under axis of fast and middle ridges has a relatively steady uprise with a width about 15-30 km at 6-10 km under sea bottom; 2) the flatten roof of magma chambers are inferred from seismic reflectors under axial zones of fast and middle MOR. These flat roofs are characterized by a width of 1-4 km and depths of 1.5-3 km under seafloor; 3) the process of oceanic crust accretion accomodates with rapid melt accumulation in magma chamber and intensive basalt intrusion in the upper crust. Eruptions and intrusions of basaltic magma are rather discrete than continuous. It seems, they occur on average once in 100-1000 years for fast spreading and once in 1000-10000 years for the middle ones. It is significant that the process of intrusion itself is as short as a time span between intrusions.

The model simulates numerically the process of magma chamber initiation in oceanic rift zones and principal stages of its evolution. It shows that the depth of magmatic chamber roof depends on spreading rate, cycling of tectono-magmatic events, crust fracturing, hydrothermal activity and physical attributes of the crustal rock. The results of modelling suppose that quasi-steady structures of AMC do not exist probably in axial zone of MOR with spreading rate less 3 cm/year. About 150-200 thousand years are needed to form steady AMC in fast-spreading ridges. Interruption in accretion processes about 100 thousand years or more leads to disappearing of magma chambers. Periodical extraction of liquid basalt and formation of melt lense in the upper part of AMC result in flattening of its roof. It should be noted that the same flat roof of magma chamber will maintain also during cooling of this chamber.

The "thermal" relief of axial rise is in close connection with relief of AMC. It changes from triangular semicircular and to trapezoidal forms. Maximum amplitudes of the "thermal" bottom relief of axial zone vary from 50 to 200 m. Trapezoidal relief of axial rise occurs more frequently. It is characterized by a flat roof. As a rule, the width of roof on cross-ridge profiles is 0.5-2 km (Macdonald et al., 1984). Similar relief is typical for the regime of chamber cooling. Numerical modelling illustrated that the triangular form of axial relief is typical for the initial stage of chamber formation or for lower temperatures of lense material.

NORTH-EAST ASIA PALEOGEOGRAPHY IN TRIASSIC

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The complicated plate-tectonic history makes paleogeographic reconstructions of North-East Asia quite difficult. Nevertheless, shelf, deltas, continental slope with subaqueous canyons and fans, deep marine troughs, volcanic island arcs and ocean floor sediments have been recognized in this area. Shelf sediments are widespread in the bigger portion of the Verkhoyansk Mountains, and are represented by different clastic deposits. A huge delta was located near the modern mouth of the Vilyui River. A continental slope sediment area is situated in the eastern portion of the Verkhoyansk Mountains. These sediments are represented by different types of turbidites with conturites interbeds. Two subaqueous canyons with olistostrome horizons have been recognized within the area. One of them is located at the Polonsky Ridge, the other one - near Tompo River. Deep marine troughs represented by condensed shales' sequences with conturites are known fragmentarily at the Chersky Ridge and near the Okhotsk Sea coast. Two volcanic arcs have been distinguished near the deep marine troughs. One arc extends from the left side of the Kolyma River to the north-east, the other one - from the Anyui River to the south. Andesites, their tuffs and tuffites and tuffaceousclastic sediments are typical for the volcanic arcs' area.

The ocean floor sediments are known only in the Koryak region. They are composed mainly of thin siliceous sediments and mixtites.

Later, plate tectonic movements change and disrupt paleogeographic zonation. Therefore it can be seen only on the palinspastic reconstruction.

HIGH-GRADE METAMORPHIC TERRANE OF THE EASTERN KAMCHATKA: A POSSIBLE EVIDENCE FOR ISLAND ARCS COLLISION

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Accretionary belts of the Circum-Pacific often include high-grade metamorphic complexes (HGMC), forming amphibolites, gneisses and granulites, both mafic and felsic, which are similar to the Early Pre-Cambrian rocks. The age and the tectonic setting origin of the HGMC are unclear. The Kamchatka Accretionary Belt, for example, contains metamorphic terranes, which are named the Central Massif Terrane in the Middle Range and the Ganal Terrane in the Eastern Ranges. They include HGMC having fault-boundaries with low-grade metavolcanics (greenshists, rare blueshists), which originated in arc-related settings. These terranes were considered as fragments of island arc basement or as exotic continental blocks. New data for the HGMC of the Ganal Terrane is evidence for their origin by arc collision processes.

The Ganal Terrane belongs to the Eastern Ranges Terranes Belt. This belt is formed by arc-related fragments of Cretaceous to Paleogene age, rarely by Pre-Cretaceous and Cretaceous MORB-like remnants, which were amalgameted during Early Neogene time. The HGMC is located in the south part of the Ganal Terrane. It is fault-bounded from greenshists of probably Cretaceous age in NE and SE and from Cretaceous, Paleogene and Early Neogene unmetamorphosed volcaniclastics in SW.

The Ganal HGMC is separated by NE vergence thrust in two major tectonic units of different composition, the Amphibolites and Shists Complex (ASC) in the bottom and the Metagabbroic and Granulites Complex (MGC) in the top.

The ASC in the lower part consists of imbricated slices, composed predominantly of MORB-like amphibolites with minor ultramafics, Fe-Ti-rich eclogites and small trondjemetic intrusions. The upper part, which thrusted over amphibolites, is a thick nappe, which is formed by gneisses and crystalline shists, metavolcanics, both mafic and felsic, and also metasilicites and metaterrigeneous rocks.

The MGC overlaying tectonically both parts of the ASC. It contains predominantly flaser gabbro and gabbronorites with minor dismembered ultramafic bodies in their basement. The upper part of MGC consists of disrupted mafic granulites and minor charnokite-like acidic rocks. The matagabbroic rocks are similar to ophiolitic cumulates and mid-ocean ridges plutonics in chemical composition. The mafic granulites correspond to island arc basalts in immobile incompatible element ratios, and charnokites are similar to calc-alkaline granites.

The Ganal HGMC are formed a folded nappe system with NE vergence. They are included in large granitic gneisses bodies; the textures of the latter are in discordance with related metamorphic textures of exclusion rocks, but are conform to folds and thrusts orientation. The granitic gneisses are represented by calc-alkaline suite, similar to magmatic arc granites.

So, the both high metamorphic complexes of the Ganal Terrane are divided into two parts of different composition. The lower parts include oceanic-like components; the MORB-like metabasites in the ASC and the oceanic metagabbroic rocks in the MGC. The upper parts of both complexes are similar to arc-related assemblages in composition, the metavolcanisclastics and the metavolcanics in the ASC and the bimodal island arc suite in the MGC. It is interpreted as a system of two superposed island arcs, both include the accreted oceanic remnants and magnetic arc fragments. But the Ganal Terrane differs from accretionary systems in the structure aspects (low-angle folded nappes of large extension) and in the composition aspect (high-grade metamorphism, granitisation). They are similar to collision belts. So, granitic gneisses are represented by arc-related rocks in composition, which are different from collision granites. It is suggested that the high-grade metamorphics of the Ganal Terrane originated by collision of two active island arc systems. This process takes place, possible, contemporaries to the amalgamation of the Eastern Kamchatka Ranges Terranes Belt.

PRE-CRETACEOUS AND CRETACEOUS OCEANIC FRAGMENTS OF KAMCHATKA: BASALT GEOCHEMISTRY EVIDENCE FOR THEIR POSSIBLE ORIGIN FROM DUPAL AREA

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The geochemical data suggest that oceanic fragments of the Kamchatka Accretionary Belt were formed in an anomalous oceanic setting. It may be an evidence for their motion from the DUPAL area. The oceanic-like rocks of Kamchatka are represented by probably Pre-Cretaceous ophiolites and dismembered basalts and jaspers assemblages (BJA) of both Middle Cretaceous and Senonian age. They formed allochthonous fragments within an accretionary system, which were amalgamated with Cretaceous to Early Neogene arc-related terranes during Late Eocene to Late Neogene time.

The Pre-Cretaceous ophiolites contain greenshistose metamorphosed maffic plutonics, diabases and pillow basalts. These basalts are only MORB-like tholeiites, which have low REE content (up to 10-15xCh) and depleted REE pattern (LaN/SmN ratio from 0.4 to 1.0). Unlike to typical N-MORB, these rocks have low Zr/Nb ratio (13-22) and Nb enrichment relative to LREE (La/Nb ratio 0.5-0.9).

The Middle Cretaceous and Senonian BJA are represented by pillow and massive basalts with jaspers and cherts. The Middle Cretaceous basalts are Fe-Ti-tholeiites with high content of REE (up to 30xCh), strongly depleted REE pattern (LaN/SmN ratio 0.31-0.83) and low Nb content relative to other incompatible elements (Zr/Nb ratio 17-52, La/Nb ratio 1.3-1.5).

The Senonian basalts consist of MORB-like tholeiites, E-MORB, and minor OIB-like basalts. The first are both normal and Fe-Ti-tholeiites with depleted REE pattern (LaN/SmN ratio is 0.6-0.9). The basalts from the Middle Kamchatka Range are usually enriched by Nb relative to LREE (La/Nb ratio 0.6-0.9), similar to the Pre-Cretaceous basalts. The basalts with Nb deficiency relative to LREE (La/Nb ratio 1.0-1.9) are dominated in the Olutor Range. The E-MORB have high LREE content (up to 50xCh) and fractionated REE pattern (LaN/SmN ratio is 1.4-1.7). They have Nb depletion relative to LREE (La/Nb ratio 1.2-1.5), that corresponds to low Nb MORB-like tholeiites. The OIB-like basalts have high content of all incompatible elements (LREE up to 150xCh, LaN/SmN ratio 1.8-2.6) and a strongly Nb enrichment relative to LREE (La/Nb 0.5-0.7).

The trace element ratios of the Kamchatka basalts comparative to those of typical oceanic and back-arc basin basalts suggest that they originated from different mantle sources.

The MORB-like tholeiites are similar to N-type MORB and, like the latter, were formed by melting of depleted MORB mantle. However, the composition of many MORB-like tholeiites show anomalous features, which may reflect different mantle components contamination.

The high Nb MORB-like tholeiites are similar to oceanic plateau basalts (e.g. the Nauru Basin), which originated from DMM contaminated by enriched source; the low La/Nb ratio in both suggest that their sources may contain a HIMU component. The Senonian OIB-like basalts show also strong HIMU affinities.

The low Nb MORB-like tholeiites and E-MORB, which have high La/Nb ratio, unlike typical E-MORB, are similar to many back-arc basin basalts (BABB), which were considered as supra-subduction mantle derivates. Though, Nb deficiency relative to LREE is also typical for basalts from Indian Ocean, both MORB and OIB. The isotope ratios suggest that all these rocks contain an anomalous mantle component, named DUPAL. Therefore, the negative NB anomaly in these Kamchatka basalts are not their BABB affinities.

Acception of hypothesis of oceanic setting origin for the Kamchatka oceanic fragments suggests that they are not formed in normal spreading ridges, because all individual basaltic series show anomalous (HIMU or DUPAL) geochemical affinities. The area of both HIMU and DUPAL derivated is recently located in the Southern Hemisphere along 30°. It correlates with geophysical anomalous lower mantle and, possibly, is independent from plates motion. Therefore, HIMU and DUPAL affinities of the Kamchatka oceanic fragments may be an evidence for their origin from DUPAL area and large the N motion.

THE GEOCHEMISTRY AND ORIGIN OF CENOZOIC VOLCANIC ROCKS FROM EASTERN KORYAK HIGHLAND

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The Cenozoic volcanic belt located in the eastern Koryak highland is a complex continental margin related both to subduction of the Paleopacific plate beneath the Asian, and to the origin of arc-related volcanic centers, and with subsequent rifting environments. This region includes volcanic units which may be classified into three major complexes: Kakanaut, Kereksky and Navarin.

The Danian-Paleocene basalts and basaltic andesites of the Kakanaut complex are similar to the island-arc tholeiites, differing by higher content of high field-strength elements (HFSE). The Kakanaut basalts are characterized by moderately high contents of large ion lithophile (LILE) elements (Rb 7-31 ppm, Ba 110-330 ppm, Sr 150-650 ppm, Th 1.4-2.2 ppm) and the presence of strong Nb and Ta anomalies, typical of arc-type rocks. The REE distribution is marked by low contents of light lanthanides (La_n/Yb_n=1.6-2.5). In addition, most Kakanaut basalts have higher contents of HFSE (Zr 90-240 ppm, Y 18-40 ppm, Hf 3.3-3.9 ppm, Ti 0.9-1.9 wt.%) relative to the arc tholeiites.

The Miocene calc-alkaline volcanic rocks of the Kereksky complex differ in composition from basalts to dacites, show relatively high HFSE contents (Zr 110-220 and 130-170 ppm, Y 18-24 and 16-26 ppm, Ti 1.3-2.1 and 0.6-1.4 wt.% in basalts and dacites, accordingly) and Al_2O_3 (15-19 wt.%). The LILE abundances are relatively high (Sr 380-960 ppm, Ba 130-590 ppm, Th 1.1-3.5 ppm) with the exception of Rb (6-16 ppm). The basaltic rocks also have high La_n/Yb_n ratios (3.8-11.8). The Kereksky complex volcanic rock composition is similar to that of calc-alkaline series of a continental margin rift zone (e.g. Tepic-Zacoalco rift, Mexico).

The Middle Quaternary alkalic mafic rocks of the Navarin complex with high concentrations of HFSE (Zr 190-260 ppm, Y 21-33 ppm, Ti 2.3-3.1 wt.%), LILE (Rb 25-46 ppm, Ba 400-640 ppm, Sr 470-930 ppm), and Nb (30-61 ppm), ranging from alkali olivine basalts to basanite are close in composition to volcanic rocks of continental rifts as well as of the intra-Pacific ocean island basalts. La_n/Yb_n and Nb/La ratios are high (16-21 and 1.1-1.5, accordingly).

Geochemical modelling of the melting processes beneath the Koryak continental margin suggests that primitive magmas appear to have resulted from melting of three distinct heterogeneous magma-generating sources. The Kakanaut volcanic rocks are related to the 12-13% melting of a source formed from mixtures of the depleted mantle (MORB-source type) and of a relatively LILE-enriched slab derived source in a "plum pudding" type mantle wedge (Morris and Hart, 1983). The Kereksky complex basalts are a mixture of a depleted mantle and a metasomatically enriched OIB-component by 8-10% melting of this complex source. The alkaline rocks of the Navarin complex may have formed by 2-4% melting of the enriched OIB-source.

Thus, the change of geodynamic regimes in the eastern Koryak highland from marginal-continental to subcontinental in the course of the Cenozoic has yielded a change of character of the melting mantle substrate from arc-related to intraplate.

SEDIMENTARY BASINS OF THE RUSSIAN PLATFORM AND THEIR PETROLEUM POTENTIAL FORECASTING

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Main area of investigation is Moscow and Mezenskaya intracratonic syneclises from Smolensk to Syktyvkar and from Ryazan to Archangelsk. The area is limited by Tymansky mountain ridge, Tokmovsky swell, Kotelnich swell, Voronezh massif, Belorussia anteclise, Baltic shield. The area is the element of ancient platform with Archaen - early - Proterozoic basement. The sedimentary cover is formed by the rocks from late Precambrian to Quaternary deposits. Maximum of the late Precambrian sediments thickness is localized in paleorifts. Basement depth changes from 1 to 4.5-5 km. The area is poorly studied by geological and geophysical methods. Nevertheless the indications of oil and gas are known. For investigations of geological evolution of sedimentary basins the mechanical-mathematical models of geothermal reconstruction are used. Paleo-tectonic maps, lithological-stratigraphic columns, seismic sections, geological cross-sections, schemes of boreholes cross-sections correlation, geothermal data together with elements of mathematical modelling give possibility of the preliminary evaluation of oil and gas potential and choice of general strategy of prospecting.

TECTONICS OF THE YONA COLLISION ZONE (NORTH-WESTERN BELOMORIAN)

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The Yona region is the north-western part of Belomorian belt bounded by the Lapland granulite belt from the north, Karelian granite-greenstone system from the west, and Imandra-Varzuga zone from the east.

Metamorphic rocks of the Yona region can be divided into Archean and Proterozoic complexes. The Archean complex with the age of 2.65-2.7 Ga includes two rock groups which had originally been the parts of a granite-greenstone system. These groups are amphibole-bearing gneisses, garnet amphibolites, amphibolites, meta-komatiites of the greenstone belt and kyanite-garnet-biotite, garnet-biotite, biotite gneisses and granite-gneisses of the adjacent granite-greenstone belt.

The Proterozoic complex includes pegmatites with the age of 1.8 Ga and 2.45 Ga old "druzites" which are often allochthonous.

As the result of strong remobilization with the age of 1.8 Ga accompanied by regional metamorphism and folding, the Archean granite-greenstone system was disrupted. Therefore all existing linear and dome structures have the early Proterozoic age.

Metamorphic complexes of the Yona greenstone belt and other members of granite-greenstone system are allochthonous. There are many nappes like laying asymmetric folds with subhorizontal axes and axial planes of north-western strike, isoclinal folds with subhorizontal axes and subvertical axial planes, subhorizontal blastomilonites, and NE-SW lineation of quartz, amphibole and other minerals.

The modern structure of the Yona region has resulted from different synmetamorphic plastic deformations of strike-slip and thrust type and dome growth. We favor the following sequence of tectonic events. Archean Karelian and Kola continents were separated by early Proterozoic rift or probably oceanic structures. Their subsequent convergence led to the closure of rift systems and intense thrusting. Archean granite-greenstone system was disrupted and obducted as numerous slabs on the southern autochthonous (?) zone. The upper slab presumably the "druzite" one was extruded from the zone between continents. The oblique collision led to wide-spread strike-slips and conjugated nappes and thrusts, and the growth of domes both in allochthone and autochthon as the result of amphibolite remetamorphism.

DESTRUCTION OF A CARBONATE SHELF CONNECTED WITH THE CLOSURE OF MARGINAL BASINS (EARLY PALEOZOIC, SOUTHEASTERN PART OF THE EASTERN SAYAN)

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The south-eastern part of the Eastern Sayan Range represents the northern margin of the Sayan-Mongolian segment of the Central Asian foldbelt, separated from the Siberian Craton by a zone of long living faults. This territory is regarded now as a region of wide development of allochthons of different age and nature, obducted on the margin of the late Precambrian-early Paleozoic Khamai-Dabon microcontinent.

The environment that existed at the time of the destruction of the carbonate-shelf, formed on the crust of this microcontinent in the Vendian-early Cambrian, could be reconstructed for the early Paleozoic stage of the evolution of the south-eastern Eastern Sayan, possibly including the latest Vendian. This stage is considered as the time of closure of marginal basins, connected with island arcs. The stage is concluded by the obduction of ophiolote allochthons with volcanics of boninite type and thrusting of other island arc complexes on the edge of the micro-continent. These events came to their end in the Ordovician.

The presence of tectonically dismembered carbonate complexes of the shelf type was established in the association with the deposits of different structural-facial zones. They form olistholiths and olisthoplacses in olisto-hostromes, connected with different types of sediment (1), blocks in serpentinite melange forming the upper sheet in one of the zones of development of ophiolite allochthon (2), packages of tectonic slices (3). Olisthostromes are connected as well with flysch as with molasse-like deposits. Carbonates detected in these conditions lie between tectonic units of island arc origin. Carbonate complexes present in the situation (3) are forming the Bokon allochthon unit. In the situations (1) and (2) carbonates are taking part of a melange-olisthostrome complex, lying at the base of this nappe. The composition of the sediments connected with olisthostromes varies in such a manner: the deposits of molassoid type are lying as neoautochthon on the nappe sheets of the island arc complex with calc-alkaline volcanics; flysch deposits are connected with the ophiolite allochthon.

It is assumed that the environment in which the destruction of the carbonate shelf occurred, existed during a rather long stage of the evolution of the continental margin. The beginning of this stage is limited by the age of the carbonate complexes experiencing destruction not earlier than the end of the Vendian. The termination of this process is correlated with the time of the ophiolote obduction and of the thrusting of other complexes, forming the modern structure of the allochthon and is related probably to several stages, lasting during the Ordovician and possibly until the beginning of the Silurian.

METALLOGENIC ZONALITY OF MARGIN SEAS AND ISLAND ARCS

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1. The variety of geological and ore formations of margin sea types is due to different substratum of island arcs on the basin front, the degree of ocean crust opening and presence or absence of marginal volcanic belts at their back part.

2. The regular associations of geological and ore formations of spreading behind arc zones include ophilite complex with Cr-Kympersaysky type and Cu-pyritic deposits of Cyprus type, or under more intensive sedimentation rhyolite-basaltic carbonate-terrigenous with Zn-Cu- of pyritic type of bessy which alternate on the removing from spreading zones in frontal parts of basin by Pb-Zn-pyritic of Filizchaisky type, but in back parts also with connection of black schistous-terrigenous series- Au-sulphide of Sukhoi Log type.

3. Metallogenic zonality of near wall parts of margin seas is determined by lateral-vertical zonality with respect to spreading axis of early basaltoid, andesitoid and rhyolitoid island arc complexes with which associate pyritic Cu-Zn, Pb-Cu-Zn and Cu-Pb-Zn deposits of Ural, Kurok and Altai types. This zonality is also complicated with the development of stratiform Fe, Fe-Mn and Pb-Zn deposits of carbonate-silico-terrigenous series buried pyrite-bearing geological formations. Cu-porphiritic, Au-porphiritic, Cu-scarn and Fe-scarn deposits are associated with later island arc complexes. In this case frontal island arcs in double arc systems are especially productive.

THE STRUCTURE OF THE MESOZOIC TERRANES OF THE WEST KAMCHATKA-KORYAK ACCRETIONAL OROGENIC BELT: UNDISTURBED PALEOSTRUCTURES OR NAPPE SYSTEMS?

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The opinion that the eastern continental margin of Russia is the gigantic tectonic breccia which includes large terranes, becomes at present very common. Some investigators regard each Mesozoic allochthon terrane of this region as undeformed stratigraphic sequences of rocks and undisturbed lateral succession of paleostructures (island arcs, etc.), though others restored here nappes and imbricated structures. As a result of mapping and tectono-stratigraphic investigations of the vast territory of the West Kamchatka-Koryak orogenic belt from the Okhotsko-Chukotsky volcanic belt to the Olutor zone we established that the terranes of this region are presented by groups of large nappes, which include the sheets of the allochthonous sequences from Paleozoic and, possibly, Precambrian rocks to Hauterivian in age.

The Mesozoic allochthonous formations are composed of two nappes. The first is not large in volume and consists of the Middle Triassic to early Bajocian sequences. The isolated sheets of this nappe occur throughout the described region. It is best preserved in the southern area, which was named Elgavayam. The second Mesozoic nappe which was named the Anadyr-Koryak is very large. It is composed of the late Bajocian to Hauterivian sequences. The Anadyr-Koryak nappe was observed (from north to south) in the Anadyr River basin (within the basement of the Okhotsko-Chukotsky volcanic belt) throughout the Mayn, Algan, Utesiky River basins, the Rarytkin ridge and the Koyverelan, Maliy Nauchirinay, Nauchirinay River basins to the Pikasvayam and Khatyrka River basins. The fragments of this nappe occur in the northwestern Kamchatka, Kuyul and Pekulney mountains. This nappe is composed of alternating tectonic sheets represented by rocks of different origin: oceanic (intraplate abyssal and mid-oceanic ridge), island-arc and marginal sea. The Mesozoic rocks of these sheets are not only different in age and genesis but also are from various paleolatitudinal setting (Equatorial, South-Tethyan, North-Tethyan and South Boreal) based on radiolarian data and are united in single nappe now. Only a number of the tectonic sheets composed of Middle Jurassic-Cretaceous rocks and their thicknesses are varied from place to place in Anadyr-Koryak nappe. So, in Anadyr-Koryak nappe the terrane sheets of the various origin are united and this nappe is composed of the pile of the different terranes. However, there is an order in the distribution of various formations within the Anadyr-Koryak nappe. The sheets made up of MORB, WPB-like basalts and jaspers are usually distributed in the lower part of the nappe. The age of these ophiolites is younger or equal to the age of island-arc and marginal-basin-related sequences of the upper sheets of the Anadyr-Koryak nappe.

Both above-mentioned nappes overthrust the nappe of Paleozoic and, possibly, Precambrian allochthonous formations. Hence, the piles of the sheets of the various terranes are distributed in West Kamchatka-Koryak orogenic belt instead of large uniform terranes.

The nappes of Early-Middle Mesozoic sequences were formed in Pre-Albian time as the neoautochthon is composed of Albian-Senonian terrigenous sequences. The final occurrence of these nappes took place as result of an arc-arc, arc-ridge and arc-continent collision in the Pacific periphery during Middle Cretaceous time. Due to this intensive collision the Early-Middle Mesozoic rocks of different genesis (oceanic, island arc, etc.) were obducted upon the older (predominantly Paleozoic and Precambrian) complexes. The Middle Cretaceous nappes underwent additional deformations during Laramian orogeny. That gave rise to the appearance of fragments of Middle Cretaceous nappe piles and imbricated structures. These pulled away fragments of whole nappes are sometimes considered to be independent terranes.

THE MIDDLE MASSIFS AT EAST PART OF VERKHOYANO-CHUCOTSKY FOLD-AREA: TERRANES OR FRAGMENTS OF ASIA

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The eastern part of Verkhoyano-Chucotsky fold-area (VCF) is located in a large territory of NE Asia and consists of intensive deformed complexes of Pz-Mz age that investing with massifs of mostly pre-Rf consolidation (MS). The structure of VCF was formed during several folding-stages at J_2-K_1.

There are 3 types MS recognized in the region:

1. That was the part of Asia at least from P (Omolonsko-Avekovsky, Okhotsky and probably Omul'ovsky). The cover of every of it's has specifical features. But structure and facial connections between this MS are recognized. This MS is not separated from Asia by large oceanic basins during Phanerozoic but considerable lateral movements

one relatively another and relatively Asia took place as the result of continental rifting at Rif, Pz and Mz_1 and motions by strike-slip faults.

2. That's MS accreted to Asia at Rif (650-700 m.y.) - Western-Prikolymsky. It marked along front-part by suture zone with ophiolites of Rif age (1700-2000 m.y.).

3. That's MS accreted to Asia during J-K_1 (Western Chucotsky, Eastern Chukotsky and Northern-Wrangel). It was separated from Asia and one from another by oceanic basins during Pz and Mz_1. Ophiolitic fragments of Pz-Mz age now located at suture zones.

Thus there are 2 main types MS can recognized at VCFS: autochthonous relatively Asia and allochthonous (terranes). The last has common features with MS from Northern Canada and NW Alaska.

ANOMALY STRESSES IN ZONES OF HYDROCARBON DEPOSITS OF THE NORTH CASPIAN REGION

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The close connection of faults and folding structures with minerals and hydrocarbon deposits is well known. According to certain information about 80% world reserve of oil and gas are concentrated near the faults. Until quite recently tectonic stresses have only been considered in connection with forming of tectonic structures as oil and gas traps. However during the study of fold formation it was proved that tectonic stresses not only deform the rocks but have influence on migration and distribution of chemical elements.

The stress field in the sediment and basement result from common actions of the gravitational and tectonic forces on non-homogeneous rocks. From the position of the mechanics of solids the rock model as effective medium with non-homogeneous physical properties and average strain ε_{ij} is considered. The stress tensor σ_{ij} has the form

$$\sigma_{ij} = \tau_{ij} - \kappa\tau_{kl}\, g_{ijkl}, \qquad \tau_{ij} = E_{ijkl}\varepsilon_{kl},$$

where $0 > g_{ijkl} < 1$ is the tensor of the function of non-homogeneity, $\kappa < 1$ is parameter. The function of non-homogeneity is determined from distributions of the seismic velocity and density.

Moreover stresses are generated by the variations of density in the upper part of crust.

The oil and gas deposits develop by the migration of hydrocarbons from deep horizons of the earth crust. This process depends on porosity of rocks and activates in zones with low average tectonic stresses that keep open the existing voids and cracks. For this reason the search for oil deposits should be concentrated in zones where two factors coincide: low average tectonic stresses and high porosity.

This way was checked in North Caspian region for which velocity, density and stress models are created. For example the distribution of the average tectonic stresses into the section across the Tengiz deposit from common actions of the density variations and non-homogeneous properties of the rocks is shown on the picture. Dark colors mark zones with low average stresses that rise from the depth and forms the volume for hydrocarbon migration. Tengiz oil deposit arrange in the center of low average stresses on the depth 4 km.

Complex analysis of models shows that all huge oil deposits (Tengiz, Dgetibay, Oimasha) lie in zones where low density and low average stresses coincide. It allows to mark the perspective areas for oil prospecting in the region.

GEODYNAMICS OF SVECOFFENIDES OF THE BALTIC SHIELD

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1. Before we start considering the history of the Baltic shield development in the Svecofennian time it's necessary to regard the structures and rock complexes which were formed before the beginning of the Svecofennian. By this time the Karelian-Kola and proto-Russian lithospheric plates already existed. It is possible that Sveconorwegian plate also existed.

2. The paradox is that though we know (not very much) about the existence of the plate mentioned above, we know practically nothing (or very little) about the Svecofennian lithospheric plate itself, at least about its continental portion.

3. The Svecofennian formations of the Baltic shield are represented either by rocks of island-arc series or by epi- and postsubduction formations and by the products of their influence on the host complexes (the same island-arc Svecofennian or heterogeneous Presvecofennian).

4. We can discuss whether the Svecofennian subduction took place in western, north-eastern and southern directions, whether this process was simultaneous or devided into stages and whether is was accompanied by "jumping" or not. But it is obvious, that the leading role in the formation of subduction protozone belongs to pre-Svecofennian transform faults, one of which was not used in the Svecofennian time once. We are talking about the Ladoga-Bothnian zone (LBZ). Confined to this zone are not only the foreland formations of the Svecofennian and hinterland of the Karelian-Kola lithosperic plates, but also the post-Svecofennian granitoid magmatism (we are talking about "eastern" and "western" branches of LBZ accordingly).

5. In the Svecofennian time within the limits of already cratonized lithospheric plates the structures of so called interplate row were formed (besides, of course, the boundary structures). The overthrust and fault displacement structures were widely spread. As in LBZ the structures were determined by the system of faults which formed the rhegmatic grid. They already existed by the Svecofennian time. The processes of tectonomagmatic activization were developing along them.

6. The cratonization of the Svecofennian portion of the Baltic shield terminated in the process of Gothian orogen. In that time the Transscandinavian belt of granite-porphyries was formed, which could be regarded as "granites of cross wise rows". They mark the Late Svecofennian subduction zone (on the stage of its fading out). Acid effusives reported here can be taken for structural rock complexes - indicators of continental rifting, which allows to notice the regular change of structures: transform fault - granite of cross wise rows - continental rift. This inheritage is characteristic for many structural elements of the region.

PALAEOTECTONICS OF THE EAST EUROPEAN CRATON IN THE CONTEXT OF GEODYNAMIC PROCESSES IN THE SUTURE TEISSEYRE-TORNQUIST ZONE

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The Teisseyre-Tornquist zone (TTZ) originated during the Dalslandian tectonic epoch as a result of the Proto-Pangea disintegreation. This zone bounds the East European Craton on the southwest and is well-defined in all geophysical, geological, lithologic-palaeogeographical maps. It divides Europe into the western (West European Young Platform) and eastern (East European Craton) megablocks which have different crust thicknesses, heat flow values, tectonic activity etc. During the Early-Baikalian stage, the phyllite-shaly formation was accumulated in the TTZ under tension conditions and subject to folding and thrusting over the craton border during the final stage. The Volyn-Orsha Rift Trough infilled with red terrigenous rocks was perpendicular to the TTZ. The Craton location close to the South pole was responsible for a big Laplandian continental glaciation in the Early Vendian. A passive continental borderland (Mazovets-Prut Zone of pericratonal subsidences) formed in the Late-Baikalian stage due to the Japetus Ocean expansion. Its section begins with traps composed of basic, more seldom neutral, or acidic effusive rocks and their tuffs. The Moscow Syneclise originated over a triple junction of Riphean palaeorifts, including the Volyn-Orsha one. During the Caledonian stage, the Japetus Ocean was further expanded. The Rugen-Pomorje Trough developed at its periphery in the TTZ and was infilled with flyschoid and aspidic formations. The passive continental borderland was finally developed, and the Baltic-Dniester Zone of pericratonal subsidences formed there. It is composed of Cambrian-Silurian terrigenous, carbonate, carbonate-clayey and clayey formations of the platform type. The Japetus closing and the continental collision of North America and East Europe caused folding and thrusting of the TTZ folded formations over the Craton borderland platform rocks. In the Variscian stage the TTZ and the Craton were subject to active block and shift tectonics (Pripyat-Donets Palaeorift, etc.) The Cimmerian-Alpine stage is associated with latitudinal extension (the Atlantic Ocean opening) and longitudinal compression (Palaeo-Tethys closing). The Danish-Polish Furrow formed in the TTZ and was subjected to inversion at the end of the Mesozoic (Middle Polish and Kujav Swells). The West-Byelorussian Monocline and Pripyat-Dnieper Suprarift Syneclise developed west of the Craton.

POST-VARISCIAN SEDIMENTARY BASINS IN THE EAST-EUROPEAN CRATON WEST AND THEIR ASSOCIATION WITH GLOBAL GEODYNAMIC EVENTS

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The Variscian stage of the evolution of northwestern Europe was completed in the Early Permian with the formation of volcanites and terrigenous rocks. Rifting in the North Atlantic Ocean during the Later Permian caused a vast transgression of the Zechstein Sea, which embaraced the East-European Craton borderland as two large gulfs - Baltic and Podljasska-Brest ones. This basin housed thick salt strata.

During the Triassic, rifting in the North Atlantic Ocean resulted in the initiation of the North Sea rift system and the Danish-Polish furrow along the craton border. A large shallow sea gulf penetrated from the side of this furrow to the western borderland of the craton. The Pripyat Palaeozoic palaeorift developed independently of the western sea basin. Triassic molassic formations completed its evolution.

During the Mesozoic (Post-Triassic time) and Cenozoic, the North and Central Atlantic Oceans spreading resulted in the collision of the African and Eurasian plates in the Tethys area on the one hand, and on the other - the continent of Europe was subject to latitudinal extension and northward-directed longitudinal compression, which were largely responsible for a sublatitudinal position of sedimentary basins within the East-European Craton. The formation of the North Sea rift system, profound downwarping of the Danish-Polish depression caused in the Middle-Jurassic age a transgression over the Craton. The sea basin on sedimentation was replaced by the carbonate one with the formation of barrier reefs of submeridional strike. The Pripyat-Dnieper suprarift syneclise evolution over the Pripyat palaeorift started in the Jurassic.

Early Cretaceous sea basins, which formed after the break in marine sedimentation, covered a small area in the western borderland of the old platform. Terrigenous, more seldom carbonate shallow shelf rocks were deposited there.

An accelerated spreading of the Atlantic Ocean in the Post-Aptian time resulted in an important transgression over the European continent, upwellings in the western borderland of the Craton and accumulation of silic-glauconitic phosphate-bearing formations there. In the Late Cretaceous, the terrigenous sedimentation was replaced by the carbonate one (limestones, chalk, marls). Sea basin occupied the whole western borderland of the Craton. The Laramian phase of tectogenesis (end of the Cretaceous - beginning of the Palaeogene) correlated with the opening of the Norwegian and Greenland Sea basins caused the latitudinal compressive stress, rifting attenuation and inversion of several depressions (including the Danish-Polish one). The Cretaceous basin decreased in area, however, the facies conditions remained as before. In the Palaeocene, the sea basin with terrigenous-carbonate sedimentation existed as a residual one. The final episode of the basin evolution in the Craton west is associated with a transgression from the North Atlantic Ocean and Tethys and regional compression in the Alpine folding zone. The Late-Eocene sea covered the maximum area, which gradually decreased, and since the late Oligocene continental conditions of sedimentation set in within the western borderland of the Craton.

MAGNETIC PROPERTIES OF MASSIVE SULPHIDES DEPOSIT (ODP Leg 139, Holes 856 G, 856 H)

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Massive sulphide recovered from 856H and 856G Holes (ODP Leg 139) were analysed by petromagnetic, Mössbauer, X-ray and electron microprobe methods. It was found that samples have a heterogeneous texture and contain pyrite, pirrhotite and magnetite as main Fe-minerals. These phases practically have no isomorphic impurites and the traces of oxidation chalcopyrite, sphalerite and cubanite were observed very seldom as a small impurites of second phase in pyrite and pirrhotite. Chemical composition of pyrrhotite and relative concentrations of the main Fe-minerals vary along the cores. According to the complex analyses three types of pyrrhotites with different magnetic properties and structures were found. These phases are hexagonal with low-temperature Curie-point (TC ~180-250°C), hexagonal with λ-peak at T ~ 250°C, monoclinic with Tc ~ 320-360°C. As a rule samples contain mixture of these phases in different proportion. The Mössbauer spectra of the samples with pirrhotite are very complicated and poorely resolved. Visibly they consist of 4-5 overlapping six-peak magnetic subspectra with H_{eff} from 305 to 226 kOE and central quadrupole dublet belonging to pyrite.

The complex shapes of these spectra are explained by both the polyphase composition and different types of vacancy ordering in natural pirrhotites.

Computer fitting of these spectra gives the best results for model with partly vacancy ordering for hexagonal phases and partly vacancy disodering for monoclinic phase. That interpretation explains magnetic behavior of pirrothites with intermediate composition which were formed at different stages of hydrothermal activity.

The study of coercive force spectra (Sholpo-Luzianina test N_t) shows that pirrothite crystallizes above theirs Curie-point ($N_t \geq 0.3$).

Two generations of magnetite were found by magnetic measurements. The main part of magnetite crystallized on pyrite below 350°C ($N_t = 0.15$-0.19). The outher part of magnetite was formed at temperature higher than 350°C.

It follows from alternating field (AF) and thermal demagnetization of Natural Remanent magnetization (NRM). Two antiparallel NRM components were observed for samples containing pirrhotite and magnetite. It was experimentally shown that opposite directions of NRM components occurred due to magnetostatic interaction between magnetite and pyrrhotite. It is possible only if magnetite formed above pyrrhotite Curie point.

Thus the process of forming massive sulphide is multistage and occurs at different temperatures.

REGULARITIES OF HYDROCARBON DISTRIBUTION IN THE SEDIMENTARY BASINS OF LAURASIAN AND GONDWANIAN MEGABLOCK MARGINS

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During the main part of the Phanerozoic a lot of platforms entered in Laurasian and Gondwanian groups existing apart from each other. The disintegration process of both megablocks in fragments from the late Mesozic till the first half of Cenozoic affected the evolution of sedimentary basins. Here we may distinguish two stages. The first is correlated with the period of proper continental margin existence, the second purposes to the time of forming and developing foreland depressions superposed on the earlier structures.

At the early stage of continental development of these basins the hydrocarbons generating in the sedimentary deposits are considerably more on the margins of the groups of Laurasian platforms than Gondwanian (the reserves in the basins on the margins of North American platform - 7.23 mlrd. t oil, 5.16 trl.m^3 gas, South American platform - oil 1.56 mlrd.t, gas - 2.88 trl.m^3). In the second stage we have the vice versa - reserve of hydrocarbons on the basins of the margins on North American platform 0.6 mlrd. t oil, 0.68 trl. m^3 gas, South - American platform - 3.9 mlrd.t oil and 4.26 trl. m^3 gas. The same regularity is observed when we compare the reserve of hydrocarbons in basins on the margins of European and Gondwanian platforms.

PHENOMENOLOGICAL MODEL OF THE PACIFIC OCEAN PLATE TECTONICS

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On the basis of seismological data a statistical analysis with the phenomenological model of seismic processes in the boundaries of Pacific Ocean is suggested. In the framework of this model it is possible to construct the space-time outline of seismic prognosis for the class of great earthquakes.

For this model the comparison is made with 3-D convective motion which are considered in the rotating liquid sphere with hard cover (the Earth's mantle).

NEOGEODYNAMIC MODEL OF THE WEST OF THE RUSSIAN PLATE

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The major principle of regional neogeodynamic modelling of the west of the Russian Plate consists in the demonstration of spatial relationship between structural forms and tectonic-geodynamic processes that occurred in the late Oligocene-Anthropogene time and determined the main present-day relief features. Paleogeodynamic reconstructions of the recent stage are performed on the basis of remote sounding since the Anthropogene glacier formation that is visible on the space images and agrees well with the regional pattern of neotectonic deformations.

The late Oligocene-Anthropogene stage of the Earth's crust development in the plain-platform region was featured by a relatively high activity of tectonic-geodynamic processes. Neogeodynamic patterns reflect a block-ring structure in the west of the Russian Plate. Active lineaments are ascertained to have relation with the fault of regional und superregional ranking that control the position of diverse-order blocks in the Earth's crust. The latter differ in the geodynamical parameters and rates of the late Oligocene-Anthropogene vertical movements. The Kletsk-Velizh lineament zone divides the region into two terranes: south-eastern that underwent positive deformations, and north-western where neotectonic movements were generally descending. The appearance of a monoclinal tilt to the Baltic Sea is connected possibly with Bothnia rifting in recent time. The Polessie and Klintsovo ring megastructures are confined to the areas of maximum neotectonic uprising (over 100 m).

The megablocks (superregional) that sustained differential movements all through recent times with cumulative amplitude to 150-170 m (up to 200-300 m in some areas), and smaller blocks (regional and local) activated in the Anthropogene, have been first identified on the basis of geodynamic interpretation of the space images. Among genetic types of the ring formations tectonogenic structures (differential blocks of the basement, ring faults) were most mobile in the late Oligocene-Anthropogene time. The areal geodynamic anomalies, distinct in the relief and observed by the space images, have been found to correspond to the deformations in the subsurface portion on the platform cover. Such deformations are widespread in the areas of active salt tectonics, glacigenic processes and inherited block uplifts. Extensive parallel-banded terrain anomalies were formed due to tectonic-geodynamic activization, including the impact of glacier load, in the deep-seated horizons of the Earth's crust. Modern regional vertical movements in the west of the Russian Plate are of negligible amplitude (about 1-3 mm/year), and match the distribution of neotectonic structures. However, movements of local scale directly below the faults can have the amplitude as great as 25-35 mm/year.

THE ADJUSTMENT OF AEROMAGNETIC DATA IN THE DEEP AMERASIAN BASIN FOR MAPPING AND GEOLOGICAL INTERPRETATION

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Origin and evolution of the Amerasian part of the Arctic ocean remain the subject of strong scientific debate in Russia and in western countries as a first-order problem in marine geophysics. There is no widely accepted theory of the evolution of ridges and basins in the area, particularly in contrast to the neighboring Eurasia Basin.

Detailed regional aeromagnetic data were collected in the Amerasia Basin both by VNIIOceangeologia (St. Petersburg, Russia) and by the US Naval Research Laboratory (Washington, USA). Neither data set is separately good enough for geological interpretation: although its absolute navigation is good, the levelling/diurnal correction and relative navigation of the individual profiles of the US Navy data is poor. Similarly, the levelling and relative navigation of Russian data are much better but the absolute navigation is poor. Because the strengths and weaknesses of the two data sets are complimentary, after adjustment the joint US/RF data set will be the new basis for mapping and geological interpretation.

The general method of work includes correlation analyses of the different kinds of magnetic data (observed/digitized profiles, profiles, filtered data, gridded data obtained from hand contoured isoline maps, and gridded original data etc.). Some new magnetic anomaly maps and preliminary interpretative results are demonstrated.

"HOT BELT" OF THE EARLY EARTH AND ITS EVOLUTION

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The origination of relatively stable but evolving with time "hot belt" located along the equatorial (± 35° latitudes) zone of the Earth is postulated for the Early Precambrian. The conclusion is based on the spatial distribution of "hot spots" in Phanerozoic time, available paleomagnetic data for Precambrian complexes and the specific character of Precambrian Tectonic evolution of continental crust based on the concept of the nucleus model. The recent data on the tectonic setting of Venus - the planet of the most similarity with Earth in physical parameters - are considered to be in strong support to the concept of the "hot belt" of the Early Earth.

The early stages of the Earth evolution are believed to be controlled by the tidal energy caused by the Earth and Moon interaction and by the gravitational energy related to the processes of the iron precipitation from the mantle and the formation of the Earth core. Those endogenic processes and the high rotation speed of the early Earth stimulated the maximum of the thermal and tectonic activity within the equatorial zone and the development of numerous "hot spots" forming the "hot belt". The emplacement of lithophille elements into the primitive early Precambrian (4.6-2.0 Ga) basic crust at the "hot spots" was responsible for the development of granitization foci and finally for the origination of large sialic nuclei. These nuclei have been accreted later into the Precambrian super-continent.

The relatively thick continental crust of the supercontinent is supposed to be the thermostatic cover preventing the thermal dissipation and stimulating the Proterozoic (2.0-1.0 Ga) thermotectogenesis (origination of volcanoplutonic and high-grade metamorphic belts, anorthosites and complementary rapakivi-type granites and so on). Those processes resulted in the splitting of the supercontinent along the granulite belts, radial and concentric faults of nuclei. The event can be considered as the starting point of the plate tectonics in its full scale.

The relative aboundness of the "hot spots" in the equatorial belt of the Earth can be observed up to the recent time. The evolution of the "hot belt" occurred in the lose its shape with time caused by the rebuilding of convective cellas and the movement mantle plumes. It resulted in the development of two large (African and Pacific) and two small (Tasmanian and Central Asian) "hot fields" which can be observed during the last 250 Ma and are believed to represent the recent two-cells convective systems in the Earth mantle.

THE MAPMAKER PLATE TECTONICS AND GEODYNAMICS (NORTH-WEST PACIFIC)

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The MAPMAKER PLATE is lower structural element of the north-west Pacific. It is bounded by Shatsky Uplift on the north-west; the Emperor-Hawaii Uplifts - on the north-east side and Nekker-Mid-Pacific-Wake-Markus Uplifts are located along the south side.

The north-west, „Hawaiian" strike of the magnetic lineations set M1-M29 believed to prove Lower Cretaceous-Middle Jurassic age of the magmatic basement of the MAPMAKER PLATE.

According the IMGG reflection and refraction seismic studies the plate crustal seismic stratigraphy consists of Layer 1 (sedimentary), Layer 2 (volcanic) and Layer 3 (magmatic). The sublayers 2A, 2B, 3A and 3B could also be recognized. The whole crustal thickness of the plate is between 6-10 km and at least two times thinner than in the surrounding uplifts.

In the sedimentary cover (Layer 1) four seismic stratigraphy units (synthems) could be recognized (from top): (1)-synthem Alfa is mainly acoustically transparent and consists of pelagic zeolitic clays with thin layers of ashes and carbonate turbidites near uplifts. The sekhron of the synthem is a Recent-Campanian (0-80 Ma) and the average rate of sedimentation about 0.5-1.0 m/m.y. The thickness of the synthem is from meters in the south up to 150-200 m on the north of the plate. (2)-synthem Bravo is mainly opaque unit densely packed by reflectors. The synthem is represented by intercalation of cherts, porcelanites, marlstones and claystones. The sekhron of the synthem is a Campanian-Hauterivian (80-130 Ma) and the average rate of sedimentation is about 4-5 m/m.y. The thickness of synthem changes from about 100 m in the central part of plate up to 500-700 m near surrounding uplifts. (3)-synthems Charly is a lower relatively transparent unit and according to drilling (well 307) it consists of the intercalation of the chalk, porcelanites and cherts. The sekhron of the synthem is a Hauterivian-Berriasian (130-145 Ma) and the sedimentation rate about 7 m/m.y. The thickness of synthem is about 100 m. (4)-synthem Delta is a lower opaque layer and, according the well 307, it consists of intercalation of basalts and its hydroclastics and the thickness is up to 500 m in central part of the plate. The sekhron of the synthemis is, probably, a Berriasian-Callovian (145-170 Ma) and rate of formation is about 25 m/m.y.

The decreasing of the volcanic activity in the plate from Jurassic to Middle Cretaceous is well recognized. It, probably, resulted from cooling of the lithosphere and its subsidence and to finally reducing of carbonate sedimentation to Late Cretaceous in the plate.

EVOLUTION OF STRESS FIELD OF THE LESSER KURILE ISLANDS

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Lesser Kurile ridge is a complex structure, formed by the junction of the two structure zones: the northern structural zone and the southern one. These zones are separated by the Main Thrust which dips on the Shikotan island in the SE direction (angles of dipping - 15-45). The structures of the Lesser Kuriles is broken by left-hand strike-slips.

It was worked out that the structure of the Lesser Kuriles was formed during 2 episodes of deformation. The first episode is characterized by stress field with subhorizontal (N 358) orientation of the axis of compression, and the axis of extension steeply dips in the SW (242) direction. This episode is connected with overthrusting of the two structural zones and is dated by Eocene according to geological data.

The second epidsode widely spreads in both zones of Lesser Kurile islands, and we also can see it tracks on the Big Kurile ridge i.e. this episode occurred not only after collision of the two structural zones, but also after or in time of accretion of the Lesser to the Big Kuriles. This episode is characterized by slip motions and subhorizontal orientation of the axis of compression (NW-SE) and extention (NE-SW). One of the directions of fractures which were formed during this episode are close to the NW orientation of slips which break the structures of the Lesser Kuriles, and the other direction - to the orientation of the Medium Kurile fault, separating the Lesser and the Big Kuriles. On the Nemuro peninsula the episode of slip motions is dated by Miocene and is connected with the right-hand motion of the front arc of the Kurile arc-trench system. Taking into account that the Lesser Kuriles is the Late Cretaceous terrane of an island arc origin which was formed according to paleomagnetic data at 34°N, we consider the episode of slip motions to be connected with oblique collision of the Lesser Kuriles with Kurile island arc in Miocene time as a result of oblique subduction of the Pacific plate under the Kurile arc - trench system.

COMPOSITION AND STRUCTURAL POSITION OF CHAOTIC COMPLEXES OF THE SHIKOTAN ISLAND (LESSER KURILE ISLANDS)

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The structure of the Shikotan island is composed of two different structural zones divided by the Main Thrust: the Northern (simple monocline of Campanian-Maastrichtian rocks of matakatanskaya and malokurilskaya suites dipping SE) and the Southern one having a very complex structure. It consisted of Late Cretaceous - Paleocene mainly calc-alkaline volcanic and volcanoclastic rocks (Zelenovskaya suite) and within this area of volcanic rocks there are three tectonized gabbro massives. Chaotic complexes are situated mainly in the front of the Main Thrust on the contacts with gabbro massives, and also in local fracture zones of the eastern and southeastern coast of the island.

The chaotic complexes may be divided into tectonized olistostrome and tectonic breccia. The first one is a chaotic agglomeration of blocks situated in a matrix that consists of volcanoclastic sediments. The blocks of the olistostrome are represented by rocks of northern zone (mainly tuffs, shoshonites and sandstones of malokurilskaya suites) and southern ones (basalts, andesite-basalts and its tuffs of Zelenovskaya suite, gabbro). Several exotic types of rocks were found which are absent among the stratigraphic and magmatic complexes of the island: quartz-feldspar sandstones and quartz bearing clayey aleurolites.

Tectonic breccia consists of tectonic blocks of different size cemented by cataclased rocks forming these blocks. Among the blocks we also can see the same rocks which are like in case with olistostrome typical of the island and exotic quartz bearing clayey aleurolites which are very similar to clayey aleurolites of tectonized olistostrome.

So, in the composition of the blocks of chaotic complexes we see strong evidence that chaotic complexes were formed during the overthrusting of the southern zone upon the northern one.

We date this event as Eocene because of a single find of Discoaster sp. in the tectonized olistostrome which defines Paleocene-Eocene age of the rocks. It coincides well with other geological data. During overthrusting the rocks of the southern zone crushed and the space between them was filled by tectonic breccia. Olistostrome was formed in front of the Main Thrust during this process.

RANGE ARRANGEMENT OF GEODYNAMIC SYSTEMS AND CELLS

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In this paper, "geodynamic system" (GS) is interpreted as a volume of geological medium of some range (an Earth's hemisphere; a spreading, subduction or collision zone; a meganticlinorium, anticlinorium or fold limb; a cleavage microlithon; etc.), in which some geodynamic conditions - extention, compression or shear - predominate (Nikolajev, 1992). "Geodynamic cell" (GC) is treated as an aggregate of mutually balanced equal-range GSs (for instance, balancing of extension in some GS by compression in another one), arising in the process of balanced arrangement of tectonic flow (Goncharov, 1993), some examples: the Earth as a whole, a lithospheric plate in combination with spreading and subducting (collision) zones, adjacent limbs of positive and negative structures, nappes in combination with their back (extension) and front (compression) parts, microlithons in combination with their adjacent cleavage zones. GC is characterized by rotation of its rock substance around some axis or center. In adjacent equal-range GCs, detached by „plastic" boundary, the direction of rotation is opposite. In the case of fault boundary, the direction of rotation is the same.

Main features of GS and GC range arrangement are recognized. But some of them can be stated now as follows:

1. GC of the i-st range consists of several GSs of the same range. Each of these GSs included, in its turn, several GCs of the (i+1)-st range. The latters consist of several GSs of the (i+1)-st range, etc. So that "GC-levels" alternate with "GS-levels" in the range hierarchy.
2. Geodynamic conditions in a GS of some range are a result of superposition of geodynamic conditions in GS of this range properly and in GSs of lower ranges.
3. GC of the 1st range is not being deformed, in contrast to GSs of higher ranges. In the system of fixed lithospheric plates (from point of view called as „fixism"), such GC could be established, for instance, in the scale of meganticlinorium. Within the limits of plate tectonics, GC of the 1-st range is a plate in combination with spreading and subduction zones. If one considers, that in the Mesozoic-Cenozoic the Earth's Southern hemisphere surface was extended and the Northern one compressed, then the GC of the 1-st range (global GC) is the Earth as a whole (Bozhko, Goncharov, 1993).

All above-stated is the kinematic aspect of the problem only, without any conclusions about motive forces and sources. The concrete examples of GS and GC of different ranges, from the Earth to rock grains, are given.

EVOLUTION OF MAGMATIC AND TECTONIC PROCESSES BY FORMATION OF THE SAKHALIN GEOLOGIC STRUCTURE IN THE MESOZOIC

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In the fold-block Sakhalin structure Mesozoic oceanic marginal-marine and island arc structural-material complexes forming terranes were determined as well as tectonic blocks and moved plates and attached to the island folded structure during the epochs of intensive compression.

The Susunai terrane presents a fragment of the Triassic-Low Cretaceous oceanic plate. It has the inner imbricate-thrust structure with a sublatitudinal orientation of the thrust plate frontal parts and a serpentinite melange zone. A petrochemical volcanic metarocks composition, the succession of the volcanic series composition change as a whole corresponds to the abyssal plateaus volcanic centers and intraoceanic islands. Alternations and facial replacements of volcanic and sedimentary rocks as well as the multistage processes of their metamorphism indicate that volcanic processes have taken place in the perioceanic setting with tangible terrigenous sedimentation and rather active tectonic regime. The Susunai terrane started to move to the modern location from the Early Jurassic and was completed in the Late Paleozoic.

The Tonino-Aniva terrane also presents a fragment of the Triassic-Low Cretaceous oceanic plate located in a tectonically passive abyssal oceanic area adjacent to a more ancient oceanic uplift. Since the Early Triassic and up to the first half of the Early Cretaceous inclusive lavas erupting under constant extension accreted to the oceanic crust. In the middle of the Early Cretaceous a large plate fragment splitting off apparently together with the intermediate magmatic sources takes place. In the process of migration the Tonino-Aniva terrane comes to the zone of intensive terrigenous sedimentation, undergoes accretion and tectonically delaminates by the system of submeridional thrusts oriented to each other. Volcanic eruptions continuing under control of compressional setting supply residual, magmatic melts corresponding to the marginal-marine magmatic formations according to petrochemical characteristics, to the surface. Further complication of the Tonino-Aniva terrane inner structure and its movement to the present location occurred in the Cenozoic.

In the Late Mesozoic the island arc system developed all over the vast territory including the Island of Sakhalin. A synchronous manifestation of the area marginal-marine and island are linear types of magmatism is characteristic of the system considered. At the end of Cretaceous by the manifestation of the intensive compressional phase the connection between the island arc volcanic apparaturs and a seismo-focal zone interrupts and their further development ends, judging from petrochemical date, at the stage of a developed arc. After that the island arc separate fragments stratification and splitting off takes place and they move to the eastern Sakhalin areas along thrusts and strike-slip faults.

NORTHWIND RIDGE: A CONTINENTAL FRAGMENT ISOLATED BY TERTIARY RIFTING IN THE AMERASIA BASIN, ARCTIC OCEAN

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Northwind Ridge is a north-trending, fault-bounded fragment of continental crust that lies at the eastern margin of the Chukchi Continental Borderland of the Amerasia Basin northwest of Barrow, Alaska. Paleontologically dated bedrock in piston cores from the ridge includes Pennsylvanian and Permian shelf carbonate, Triassic shale and sandstone, and Albian to early Turonian continental slope or basin shale. Euhedral biotite phenocrysts separated from a marine air-fall tuff yielded a $^{40}Ar/^{39}Ar$ laser fusion age of approximately 90 Ma (Turonian). Seismic reflection profiles indicate that a minor convergent zone lies between the ridge and the oceanic Canada Basin to the east, and that a major extensional zone separates the ridge from the Northwind Basin of the Chukchi Borderland to the west. Based on tentative age correlations of sedimentary strata profiled in the Canada Basin, the eastern convergent zone appears to have been active in early (?) Paleogene and again in late (?) Neogene time. The ridge experienced uplift relative to the Canada Basin at both these times and the latter episode, which appears to be kinematically linked to the extensional system that bounds the ridge on the west, apparently continued into Quaternary time.

The stratigraphy and structure of Northwind Ridge and the bathymetry of the north-trending ridges and basins of the Chukchi Borderland suggest that the Borderland was rifted from the continental margin of the East Siberian Sea in two phases along segments of the Arctic Mid-Ocean Ridge that were transferred from the Eurasia Basin. This model predicts that a large transform fault connects the continental margin of the eastern Laptev Sea and the northern terminations of the north-trending ridges of the Chukchi Borderland, and that a second transform fault lies between the southern part of the Borderland and the continental margins of the western Chukchi and eastern East Siberian Seas. The first (early (?) Paleogene) phase of rifting can be traced across the Chukchi shelf to Hope Basin and north-central Alaska. The second (late (?) Neogene) phase may be restricted to the borderland, but our seismic coverage is too meager to preclude the possibility that this phase of rifting extended beyond the Borderland west of the Chukchi shelf.

OPHIOLITES SURROUNDING THE MUYA BLOCK

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A number of Early Precambrian (Archean?) blocks are observed in the fold system around the Siberian platform. The largest of these is the Muya block which is surrounded by various members of ophiolites. They can be encountered over the entire perimeter of the block: the Shaman, Param and Kelyana hyperbasic massifs, Irokinda, Yanguda, Middle Mamkan and Sunuekit gabbroic massifs, and the metavolcanics of the kelyana series. Complete sequences of the oceanic crust have been found on the western side (Konnikov, Tsygankov, 1992) of the block and on the eastern side (Gusev et al., 1992). Ophiolites are commonly of allochthonous nature.

The authors investigated a complexly built nappe of ophiolites on the north of the Muya block. In the middle course of the Kaalu river (the right tributary of the Mamakan river) all the members of the ophiolitic sequence have been explored. They occur in the form of an imbricated nappe complex over the Vendian-Cambrian carbonate-terrigenous deposits. 30-40 m thick zones of serpentinite melange are observed here along fault planes.

The nappe consists of no less than 3 slabs whose contact planes dip north-westwards at an angle of 65-75°. The lower slab is represented by a series of thin (20-50 m) wedge scales made up of apoharzburgite serpentinites, diallagites, rodingites, metagabbroids and metavolcanics. The middle slab is composed of cumulative complex rocks: peridotites and pyroxenites occur at the base to give way upwards to alternation of pyroxenites and mesocratic, melanocratic and leucocratic gabbro. The upper slab consists of metabasalts and metagabbro-diabases, the latter having a composition similar to that of the "upper gabbro".

The chemistry of rocks from the Kaalu ophiolite complex corresponds to that of the typical sequences of paleooceanic crust (Urals, Troodos and others). They are characterized by tholeiitic trend of differentiation expressed by low Fe- (down to 8%) and Ti-content (down to 0,3%) in ultrabasic and cumulative complexes and by concentration of these metals in gabbro-diabases and volcanics reaching 12-15% and 1.2-2% respectively. Plutonic rocks are characterized by higher CaO-content, conditioned by their widespread rodingitization, and extremely low Ba-, Rb- and Sr- content.

Ophiolites surrounding the Muya block are allochthonous and have an imbricate nappe structure. It is not improbable that the Muya block itself is an allochthonous terrane. Peculiar interrelations of ophiolites and the Vendian-Cambrian deposits expressed by tectonic overlying of the Vendian-Cambrian carbonate-terrigenous formations by ophiolites along with transgressive overlapping of ophiolites by Vendian-Cambrian strata, allow to conclude that the formation of ophiolite association was completed in Late Riphean as a result of a jumping of the subduction zone going beneath the Siberian continent. Subsequently, Caledonian collisional events caused rejuvenation of ancient faults and formation of nappes thrusted upon the Vendian-Cambrian complexes.

THE PROBLEMS AND STUDY OF RECENT AND ANCIENT METALLIFEROUS SEDIMENTS OF THE WORLD OCEAN

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Metalliferous sediments result from mixture of hydrothermal ore matter (inputting mainly in rift zones of spreading ridges) to the "normal" sedimentary material accumulating on the sea floor. Metalliferous sediments reflect hydrothermal input to the ocean and accompany the formation of hydrothermal sulphide ores. The study of metalliferous sediments is very important in prospecting surveys for presently accumulating sulphide deposits and particularly for relict ones. The study of metalliferous sediments gives a possibility to reconstruct the history of hydrothermal activity in the oceans in different scales: from local to global, i.e. to reconstruct the history of large individual hydrothermal bodies (via studying sediments it is much cheaper), the history of hydrothermal fields, the history of hydrothermal activity at different segments of spreading ridges, and the history of hydrothermal activity at the whole spreading ridges and globally in the oceans.

Recent metalliferous sediments of the East Pacific Rise, of the Mid-Atlantic Ridge and of back arc basins were studied. The correlation between metalliferous sediments accumulation and the phases of the tectono-magmatic cycle was etablished. The model of metalliferous strata accumulation at the East Pacific Rise was developed. The main regularities of ancient (from Upper Jurassic to Quaternary) metalliferous sediments accumulation in the Pacific, Atlantic and Indian oceans were established. The evolution of hydrothermal activity at the East Pacific Rise, at the Mid-Atlantic Ridge, and in the Indian Ocean from 40-70 m.y. to the present and the reasons for this evolution were studied. These results are the necessary steps for solving the problems mentioned above.

ON RELATIONSHIP BETWEEN THREE COMPOSITE TERRANES OF TRANSBAIKALIA: BAIKAL-VITIM, ALDAN-STANOVOY AND MONGOLO-OKHOTSK

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The southern frame of the Siberian Craton, belonging to the Central Asian mobile belt ist characterized by a very complicated and not yet quite deciphered structure and history. Here the structures of the mobile belt fill a reentrant in the craton's body, located between Irkutsk and Aldan-Stanovoy salients. Three composite terranes, the interrelationships of which are not clearly understood, could be distinguished here: the Baikal-Vitim, Aldan-Stanovoy and Mongolo-Okhotsk.

The Baikal-Vitim terrane is limited from the north by an arc-shaped belt of tectonic nappes of the Patom Upland, in the west - by the transpressive zone of overthrusts and sinistral wrench-faults of the Lake Baikal region, in the east - by a similar Zhuya Dzheltulak Zone separating it from the Aldan-Stanovoy Shield and in the south - by the main Mongolo-Okhotsk fault. In the meridional cross-section it consists of the Patom Riphean inner shelf, Chu-Necher zone of marginal basement uplifts, Bodaibo outer shelf and a slope of the back-arc Riphean basin, a system of Late Riphean volcanic arcs, Muya collisional ophiolite suture, Khamardaban-Barguzin microcontinent, Vend-Early Cambrian Dzhida volcanic arc and ophiolite belt, followed by Early Paleozoic flysch and, finally, by Malkhan-Jablonovoy microcontinent with Late Paleozoic-Early Mesozic magmatic arc superimposed on it. This complex structure evolved from Early Proterozoic to Late Paleozoic time. The evolution began with the formation of the Early Proterozoic oceanic basin and then a volcanic arc; its collision with the Archean craton at the end of the aeon led to the formation at the margin of a later Akitkan magmatic belt. In the Middle-Early Late Riphean, a new oceanic basin opened further to the south - in the Muya (Baikal-Vitim) basin, later being complicated by the appearance of volcanic arcs, and a back-arc basin to the north. This basin was closed by Vendian time with collision to the volcanic arcs, and then the Khamardaban-Barguzin microcontinent with the already accreted edge of the craton. Simultaneously, a basin of a new oceanic type, opened to the south of the Dzhida-Vitim later also with volcanic arcs. The closure of this basin began in the Middle Cambrian and lasted until the Devonian, when the Malkhan-Jablonovoy microcontinent collided with the Khamardaban-Barguzin, already forming the margin of Siberia (Angara land). And, finally, the ultimate collision of all this collage with Siberia accompanied by granitization, metamorphism and folding even of the southern part of the platform cover, took place in the Late Paleozoic-Early Triassic due to the subduction of the oceanic crust of the Mongolo-Okhotsk ocean, opened in the Devonian.

The Aldan-Stanovoy terrane is composed of two main continental blocks: the Archean Aldan Shield and the Archean, reworked in the Early Proterozoic Stanovoy belt. The collision of these two blocks occurred by the end of the Early Proterozoic, marked by the formation of a belt of layered mafic plutons along the suture, but movements along this suture were renewed in the Late Jurassic-Early Cretaceous with thrusting of the Stanovoy belt over the Aldan Shield. And a magmatic arc was formed due to the subduction of the oceanic crust of the Mongolo-Okhotsk basin.

The latter originated in the west of Central Mongolia as a continental rift and further to the east developed into an oceanic basin, the crust of which was preserved as mid-Paleozoic ophiolites known in the Onon and Zeya valleys. But in the Shilka valley much older Riphean ophiolites are known; they can be regarded as a continuation of the Muya belt, shifted along the Dzheltulak strike-slip fault. The western Mongolia-West Transbaikalian part of the Mongolo-Okhotsk ocean was closed in the Late Paleozoic-Early Triassic, but regenerated in the Late Triassic-Jurassic with final closure in the Late Jurassic-Early Cretaceous. This time could be considered as the time when the structure of the junction of the three Transbaikalian terranes took its modern shape.

THE NATURE OF EAST TRANSBAIKALIA OPHIOLITES

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Fragments of Late Precambrian, Mid- to Late Paleozoic and, presumably, Early Mesozoic ophiolite suites are known in East Transbaikalia. Ophiolites of various age are practically omnipresent within Aginsko-Borshchovochniy block. But the largest ophiolitic bodies (Molodovskaya, Kulindinskaya, Kholbonskaya, Schorlovogorskaya, Ul'durginskaya and Ust'-Turinskaya zones) tend to Mongolo-Okhotskiy, East Aghinskiy and Onon-Turinskiy sutures. Besides ophiolites are known within eastern segment of Mongolo-Okhotskiy suture, dividing Archean antiforms of Stanovoy and Argun blocks (Gorbitskaya and Nizhne-Shilkinskaya zones) and also within inner part of Argun block (Byrkinskaya zones).

Setting and geologic specialities of ophiolitic zones were first characterized by Yu. F. Misnik and V. V. Shevchuk (1979, 1980). L.P. Zonenshain and co-authors have concluded on the ocean nature of the rocks (Zonenshain a. o., 1990; Geodynamic map of the USSR ..., 1989).

Our geological and geochemical investigation enabled to define three types of associations among ophiolites of Eastern Transbaikalia: (1) the ocean rift (mid-ocean ridges) association, (2) the seamount (hot spots) association and (3) supra-subduction ophiolites of back-arc basins.

Ophiolites of the first type are of Late Precambrian age. These ophiolites comprise those of large ocean basins (Molodovskaya and Kulindinskaya zones) and those of minor ocean basins (Byrkinskaya zone). The most complete sequence of the ocean ophiolites is developed within Molodovskaya zone (near a town of Sretensk). The sequence consists of serpentinized lherzolites and harzburgites, gabbro (?), metabasalts and metamorphosed siliceous, clayey-siliceous and calcarecious rocks. All three geochemical MORB-types of basalts are established. Metabasalts of N-, P-type and plutonic picrites are developed within Byrkinskaya zone. Quartz-graphite-mica schists, limestones and dolomites laterally replaced with mottled calcarecious terrigenic sequence are associated with volcanites.

Late Precambrian (?) ophiolites of the second type presented by amphibolites containing relicts of gabbroid textures and probably by basalts are established within Kholbonskaya and Gorbitskaya zones. High content of Ti, Rb, Ba, K and Nb is inherent in these rocks. Rare samples may be classified as ocean T-type basalts. Amphibolites are complemented with calcarecious rocks, the latter probably being fragments of carbonate platforms.

Ophiolites of the third type are of Mid- to Late Paleozoic (Schorlovogorskaya and Ul'durginskaya zones) and probably of Early Mesozoic (Late Triassic) age (Ust'-Turinskaya zone). Sedimentary cover in all zones is represented by flysh-form gray wackes, clayey and siliceous schists and tuffs. Low-Ti tholeiitic basalts enriched in K, Rb, Th, Sr and depleted in Nb and Hf are characteristic here. Gabbro of similar chemical composition are associated with these rocks, and near a town of Shorlova Gora intensely serpentenized harzburgites occur. High-Ti alcaline basalts occur here along with tholeiitic basalts as well as medium and acid rocks.

A reconstruction of Mongolo-Okhotsk ocean basin in East Transbaikalia is demonstrated. During Late Precambrian ocean rift and seamount ophiolites has been forming within its limits; chemically the rocks are practically identical to recent ocean ophiolites. During Paleozoic and Early Mesozoic the fact of existence of ocean basin is proved by the presence of ophiolite supra-subduction zone (basins of Aginsko-Borschovochniy block) along with that of volcano-plutonic complexes of active continental margins (Stanovoy block) as well as by sedimentary suites of passive margins (Argunskiy block). Closure of Mongolo-Okhotsk ocean in Early Bajocian is witnessed by continental molasses and by folded faulting of tectonic covers.

THE NUMERICAL EXPERIMENT OF MANTLE CONVECTION MECHANISM INDENTIFICATION USING THE INVERSE PROBLEM METHOD

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In spite of the last achievements in the Earth's mantle convection research the practical failure to reach the interior regions for direct observations and restrictions of the indirect experimental data does not allow to answer uniquely on the question: what physical mechanisms do the mantle convective flows support?

In the known papers devoted to mantle convection research in the frame of concrete physical models the boundary problem for the convection equations system is usually solved. Using the results of comparison of the structure model, flow intensity and other parameters of distribution together with the interpretation results of geophysical and geochemical fields a conclusion about the relative contribution of the distinguished mechanism in the dynamical processes may be done. So, using that approach the convection mechanisms are identified using the fitting method. It is well known that for a number of geophysical methods the inverse problem is ununique. As for our problem, it means that different physical convective mechanisms can create equal distributions of geophysical fields on the Earth's surface. The problems of uniqueness, equivalency and searching of additional experimental data which would made the interpretation more unique have been researched in the frame of the inverse problem method. We have formulated the approach and received equations of the inverse problem of coefficiental type for the mantle convection equations system. On some theoretical examples the possibility of identification of mantle convection physical mechanisms has been shown using our mathematical algorithm of convection inverse problem and its numerical realization.

KINEMATIC RELATIONS BETWEEN TERRANES OF WESTERN NORTH AMERICA AND SIBERIA

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Reconstruction of the history of the western North America margin taking terranes into account suggests that there has been a continuous movement of continental slivers and blocks, and fragments of oceanic origin northward along the margin of the Americas since the late Paleozoic. At present this northward motion is blocked by the Alaskan orocline and Aleutian Trench. The present blockage may have been induced by rotation of the Arctic Alaska-Chukotka Block thought to have rotated to open the Canadian Basin and to have collided with East Siberia at about 100 Ma. At this time a large terrane complex, known as Superterrane I + II and including the Chugach, Peninsular, Alexander, Wrangellian, Tracey's Arm, Cache Creek and Stikinian terranes lay off western North America. Its north-south length exceeded 3000 kilometers and it was 500-800 km wide. Plate tectonic reconstructions suggest that its nuclei, the Alexander and Wrangellia terranes, had been moving northward from a site of origin along the margin of South America since the Permian. Staring with these nuclei, two terrane complexes, Superterranes I and II had been forming, growing in size by accreting additional terranes as they moved northward. The rotation of the Arctic Alaska-Chukotka Block caused the northern end of the Superterrane complex to be bent westward, forming the Alaskan orocline, and forced its collision with North America causing the Sevier Orogeny.

Before the mid-Cretaceous collision of the Arctic Alaska-Chukotka Block with other parts of Alaska and Superterrane I + II, it may have been possible for terranes to move along the western margin of North America and on along the eastern margin of Siberia.

STRUCTURE OF THE JAPAN TRENCH CONVERGENT MARGIN

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Pre-stack depth migrated seismic reflection data across the Japan Trench, a convergent margin where tectonic erosion during the past 20 m.y. has removed up to 100 km of the margin, reveals a transitional boundary between erosion and accretionary regimes. This boundary is beneath the mid-slope where consolidated Cretaceous rocks are thrust over less consolidated Neogene materials. Cretaceous basement rock extends as a coherent mass to the upper-slope where it is flexed downward toward the trench. Here it forms a backstop against which sediment and debris from mass wasting are accreted. Although erosion has predominated, the interplay between subduction erosion, sediment subduction, and accretion is poorly known. The dynamics that allow huge volumes of terrigeneous materials to be subducted beneath this margin has long been a puzzling question. We speculate that a small accretionary prism is required to initially elevate fluid pressure which reduces friction along the plate boundary. Reduced friction is needed to underthrust and subducted less consolidated terrigeneous material. The Japan margin example appears similar to most margins of the western Pacific converging at about 10 mm/yr. An exception is the Nankai Trough. Here the convergence is much slower and the ratio of sediment accreted to sediment subducted is much larger.

The non-accretionary nature of these margins in not only a matter of sediment supply but also critical taper, a major controlling feature of the accretionary process. The critical taper has commonly been envisioned as controlled by the seaward outbuilding of the accretionary prism. However, if the basal friction is weak, the horizontal forces are correspondingly small and the height of the backstop rather than width of the accretionary wedge could become a control. If the backstop stabilizes at a particular height, accretionary prism growth will cease and sediment will essentially bypass the deformation front and be subducted. We observe in seismic data that most of the sediment of the Japan Trench is subducted of which little is underplated beneath the slope as shown by its Neogene paleo-depth history.

If this model is correct, it would aid in the assessment risk from of tsunami earthquakes. The steep upper slope is a rigid block transmitting convergent plate motion into the ocean during a major earthquake at the seaward part of the seismogenic zone. In contrast, parts of the margin where internal deformation absorbs such motion are inefficient transmitters of sudden motions during earthquakes.

GEODYNAMIC AND PALEOGEOTHERMIC CONDITIONS OF FORMATION AND PREDICTION OF OIL AND GAS ACCUMULATIONS IN THE AMU-DARIA GAS AND OIL BEARING BASIN

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The investigations of geothermic evolution of Amu-Daria basin has been carried out on the basis of paleogeodynamic reconstructions supported with the method of Lopatin and Waples. Geothermics of the sedimentary sections was studied in order to define more precisely the mechanism of oil and gas generation in lower-middle Jurassic, upper Jurassic and lower Cretaceous source rocks and to detalize the geological regioning of investigated territory. The essence of Lopatin-Waples method is concluded in determining the organic maturation of source rocks by the temperature-time index (TTI).

On the foundation of computed data paleothermic maps were drawn up and six stages of oil and gas fields formation were considered. These stages are: horst-graben stage (P-J_1), early-syneclise stage (J_2-J_3k), early-syneclise (J_3km-t), early-invertion (J_3-K), late-syneclise (P_2) and late-inversion stage (P_3-Q).

In conformity with the levels of organic maturation and geodynamic stages possible yield of hydrocarbons, ways of migration, conditions of conservation and phase composition of hydrocarbons were predicted.

RHEOLOGICAL PRINCIPLES OF THE EARTH CRUST GEODYNAMICS

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Geological observations including study of water regime of metamorphism and hydrodynamics of subsurface fluids in very deep boreholes, experimental results of rock deformations at high temperatures and pressures and seismic research have made it possible to draw the following conclusions.

At a depth of about 10-12 km, closure of fissures, cavities and open pores in rocks creates a dense "transition" zone impermeable for fluids, separating the upper crust from the middle one. Immediately below the dense zone, water released from thermal breakdown of hydrous minerals and arriving from lower crust and mantle is under lithostatic pressure (P_{lt}). In this "lithostatic" zone, effective pressure (P_{eff}) is zero ($P_{eff}=P_{lt} - P_{fluid}$, at $P_{fluid}=P_{lt}$, $P_{eff}=0$). For this reason, rock strength depends only on cohesion forces considerably weakened by hydrolithic effect. Considerable rock weakening under the dense transition zone favors formation of hydrofractures and accumulation of fluids.

In case of deformation, a significant difference in rheological features of rocks between the upper ("hydrostatic") and impermeable transition zones, on one hand, and lithostatic, on the other hand, causes a detachment fault at their boundary, just below the transition zone. The report gives brief reasons for the assumption, that both the dense transition zone and its characteristic feature - detachment fault are recorded by seismic methods as a reflection or, partly, refraction K_1 (or F) horizon situated mostly at depths of 7-15 km. The main geological factors influencing on its position are described; among them, there are a high heat flow and gravity load deformations, which are responsible for a reduction of the K_1 depth.

The effective confining pressure is developed again in the rocks of mafic composition (non-quartzous) with deepening below the dense permeable zone. It results in the increasing rock strength which is in progress down to the level of their temperature softening. At this level the sharp decreasing of rock strength occurs once again. This level appears to be marked by seismic methods as the boundary K_2 separating the middle crust from the lower one.

The decisive confirmation of supposed rheological model has been received by the drilling of the Kola superdeep borehole. This borehole consecutively crossed the hydrostatic, the dense transition and the lithostatic zones and temporarily was stopped in the latter at the depth of 12 km.

NEOGENE PALEOGEODYNAMIC RECONSTRUCTIONS AND CLIMATIC ZONATION OF THE INDIAN OCEAN: NEW RESULTS BASED ON ODP DATA

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Biogeographic patterns of the planktonic foraminiferal assemblages are plotted on palinspastic maps for seven time intervals to reconstruct the climatic zonation and general features of the surface circulation in the Indian Ocean during Neogene.

Paleopositions of DSDP and ODP sites for time intervals 22, 16, 11, 5.3, 4.5., 3.5, 2.5 m.y. and the coordinates of finite pole of rotation of Indian-Australian, Arabian and Antarctical plates relatively to Africa were computed using N.Y. Bocharova's program "ROTETER", "MIDPOINT" and "DETPOLST". These programs are based on model K. Le Pishon et al., 1978, in which finite pole of rotation has described resulting relative movement of lithospheric plate on any interval of time. These paleogeodynamic reconstructions are based on a map of magnetic lineations, Candy et al., 1990, and other original data. Sometimes there are no points of intersection of magnetic lineations with transform fractures on these maps. Gravitational data allow to continue magnetic lineations to transform fractures, because gravitational anomalies depend on the age of the lithosphere.

The table of finite poles of rotation for 22, 16, 11, 5.3, 4.5, 3.5, 2.5 m.y., the table of paleopositions of DSDP and ODP sites for these intervals and paleogeodynamic reconstructions of exposure of Indian Ocean during Neogene (N4, N8, N14, N18, N19, N20, N21) with paleopositions of ODP and DSDP sites were received.

The previously established position of climatic zones and surface circulation systems are ascertained using new planktonic foraminiferal data from ODP reports (Leg 115, 119, 120, 122). As a result, paleoclimatic maps of the Indian Ocean became more complicated, although in general, climatic zones and gyral systems occupied the same latitudes revealed by DSDP data. The main differences concern three regions of the ocean.

In particular the western part of equatorial divergence intensified during the coolings (at the earliest Miocene and the end of middle Miocene) as registered by subtropical foraminiferal assemblages.

The Western Australian Current can be traced better than previously from the beginning of Neogene by rather cold-water foraminiferal assemblages, so the boundaries of tropical and equatorial-tropical zones were shifted northward near Australia than in the center of the ocean, especially in Miocene.

In the Southern Indian Ocean, over the Kerguelen Plateau high-latitude progressive cooling became more pronounced at the end of middle Miocene, latest Miocene and late Pliocene followed by an equatorward migration of temperate and subpolar climatic zones.

COMPOSITION, GEODYNAMIC SETTING AND ORIGIN OF THE CYPRUS UMBERS

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Umbers are typical Fe-rich sediments of the Tethian ophiolites, which covered the upper pillow lavas. Usually umbers are regarded as ancient analogues of the Mid-oceanic ridge hydrothermal, metalliferous sediments. However, our investigations of Cyprus umbers suggest its more intricate genesis.

They actually contain features of typical pelagic metalliferous sediments: high Ti-modules {(Fe+Mn)/Ti=40-160} and low Al-modules {Al/(Al+Fe+Mn)=0.02-0.05} of the umbers testify about hydrothermal genesis of this rocks, and the sediment enrichment in such elements as Fe, Mn, Cu, Zn is caused by hydrothermal input. The REE distribution with the high negative Ce anomaly imply that the umbers were deposited in an open ocean basin with normal-saline water and with bottom depth below the CCD level since they contain only siliceous but no calcareous fossils.

However, the idea on this rock genesis in geodynamic setting on the mid-oceanic ridge conflicts with a number of facts. First, the underlying lavas do not belong to MORB types, but instead to boninites and calc-alkaline series. Second, we have detected a few types of umbers. They are various in mineralogy, geochemistry and volcaniclastic components. The different types of umbers are in various rocks associations (cherts, phosphorites, rodochrosites, Mn-concretions and hyaloclastites). This association is not typical of oceanic pelagic deposits, because phosphorites layers are not known within modern mid-oceanic ridges. The lithology and mineralogy of the phosphorites discovered in association with umbers are similar to those of seamounts phosphorites. Third, distribution of Ba, Nb, Th, As in umbers is not similar to that in metalliferous sediments in modern oceans.

We propose the association umbers with boninites and calc-alkaline volcanites may be connected with the origin of the umbers in geodynamic position near spreading centers in a fore-arc basin. A hydrothermal plume was a major process in genesis of umbers. The various types of umbers are caused by different inputs of hydrothermal, hydrogenous and volcanoclastic components. The presence of volcanoclastic rocks and pebbles of phosphoritized limestones indicates that sediments were deposited in a basin with a rugged topography.

TECTONIC EVOLUTION OF THE WESTERN JAPAN SEA

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The western Japan Sea includes the Japan Basin, Korea Plateau and Genzan Trough. The Pacific Oceanological Institute has conducted a detailed seismic reflection (single channel) survey in the western Japan Sea. According to the acoustic basement relief the Japan Basin can be divided into three parts: the northeastern, the central and the southwestern one. The north-eastern part has a smooth basement relief, the depth of the basement is more than 6.8 s. On the contrary, the central and south-western parts have a rough basement relief, the depths of the basement are 5.6-6.4 s and 4.0-5.2 s, correspondingly. There are some basement depressions along the continental slope of the Primorye. Maximal sediment thickness (2.2-2.4 s) occurred in the northeastern Japan Basin. The sediment thickness varies from 1.4 to 1.8 s in the southwestern and central parts. The continental slope depressions have the sediment thickness of 1.8-2.0 s. The sedimentary sequence of the western Japan Sea is divided into two acoustic units: the upper stratified layer and the lower transparent layer. The stratified layer and transparent layer show conformable relation in the Japan Basin, whereas they show disconformable relation around the western part of the Yamato, Bogorov and Pervenetz Rises, Korea Plateau, in the Genzan Trough and along the continental slope. The disconformity is shown in the manner that the transparent layer is continuous in the Genzan Trough, the western part of the Yamato Rise and on the continental slope. According to deep-sea drilling data (Sites 301 and 795), the upper unit is of Pliocene-Pleistocene age, the lower unit is of Miocene age. The disconformity is correlated with 5 Ma. There are a lot of normal faults in the acoustic basement. These faults form numerous fracture zones. Many of them have a northeastern trending. Numerous normal faults are found in the lower part of the stratified layer and the upper part of the transparent layer. This part of the layers can be considered as the separate acoustic unit (fractured unit). The fractured unit exists in the marginal areas of the Japan Basin only. According to our interpretation of the reflection data, the Japan Basin subsidence began in the pre-Middle Miocene. The subsidence ceased in different parts of the basin at different times. The subsidence of the central part ceased in the Late Miocene, while the subsidence of the marginal parts ceased in the Late Pleistocene. The region of the basin around the Pervenetz Rise keeps subsiding at present.

TECTONICS OF THE URDANETA PLATEAU, WEST PHILIPPINE BASIN

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The Urdaneta plateau is a broad topographic rise located in the northwestern part of the West Philippine Basin. The Pacific Oceanological Institute conducted a geophysical survey and dredging on the Urdateta plateau in spring and autumn of 1990. The geophysical survey included bathymetry and seismic refraction and reflection investigations. The refraction survey was carried out by ocean bottom seismometers, sonobouys and airgun. The reflection survey was done by a single channel method. According to our bathymetrical data, the Urdaneta plateau pedestal rises only 600 m to 1 km above the basin floor. The plateau is intersected by a seamount chain trending in E-W direction. There are extended elevations of the northwest trend in the north and in the south. A set of volcanic rocks was dredged on slopes of the highest top of the seamount chain. The set includes basalts, trachytes and phonolites. The absolute age of basalts and trachytes is about 40 Ma, the age of phonolites is 23 Ma. According to our refraction study, the crust consists of a thin sediment layer, the intermediate layer with a velocity increasing from 4.8 to 7.1 km/s (thickness is 4.3 km) and oceanic layer 3 with velocity 7.1 km/s. According to our reflection data, a seafloor morpholoy clearly reflects that of the acoustic basement. The sediment layer 0.1 to 0.5 seconds thick blanckets the most part of the plateau. The fracture zones (FZ) can be recognized in both the northern and the southern extended elevations. The main FZ is situated between the seamount chain and the northern elevation, it has northwest - southeast (295-300) strike. The main FZ (MFZ) is represented by a graben about 10-12 km wide in the east and in the west. The graben is succeeded by smooth basement steps in the plateau center. The MFZ is being formed at present. The faults of the extended elevations were probably formed in the early Miocene. Our data supports the notion of Hilde and Lee (1984) that the Urdaneta plateau was formed at the Central Basin Fault about 40-45 Ma ago. We conclude that there are two tectonic activization periods of the Urdaneta plateau after cessation of the West Philippine Basin spreading. The first occurred in the early Miocene (23 Ma ago) and the second one is still going on.

GEODYNAMIC MODELS OF CAUCASIAN FOREDEEP

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Thermomechanical models of the Caucasian orogen evolution are constructed on the basis of generalization of geological and geophysical data. The problem is considered in the context of classical geosyncline approach as well as of two-layer plate tectonics conception. The computations are accomplished along two submeridional profiles which cross the Tersko-Caspian bending on the north, the Alazan river basin on the south and folded massives of the Great Caucasus. In both cases the mechanical field of lithosphere was reconstructed firstly according to the structure of sedimentary cover of the bending taking into account both elastic and viscous-elastic rheologies. After that by the type of changes of the elastic features of lithosphere during its submersion the assumptions were made concerning the nature of additional (weight of sediments is ignored) bending load of thermal origin. The distinction between two models is the following. In the geosyncline approach the free edge of lithospheric plate passes along the axial line of the flexure (along the system of deep breakings), so the load of forming mountain system is disregarded in the computating scheme. In the plate tectonic approach the load of growing Caucasus is regarded as one of the possible sources of load on the edges of subducting mantle plates of lithosphere.

By means of the geosyncline approach the thermal thinning of lithosphere in late Oligocene and in early Miocene as well as the phase of transitions in the bed of the crust are to be considered as the main processes causing submersion of the basin. The following cooling of lithosphere could give about 70% of submersion in isostatic conditions and no more than 40% out of them. The phase of transitions give additional submersion to 50% of the whole thickness of sediments in the axial part of bending. On the whole, the model calculations in this approach are in bad agreement with available geophysical information. The second approach seems to be preferable. It does not need a thermal event in the classical sense. The main submersion in plate tectonic approach tool place in isostatic conditions under the load of accumulating sediments. For this in rheologically stratified lithosphere the displacement of viscous-elastic material from under the forming basin took place which was total in the bed of granite layer and partial in the bed of basalt ones. This displacement caused the Karpinsky swell to rise. Dissipation owing to the shearing stresses in these layers caused the warming of the crust and hence the increasing geothermal activity.

The inclusion of viscous-plastic features of lithosphere gives considerable improvements in convergence of the model calculations with the data at hand.

NEW PALEOGEOGRAPHIC PROJECT IN RUSSIA

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In 1992 a new large-scale paleogeographic project was initiated by Dr. Lev Zonenshain under the provisional title "Paleogeographic atlas of northern Eurasia". The project is a first attempt to reconstruct the detailed paleogeography maps that are to be compiled with the time interval of 10 m.y. (Late Jurassic-Recent) and 25 m.y. (Early Mesozoic-Paleozoic).

The first set consists of data-base maps compiled on the present-day topographic base. The legend includes about 133 items showing plate boundaries, indicators of paleotectonic situations, lithologies, facies, indicators of paleoclimate, structural symbols, paleomagnetic data, thickness of sediments, and other features. Graphic and digital versions of the maps will be finally presented. To compile the data-base a group of several dozens of the best regional experts was organized and is presently at work. 12 maps from 120 m.a. upwards will be completed at the end of this year.

The second set of maps includes plate-tectonic reconstructions on which paleogeographic data will be transferred from data-base maps. A new set of reconstructions is being compiled by a group from the Institute of Oceanology in collaboration with Dr. Ch. Scotese, Arlington University, USA. To reconstruct the position of minor blocks and terranes a bank of paleomagnetic data has been compiled for the whole territory in question.

Though great attention is paid to the reconstruction of the history of fold belts, the main emphasis will be laid on the development of sedimentary basins - potential reservoirs of hydrocarbons.

Scientific and adminstrative guidance is achieved by two non-governmental organizations: Scientific Council on Plate Tectonics, originally founded by Lev Zonenshain and the Institute of Plate Tectonics. Necessary funds are provided by the Geological Committee of Russian Government and by sponsors: Shell and Esso Companies. Other sponsors are welcome to join the project.

During the first phase of the project (2 years) the maps for the Late Paleozoic, Mesozoic and Cenozoic will be compiled. The next two years will be dedicated to the Middle and Early Paleozoic maps. The total duration of the project is 4 years.

TECTONIC HISTORY OF THE BLACK SEA

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Geological data suggest at least 3 stages of the Black Sea opening. The earliest opening occurred in the Late Triassic-Early Jurassic, when a single basin stretching from Dobrodgea to Kopet Dagh was formed along the Early Cimmerian suture. The western part of the basin was closed in the Middle Jurassic, after the oceanic crust was consumed in the south dipping subduction zone. Spreading resumed in the Late Jurassic at least in the western Black Sea, while in the east rifting of the continental crust most probably prevailed. The oceanic crust created at this stage was again partially or completely subducted during the Aptian-Albian in the Benioff zone at the northern margin of the sea. Finally the major opening occurred in the late Cretaceous-Paleocene behind the Pontides - Lesser Caucasus island arc associated with the north dipping subduction zone.

Re-interpretation of magnetic anomalies in the Eastern Black Sea basin indicates their spreading origin. They can be correlated either with anomalies 25-29 (57.2 - 64.8 Ma) or M24-M25 (Late Jurassic 152.5 - 155 Ma). Correlation with geological data shows that both solutions are possible but the last seems more plausible. Displacements of the anomalies can be associated with transforms of NE-SW strike, coinciding with faults inferred from seismic data.

DEEP EARTH'S INTERIOR DYNAMICS: STATUS AND PERSPECTIVES

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The progress achieved by Earth sciences during the last half-century led the investigations to more and more deep levels of our planet's body. After the discovery of the asthenosphere in the fifties, the attention was attracted in the sixties-seventies to its role in the lithosphere evolution, but then it was realized that the subasthenospheric upper mantle is also involved in tectonic and magmatic processes. Now the focus of interest has been shifted to the lower mantle and the core of the Earth. So the notion of deep geodynamics emerged, introduced by Lev Zonenshain in his posthumous publication with Michel Kuzim. The deep geodynamics became the last frontier of the exploration of the Earth's interior. Only after solving the main problems connected to the deep geodynamics, the geology, in the broader sense of the term could really claim to be the science of the Earth and a genuine theory of the Earth could be created, 200 years after the first attempt by James Hutton.

Two main problems arise before the deep geodynamics:

1) the character of convection in the mantle-whole mantle or two layers or even more complicated, and 2) the relation of mantle plumes to this convection, or, largely, the relation of plume-tectonics to plate-tectonics. From my point of view, both problems could not be solved in a simplified way (or-or). The mantle convection is most probably even multilayered, but the convection in each layer induce and influence the convection in the upper layer. More than that, the changes in the thermal regime of the Earth's interior, due to periodical increase or decrease in the heat loss at its surface, lead to overstepping the boundary layers and to temporal establishment of the whole mantle convection instead of a layered. These changes may be connected with the birth and break-up of supercontinents. And concern-

ing the relation of plumes to convection, I think that these two processes should not be regarded as independent. The location of hot spots on the Earth surface is to a great extent accounted for by spreading axes junctions or crossing by transform faults in the oceans and preexisting, often buried zones of weakness in the continents. And some plumes could originate at the 670 km boundary and some others, especially in the Pacific area, at the mantle/core boundary.

Finally it should be taken into account that due to heat and fluid loss during the Earth's history the style of convection and the role of mantle plumes must change with time, and this change, I believe, will become the goal of a new branch of geodynamics - historical geodynamics.

STRUCTURE AND GEOLOGICAL EVOLUTION OF SHATSKY RISE

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Shatsky Rise located in the northwestern Pacific is a structure dissected by faults into massives of the same age which are shifted relatively to each other and complicated by subsequent stages of the Cenomanian-Eocene volcanism. The same age of these blocks is verified by similar hipsometric characteristics of the acoustic basement, smoothed topography of their dome part, similar thickness of their sedimentary cover and inner structure.

Increase in sedimentary cover thickness in the depression between massives and thinning of its thickness at the margins of the slopes evidence for the simultaneous processes of sedimentation and faulting. Crust deformation, expressed also in the sedimentary cover as overthrusts and underthrusts off the depression under rise structure, is recorded at the rise/depression boundary, as well as suture junctions of the rise and the depression that may evidence for a genetic difference of these areas and explain the thickening of the second and third crustal layers of the rise and appearance of additional horizons there.

Young normal faults in the marginal parts of the rise, as well as faults and diapirs embracing the upper sedimentary horizons evidence for the activation of tectonic processes in the recent time.

SUBDUCTION PROCESS OF SERPENTINITES: STABILITY OF HYDROUS MINERALS IN SINKING SLAB (BASED ON EXPERIMENTAL DATA)

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A characteristic feature of volcanism of subduction zones is a wide development of calc-alkaline and alkaline series of rocks which generation is usually referred to melting of mantle material in Benioff zone influenced by water. Geochemical sites and sources of water is supplied in the mantle are problematic. It is generally suggested that water is supplied in the mantle with sinking oceanic lithosphere consisting of oceanic crust rocks (basalts, green schists, gabbro, amphibolites and serpentinites) and mantle harzburgites and lherzolites. Possibility of water presence in subducted mantle must depend on stability of water-bearing minerals at appropiate P-T-conditions.

Compositions of subducted serpentinites and ultrabasites are represented by model system $MgO-SiO_2-H_2O$ studied at high pressures. It is of great interest to show possibilities and conditions of transport of water in the mantle in the form of serpentinites and aposerpentinite water-bearing phases.

Phase relations for above types of rocks are characterized with P-T-diagram for compositions $3/2 < MgO/SiO_2 < 2$. Hydrous phases of the system $MgO-SiO_2-H_2O$ participating in reactions at high pressures contain water in the following amounts: brucite ~ 31%; serpentine ~ 12.5-14%; talc ~ 4.5%; 10A-phase ~ 9%; phase A ~ 12%. Possibility of direct generation of hydrous high-pressure phases from serpentinized matter was demonstrated in our experiments.

Using P-T-diagram of the system $MgO-SiO_2-H_2O$ and literature data on temperature distribution in sinking slab a model of the upper mantle of the subduction zone was proposed which shows stability of hydrous-bearing paragenesises in ultrabasic rocks. In oceanic regions, according to the model field of stability of hydrous-bearing paragenesises brucite + serpentine, forsterite + serpentine and forsterite + talc is limited with the thickness of lithosphere layer (~ 100 km). At higher depths at conventional geothermal gradient hydrous phases of the system $MgO-SiO_2-H_2O$ are not stable. However, the temperature of upper mantle in subduction zones is much lower than the temperature of oceanic mantle. Therefore, the possibility of water transport at depths of more than 200 km occurs. Phase transformations of hydrated ultrabasic matter are represented by paragenesises brucite + serpentine and serpentine + forsterite (80-170 km); forsterite + talc (to 160 km); forsterite + 10A-phase (130-205 km); brucite +

10A-phase (160-215 km) and A+10A-phase (180-240 km). Transformations are complete at depths of 200-250 km and lead to appearance of water-bearing paragenesis A + enstatite which is stable at depths of more than 200 km.

Water released in metamorphic transformations in subducted slab is supplied in zone of generation of andesitic alkaline magmas.

PALEOGENE RADIOLARIA OF THE NORTH TETHYS: TAXONOMIC COMPOSITION AND PALEOECOLOGICAL RECONSTRUCTIONS

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Radiolarian fauna formed in conditions of more or less shelf-water epicontinental basins differs from the synchronous oceanic one very much. For epicontinental sediments with radiolaria widespread in Paleogene of South and Middle Russia and adjacent areas there are objective difficulties in age determinations and correlation between oceanic and shelf-water radiolarian associations. For siliceous sediments lacking calcareous plankton the decision of this problem is quite necessary.

Radiolarians were obtained and studied from four sections: 1 - Rubas-Tchay River(North-East Caucasus), 2 - Site SP-1 (Caspian depression), 3/4 - Sites 230 and 246 (Voronezh anteclise). Radiolarian associations occur in stratigraphic intervals of sections which as a rule correspond to the time of known transgressions. The next five associations were determined in Eocene sediments: 1. Lower Eocene. Lychnocanoma ponderosa-Petalospyris fiscella. 2,3. Middle Eocene, Lutetian. a) Dictyoprora mongolfieri, b) Lychnocanium separatum-Artobotrys norvegiensis. 4,5 Middle Eocene, Bartonian. a) Heliodiscus quadratus, b) Heterosestrum shabalkini. The age of associations is checked by forams and nannoplankton in all cases of their presence in sediments. Taxonomic compositions of associations were analyzed in detail. Only Lower Eocene and Middle Eocene Dictyoprora mongolfieri associations may be directly correlated with oceanic radiolarian scale. In this period the absence of clear latitudional gradient and the direct connection between Tethys and Atlantic and Indian basins caused the same radiolarian fauna in Central and North Tethys to exist. The cooling beginning in Early Middle Eocene led to latitudional differentiation of oceanic water and two paleogeographic provinces with their own radiolaria were formed in Tethys. In the south(carbonate) province radiolarian associations reflect the cooling tendency within the Middle Eocene very well. In the north (siliceous) one the large amount of stratigraphically widespread cosmopolitan species, the low taxonomic diversion and sometimes the predominance of small Spyrids say about rather shelf-water conditions, may be about salinity decrease also. Large quantity of Spongodiscids testify the close source of terrigenous material, may be the shore line.

GEOMETRY AND EVOLUTION OF THE WEST KORYAKYA ACCRETIONARY STRUCTURES

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Accretionary complex of the west Koryakya contains tectonostratigraphic terranes that consist of metamorphic, magmatic and sedimentary rocks and serpentinitic melanges of Paleozoic-Mesozoic age. Basing on relations between different structural elements three stages of deformation are established. Every stage could be divided into phases.

Structural elements of the first stage are only recognized in the metamorphic complex. Most ancient ones are small isoclinal folds of 1C to 3 geometrical classes of Ramsay (1967). Axial planes of folds are curved concordantly with schistosity of host rocks. There are some evidences on the presence of isoclinal folds of regional scale. Dome-like structures and ductile shear zones in the Ganychalan terrane are relatively younger. Radiometric Rb-Sr age of metamorphic event accompanied 1st stage deformations is 327 m.a. (Vinogradov et al., in press).

The second stage of deformation corresponds to Mesozoic accretion of Asian paleocontinent and manifested in all terranes. Folds are of 1B-1C geometrical classes, subcylindrical, open to close. Axial planes steeply dip (dip angle varies from 70° to 85°) to north-west whereas fold axes gently dip (dip angle is not more than 10°) to north-east. Deformation of rocks increases from west to east up to formation of terrigenous melange. Cleavage is only typical of the eastern part of the region. Leading imbricate fans of thrusts and duplexes are widespread in Mesozoic rocks of the Ainyn terrane. Thrusts are usually subparallel to axial planes. During this stage serpentinitic melange of Kuyul terrane with regular internal structure was formed. Study of slip vector directions using drag folds and asymmetrical fabrics of terrigenous melange shows occurrence of dextral strike-slip movements accompanied thrust development being especially important during middle deformation phases of the second stage. Magnitudes of strike-slip and thrust displacements are established to be similar. Radiometric Rb-Sr ages of metamorphic event related to deformations of the second stage vary from 139 to 92 m.a. (Vinogradov et al., in press). Thrust-fold structures of this stage are unconformably overlain by Upper Albian sediments showing upper limit of the time of deformation.

During the metamorphic events of the first and second stages a part of the rocks was altered up to quartz-chloritic and blueschists and affected by intensive strain. Strain ellipsoid in the metamorphic rocks is clearly prolate with axial ratio X:Z reaching 10:1. Out of the metamorphic terranes strain ellipsoid is oblate or, rarely, plane with X:Z axial ratio being lower 3:1. Axis of elongation (X-axis) is usually parallel to fold axes and only in the areas of low strain it is nearly normal to strike of regional structures.

Third stage of deformations is characterized by significant sinistral strike-slip movements along subvertical faults widespread near south-east margin of the west Koryakya accretionary complex. They led to the formation of a new set of structures related to sinistral strike-slip faults, reorientation and modification of structures had been formed during two previous stages. Age of the sinistral strike-slip displacements is supposed to be Late Cretaceous-Cenozoic.

SEISMIC ZONES OF THE LAPTEV MARGIN PLATE AND THEIR CONTINENTAL AND OCEAN PROJECTION

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The recently obtained data on the seismic activity on the Laptev Sea shelf (G.P. Avetisov, 1991) along with earlier published data (N.A. Linden, 1959; 1963; G.P. Avetisov, 1971; 1975; 1979; B.M. Kozmin, 1984; L.M. Parfenov et al., 1988) makes it possible to recognize four seismic zones and to establish that three of them are related to main rift structures of the plate where the "M" discontinuity lies at a depth of 26-28 km.

The first zone follows the coastal line and is related to the Olenek aulacogen at the juncture with a linear structure of the Lena-Taimyr boundary uplifts. The zone is confined to the Lena-Anabar and West Verkhoyansk (northern part) faults and to the Elgin, Nersky, and Inyali-Debinsky faults farther south on the continent. East of the Chersky Ridge, the zone joins the Komandor-Aleutian seismic belt. The earthquake magnitude within this zone is 4.5 to 6.0.

The second zone stretches actually parallel to the first one and is related on the shelf to the Ust-Lena and Ust-Yana grabens and to the Momo-Selennyakh linear system of young grabens, on the continent. The zone is marked by rare earthquakes with a magnitude from 4 to 4.5 except for the two earthquakes with a magnitude of 4.9 and 5.2, respectively. The zone merges with the first zone on the right side of the upper Moma River and the north-eastern extremety of Taimyr Peninsula continuing farther north-eastward as a single zone confined to the continental slope of the Eurasian subbasin. The earthquakes with magnitude from 4.5 to 5.2 are not densely spaced, and only two earthquakes with a magnitude of 6.0 were recorded.

The third zone is related to the Omoloi graben which is a structural continuation of the Gakkel Ridge rift valley on the shelf. Earthquakes with magnitudes from 4 to 5.9 are fairly densely spaced here projecting to the Buor-Khaya Bay. This zone crosses the second zone abutting on the first seismic zone. It forms a shelf projection of a seismic zone confined to the Gakkel Ridge rift valley in the ocean marked by high density of earthquakes with magnitudes from 5 to 6 and 7 and volcanic activity.

The fourth zone occupies the easternmost part of the shelf and stretches from the northern extremety of Kotelny Island to the southern extremety of Belkovsky Island where it forms two branches. The eastern branch is related to the eastern slope of the Belkovsky-Svyatoi Nos fault trough and meridionally striking western branch reaches the Yana River delta abutting on the second zone. This zone is marked by earthquakes with magnitudes from 3 to 4.5. A fragmentary seismic zone confined to the western continental slope of the Lomonsov Ridge forms an oceanward projection. Earthquakes with magnitudes from 3 to 5.2 were recorded there.

UNSTEADY REGIMES OF HEAT GRAVITATION FLOWS IN THE MANTLE

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Initiation and development of heat gravitation flows in horizontal fluid layer heated up from the bottom at Prandtl numbers greater than 10^3 and Rayleigh numbers of 10^4 - 5×10^6 are investigated experimentally.

Development of convective flows at constant heat flux is analyzed thoroughly. During the experiment a time change of the following values is determined: temperature difference between the horizontal surfaces of heat exchange, a value of Rayleigh criterium, heat flux and Nusselt criterium value. Synchronously a pattern of cell flow is registered.

The values of Homochroneity criterium $Ho = \frac{ut}{l}$ for non-stationary convection have been determined experimentally, characteristic frequencies with increase of the Rayleigh criterium.

Inert members in motion equation are distinguished to influence slightly the regime of convection establishment.

The time of convection establishment in the mantle and characteristic periods of the heat flux variations are analyzed.

MESOZOIC-CENOZOIC INTRACONTINENTAL RIFT BASINS OF EAST ASIA: STRUCTURE AND EVOLUTION

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Mesozoic-Cenozoic rift basins occupy a rather wide territory (up to 1000 km) along the eastern margin of Asia tracing from the north to the south more than 6000 km. They are grouped in echelon systems controlled by the faults. In the territory of China their knowledge is rather high in the connection with the rich hydrocarbon deposits discovery which creates favorable prospects for the comparative analysis in poorly studied Russian Far East basins.

The basins' basement is very different: from Mesozoic and Paleozoic foldbelts to Pre-Cambrian cratons which have left traces on the structural style and the size of the Mz-Kz basins.

The formation and evolution of the sedimentary basins are connected both with global and regional factors which influenced the character of the sedimentation, volcanism, tectonics and deep structure of the basins.

The first phase of rifting took place in the Late Jurassic-Early Cretaceous which is related to the Pacific Plate subduction under East Asia. At that time a net of the faults of ENE-WNW direction has been formed, as well as of NNE Cathaasian direction which late have been repeatedly rejuvenated. The character of the movements was different and volcanism took place repeatedly. Terrigenous, volcanoclastic and sometimes red sediments with thickness of 2-4 km have been accumulated in rather narrow troughs at that time.

During Late Cretaceous subsidence became somewhat slower and in some basins inversion occurred.

During Eocene-Early Neogene the second cycle of rifting began, most brightly manifested in the eastern basins (Bohai, Middle Amur basin, a number of narrow rift basins of the north-eastern trend). This cycle is related to the Pacific Plate movement (43 Ma) as well as to the collision between Euroasia and India. Owing to the activization of fault zones, within the former basins a group of horsts and half-grabens dominantly of north-eastern trend, cut by younger ones of the north-western trend, have been formed. During rift stage a thick series of lacustrine-alluvial terrigenous sediments often coal-bearing has been accumulated. Along the sides of the basins volcanism took place. At the post-rift stage extensive swamped plains have been formed.

Rift-basins are characterized by low crust thickness caused by the mantle elevation, higher heat flow values and high seismicity. They are marked by a steep gravity gradient which trends in a NNE direction.

Rich energy resources are connected with these basins.

AN ALTERNATIVE MODEL OF PLATE TECTONICS MECHANISM

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The new alternative mechanism of plate tectonics proposed formerly by the author is substantiated, key features of which as compared with the previously discussed hypotheses are:

1. Formation of the global rifts system is not due to the thermal convection in the asthenosphere and rise of light material from the mantle, but to the rupture of lithosphere as a result of global tensions at small gradual increase in the planet dimension and also of a change in its form, the axis and the rotation velocity.

2. Horizontal forces directed normally from rifts are also caused not by rising convective flow from the mantle, but by lift in the upper horizons of decompressionally melted light material, following an elevation of the asthenosphere boundary under rift zones and gravitational instability of plates.

3. The Wadati - Benioff zones are formed not as a result of transportation of the lithosphere by the descending convective flow, but due to realization of compression at plates gravitational crowl from the asthenospheric boundary elevations under the rift zones.

4. The density inversion of the lithosphere and asthenosphere in the subduction zones is not a cause of plates movement but is its result, then this density inversion plays an important role in the slab immersion.

This mechanism preserves a common kinematic scheme of lithospheric plates displacement but quite alternatively explains a plate system formation, reasons of the movement, directions of plates displacement and their realignments.

According to this model, the plates ensemble forms not by the action convective flows in the mantle, whose regularities are determined mainly by the mantle hydrodynamics, but due to the realization of global tensions in the rigid, brittle lithosphere at the action of inner and external (cosmic) factors. Consequently, a decision of the problem of the plate system formation and the plates realignment should be searched for the reaction of mechanically heterogeneous lithosphere at the action of global strains, among them at small gradual increase in the planet volume during the gravitational differentiation and the core growth.

The developed model of the global tectonogenesis allows to provide a uncontradictory scheme of origin, geological structure and evolution of the global rift system, spreading and subduction, formation and development of ocean basins.

The quantitative estimates show the consistency of calculated and observed directions and velocities of the plate movement. One can explain on the new base reasons and regularities of the large-scale circling during the Earth's history: alternating sequences of the continent intergrations in Pangea's and their disruptions, periods of the high tectonomagmatic activity, global sea transgressions and regressions and climate changes.

CRITERIA OF EMPLOYMENT OF BOUSSINESQ APPROXIMATION FOR CONVECTION DESCRIPTION IN THE EARTH'S MANTLE

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A theoretical analysis of the thermal convection in the mantle is based as a rule on the employment of Boussinesq approximation for the Navier-Stokes equation and the use of the Rayleigh number as a criterion governing the occurrence and dimensions of convective cells. The system of the Navier-Stokes nonlinear equations can not be solved analytically for the convective movement description of very thick liquid layers. The next approximations are used for their linearisation and simplification.

1. The Prandtl number $Pr = \nu / \chi$ (where ν - the liquid viscosity, χ - the temperature conductivity) is required to be not too high, in other words, a thermal conductivity is bound to ensure only by temperatures gradients but not hydrodynamic ones.

2. Density change in a liquid column due to hydrostatic pressure ($\Delta\rho$) is bound to be small as compared to the value of density itself

$(\rho_0)\ \Delta\rho << \rho_0$, or:

$$\Delta\rho = (\partial\rho / \partial p)\, \Delta p = \rho_0\, gh / c^2 << \rho 0\ ;\ gh/c^2 << 1 \qquad (1)$$

where g - the free-falling acceleration; $c = (\partial p / \partial \rho)^{1/2}$ - the sound velocity in the mantle (~ 10 km/s), h - the vertical extension of the mantle.

3. The density change in a liquid column is required also to be less than temperature density changes

$$\Delta\rho << \beta T, \quad \text{or} \quad gh/c^2 << \beta\Delta T/h > g/\beta c^2 \qquad (2)$$

where $\beta = \rho^{-1} (\partial\rho / \partial T)$ - the thermal expansion coefficient for the liquid, ΔT - the temperature difference between the bottom and top parts of the layer.

The condition (2) for the mantle is more stringent than the condition (1).

The value of $\Delta T/h$ for the mantle parameter exceeds the thermodynamical unstability condition: $\Delta T / h > gT / c_p$(c_p - the isobar heat capacity) and also the geothermal gradient value, calculated on the base of geophysical data more than a factor 10. Consequently, the stability conditions in the Boussinesq approximation: 1. the Rayleigh number $Ra = \beta g \Delta T h^2 / \nu\chi$ must be higher than critical one, and 2. the convective cell dimension $\lambda \sim h$ are not warranted for the Earth's mantle.

The outlined criteria are principal as both analytical and computer mantle convection decisions are unknown.

STRUCTURE OF THE KURILE TRENCH FROM SEISMIC REFLECTION RECORDS

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Three multichannel seismic reflection profiles across the southern tip of Kamchatka, the central Kuril arc, and north of Hokkaido Island show three major tectonic regimes. The lower slope contains a wedge shaped buttress surrounded by low velocity sediments. Underplating sediment uplift the buttress, as indicated by faults that displace its upper surface. The middle slope is a massif of acoustic basement, which has a rough surface with significant arcward dipping faults. The middle slope is separated from the upper slope along a steep arcward dipping reflection. The upper slope structure is different in the south off Kamchatka and in the north off Hokkaido. In the south off Kamchatka a regular stratified sediment section has been uplifted, tilted, and dips seaward. In the north off Hokkaido stronger uplift and regional tilted blocks dipping seaward and arcward indicate active tectonism. Along the southern line north of Hokkaido, the projections of the well known tsunami earthquakes occur under the middle slope and arcward of the accretionary prism. Non-tsunamic earthquakes correlate well with the boundary between middle and upper slope which is positioned in the middle of the focal zone from the Benioff zone.

PALEOZOIC PALEODYNAMICS OF TIEN SHAN BASED ON PALINSPASTIC RECONSTRUCTIONS

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Working on the Kirghizian geodynamic ground (Tien Shan) a lot of determinations of paleo-latitudes of sedimentary complexes formation were received for the time from middle Ordovician to early Permian.

Due to paleomagnetic data a change of paleo-latitudes of northern continental blocks was indicated from +2° - +4° at the end of early Ordovician to +25° to +29° at early Permian.

For Tarimian microcontinent "displacements" from - 3° at late Devonian to +26° at early Permian were indicated. Alaian microcontinent between middle Ordovician and early Silurian shifted to the North (from -2° to +6°) at late Silurian - early Devonian - to the South (from +6° to 0°) and from middle Devonian to early Permian again to the North (from 0° to +26°). Maximum opening of Turkestanian paleoocean (due to paleomagnetic data) took place at the end of middle Devonian, its closing and collision of continental blocks took place at Permian.

Paleomagnetic data are in keeping with geological materials, indicative of the existence of Turkestanian paleo-ocean. At Silurian - early Carbonic tholeiitic basalts of middle-ocean type were formed, condeced deep-submarine, mainly cherts, island arc volcano-sedimentary complexes. From the beginning of middle carbonic flysch-olistostromic complexes widespread.

At southern continental blocks the regime of passive continental margin with formation of terrigenous or carbonaceous submarine sediments, from time to time of increased salinity, remained all the time.

At northern continental blocks the features of active continental margin with calc-alkaline volcanism at Devonian, late Carbonic (C_1t - C_1v) and middle Carbonic-Permian are brightly represented. Outside the volcanic centers and between the times of volcanism redstone continental terrains and carbonaceous sediments accumulate in epi-continental basins.

Stable shelf regime remained at Devonian-early Carbonic along southern margin of Northern Tien Shan.

WIDE APERTURE DEEP SEISMIC PROFILING (WADSP) RESULTS OF THE EARTH CRUST INTERNAL STRUCTURE STUDIES IN THE INDIAN AND THE ATLANTIC OCEANS

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In 1988-1992 on the base of the WADSP method in single ship and two-ships modifications (WADSP-1, WADSP-2) huge studies of the internal structure and deformation of the ocean crystal crust in the zones of modern and ancient dynamic activity were conducted.

In 1988 a series of CDP and WADSP-1 investigations was finished studying an internal structure of the eastern part of the Azores-Gibraltar fracture zone in the Atlantic Ocean.

It was shown that predominantly the structures of compression were intensively going on the margins of the African and the Eurasian plates in the Cretaceous times and still continue nowadays. It resulted in the formation of the marginal thrust ridges as the Coral-Patch Ridge and Gorringe Ridge where serpentinites lift up (press out) to the bottom.

In 1989-1990 a series of WADSP-2 CDP studies was conducted in the zone of the intraplate deformations in the Indian Ocean in the area of the Afanasiy Nikitin Rise. It allowed to reveal internal structures of sedimentary cover and consolidated crust and to show a predominance of local compression structures which appeared during phases of tectonic activity in the Cretaceous, Tertiary and then during later times as reaction on interaction of the Indian and the Eurasian plates.

In 1991 the Blake Spure fracture zone in the Atlantic Ocean (crust age 120 m.y.) was studied by WADSP-2. The titled boundaries (Mutter et al., 1985) in the lower layers of the crystal crust were confirmed. WADSP-2 refraction profiling with a distance of 60 km between ships showed lifting of M-boundary in axes of the West, East and Blake-Spure fractures. This can be due to the alternation of local compression phases on flanks and extension along the axes in active parts of transform faults and subsequent lithological and tectonic lamination of young crust.

Similar WADSP-1 results were obtained in 1991-1992 in the intersection of transform fracture zones of Kane (24°N), Green Cape (15°N) and Strakhov (4°N) with MAR i.e. in the zones of very young crust.

At present all WADSP-1, 2 data acquired in the last 5 years (about 6000 km and 10-ESP) are being analyzed and interpreted for construction of the most probable geodynamic models of the ocean crust formation and deformations.

But even now it is quite clear that original structural heterogenity of the ocean Earth's crust and presence in the crust of several structurally heterogeneous layers with various durability properties, leads to its dynamic instability and to tectonic layering resulted from local and regional stress. During the global plate movements a differential reaction of crust took place both in the marginal and the inner zones of plates. It sets conditions for regional and local shifts of layers inside crust and upper mantle i.e. results in tectonic lamination both in the boundaries and inside the plates.

MORPHOTECTONICS AND MAGNETIC HETEROGENEITIES OF OCEANIC LITHOSPHERE OF THE MID-ATLANTIC RIDGE IN THE AREA OF ANGOLO-BRAZILIAN GEOTRANSECT

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The aim of this work was to study different scales of spatial and temporal changes caused by lithosphere generation processes, and also to determine periods of large and small reorganization in spreading kinematics.

So, we investigated structure of eastern and western flanks of the Mid-Atlantic Ridge (MAR) in the area of Angolo-Brazilian Geotransect (ABGT). The vast bathymetric and magnetic data material have been interpreted.

Research of the first structure level was based on bathymetry data. The main results of our investigations are: 1. The roughness of the seafloor and azimuth of the local morphostructures are periodically changed; 2. The real relief of the western flank is 500 m lower on average than the theoretical one, and on the eastern flank - 1000 m higher; 3. Two distinctive structure zones on the eastern flank are distinguished; 4. Numerous mountains and mountain chains on the eastern flank are observed.

In order to determine magnetic heterogeneity of lithosphere, connected with periods of spreading kinematics reorganizations, we made modelling of magnetic anomalies, defined characteristics of magnetic anomalies sources, and geometric parameters of lithosphere heterogeneity, and also analyzed connection between sources of magnetization and crustal age. The results of the second level investigations are: 1. The form, extensions and dimensions of magnetic anomalies and also geometric parameters of magnetic anomalies sources are rather different on the various MAR flanks; 2. Features of magnetic sources have almost symmetrical quasi-sinusoidal variation on both flanks. To determine most of the numerous local fracture discontinuities on eastern MAR flanks. Inside the first and the second structure levels concordant, orthogonal, diagonal, isometric and circular structures were determined. The structures extensions have good correlation on both levels.

As a result we can conclude that the relief structure and lithosphere magnetic heterogeneous features prove periodical variations and asymmetrical nature of structure generation processes. Also these features are reflected in spreading dynamics.

COLLISIONAL STRUCTURAL PARAGENESES OF THE MUYA REGION (NORTH-BAIKAL UPLAND)

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The Muya structural paragenesis is a typical pattern, formed in late Riphean and early Paleozoic by accretion of microcontinents and larger Siberian lithospheric plate. We studied sub-latitudinal suture separating Siberian plate and Muya microcontinent together with Konkudero-Mamakan dome structure.

Three stages of deformation have been distinguished on the basis of structural paragenesis using stereogeometric analysis of paragenesis folds.

In the first (late Riphean) stage the major structural figure of the region is manifested in large nappes slightly deepened to the north and north-west. These data give the definite conclusion of existence of predominant submeridional nearhorizontal compression in megaregional scale.

In the second (post-Cambrian) stage steep deepening of nappes changed orientation to south-west and west, toward the center of Konkudero-Mamakan dome structure.

At the end of collisional structural evolution of Muya region the third stage of left-lateral strike-slip faulting predominated.

RIPHEAN AND EARLY PALEOZOIC SEDIMENTARY BASINS OF THE EASTERN MARGIN OF THE RUSSIAN PLATFORM AND THE URALS

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Riphean-Early Paleozoic history of the eastern margin of the Russian platform and the Urals was a successive change of pre-rifting, riftogenic and oceanic stages and corresponding evolution of sedimentary basins (SB) of various types. Riphean magmatic and sedimentary complexes of the Urals have riftogenic-platform nature (S.N. Ivanov et al., 1986). Early Riphean SB was apparently similar to isometric or oval forms. Its dimensions were more than 500-600 x 700-900 km. Western, north- and southwestern flanks of this SB were occupied by alluvial-delta plains, changed eastward by shallow-marine zones. Southeastern flank (periphery of the Taratash massif) was presented by zone of active tectonic events, volcanism and strongly rugged topography. Mainly continental nature of volcanic and terrigenous deposits of the basal part of Riphean type section characterized this zone as a part of rift basin but regional paleogeographic reconstructions for the Volga-Urals region and South Urals indicate that we may consider this SB as gentle platform depression and not as a structure similar to East-African rift system. More typical riftogenic-depression series of sedimentary and volcanic rocks has been manifested in Middle Riphean cycle. Basal levels of Yurmatin series (Mashak suite and its analogues) contain sandstones and siltstones alternating with conglomerates, basalts and liparites. Mashak volcano-sedimentary association can be considered probably as "filling" of rift basins similar to Western zone of East-African rifts but not a structure similar to Province of Basins and Ranges (USA) at it has been thought before. In standard section of Late Riphean riftogenic associations are absent. Late Riphean SB was a shallow marine and in some temporal intervals, partially continental depression. Next, more younger graben complexes in South Urals occur in Vend sections. This is the so called Arsha suite: sandstones, grits, conglomerates and alkaline clastolavas alternating with basalts which are characterized by high titanium and iron content. In general Vend-Riphean riftogenic processes in the zone of future Urals did not lead to the complete extension of continental crust. A new extension began at the end of Cambrian (there are also some signs of existing extension event earlier in Cambrian). Molassoid complexes of that time are known in the Polar Urals, Sakmar zone of South Urals and in some other places. The Tremadocian Kidrjas suite of Sakmar zone contain shallow marine arkose grits, sandstones and shales with subordinate subalkaline basalts. This deposit is the striking example of the Early Paleozoic "graben facies". They are overlapped by Late Tremadocian Arenigian volcano-sedimentary complexes with high-titanium and iron basalts, tuffs and breccias that mark the beginning of the rift opening. Higher there are Upper Arenigian-Middle Ordovician sequences of pillow tholeiitic basalts caused by wider rift opening and appearance of suboceanic crust. Short spreading interval and some geochemical characteristics of basalts allow to suppose that this SB was not more than a few hundred km wide. Extension of continental crust occurred along several subparallel zones.

Subduction and accretion paleogeodynamic systems of the Urals orogen

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The Uralian Paleozoic paleoocean development the formation which was caused by differentiated moving of paleoplatform system which was confirmed by many researchers (L.P. Zonenshain, V.A. Koroteev, S.N. Ivanov, V.M. Necheukhin and others), was accompanied by the formation of subductive and accretion-collisive paleogeodynamic systems. One distinguishes two groups of subductive systems. The first group comprises volcanic belts of ensimatic paleoarc type with elements of postarc and interarc basins. One can trace the signs of lateral zoning in ensimatic paleoarc structures, marked by a prevalence of the main volcanism products and granitoid absence. On the other hand ensimatic paleoarc rocks according to their petrological and geochemical parameters have much in common with the products of oceanic paleocrustpaleospreading while some components are being accumulated which are typical of andesitoid series. All this is evidence of the formation of ensimatic paleoarcs and structures accompanying them in interoceanic conditions in the process of oceanic crust moving under the continental crust (subduction, type A). Another group comprises paleogeodynamic systems of volcano-plutonic belts of the eastern active paleomargin. Formations of calc-alkali andesite series and also products of tholeiitic and alkaline series in subordinate quantity are involved in these belt structures. Within these belt limits rocks of tholeiitic, calc-alkali and alkaline series manifest appropiate change toward the paleocontinental margin, this fact characterizes the links of marginal belts with geodynamic conditions of subduction and oceanic crust moving under the continental crust (subduction, type B). Paleogeodynamic systems of ensimatic paleoarcs and marginal volcano-plutonic belts are localized in the Urals within the limits of two sectors of different age. This fact permits to suppose that there are either two paleooceans of different age here in Paleozoic period of two independently developing segments of one paleocean at least.

Paleogeodynamic systems of accretion are developed within the eastern frame of the Paleozoic paleoocean and serve as the base of marginal belts and accompanying them sedimentary depressions. They include big blocks of the ancient continental crust, ultrabasite plates, zone fragments, made of oceanic and island-arc volcanites. In accretion structure they conjugate in tectonic suture zones forming projections of terrane type. We have here also developed intrasectional granite plutons, magmatic and metamorphic complexes of tectonic sutures, and also sedimentary deposits of syn-and-post-accretion depressions.

The joint of the western continental margin and Paleozoic oceanic region occurs along the zone of Transuralian deep suture that corresponds to paleogeodynamic collisive system. There are three sector formations in suture composition differing in structure and component composition. And as for its Transuralian structure significance the suture took it in the Middle or even in the Late Paleozoic Period after articulation into one zone of distinguished sectors. The formation of transstructural band of glaucoslate metamorphism along the suture zone was the reaction on the final stage of collisive compression and oceanic crust overthrust.

GEOLOGY OF NEW SIBERIAN ISLANDS. CONSTRAINTS ON PALEOGEODYNAMIC RECONSTRUCTIONS

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The rock and structural assemblages indicative of the paleotectonic environments in terms of plate tectonic theory can be distinguished on New Siberian Islands. Some of these assemblages can be traced offshore on the basis of the results of geophysical surveys revealing discrepancies with respect to the most advanced plate tectonic reconstructions. South Anyui-Lyakhov ophiolite suture cannot be mapped on Laptev Sea shelf west of Lyakhov islands. Hence a new version of explanation of structural links between Taimyr Peninsula and Mesozoides of north-eastern Russia as well as of the character of the Siberian boundary of Arctida is to be elaborated. Devonian continental rift assemblage in the western part of Anjou Islands as well as Paleozoic Island arc type assemblage on De Long islands have been treated adequately in published schemes. Cretaceous granites provide evidence for tectonic and thermal processes within thick continental type crust and cannot help in principle to choose between fixist and mobilistic approach in understanding paleotectonic environments. Paleontological studies have discovered similarities in faunal assemblages between New Siberian Islands on one hand and northern Siberia and some areas within North-Eastern Russia on the other hand. They can not be used to support the idea of a vast ocean between these areas in Paleozoic. It is concluded that Paleozoic-Early Mesozoic South Anyui Ocean of L. Zonenshain and co-authors terminated near Bolshoi Lyakhov Island and its size has been relatively small.

THE CONTINENTAL PLATE TECTONIC MODEL OF TYMAN-PECHORAN PROVINCE BASED ON INTEGRATED DEEP GEOPHYSICAL STUDY

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3-component deep seismic soundings (DSS) along regional profiles were carried out by GEON Center in the Tyman-Pechora province. The profiles crossing different parts of the province and the main tectonic units of it were investigated. The results from various geological and geophysical studies were worked up and the crust along the GEONs DSS profiles was modeled during an integrated study. Gravity and magnetic modelling were carried out and incorporated in the sections. The additional refraction and reflection seismics, drillling data, the interpretation of gravity and magnetic anomalies were used. From these new results the structure, velocity distribution, density and magnetic features of Tyman-Pechora crust were recognized, the maps of the depth of the basement and of the Moho and the schemes of physical parameters (velocity, density) of the basement were produced. By geological interpretation of these data the new regional tectonic model of Tyman-Pechora province in terms of plate tectonic conception was established.

Based on the evidence, as it appears now, the depth of Tyman-Pechora basement varies by up an erosion surface in the northern, middle and southern Tymanian range in the west part of the province (known as Tymanian stones) to

10-12 km in foreland basin in the east. As new data bear witness most of Middle Paleozoic and especially Mesozoic-Cenozoic tectonic structures in the sedimentary cover have not the roots in the basement surface.

As it is established the Moho depth is about 36 to 40 km in the west (Tyman and Izhma Pechorian) part of the region, from 38 to 42 km in the middle (Denis-Horeyverian) area, 34-36 km in the north-eastern (Maloyusian and Korataihian) part of province and grows with strong gradient from 42 to 48 km in direction to Urals. The narrow south-east, north-west direction trough with the depth to the Moho more than 42 km is available in the west flank of Denis-Horeyverian area.

The Tyman, Izhma-Pechorian, Denis-Horeyverian, Maloyusian, Korataihian, Kosyu-Rogovian and Verkhne-Pechorian lithosphere microplates; the spreading zone (rift) in the northern part of the province and collision (subduction) suture between Izhma-Pechora and Denis-Horeyverian microplates are in the Tyman-Pechora tectonic territory. The linear magnetic anomalies, the uplifting of the consolidated crust surface with a median valley and the magnetic body penetrating the crust and interpreted as the magma chamber make the spreading zone similar to the Mid-Ocean Ridge. The intracontinent subduction zone is characterized by the fault-line scarps on basement topography, the linear trough on the Moho mentioned above, strong contrast of velocity (from 5.7 to 6.7 km/s) on basement and by narrow zone of low velocity (8.0 km/s) on the Moho. The piercing of the crust by magmatic bodies and linear magnetic anomalies also marks subduction zone. The regional fault between Denis-Horeyverian and Maloyusian microplates from one side and Kosyu-Rogovian unit from another side (in the same place where the present Chernishov range exists) may be interpreted as transform fault. The thrusting of Urals approximately above 100-150 km on Tyman-Pechorian plate appears by the deep intergrated study, too.

The Upper Proterozoic to Presilurian time interval is more probable for active plate tectonics in the Tyman-Pechorian province. We suppose that Lower Paleozoic horizontal movements of consolidated crust controlled the formation of main linear fold structures in the sedimentary cover as well-known as Pechora-Kozhva anticline fold, Chernishov range etc. The next tectonic evolution stage was in terms of Hercynian to Early Mesozoic (Triassic) collision the West-Siberian plate to on Tyman-Pechorian plate with Urals orogen formation.

TRANSFORM FAULTS IN OROGENIC VOLCANIC BELTS

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Paleoreconstructions of folded structures are revealing the great importance of transform faults at the oceanic and arc stages of mobile belts. Orogenic volcanism is evolving toward the continental stage. Depending upon the geodynamic conditions a distinction is made between the edge-continental and collision orogenic volcanic belts.

The importance of transform faults can also be seen in the development of both types of orogenic volcanic belts.

First, the abnormal siting of volcanic areas should be discussed specially. Volcanic areas can be found in volcanic belts of both types. For example, orogenic volcanic belts of the Cenozoic of the Caucasus and the Upper Paleozoic of the Central Kazakhstan are located in meridional zones. The former are discordant with the extent of the Alpine collision orogenic belt. In both cases the volcanites are associated with deep-seated faults that restrict continental plates and are placed across the corresponding mobile belts. A detailed analysis of the siting of the volcanites that belong to different age and different petrochemistry series of the above-mentioned meridional zones is indicative of the great role performed by transform faults in the evolution of the inner structure of these zones.

Both types of orogenic volcanic belts are characterized by narrow linear zones of abnormal structure and evolution. They cut the belts across the extent (transverse faults). These zones may be differentiated from the background by the age, structure, and associations. Single-type formations in the above-mentioned groups are getting younger starting from the axial parts of the zones toward their margins. Similar abnormal zones are widely spread in young volcanic belts around the Pacific Ocean. In the opinion of some researchers in many cases these zones trace transform faults of the ocean bottom on the continent.

Thus transform faults are exhibited at all the stages of mobile belt evolution. The study of this important category of rocks ensures the possibility of getting a more detailed picture of evolution of continental margins and peculiar features of continental volcanism.

ACCRETION PRISM AND HEAPING ZONES OF THE OCEANIC CRUST

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It first was suggested that the heaping zones of oceanic crust appear during formation of the basement of island arc. Their development continues after formation of volcanic arcs (Dewey, Bird, 1970) at external parts of accretion prism.

However, the experience of preparation of the forecasting maps on the geodynamic testfields of Kyrghizstan and South Kazakhstan shows that processes of heaping of oceanic crust, that is to say, the formation thrust and nappe zones that consist of the ophiolite complex and overlapping them by sediments of the oceanic bottom have not been only at island arcs, but at more widespread areas in the different geodynamic setting (Kovaljev, Leonenko, 1992).

Analysis of the structures of oceanic floor and also of fold-thrust belts by paleotectonics methods leads researchers to the understanding of heaping zone structures. We suggest that heaping zones often appeared on oceanic floor in pre-island stage.

The next geodynamic setting of formation of heaping zones are establishing:

1) at reconstruction of spreading system of midoceanic ridges (for example, in the Indian Ocean 30-50 Ma in the Pacific Ocean - 180-200 Ma);

2) at jumping of quick-spreading ridges (the Mathematician ridge in the Pacific Ocean);

3) between earlier and new appearing subduction zones (modern situation before Kurile trench);

4) at reconstruction, changes of strike of spreading zones (North Fidji deep 2-3 Ma);

5) at closing of the marginal sea (the New Caledonia island);

6) at inversion (closing) of pull-apart structures: (contemporaneous mid-Cayman rise spreading center, Gayamas and other basins in California bay; the paleoanalogues: many main districts with raremetal scarnoids are suggested);

7) at closing of the local spreading zones at transform faults I, II and III types which structures are analogous of pull-apart basins (contemporaneous: Romanch, Vime, Chain in Atlantic ocean, Argo, Maria Celesta in Indian ocean);

8) at closing (collision) of parts of ocean, large spreading marginal seas with heaping of the oceanic crust and with overlapping of thick sediments (often after periods of stabilisation and accumulation of terrigeno-carbonate sequences): Turkestan-Kokshaal branch in middle Carboniferous; probably Turgay branch Paleoasian in vise; may be in Neo-, Meso- and Paleo-Tethys.

Highly dislocated "geosynclinal" sequences in fold-thrust belts having nappe-thrust structure sometimes are considered as foreign blocks of "terranes". In our opinion, for many of similar "geosynclinal" formations when they do not carry features of the island arc structures it is more correct to refer them to the heaping zones of the oceanic crust. This time dislocated "geosynclinal" sequences should be referred to the sedimentary sequences thickness 500-1000 m accumulated in the period of travelling oceanic lithospheric plates.

Basaltoids of oceanic lithosphere can be of a different age fixed by the period of moving time for oceanic lithospheric plates between basic transformation of the ocean spreading system or the whole ensemble of lithospheric mega-plates.

The term "heaping zones" is characterized by the oceanic crust deformation and possibly presents a basement over which initiation and evolution of the oceanic crust structures took place. It must not be identificated with imbricating zones that are widespread in subduction and collision orogen over big faults (decollements).

USE OF PLANKTONIC MICROFOSSILS FOR STUDY OF STRATIGRAPHY DEPOSITS OF THE EAST PACIFIC RISE AND THE GALAPAGOS SPREADING ZONE AND PALEOENVIRONMENT IN PLIOCENE-QUATERNARY TIME

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The distribution of planktonic foraminiferas, coccoliths, radiolarians, diatoms and silicoflagellates was studied from the same samples of sediments obtained by "Glomar Challenger" in Leg 54.

The data on the microfossils permitted to stratify Upper Pliocene-Quaternary sediments in detail. The biostratigraphic boundaries as we concluded are not sharp. It represents time interval during which biota undergoes gradual transformation.

Based on ecological analyses several conclusions were drawn about bionomy of the region in consideration: alternation of microfossils in connection with climatic fluctuations and influence of intensification and weakening of the nearshore upwelling in different time.

We cannot affirm that alternation of different groups of microplankton took place simultaneously. Only rare species extincted during Pliocene-Quaternary time. The most probable suggestion is that migrations of plankton in connection with climatic fluctuations have been more rapid than evolution transformations.

The replacement of ages of the basal sediment layers from the Early Pliocene (Late Miocene?) to the Late Pleistocene toward the axis of the East Pacific Rise testify about the ocean bottom spreading. For the first time spreading of the ocean bottom was confirmed in such young deposits by several microfossils groups together.

PALEOMAGNETISM OF AMURIA BLOCK (PRELIMINARY DATA)

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I studied Paleozoic and Mesozoic sediments and volcanic rocks in Transbaikal region. All suites have paleontologically determined age. Three suites were sampled toward south from Mongol-Okhotsk geosuture: Kharashibirskaya suite (early-middle Carboniferous), Biliktuiskaya suite (late Permian), Tergenskaya suite (late Jurassic). Two suites were sampled toward north from Mongol-Okhotsk geosuture: Alentuyskaya suite (late Permian), Badinskaya suite (late Jurassic).

We may conclude from preliminary investigation of the paleomagnetic data that Amurian block was separated from Siberian continent in late Paleozoic. Paleolatitude of Amuria block was 34 degrees. Siberia continent was situated at 70 degrees (in both cases in Northern hemisphere). North China Block was to south (about 10 degrees). Accretion of Amuria and North China plates was accreted with Siberian plate. Paleolatitude 48-52 degrees is the same as for Siberian continent.

RADIOLARIAN ASSEMBLAGES FROM THE RARITKIN RIDGE (NORTH EASTERN RUSSIA) AND THEIR PALEOGEOGRAPHIC AFFINITY

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Radiolarian fauna have been extracted from jaspers by means of HF.

Middle Jurassic (Bathonian - Callovian) radiolarian assemblage of the Talyainin River Basin is represented by Archicapsa pachyderma (Tan Sin Hok), Parvicingula burnsensis Pessagno and Whalen, P. elegans Pessagno and Whalen, P. vera Pessagno and Whalen, P. matura Pessagno and Whalen, P. sp. C Yao, Canoptum anulatum Pessagno and Poisson. These radiolarians have close affinities with those faunas from Oregon and Southern Alaska, which show both Boreal and Temperate affinities. The same type of radiolarian faunas has been described by V. Vishnevskaya from the Koiverelan River Basin of the Koryak Mountains and from the Omgon Ridge of the Kamchatka Peninsula.

Late Jurassic radiolarian assemblage includes Orbiculiforma mclaughlini Pessagno, Tripocyclia trigonum Rust, Triactoma ex gr. blakei (Pessagno), Pantanellium riedeli Pessagno, Paronaella pygmea Baumgartner, P. ex gr. casmaliaensis Pessagno, Parvicingula? hsui Pessagno, Archaeodictyomitra apiara (Rust), Spongocapsula palmerae Pessagno, Williriedellum carpaticum Dumitrica, Amphipyndax tsunoensis Aita. Key taxa have both Pacific and Tethyan affinities.

Early Cretaceous (Berriasian - Hauterivian) radiolarian assemblage consists of Pantanellium berriassianum Baumgartner, Triactoma cf. echodes Foreman, Parvicingula Khabakovi (Zhamoida), Ristola cf. boesii (Parona), Archaeodictyomitra apiara (Rust), Williriedellum aff. salumicum Kozlova and exhibits both Boreal and Tethyan affinities.

TO THE RELATIONS OF RADIOLARIA HIGH-RANK TAXA AS AN INDICATOR OF PALEOENVIRONMENT

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I found correlation between relative content (degree of domination) of different Radiolaria high-rank taxa and some environment parameters. The correlation coefficient between relative abundance of 8 taxa (order or suborder ranks) and the average data on the annual temperature, salinity and density of modern surface-water layers was calculated in the point, where the sediments were taken. The relative content of these 8 taxa were calculated using data on abundance of all the species of radiolarian assemblages.

The data of this report are based on the author's studies of Radiolaria obtained from the surface layer of the bottom deposits, core sediments and drilling cores from the Northern part of the Pacific (from Aleutian Islands to the equator), the Southeastern Pacific (from equator to 20°N), the Atlantic and Indian oceans, the Arctic and the Antarctic, the Sea of Okhotsk, the Sea of Japan, some material from the Bering Sea, the Philippine and Norwegian seas.

I introduce special coefficient "R" for relationships of the species number (R^v (variety)) and of their abundance (R^a (abundance)) for every couple of the high-rank taxa. These two coefficients, calculated for the same couple of taxa, are very specific for different seas and parts of the World Ocean. Each of them is rather different in the same localities in the various intervals of the geological time. For example,

$$R^a = \frac{\text{Spumellaria}}{\text{Nassellaria}} \left(\frac{S}{N}\right)$$

fluctuated from parts of hundredth in the Arctic, parts of tenth in the northern boreal Pacific and in the Antarctic to some tens in the West part of the equatorial Atlantic.

$$R^v = \frac{S}{N}$$

as usual is not more than 1 or some more in oceans and a few units in seas. In ancient deposits

$$R^a = \frac{S}{N}$$

sometimes reaches many hundreds (Miocene the Monterey province, middle Miocene of the Sakhlin island, Oligocene of the Bering island).

$$R^a = \frac{S}{N} < 1$$

is characteristic, as I propose, for high prouaction and coldwater regions of the World Ocean.

$$R^v = \frac{S}{N} < 1$$

(the number of nassellarian species prevail over the number of spumellarien species) is typical of all coldwater regions of the World Ocean. Spumellaria considerably prevails over Nassellaria on the number of species only in the tropical seas and in all near-shore regions of oceans.

Variation of R^v different couples of taxa perhaps is connected with circulations, direction of currents, depth of basins and distance from shore.

Analysis of combinations of coeff. R for all couples of taxa in radiolarian assemblages makes it possible to indicate levels of rather strong alterations in paleoenvironment in geological sections.

The alteration of relative abundance (R^a) of Spumellaria and Nassellaria is a paleoenvironmental indicator and cannot be used as an indicator of stratigraphical boundaries but in the very local regions.

ON THE STRATIGRAPHY OF CENOZOIC SEDIMENTS AND THE AGE OF MANGANESE NODULES IN TWO AREAS OF THE CLARION - CLIPPERTON PROVINCE IN THE PACIFIC OCEAN

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During the 41st cruise of RV "Dmitry Mendeleev" the sediments and manganese nodules in two areas in the east tropical Pacific between the transform faults Clarion and Clipperton were investigated. The centers of the areas were in the points: 10°N, 140°W and 13.5°N, 133.5°W.

By bottomgrabs and coring tubes the Late Eocene - Pleistocene deposits were revealed. The radiolarian fauna was most abundant. The continuous sequences of the radiolarian biostratigraphic zones from the Late Eocene to the Early Miocene (40-17 my) and the regional hiatus between 17 and 1 my were found. The Quaternary zonal stratigraphy was based on radiolarian and diatom data. The planktonic foraminifera as well as diatoms were revealed in the rare Oligocene and Early Miocene layers.

The Tertiary outcrops are either exposed on the bottom or covered by a thin layer of the Quaternary sediments. The Quaternary sedimentation rates are 0.5-1.0 mm/1000 yr. In the west area the Early Miocene deposits are most distributed while in the east area - the Oligocene ones. In the Quaternary sediments the redeposited Tertiary mostly Oligocene radiolarians are abundant.

The microfossils were studied in 19 manganese nodules elevated from the bottom surface. The age of the underlying layers is mainly Quaternary. 80-85 radiolarian species and groups of species, a comparatively high number of ichthyoliths, rare diatoms and foraminifers were found. Three diatom Oligocene species were found in two samples. The foraminifera and ichthyoliths were not identified. The radiolarians in the nodules cores, as well as in the inner and surface layers were researched. Usually 1-4 radiolarian species (in a few cases 6-19 species) were detected in the investigated samples. The Middle Eocene, Late Eocene - Early Oligocene, Oligocene, and Oligocene - Early Early Miocene species were found. Rare Neogene species were revealed only in crevassed surface layers. Taking into account the absence of the data about the precise stratigraphic intervals of some species it is possible to detect the nodules age as mainly Oligocene.

It is worth-while to note that in the nodules surface layer the rare Quaternary radiolarians and diatom species *Ethmodiscus rex* known from the Middle Miocene to Quaternary were found although other Quaternary microfossils are absent. These rare foundings may not be qualified as an evidence of the Quaternary nodules age taking into account the crevassed texture of the nodules especially of their surface layer.

It is possible to be assumed because of high seismicity of the region the seismic waves cause sediment vibration, loosing, suspending and outcarring of the suspended matter by the bottom currents. Due to the vibration effect the ancient nodules can turn out on the surface of the Quaternary sediment. So, this is one reason of the regional hiatus and accumulation of the residual field of the ancient nodules on the bottom surface.

RECORD OF TWO GEODYNAMIC SITUATIONS IN A SINGLE OPHIOLITE SEQUENCE (GANKUVAYAM NAPPE, KUYUL OPHIOLITE TERRANE, NORTHERN KAMCHATKA

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In the Penzhine Ridge, we mapped a large ophiolite terrane - Kuyul Composite terrane (>150 km in length). The inner structure of Kuyul terrane consists of a few nappes. Each nappe contains an individual complex of rocks (which distinguish in age, composition and condition of the metamorphism). Mains from these nappes are Vesely (VN) and Gankuvayam (GNc). VN is a serpentinate melange, which contains differently sized blocks of basalts, limestones with jaspers and ultramafic rocks (undepleted lhersolites). We propose an oceanic nature for VN. The nature of the GNc is more intricate, because it contains features of oceanic and island arc origin in the whole ophiolite sequence.

Geochemistry studies of volcanic rocks from GNc show that volcanic rocks from sheeted dikes complex *sdc* and upper pillow lavas *upl* contain a few series. MORB-like volcanic rocks from tholeiites series and SSZ-like (supra subduction zone) are from calc-alkaline (CA) series. Calculations show a geochemically common mantle source for all series, but conditions of melt produce were different. The CA series had a stronger influence on the fluid component which caused an increase in the LIL/HFSE ratio (Ba/Zr etc).

Lenses of jaspers in *upl* GNc contain radiolarians upper Batonian - early Callovian 172-166 m.a., and Titonian ages 152-144 m.a., (Vishnevskaya et al., 1992). These ages are in good correlation with ages of basalts, limestones and jaspers from VN, which have numerous ages from Middle Triassic to Late Jurassic 235-152 m.a. We have also a few ages from *sdc & upl* GNc with range: K/Ar = 134 m.a., 132 m.a., and six isochrone Ar^{39}/Ar^{40} from 124 to 80 m.a., but the age of basal layers of the neoautochthone are 102-97 m.a. (upper Albian). We suggest that a few ages from *sdc & upl* GNc, which are younger than 102 m.a., are the metamorphic ages. They indicate an age of accretion episode.

Paleomagnetic data from GNc gave us two series with different characteristics: 1. with a shallow magnetic component, 2. with a deeper magnetic component. The basalts from VN have only a shallow component. These shallow components indicate a low paleolatitude where rocks from VN were formed. It is well correlated with Tethyan faunas from limestones and jaspers in VN.

The available data imply that two complexes are juxtaposed in the Gankuvayam ophiolite section. These complexes are of different age and have been formed in different geodynamic settings at different paleolatitudes. In addition, the older MORB-like series of the Gankuvayam ophiolite section does not differ in any relation: geochemistry, magnetic properties, age etc., - from rocks of the VN nappe and is regarded as the basement where the Gankuvayam ophiolite section sensu stricto was later evolved. We propose there are two different complexes in *sdc & upl* GNc ws formed in a different geodynamic situation and age. Older series volcanites from GNc (MORB-like) have similar features in geochemistry, magnetic characteristics and in age with basalts from VN, and we propose that was a common plate. In Lower Permian - Triassic ages in lower paleolatitudes an oceanic crust was formed. Then this plate had a large drift in northern direction. In lower Jurassic age a new zone of subduction (possible along transform fault) was initiated and this zone divided a plate into two parts. First part of this PaleoPacific plate (m.b. PaleoIzanagi) stay in suprasubduction condition, but a second part underthrust below with a forming a subduction serpentinate melanges (VN today). Spreading which formed GNc start in the part in suprasubduction position. Usually this situation determinded such us an initiate stage an island arc, but we propose a model of spreading in fore-arc position on the initiate stage of island arc system development.

STRUCTURE OF SOUTH-WESTERN CYPRUS

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Detailed complexes geological studies of south-western Cyprus carried out in 1990 permit to interpret the intricate nappe-folded structure. It was established by large-scale geological mapping:

1. Melanged rocks Troodos ophiolitic Complex including sediments of the Perapedhi and Kannaviou Formations are subautochthon. It is the lowest observed unit in the nappe-folded structure of the south-west Cyprus;

2. Subautochthon is tectonically covered by allochthonous Mamonia nappe-folded Complex. Mamonia Complex is divided into following tectonic nappes distinct in rock composition: lower nappe, composed of metamorphic rocks of the Agia Varvara unit; middle nappe, composed of serpentinitic melange with included tectonic plates and blocks of ultramafic (different from ultramafic rocks of Troodos Massive), volcanic and sedimentary (siliceous and carbonate) rocks of the Diarizos Group; upper nappe, composed of siliceous-carbonate-terrigenous deposits of Agios Fotios;

3. Subautochthonous and allochthonous complexes are stratigraphically covered by mainly carbonate deposits of Upper Cretaceous - Pleistocene. This sedimentary cover is considered as neoautochthon;

Established regularity allows to restore following succession of structure's formation:

1. Formation of inner napped structure of Mamonia K_1al^3 - K_2sm (103-90±3 m.a. - the age of metamorphic rock of Agia Varvara unit, which is interpreted as age of cooling and of rising in upper part of the crust, assumes to be upper limit of this interval);

2. Practically at the same time formation of sublatitude spreading zone (the formation of the Troodos ophiolites and sediments of the Perapedhi and Kannaviou Formations) in the rear of appearing napped structure (accretion's complex) K_2sm-ma^1;

3. Moving from south to north of the whole of nappes package of the Mamonia Complex over Troodos ophiolites, and at the same time a 90° anticlockwise rotation of the ophiolites and genesis of Kathikas olistostrome in front of the Mamonia nappes package K_2ma^2;

4. Covering the whole of napped structure by the neoautochthon, which starts from the Lower Lefkara Formation K_2ma^3;

5. Neotectonic movements along southern boundary of the structure and formation of terrigenous melanges, related with underthrusting of African plate under Cyprus arc, rejuvenence of basal horizons of the neoautochthon connected with this moving and including basal parts of neoautochthon into terrigenous melanges in Southern Cyprus K_2d - Eocene.

OPHIOLITE (SERPENTINATE) MELANGES IN THE STRUCTURE OF THE KORYAK HIGHLAND

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Ophiolites are typical members of the Koryak highland structure. Usually they occur as large stripes of tectonic melanges (more than 100 km) with shear serpentinates in matrix and a different type of rock in blocks. These structures are named serpentinate melange SM by Russian geologists. SM has different geophysical characteristics, a different position in a Koryak highland structure and a different inner structure.

All SMs have positive magnetic anomalies, which are due to their rock composition (secondary magnetite in serpentinates etc). We can divide all SMs in two groups on the base of characteristics of gravity anomalies: 1. Group with large positive anomalies LgaSM (Ganychalan SM, Elistratov SM and other); 2. Group with a small positive anomaly SgaSM (Kuyul SM, Upper Chatyrsky SM and other). The first group - LgaSM has deep roots in crust and can be interpreted as exposures of deeper thrusts. The second group - SgaSM has not deep roots in the crust and can be interpreted as non-root ophiolite nappes with a small tectonic thickness of each nappe (1-3 km). LgaSM in the structure of the Koryak highland are disposed on the margin of large terranes. They are typical suture zones, which divided terranes with complexes of faunas from different paleobiogeographic zones. For example, Ganychalan LgaSM divides a few terranes with boreal Paleozoic and Mesozoic faunas from eastern terranes with Tethian faunas. We propose different paleolatitudes for them. In contrast SgaSM does not divide terranes from different paleobiogeographic zones, but often contains "exotic rocks" in blocks (exotic terranes?) non-typical of Koryak highland. Usually "exotic rocks" contain the Tethian faunas and had a large northern drift before their accretion. The inner structures of SM are ordered, that can be mapped by distribution of stripes with blocks of uniformity rocks. Their change from simply ordered structure (take turns sinforms with antiforms) - Yagelny SM, to complexity ordered structure (folded nappes) - Upper Chatyrsky SM. Investigations of the large SM with ordered structure - Kuyul SgaSM show that it contains a few nappes with different associations of rocks, each of these associations was formed in different geodynamic positions.

We propose an accretional model for origin of ordered non-root SgaSM in contrast to a collision model for LgaSM.

THREE-DIMENSIONAL STRUCTURE OF LATERAL HETEROGENEITIES IN P-VELOCITIES IN THE UPPER MANTLE OF THE SOUTHERN MARGIN OF SIBERIA AND ITS PRELIMINARY GEODYNAMICAL INTERPRETATION

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A three dimensional model of lateral variations of P-wave velocities in the upper mantle of Southern margin of Siberia has been obtained using more than 6000 teleseismic arrival times registered at the stations of Siberia and Kazakhstan. The method was based on the triangular block parameterization and permits to accord the output information with the density of input information. The inversion stability has been improved significantly compared to traditional approaches. Special attention was paid to the problem of testing the obtained results. The study of stability of the method (sensitivity of results toward noise) shows that the reconstruction was stable even if the noise level exceeded the revelant signal. Another test consisted in a reconstruction using two independent sets of events. For these two sets determined velocity structures were found in satisfactory coincidence.

The preliminary interpretation of the results permits to suggest some mechanisms of development of the study region. According to the obtained tomography images the upper mantle from 700 km to 300 km deep was established to obtain three independent rising flows corresponding to the regions of recent activity: Altai and Sayan fold areas and Baikal rift zone. We suggest the existence of two-layered convection in the upper mantle. The absence of anomalous heat flow in the Altai and Sayan fold areas also shows a good correlation with tomographic results indicating the great depths for the main sources of mechanical activity of these areas. Three possible mechanisms of tectonic activation corresponding to different rheology models are considered here.

THE LATE-MZ / EARLY-KZ GEODYNAMIC EVOLUTION OF THE NEW PACIFIC RIM

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It is known that several versions of the interpretation of late-Mz/early-Kz evolution of the NW Pacific Rim existed. All-round research in the Kamchatka peninsula allow to propose new points of view about the geodynamic history of the region. It looks as follows:

1. During Malm-Neocomic in the NW paleo-PO the convergent boundary existed. It separated the Kula plate from the Si/Al-massif of Okhotsk Sea (SMOS) and was marked by the Kvakhona suite volcanic rocks. At that time an oceanic basin was located between SMOS and the Paleosiberia continent. It probably resembled the modern Tasmanov Sea. The paleomagnetic and paleobiogeographic data show that the evolution of the Kvakhona volcanic island arc (VIA) was in paleoequatorial area. The end of the volcanism, the metamorphism and the intrusions of the granitoid (140-120 M.a.) indicate the Kvakhona zone of subduction was dying. This event may be correlated with late-Neocomic reorganization of the lithospheric plates of paleo-PO.

2. Toward the middle Cretaceous the Kvakhona VIA building was overlapped by the subarkose sediments (Kikhchik and Vakhvina suites). Approximately at this time the Okhotsk-Chukotsk volcanic belt (OCVB) began its function at the Siberia margin. It indicates that the subduction of the ocean basin crust was started. Perhaps at this time the motion direction of Kula plate was changed and the Si/Al-crust of the SMOS (NW framing of paleo-PO) was rifted. Here picrites and picro-basalts were erupted and basic-ultrabasic rocks were intruded (Suntuk-Alistor association). Later this process lead to the formation of a small basin of the oceanic type (Iruney-Andrianov ophiolitic association).

3. In Senonian the new subduction zone formed under oceanic side of the Si/Al-block which was isolated from SMOS. During Senonian and Danian the Kirganik-Valagin VIA was formed above this zone (Kirganik and Khapisk suite). The extensional back-arc basin was located backward this VIA (Khosgon suite). This epicontinental sedimental basin was complicated by the Iruney microoceanical trough (Iruney suite). In the fore-arc basin the Vetlovsk suite was accumulated.

4. The jumping of this subduction zone occurred in Danian time and new subduction zone moved to the NW margin of Iruney trough. The lower part of the young oceanic lithosphere was subducted in this zone. At the same time the upper parts of the oceanic crust of this trough were obducted onto the sedimentary complexes of the epicontinental part of the back-arc basin. High-gradient metamorphism (70-65 M.a.) took place in the bottom of the large allochthonous sheets. Closing down of the Iruney trough lead to collision of the Senonian VIA and SMOS, regional metamorphism and intrusion of granitoide (65-60 M.a.). In Danian the SMOS was "clashed" with OCVB (active margin of Paleosiberia). The SMOS updated the Asia itself.

5. The process of the Eocene reorganization of the PO-plate motion was accompanied by the riftogenesis of newly-formational NE margin of Asia (the intrusion of the potassium subalkaline basic-ultrabasic rocks and eruption of the subalkaline lavas and tuffs - Sharomsk-Chengnut-Filipp complex).

6. The part of the Si/Al-crust isolated from Asia is moved toward PO. In Oligocene modern subduction zone was formed along the oceanic side of this block. Modern VIA was developed over this zone. The Eocenic rift zone was transformed to Okhotsk back-arc basin.

TECTONIC POSITION AND SOURCE PARAMETERS OF KORYAKIYA (KHAILINO) EARTHQUAKE, MARCH 8, 1991, IN FRAMEWORK OF PROBLEM OF PRESENT DAY BERINGIA PLATE EXISTENCE

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As it can be seen from seismicity of the last ten years a continuous seismic belt limits Bering sea from the West. So the Bering sea region is surrounded by seismic belts and present-day Beringia plate can be marked out. Alternative hypotheses consider the seismicity of South Koryakiya as a relic of the Neogene-Quaternary tectonic processes on Northern Kamchatka. These hypotheses are compared on the base of the strongest Koryakiya earthquake study.

Estimates of this earthquake focal mechanism and source spatio-temporal integral parameters have been obtained from long period surface wave records. Seismogeneous strain fields have been reconstructed from aftershock data. A qualitative model of the source region evolution was developed. It shows that the earthquake rupture cannot be connected with any big recent fault system. At the same time some features of the recent tectonics of South Koryakiya may be recognized in the picture of the stress-strain fields being observed in source region.

Apparently Khailino earthquake occurred in the region which separates two relatively uniform parts of the western boundary of Beringia plate. The north-eastern part of the boundary goes along young lineament through Central and Northern Koryakiya and the Gulf of Anadyr. The southern part of the boundary coincide with the structures of the Cenozoic subduction zone in Northern Kamchatka. Beringia plate is rotating clockwise relatively to North-East Asia (which is probably the part of the North American plate) around the pole in Central Chukchi.

THE ICELAND HOTSPOT: TAIL OF THE SIBERIAN TRAPS?

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A model of plate motions relative to major hotspots underneath the African, Indian, North American, and Australian plates is used to compute the track of the Iceland hotspot for the past 130 million years. Prior to 130 Ma, motion of the major plates over a fixed hotspot must rely on less well-constrained data including synthetic apparent polar wander paths. The present day Iceland hotspot is located under eastern Iceland offset about 240 km east of the Reykjanes and Kolbeinsey ridges. At 40 Ma, the Kangerlugssuaq region of East Greenland would have been directly above the hotspot which may have been responsible for the 41-36 Ma swarm of porphyritic dikes found there. The anomalous post-drift uplift of the East Greenland margin can also be explained by passage of the rifted margin over a hotspot. At 60 Ma, the Umanak Fjord region of the west coast of Greenland was above the hotspot, where the picrites and hyaloclastites of nearby Disko Island are dated at 59-61 Ma. Between 130 and 100 Ma, the absolute plate motion reconstruction shows Ellesmere Island above the hotspot. Latest Aptian to early Cenomanian volcanics on Axel Heiberg Island indicate a nearby hotspot at that time. At 130 Ma, the model locates the hotspot near the northern margin of Ellesmere Island, close to the intersection of the Alpha Ridge with the coast. The hotspot would have been located beneath the Arctic Alaska/Chukotka plate when it formed Mendeleev Ridge, and as the spreading center migrated over the hotspot it transferred to the North American plate where it formed Alpha Ridge. Earlier evidence for a possible track for the Iceland hotspot include: volcanics on Franz Josef Island that have been variously dated as Paleogene to Jurassic; extrusive basalts found near the mouth of the Ienissei River that are listed as lower Triassic in age; and the Siberian Traps which are dated fairly precisely at 248 Ma.

While the absolute plate motion model is not constrained by other hotspots for ages older than 130 Ma, the paleomagnetically constrained absolute motion framework has the region of the Ob River near fixed Iceland hotspot at 160 Ma and near 65°N 83°E (in present day coordinates) at 200 Ma. Neither of these times or dates coincide exactly with either early volcanics or the location of the outpouring of the Siberian Traps, although they are close, considering the tremendous uncertainty. The 240 Ma position of the Iceland hotspot has the Siberian Traps at the correct latitude to have been produced by the fixed hotspot but the longitude is offset by almost 35°. A disagreement in the longitude is not surprising since there is no independent hotspot track to control the longitudinal position of the Gondwanide mass.

The fixed hotspot model suggests that the initiation of the Iceland hotspot predates the opening of the North Atlantic by at least 70 m.y., and is compatible with the Iceland hotspot having originated as a mantle plume under the Siberian traps. This model also implies that the massive early Tertiary volcanism along the North Atlantic plate margins reflects the effect of rifting in the vicinity of existing thinned crust, rather than the arrival of a plume head and explains the anomalous post-drift uplift along the eastern Greenland margin.

THICKNESS AND STRUCTURE OF THE DISTAL BENGAL FAN SEDIMENTS: TECTONIC IMPLICATIONS

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The Bengal Fan is the largest deep-sea fan complex in the world. In this great sedimentary basin, seismic reflection profiles provide complete information about thickness and structure of distal sediments only. The sediment thickness map for the Distal Bengal Fan between 9°N to 6°S and 78°E to 98°E is compiled. The Ninetyeast Ridge, the 85°E Ridge and the Aphanasy Nikitin Seamounts, which were generated in the gigantic old deep-seated N-S fracture zones, as well as the Comorin Ridge and Warton Ridge are clearly expressed in the map. More young dislocations, including the well-known Late Miocene intraplate deformation of the Central Indian Basin lithosphere, are revealed significantly worse in the sediment isopachs. Two reasons could explain that: comparatively small dimensions of these young folds and faults or quasi-synchronous bending of the total pre-Pliocene sediments. General N-S and SW-NE trending structures dominate there, though the Ninetyeast Ridge and adjacent Central Indian and Cocos Basins have individual isopach patterns. The N-S structures agree good with well-known spreading history of the Eastern Indian Ocean, while origin of the SW-NE structures similar to faults which break the Ninety-east Ridge into series of en-echelon blocks or deep depressions with thick sediments in the Central Indian Basin is open for discussion. In general, sediment distribution is controlled by interrelation of two genetic depositional sequences: progradational onlap fill sequence (terrigenous turbidites) and aqueous sequence (pelagic sediments). Structural style of the Central Indian Ocean intraplate deformation has been studied in some small detailed survey areas during cruises of the RV Dmitry Mendeleev and Professor Shtokman. The tectonic maps of these areas are compiled as well as general tectonic map of the region. The tectonized blocks differ morphologically from one another, but there are some general features, too. The whole of the intraplate deformation region has a greatly complicated block-style framework.

PLATE TECTONICS AND EVOLUTION OF THE SEDIMENTARY BASINS OF THE MARGINAL SEAS OF ASIA

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In the east of Asia the marginal seas were being formed predominantly in the period from the Late Cretaceous to the Pleistocene. Their formation was controlled by the interrelated processes of migration of subduction zones and reconstruction of back-arc spreading zones, collision of different types and changes of stress orientation in the lithosphere in time.

In the Bering Sea the migration of the subduction zone occurred in the period from the Late Cretaceous and the beginning of the Cenozoic in the direction from the region of recent continental slope to the Aleutian arc. The migration caused the detachment of large blocks of the Early Cretaceous Kula oceanic plate; the differences in the ages of the crust of three deep-sea basins; the Aleutian (Early Cretaceous); the Bowers (Oligocene); the Komandors-kaya (Miocene).

The Late Cenozoic rifting contributed to the formation of four deep-sea basins: the Kurile, the Japan, the Vacasa, the Okinawa. Along the strike of the rifts the degree of extension varies from thinning of the continental crust to new formation of the suboceanic or, sometimes, the oceanic crust. These deep-sea basins were formed later than in Aleutian. The Kurile deep-sea basin was being formed between the Middle and Late Miocene, the Okinawa - between the Late and the Early Miocene.

The existence of the system of the Late Mesozoic-Early Cenozoic rifts contributed to the formation of three large sedimentary basins in the Yellow Sea (Subei, West Korean Bay, Huabei-Bohai). Here rifting was a consequence of interaction of the Kula and Laurasian plates and progressive displacement of the subduction zones to the east.

In the south the interaction of the Kula, the Pacific and the Indo-Australian plates was responsible for different beginnings of spreading in the deep-sea basins of South China (from Early Oligocene), the Sulawesi and the Sulu Seas. In these seas the evolution of the sedimentary basins was followed by the displacement of the subduction zones from the west to the east, the emergence of the new inner subduction zones oriented toward the Pacific plate.

A complex interaction of geodynamic processes in time and space (taking into consideration that the linear or diffuse spreading predominated) was responsible for the formation of the sedimentary basins of different structure and different genetic types in the marginal seas: the basins of recent active margin; transition area from analogues of passive margin to recent active margin (the "entrapped", the back-arc spreading); intermountain basins of the Early Mesozoic arch-blocked orogens. The general feature of the evolution of these basins is their relation to the active rifting injected by mantle diapirism.

GENESIS OF THE BALTIC BASIN: EXARATION OR TECTONICS?

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The genesis of the Baltic Sea basin is one of debatable problems in geology of Europe. Many scientists attribute the origin of the Baltic basin to uniquely exaration, while others accept a subordinate effect of neotectonic movements. To solve the problem, the distribution of thickness and composition of Pleistocene deposits left by Scandinavian glaciers was analyzed. Calculations show that only about 40% of the Baltic Depression volume can be attributed to exaration, which suggests the domination of the tectonic factor in the morphogenesis of this structure.

In the Neogene and Early Pleistocene the territory of the Baltic basin was a rather elevated excavation area. Sediments were mostly deposited in a sublatitudinal zone of depressions, which occupied the territories of Paleogene seas from the Pripyat Polessie region to the North Sea.

The first evidences of downwarping and appearance of sea deposits on the south of the Baltic region date from the Holsteinian Interglacial (ca. 0.3-0.4 m.y. B.P.). During the Eemian Interglacial (ca. 0.1 m.y. B.P.), the sea basin expanded and shifted to the north. Therefore, in the Middle Pleistocene the reconstruction of the structural pattern started, and the inversion influenced there with mainly the west of the old East European Platform. The reconstruction of the nature of the recent movements shows that since the mid-Pleistocene the tectonic pattern was governed by the evolution of three principal units: Ukrainian-Voronezh and Fennoscandian Arches and Baltic System of graben-like lows. The graben-like units are 70 to 200 km wide, and their shoulders going beyond the Baltic Sea water area range in width from 30 to 150 km. A body of evidences (seismicity, heat flow, rates of vertical movements, fault system pattern, floor relief, etc.) allows a conclusion about the rift origin (rifting initial phase) of this system comprising three members: Baltic Sea, Gulf of Bothnia, and, probably, Gulf of Finland. The total amplitude of vertical movements since the Holsteinian (possibly even since the Eemian) is no less than 0.2-0.4 km, and could be considerably higher in some sites of the Gulf of Bothnia.

ORIGIN, EVOLUTION AND INTERPLAY OF THE MAIN SUTURE ZONES IN THE TIEN-SHAN

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The accretionary history of the Tien-Shan orogenic system was connected with closure of small ocean basins in the Early Paleozoic and in the Late Paleozoic. During the Late Cenozoic its tectonics was especially complicated due to India/Asia collision. The primary ophiolite sutures were bent in oroclines, cut and displaced by younger strike-slip faults. All that should be taken into consideration when the sutures are used for paleoreconstructions.

Field investigations have shown that the ophiolites of the North Tien-Shan are predominantly allochthonous, with tectonic melanges at the base. The ophiolites were emplaced in the Caradoc when the Kirghiz-Terskey basin closed, and the fragments of oceanic crust were obducted northward for 10-75 km. The remnant Kirghiz-Terskey ophiolite suture consists of two segments. The closure of the NW-SE trending segment was followed by fold-thrust deformations. AS soon as in the Late Ordovician-Silurian this part of the suture was consolidated by batholith intrusions. Another, W-E trending segment of the suture has avoided this deformational and magmatic consolidation. During the following tectonic evolution it worked as a weakness zone in the continental crust.

In the Middle Paleozoic this part of Kirghiz-Terskey ophiolite suture controlled the boundary between terrestrial (molasse) and marine (mainly carbonate) deposits. The first deformational remobilization of the suture took place in the Late Paleozoic, and was connected with the closure of the Alai-Kockshaal oceanic basin farther south. The carbonate facies of the Middle Paleozoic were thrusted northward over the suture zone. Some ophiolite allochthones were involved in this napping and suffered secondary horizontal displacement. The next deformational phase is evidenced by S-like oroclinal bending of the suture zone as a result of sinistral shear. It was followed by wrench faulting and by intrusion of the Middle-Carboniferous granites along the faults.

The Late Cenozoic collisional stresses were realized by a system of NE-SW trending left-lateral and NW-SE trending right-lateral strike-slips. The most important and still active one is Talas-Fergana dextral wrench fault. The compressional axis is located east of the Tien-Shan, at the widening of Tarim plate. This caused additional sinistral movements along the latitudinal segment of Kirghiz-Terskey suture.

TYPES AND VOLCANIC EVOLUTION OF BACK ARC BASINS

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Volcanics of the present day and paleo-back arc basins form a wide spectrum of volcanic series, including MORB of spreading ridges, WP-type volcanics of transform and transcurrent faults as well as subductional boninites, tholeiites, calc-alkaline and shoshonitic series. MORB and WP-type volcanics of marginal seas bear more or less distinct subductional geochemical signature - negative anomalies of Nb, Ta (Ti, Hf, Zr), elevated concentrations of LIL, light REE, radiogenic isotopes of Sr, Nd, Pb, of water and HCl. Intensity of the subductional geochemical characteristic depends on the degree of mantle transformation above the subduction zone, on rifting stage as well as on type and velocity of spreading. Oceanic characteristic are strongly prevalent in the basins, related to immature boninitic-tholeiitic arcs (basins of the Philippine Sea, Lau, Parece Vela, Fiji, some Late Paleozoic-Early Mesozoic basins of the Mediterranean belt - Late Paleozoic to Early Mesozoic Küre and Baiburt back-arcs, Mesozoic marginal sea of Crimea-Greater Caucasus). Subductional geochemistry is generally prevalent in the volcanics of marginal seas, situated within long-living active margins (Japan and Thyrrenian seas, some Late Cretaceous to Paleogene back arcs of the Mediterranean belt - Burgas, Adjara Trialetia, Talysh). Within each basin subductional characteristics are decreasing from initial rifting to diffuse and then to linear spreading, but even along spreading ridges composition of lavas may change from MOR tholeiites to subductional andesites and dacites. Thus, geochemical characteristics of volcanics alone are not sufficient for distinguishing among back arcs, island arcs, fore-arcs and post-subductional transtension basins. Only a complex analysis of the related volcanics, sedimentation and tectonic processes at the background of geological development of large regions allows to identify paleo-back arc basins, to determine their type and evolutional path.

VOLCANISM, HYDROTHERMAL ACTIVITY AND METALLOGENY OF THE BACK ARC BASINS OF THE MEDITERRANEAN BELT

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Among Upper Paleozoic to Paleogene back arcs of the Mediterranean active margin of the Tethys, basins related to immature oceanic arcs are mainly characterized by MOR and WP-type volcanism. Nevertheless, more or less distinct subductional imprints, manifested by Nb, Ta (Zr, Hf, Ti) negative anomalies as well as by elevated contents of the light REE, radiogenic isotopes of Sr, Nd, Pb, ∂D of water and hydrogen chloride, may be traced both in tholeiitic basalts formed at spreading ridges and tholeiitic to alkaline WP-type volcanics of transform and transcurrent faults (Cyprus, Greater Caucasus, Küre, Baiburt etc.). As a rule, crustal influence is even more pronounced in metallogenic features of the considered paleo-back arcs. Hydrothermal activity resulting in the formation of synsedimentary base metal massive sulphide deposits is due to the interaction of mantle fluids with crustal framework. ∂D/∂O ratios in fluid inclusions and other thorough geochemical features indicate that in spreading ridges hydrothermal convective systems are active in primitive basaltic crustal environment, whereas in transform and transcurrent faults role of contamination processes increases. These phenomena result in the distinct metallogenic zoning of proximal to distal base metal massive sulphides in which a zonal range of Fe -> Fe + Cu -> Fe + Cu + Zn (Pb) -> Cu + Zn + Pb (Au) from spreading ridges toward island arcs is well expressed.

In marginal seas related to long-living mature arcs (Burgas, Adjara Trialetia, Talysh etc.) mainly subductional arc-type tholeiitic, calc-alkaline and shoshonitic volcanic series are dominant. Here the metallogenic activity is due to calc-alkaline fissure volcanics (Au-bearing base metal massive sulphides of central rifts). In off-axes volcanic centers hypabyssal to subvolcanic ore mineralization is present. The latter is manifested by prophyry copper core in the crystalline rocks of magmatic chambers followed by Au-Cr-Zn-Pb vein-type deposits in distal environment. Ore-forming convective complex hydrothermal systems here are entirely governed by paleothermal features of cooling magmatic plumes.

EVOLUTION OF SILICATE AND SULPHIDE COMPONENTS IN WITHINPLATE MAGMAS (N SYRIA, SW CYPRUS)

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We have investigated in the present work the igneous rocks of withinplate magmatic origin from Early Mesozoic volcano-sedimentary sequences tectonically connected with the Upper Cretaceous Baer-Bassit Ophiolite Complex (N Syria) and from similar magmatic associations of the Mamonia Complex (SW Cyprus).

The established geochemical and mineralogical features as well as the obtained compositions of the solid silicate and oxide phases and sulphide globules inclusions in phenocrysts show that Syria and Cyprus areas magmatism has been proceeding under the similar genetic and geodynamic conditions.

The observed abundances of major components of investigated basalts and trachites as well as the composition peculiarities of the liquidus mineral assemblage (spinel, clinopyroxene, amphibole, plagioclase, magnetite) of the representative samples indicate that the studied magmatism exhibits a strong similarity to igneous rock series of withinplate magmatic origin.

The obtained data on LILE, HFSE, and REE are also in agreement with the geochemical characteristics postulated for the withinplate magmas, such as a significant enrichment in Ba, Th, Ta, and LREE relative to the HREE. However, a considerable depletion in Cs and Rb is observed in comparison with the other LILE through all the range of basalts and trachites compositions and a strong negative U-anomaly especially displayed in the most differentiated rocks. The studied basalts and trachytes are highly evolved, therefore the noted geochemical feature may be explained by fractionation of accessory minerals. But one can not also except the primary nature of deficiency of Cs, Rb and U, that may be related to multicomponent compositions (including those comparatively depleted in these elements) of the mantle sources of withinplate magmas.

The correlation between the compositions of host phenocrysts and syngenetic solid microinclusions in conjunction with the trends of changes in chemical characteristics of liquidus mineral assemblage in the compositions wide range show evidence of predominantly fractional mechanism for the evolution of the examined magmatic systems.

Separate sulphide inclusions as a pyrrhotite were found in the most high-magnesian pyroxene and amphibole megacrysts and phenocrysts. Globules of pyrrhotite have an almost constant composition that indicates the presence of an immiscible homogeneous sulphide liquid phase crystallization. Low Ni and Co contents in pyrrhotite indicate essentially evolved character of the melt and also allow to assume sulphide-silicate liquation within the considerable range in compositions of magmatic system.

Sulphide inclusions in the latter crystallized phenocrysts such as ferrous clynopyroxenes and amphiboles, low-anortite plagioclases and also in magnetite and apatite are mainly represented by a pyrite. Its generation probably resulted from the subsolidus processes of interaction between solid mineral phases and sulphur being present in magmatic system. This conclusion is based on the sulphur ability for extracting iron and chalcophile elements from the iron-bearing components that leads to the formation of secondary sulphide phases. Such an explanation for the genesis of pyrites follows typical features of their compositions. There is a distinct positive correlation between Ni and Co contents in pyrite inclusions and those in hosted minerals. Moreover, relatively high concentrations of these elements were found in sulphide inclusions from clynopyroxenes and the lowest in pyrites from plagioclases and apatites.

PETROLOGY AND GEOCHEMISTRY OF THE HAYES AND PETROV FRACTURE ZONES MAGMATISM (NORTH ATLANTIC)

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The detailed petrological (melt and solid inclusions in phenocrysts) and geochemical (REE, HFSE, LILE) investigations of Hayes and Petrov FZ area magmatism have been carried out.

The studied in Hayes FZ area magmatism has different age: 10-12 m.y. (fracture offset part) and zero age (adjoined MAR sectors). Petrological investigations permitted to reveal the homogeneous character of studied magmatism and showed the identity of magmas generation and evolution conditions (the primary melt and liquidus assemblages compositions, the crystallization temperature regime, oxidation-reduction potential etc.) in age interval 10-12 m.y.

Reconstructed on the base of magmatic inclusions in the most magnesian olivines compositions of primary melts have narrow composition ranges (in wt.%): MgO=13.30-13.50, TiO_2=0.50-0.55, Al_2O_3=15.20-15.50, Na_2O=1.40-1.50, K_2O=0.02-0.06. It is established the melts studied fractionation starts with olivine (Fo=91.5) and spinel (Cr#=0.44) cotectic crystallization under oxygen fugacities -lg (fo_2)=7.3-7.5 and T=1290-1310°C (relatively high temperature regime for typical MORB).

The Hayes FZ tholeiites of different age do not show the essential differences in their geochemical peculiarities and correspond to typical depleted oceanic tholeiites of N-MORB type.

The obtained result is the base for the lifetime determination of the homogeneous mechanism functioning of the oceanic magma generation. At least in this segment of MAR the period of 10-12 m.y. is undoubtedly the minimal estimation of duration of the oceanic magmatism that corresponds to the oceanic melts High-T° C N-MORB genetic type.

The Petrov FZ magmatism formation composition and conditions are reconstructed too. The obtained primary melts vary in the following composition ranges (in wt.%: MgO=9.90-10.60, TiO_2=0.70-0.90, Al_2O_3=17.50-18, Na_2O=1.90-2.20, K_2O=0.03-0.06 under T=1250-1270°C and -lg (fo2)=7.0-7.3. The most primitive liquidus assemblage is presented by olivine (Fo=90.50), spinel (CR#=0.43) and plagioclase (An=89.00).

The established Petrov FZ basalts geochemical heterogeneity does not have analogues in the oceanic crust. The most depleted within North Atlantic oceanic tholeiites are found here together with exceptionally wide diapason of this structure basalts relative depletion degree.

All heterogeneous basalts here geochemically dredged are undoubtedly differentiates of homogeneous low-temperature oceanic magmatism (Low-T° C N-MORB) as the investigations of quenched glasses, phenocrysts and magmatic inclusions in phenocrysts have shown.

The detailed mineralogical investigations permit (as seems to us) satisfactorily to decide (or at least to explain) this paradox. The relatively great crystals of Opx and Pl (including Amf-bearing) are established in basalts. These crystals compositions features do not give genetic affinity with including them host basalts but simultaneously they closely correspond to the analogues described for the oceanic plutonic complexes. It seems appropriate to interpret them as separate fragments of xenocrysts of desintegrated partially melted crust xenolits. This version permits to explain the exposed geochemical heterogeneity of the Petrov FZ tholeiites under different degree of crust contaminant participation in basalts separate samples that are derivates of the one (in genetical sense) homogeneous melt. Complementary distribution of REE in quenched glasses and the absence of considerable variations La/Ce and La/Sm ratios comparable with the same in basalts confirms also this conclusion of principle.

ON GEODYNAMIC NATURE OF GEOMORPHIC CYCLES

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The problem of geodynamical analysis of the fluctuations of the sea level for the last 100 m.y. as the principal base level of erosion fluctuations is discussed. This is particularly important for geomorphological chronology founded on the idea of relief formation cycles. Deformations of continental lithosphere are considered in connection with the sea level fluctuation. Geodynamic crises - such as plates' disruption, collision - change stress-strain state of lithosphere and freeboard conditions. The tectonic-eustatic curve is in close correlation with these changes and can serve as a convenient basis for the division of geodynamic regimes, relief formation and sedimentary cycles into periods. Short-term sea level drops of an unglacial origin at the periods of the plates' motion rearrangement during the geodynamic crises correspond to "quick uplift of the land" (W.M. Davis) and was caused mainly by localized plastic deformations under compression which partly compensate for the lithospheric plates displacement. These events are accompanied by orogeny, unconformities formation, drainage network downcutting and we may say on global scale about L. King's "phases of relief active destruction". The response of continental lithosphere to stress changes is conditioned by rheological stratification and former strength properties in different regions.

Several independent methods provided evidence for global peneplain (average dry land height is less 250 m above sea level) in the Late Cretaceous - Paleogene under the very high sea level condition. This determines an age limit of the beginning of the chronomorphological scale to which the history of relief may be studied by geomorphologic methods proper. A notion of the limiting base level is introduced, that is a theoretical sea level toward which the real sea level tends under condition of total degradation of endogenic and exogenic relief forming processes. The difference between the real and limiting base level is an important indicator of the state of global relief. The criterion of peneplanation degree determination by the sea level fluctuations curve is brought forward.

NEW DATA BY THE SHTOKMAN GAS FIELD ON THE BASE OF DETAIL GRAVITY AND MAGNETIC SURVEY

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SE MAGE

The Shtokman gas field is the largest on the Barents Sea Shelf. First drillholes have recovered a complicated structure of the pay zone, not observed in full in the seismic pattern. Besides, one of the holes did not display a promising hydrocarbon occurrence. This makes us to use additional geophysical data for the reservoir modelling.

The high-resolution offshore gravity and magnetic measurements were conducted over the area of 4500 sq. km by network of 2 by 4 km (SE MAGE, 1990). The accuracy of the gravimetry is less than ±0.3 mGal, and of the magnetometry is less than ±1.0 nT. Positioning accuracy reaches ±25 m. Gravimeters GMN-KM, proton gradiometers with three sensors and autonomous marine magnetovariation stations were applied.

As a result of data processing, the maps set was compiled, including: a bathymetry, gravity and magnetic anomalies, structure and hydrocarbon prospects. In respect with the latter, it is worth mentioning results of the section physical modelling. In particular, a correlation between some local anomalies and likely fluid concentrations in the pay zone is supposed. The conformity to natural laws allows to contour a most promising area of gas accumulations. Moreover, the field main direction has turned out to be different than supposed before by CDP-seismic data. This prediction is indirectly confirmed so far by drilling results: unsuccessful well has proved to be out of the promising contour, while the last hole inside the outlined zone shows a good production.

So, the obtained results have made more precise the Shtokman reservoir structure and give a ground to correct the trend of future exploration drilling. Mutual analysis of the data complex obviously enhances the reliability of common geological interpretation: perhaps, the same surveys should be inserted into standard set of the field exploration methods.

GENERAL REGULARITIES OF THE DISTRIBUTION OF THE ATLANTIC AND PACIFIC VOLCANIC SEAMOUNTS

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The data on more than 4500 volcanic seamounts higher than 1000 meters and on the islands of identical origin for the oceanic lithosphere of Atlantic and Pacific were summarized.

Based on the statistical analysis data considered, the heights and volumes of the submarine volcanoes were correlated to the underlying lithosphere age.

The conclusions received are as follows:

The average density of the volcanoes (the number of the seamounts per seafloor unit) increases with the crustal age. This shows a consequence of the gradual accumulation of the volcanic edifices through the whole geological age of the seafloor.

The percentage of the great seamounts also increases with the crustal age. The same situation was revealed for the volume of the volcanoes. These results confirm the conclusion of P. Vogt and A. Gorodnitzky, that the size of the volcanic edifices depends on the lithosphere thickness as well as on its age.

Consequently, when volcanoes of the different height occur within the crustal strip of the same age, the relative age of these volcanoes can be established: the higher seamounts are the younger ones.

All the data presented above confirm the connection between the volcanic seamounts distribution and the oceanic lithosphere evolution.

TECTONICS OF THE WESTERN MAR FLANK AND KANE FRACTURE ZONE INTERSECTION BASED ON GEOPHYSICAL DATA INTERPRETATION

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We report new gravity, magnetic and bathymetry data interpretation based on original areal survey carried out by RV "Akademik Karpinsky" in 1993 at the western flank of the MAR. Coherent data base inclusive previous information have been created for the mapping and tectonic interpretation.

Each magnetic lineation has been identified to provide detailed kinematic information. South of Kane fracture zone a series of shifts of the lithospheric blocks marked by MA 13 have been recognized. Northern flank of Kane F.Z. just opposite these shifts is characterized by intensive specific gravity and magnetic anomalies as well as shallow seafloor depths that have been interpreted as the result of out of axis volcanic activities.

Geophysical patterns are explained using "transform response model" to the plate assemble movement's changes (Tucholke & Schouten, 1988). Intensive volcanism similar to the spreading center magmatic activities is due to the extensional phase of the transform development. Existing at the one of the longest intervals of positive geomagnetic field direction during Cenozoic time (Kent & Gradstein, 1986) this volcanism formed large positive magnetic anomaly. Since the moment of creating Ma 6 the MAR axis has changed the direction as the result of the ridge and transform interaction. U-shaped structure with oblique magnetic lineations (Maschenkov et al., 1991) is an effect of this process. Proposed tectonic model developed from geophysical data interpretation could be used as a base for mineragenic zonation and off-axis geological prospect planning.

COMPLICATED STRUCTURE OF THE RIPE OCEANIC CRUST AT THE WESTERN END OF THE CANARY-BAHAMAS GEOTRANSECT (23°N - 29°N, NORTH CENTRAL ATLANTIC)

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We report some new results obtained in the Western Central Atlantic during "Akademik Karpinsky"-1993 cruise under the head of Canary-Bahamas Geotransect Project. Deep seismic reflection profiling complemented with gravity and magnetic surveys have been carried out in the various areas composed by the ripe oceanic crust (50-200 MY). One profile crossed Kane F.Z. where magnetic anomalies 25-30 are located. Three profiles have been carried out in the Mesozoic magnetic anomalies area and one in the Jurassic Quite Magnetic Field (JQMF) zone.

Seismic reflection data were obtained using original techniques with low frequency signal 7.5 hz that allowed the deep part of the crust to be studied. For complex interpretation we use the methodology based on the principle of the specialization at each geophysical parameter of geological structure. So only common structural solutions obtained using inner possibility of the method must be a basis for tectonic interpretation.

At the seismic reflection time-sections we can recognize the three-layer structure well corresponded to the ophiolite type of crust. At least two levels of segmentation have been observed: one is correlated with basement/Moho isostatic compensation as well as second is composed by dipping and subvertical reflection events imprints. Everywhere near transforms we can recognize anomalous structure and thinning of the crust.

Crossspectral gravity/bathymetry analyses have been performed to estimate isostatic models. The best corresponding between theoretical and experimental admittance curves for both 25-30 MA and Mesozoic areas have been obtained for Airy model with high amplitude changes near of transforms. The anomalous bodies at the bottom of the section have been modeled using Marquart inversion technique, density estimations support the serpentinite model.

Different techniques (Parker's inversion, Werner deconvolution, singular point method) have been applied to estimate the depths to magnetic sources. The main part of sources is located at the level of seismic layer 2, practically all transforms (including Blak Spur F.Z. in the JQMF area) are traced by subvertical chains of sources from the basement to the Moho discontinuity.

Reported interpretation results demonstrate different levels of segmentation of the ripe oceanic crust corresponded to the long-time variation of the accretion process as well as postspreading tectonic activity.

RECONSTRUCTIONS OF RIFT VALLEYS IN VOLCANOGENIC ARCS OF THE URALIAN PALEOCEAN

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In the Southern Ural Western-Magnitogorsk and Eastern-Magnitogorsk Devonian island arcs divided by Magnitogorsk interarc basin are isolated (V.V. Zaikov et al., 1991). Within these structures narrow linear zones are traced and the majority of copper-zinc-pyritic deposits of Southern Urals are connected with them. According to the deep drilling in the central part of Western-Magnitogorsk island arc within the Makan ore field the rift valley first is reconstructed. It is a fragment of linear depression 2-3 km wide and 100 to 400 m deep. From the south-west and north-east the depression is limited to basaltic ridges; to the north-east it passes to the basalt-rhyolite-plagiogranitic transverse rise and in the southern-eastern direction it is observed more than 10 km.

The bottom of the rift valley consists of parallel dikes complexes of dacites and rhyolites, containing relict basaltic bodies. At a depth of 100-500 m from the lower level of ore-deposit by several drill holes the roof of a synchronous magma chamber is exposed. It contains quartz diorites, plagiogranites with inclusions of diabases. The rift depression is filled up by xenoclastolavas, xenohyaloclastites of aphyric dacites, metalliferous sediments. Ore-bearing thickness is overlapped by hyaloclastites of andesite-basaltic composition and extrusive-effusive bodies of quartz-plagioclasic rhyolites.

In the Makan ore field six volcanogenic-sedimentary packets are determined, with the latter 60 copper-zink-pyritic bodies associates. Originally unified volcanogenic-sedimentary packets were divided by dike belts into linear blocks. Distances between neighboring blocks in lower levels account for hundreds of meters, in upper levels - several meters. Fragments of the most ancient sulphide hills are confined to boards of rift valleys, younger ore bodies gravitate to their axis part. Blunt wedges out of ore bodies are directed to the side of spreading axis. Not infrequently several fragments of ore bodies can be easily reconstructed into united ore hill with exact coincidence of boundaries of morphostructural and geochemical fields. Colluvial or breccias occurrence in narrow levels of Makan fragment of rift valley, deposits of proximal turbidites - in middle levels, deposits of sufficient turbidites and siliceous pelitolites - in upper levels. Evolution of lithodynamic types of sediments thus in addition confirms the broadening of the rift valley in time.

As a whole the position of rift valleys in Urals island arc complexes can be determined by halos of autochthonous xenohyaloclastogenic deposits, keeping numerous xenoclastes of comagmatic intrusive, effusive rocks, hyaloclastites and metalliferous deposits. Situation of rift valley in Eastern-Magnitogorsk volcanogenic arc coincides with occurrence of limestones, containing chemosynthetic community, which developed over residual seeping zones of hydrothermal solutions.

Obviously, that recurrent local spreading accompanied the rhyolite-dacite-andesite-basaltic volcanism of submarine volcanic arcs of the Uralian paleocean.

ON THE PALEOCEANOLOGICAL CHANGES IN THE NORTHERN NORTH ATLANTIC FOR THE LAST 13 KYR BY THE RADIOLARIAN DATA (CORE MK-340, REYKJANES RIDGE)

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By the radiolarian records from the sediments of the core MK-340 (58°30.6' N, 31°31.2' W; sea depth 1689 m; core depth 387 cm; annual sea surface temperature (SST) 9°C; the lower time boundary about 13 kyr B.P.), the most significant pre-Holocene climatic changes took place in the Reykjanes Ridge region within 13.0-7.8 kyr B.P. A matter of these changes - an increase in the influence of the Labradoric and Norwegian-Greenland water masses, in turn. An input of the Labradoric water led to the warming (the environmental conditions neared to the recent ones). On the other hand, the input of the Norwegian-Greenland water led to the cooling. The radiolarian species being typical for the recent sediments from the various subarctic provinces are the indicators of the water masses: "Labradoric species" - Ph. clevei, S. osculosus, L. arachnea, S. glacialis; "Norwegian-Greenland species"- A. setosa, C. borealis, Ps. gracilipes, C. davisiana.

13-11.7 kyr B.P. the natural conditions in the Reykjanes Ridge region were formed by the dominance of the Labradoric subarctic water masses with SST being by 3-5°C lower than recent one. The SST relative rise within interval 13-12 kyr B.P. conforms to the interstadials Boelling and Alleroed, and the SST fall at 12.8-12.2 kyr B.P. conforms, probably, to Older Dryas. The deep cooling ensued after the level 12 kyr B.P.

11.7-10.3 kyr B.P. the subarctic conditions existed as before. But they were of different types. The subarctic and, perhaps, arctic water masses from the Norwegian-Greenland Basin were penetrating the Reykjanes Ridge region. SST fell sharply (to 2-4°C). The high concentration of the arctic species A. setosa (30-35%) is typical for the thanatocoenoses from this core's interval. Perhaps, not only the shallow but also deep water was transformed indicated by the significant increase in the concentration of C. davisiana being habitual, as it is considered, for the deep water. Extremely low SST (about 2°C) has been within interval 11.2-10.5 kyr B.P. This interval conforms to the Younger Dryas cooling event.

10.3-9.5 kyr B.P. the influence of the Labradoric water masses increased again. The greatest rise over the past 13 kyr SST (from 2-4 to 8°C) was a result of this event. After the level 10.3 kyr B.P. the concentration of the "Labradoric species" and all the species of the boreal and subtropical groups increased.

9.5-8.3 kyr B.P. the warming has been broken by the input of the Norwegian-Greenland water masses. SST was unsteady and by 1.5-2.5°C lower than recent one. Probably, the environmental conditions were like the conditions of the Younger Dryas cooling event.

8.3-7.8 kyr B.P. the natural conditions reached their recent level, and 7.8-0 kyr B.P. the oceanological situation, with some fluctuations, was similar to the recent one. The SST magnitude was about 1.5°C. The SST maxima appeared at 7.8-6.0, 4.6, and 3.5 kyr B.P.

RIPHEAN OPHIOLITE BELT IN FOLDED FRAME OF THE SIBERIAN PLATFORM

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A possibility of distinguishing the Riphean ophiolite belt in folded frame of the Siberia platform was first suggested by V.E. Khain (1984). Data collaborated and, to a great extent, supplemented on these constructions appear nowadays. Thus, the ophiolites of Riphean age were distinguished in the limits of the Baikal folded region.

Inspite of a low exploitation of sections of ophiolite complexes in a belt their tectonic location and stratigraphic level of formation become more concrete. In the present plan they compose the imbricated nappe structures and, as a rule, are in allochthonous occurrence. These are the ophiolites of the Baikal folded region, Eastern Sayan, the Yeniseian ridge and the central zone of Taimyr. All of them according to their petrochemical parameters are conform with oceanic ones. Age of data is in the Middle Riphean interval.

Most complete sections of ophiolite series are restored in the Muya zone of Baikal folded region (Grudinin, Demin, 1992), in Isakovsky zone of the Yeniseian ridge (Vernikovsky et al. 1993) and in the Eastern Sayan (Dobretsov et al. 1985) composing strips with width up to 50 km. Nearer to a platform they are changed by a complex of rocks corresponding with island arcs' ones. Age of these origins fluctuates from Middle to Upper Riphean.

Along the periphery of the Siberian platform fragments of basins are distinguished. They are executed by carbonate-terrigenous strata of the Middle-Upper Riphean age which according to their features correspond to sediments of passive continental margins (Zonenshain et al., 1990).

Thus, the Siberian platform frame material complex pointing out an existence of paleoceanic basin which has been developed from Middle to Late Riphean is established. Main evidences which led to Riphean oceanic basin closure finished to Vendian, because of the Vendian-Paleozoic rock masses overlapping Riphean ones were formed under other conditions being similar to formations of passive continental margins. As the result of the Pre-Vendian accretion increment of the Siberian continent took place along a perimeter except the Verkhoyanian folded region.

THE INNER MESOZOIC TO EOCENE OCEAN OF SOUTH AND CENTRAL IRAN AND THE ASSOCIATED MICROCONTINENTS: A NEW INSIGHT

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Senghor et al. (1988) in a discussion of the „Tethyside Orogenic Collage" offered several original reconstructions of the mircrocontinent and ocean rearrangement of central and southern Iran. This was the first attempt to incorporate the newly discovered extension of the elongate and attenuated Sanandaj-Sirjan microcontinental block through the entire Makran in the south (McCall and Kidd, 1982). The author has recently completed the compilation of the Nikshahr and Saravan quadrangle reports and 1:250,000 maps with Dr. Eftekhar-nezad for the Geological Survey of Iran. During this work, the history of the internal ocean and associated microcontinents has become clearer. The

Sistan ocean and Sabzevar ocean named by Senghor formed parts of a much larger internal ocean, north of the narrow and attenuated Sanandaj-Sirjan/Bajgan - Dur-kan microcontinent (SS/BD): this appears to have ringed the central Yazd/Tabas/Lut (Y/T/Z), which itself consists of three earlier assembled pieces of continental crust. It separated the Farah/Helmand block from the Y/T/Z nucleus and extended out southeastwards between the Farah/Helmand block and the easternmost taper of the SS/BD microcontinent. Permian shelf sediments and volcanics of the Morghak unit Cretaceous shelf sediments of the Birk unit and Eocene shelf limestones of the Saravan unit (Abedan sub-unit) represent deposition on the SS/BD ridge, which separated two deep Paleogene flysch troughs to the north and south. The inner ocean contains ophiolitic rocks of Jurassic to Cretaceous age and closed at different times in different sectors: there are developments of blue-schists on the Fannuj sector: the inner ocean may also have extended northwestwards from the Baft-Nain sector. The last sector to close was the Sistan ocean and this is represented by immensely thick Eocene flysch in the Saravan quadrangle. It closed in the Eocene but late Eocene-Oligocene flysch and neritic sediments lapped over the SS/BD ridge to merge with the deep flysch basin to the south (of the Pishin and Nikshahr quadrangles). The Shah-Kuh granodiorite in the northeast of the Saravan quadrangle represents a last phase of calc-alkaline magnetism related to the Sistan ocean. The Talkhab melange nearby represents the ophiolites of the northeastern margin of the Cretaceous Sistan ocean.

The subduction zone to the south of the SS/BD microcontinent is represented by the Coloured Melange complex (Jur., Cret., E. Paleocene) and the flysch basin here continued to exist right up to the early Miocene, extending eastwards into Pakistan. The peculiar structural history of the Makran, dislocation, folding and thrusting being concentrated in the late Miocene-early Pliocene is discussed, differing as it does from widely accepted models of Moore and Karig (1989).

TECTONIC PROCESSES AS A CONSEQUENCE OF SUPERPOSITION OF GRAVITATIONAL AND THERMOCHEMICAL FACTORS

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The tectonic processes in the Earth's crust and upper mantle are influenced by the following factors.

1. Gravitational Factor: It is the most important factor which is responsible for all geodynamic processes and it determines PT-conditions inside the planet.

2. Thermochemical Factor: It depends upon the gravitational factor. The distribution and change of phase and matter conditions inside the Earth are connected with this factor.

3. Outside Factor: The influence of lunar and solar tides which are some kind of "trigger mechanism" for relieving stress in the lithosphere and therefore giving the definite trend to the tectonic processes as well as promoting conservation of global system of breaks. The tectonic processes in the Earth's crust and the upper mantle fully depend on displacements of heterogeneities in the Earth's depth caused by gravitational differentiation of the matter. These differentiations are some space-and-time fluctuations of density, temperature and chemical composition and they are submitted to the laws of statistic physics. Due to their complexity these processes are not described by simple interpretation. However, many regularities and mainly the trend of these processes can be explained using probabilistic-and-energetic approach, general laws of conservations and balance of matter and energy as well as the surface phenomena in the Earth's scale.

UNDERSTANDING SEAFLOOR-SPREADING CENTERS: A THIRTY-YEAR PETROLOGIC PERSPECTIVE

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Many early ideas about seafloor spreading centers (SSC's) have changed little since the sixties. Early recognition of the fundamental abundance of mainly depleted basalts and their derivation from a depleted mantel source remains true. The dominant roles of volcanism and intrusion in the generation of an upper extrusive zone (seismic layer 2a), a dike layer (layer 2b) and lower intrusive zone (layer 3) in contact with the mantle also have changed little but the specific mechanisms and their relative importance have come into sharper focus. Early models of a large centrally located magma chamber have been replaced based on evidence from seismic velocity profiles by a smaller medial magma chamber beneath fast (> 8 cm/yr) to intermediate spreading centers (5-8 cm/yr). These are probably narrow

(1 km wide) and shallow and thin (1-2 km deep and extending down but a few hundred meters), and are evidently long-living, allowing crystal fractionation and generation of their commonly evolved magmas. Magma chambers under slow SCC's are so far seismically mainly undetectable. This appears to correlate with the less evolved character of their lavas: they erupt with little time nor space for crystal fractionation in a crustal magma chamber. The detailed surface features of submarine volcanic fields are far better known, and the ophiolite analogy to oceanic crust has been repeatedly examined, revealing that only a few probably formed in a mid-ocean context (in contrast to island arc and backarc settings). The past 30 years have seen the discovery too of such intriguing tectonic features as overlapping spreading centers (OSC's) and propagating rifts.

Increased sampling has revealed broad regional systematic compositional and radiogenic isotopic patterns that correlate with such parameters as crustal thickness, probable extent, depth and temperatures of mantle partial melting, and proximity to hot spots, most of which are now much better known spatially, chronologically and compositionally. Most of these trends extend over far greater distances than even the grandest of spatial-compositional volcanic trends on the continents. So far there is little evidence that even the largest volume eruptions along SSC's are as large as those typical of the great continental flood basalt provinces. Major future directions involve continued mapping of the modern global patterns and developing increasingly refined geophysical models of the oceanic crust and mantle. Submarine geothermal systems affect the composition and evolution of the oceanic crust, and perhaps the oceans and the atmosphere. Such roles of the SCC's in these and other broad-context processes remain fruitful areas of research.

EAST EUROPEAN PLATFORM: HISTORY AND GEODYNAMICS OF THE RIPHEAN RIFTING

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In the beginning of the Early Riphean the Trans-Scandinavian magmatic belt was formed on the NW-margin of the East European Platform and massifs of the rapakivi granites were created. The west margin of the platform is supposed to present an active continental margin. A passive continental margin and a system of continental rifts related to it were formed in the east of the platform.

In the beginning of the Mid-Riphean a period of general compression of the platform took place. It was followed by the formation of two systems of triple junctions, their evolution resulting in the creation of the Polish-Black Sea and Timan passive margins, and abortion continental rifts giving rise to the Mid-Russian rift system. Rift basins running parallel to the Timan passive margin originated at the same time.

In the late beginning of the Late Riphean general compression of the platform occurred (Dalslandian orogeny), and penetration of granitoid intrusions along the craton boundaries. Then the Pechora-Paleo-Ural ocean opened. Creation of aulacogens along the eastern boundary of the platform is associated with this opening.

A number of general compression epochs can be distinguished in the Riphean history of the Russian platform. They resulted in reconstruction of the craton structure pattern and are related to orogenesis periods in mobile belts surrounding the platform. Geodynamics of recurrent rifting processes on the platform is connected with geodynamics of opening and development of oceanic basins adjoining to the ancient craton as well as with global lithosphere plate reorganizations. Riphean compression periods of the Russian platform coincide with periods of movement change of the European continent along the paleolatitude (paleomagnetic data).

THE INTEGRATED PATTERN OF THE EARLY PRECAMBRIAN EVOLUTION OF THE NORTHEASTERN BALTIC SHIELD

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The Early Precambrian geological history of the Northeastern Baltic Shield includes two geodynamic Wilson cycles: Late Archean and Early Proterozoic.

The paleogeodynamic settings of the origin and emplacement of the main Early Precambrian units have been reconstructed using the field structural-geological and geochemical (REE and trace elements) investigations and metamorphic zoning analysis accompanied by detailed reinterpretation of available geophysical and petrophysical data. Those units fall into seven groups: (1) the greenstone and volcano-sedimentary assemblages. Some parts of them in the main parameters are similar to those of modern riftogenic, oceanic, island-arc or active continental margin environments (Late Archean Kolmozero-Voronia and Early Proterozoic Pechenga-Imandra-Varzuga and Northern Karelia belts); (2) the granitoid and migmatite-granite dome-forming assemblages of root zones of active continental margin magmatic arc (Late Archean Murmansk unit); (3) the Late Archean Keivies unit including Gr-Bi and Bi gneisses, Arf-Aeg alkaline gneisses (metamorphic "alkaline granites") and subordinate amphibolites and Am-Bi schists were interpreted as the bimodal volcanic sequence of mafic-intermediate rocks and predominant felsic calc-alkaline and alkaline volcanics appeared to be the pyroclastic flow deposits that seemed to have been formed in the riftogenic setting of an active continental margin back area; (4) the front thrust nappe pile emplaced for the Late Archean collision stage and was composed by migmatites, gneisses, mafic and intermediate rocks of granulite and amphibolite facies (the Central-Kola thrust nappe belt); (5) the Early Proterozoic initial back-arc and then collision thrust nappe belt formed by the mafic and felsic granulites with gabbro-anorthosite sheet-shaped bodies in the pile sole part and with boudinated inclusions of upper mantle ultramafites in the underlaying melange zone (the granulite facies metamorphism and calc-alkaline mafic melt origin are supposed to have initially arisen in the continental margin lower crust above Early Proterozoic subduction zone - Lapland-Kolvitsa granulite belt); (6) the exposed area was built by the Late Archean rocks that were covered by Lapland-Kolvitsa granulites and then deformed and reworked in Eraly Proterozoic time under low-gradient (T/p) conditions into high pressure amphibolite facies (so called "Belomorian gneisses"); (7) the granite-migmatite and gneiss arches and domes piercing the Early Proterozoic Lapland-Kolvitsa granulite nappes and underlaying low-gradient metamorphics (Kola-Belomorian dome collision zone).

It was shown that the boundaries between all the main structural units have tectonic nature and were completely formed by collision of Late Archean and especially Early Proterozoic ages. Generally the formation of the northeastern Baltic Shield crust structure was the result of the large-scale transpositions and deformations of the lithospheric plates and microplates. The crust structures of the 1st type are the systems of the slope piled up slices and microplates. Those of the 2nd type are emplaced orderly by migmatite-granite and granite-gneiss arches and domes. Their origin was connected with the processes of the floating up the light plastic rock masses along the linear zones of rheomorphism and formation of granitoids (zones of the thickening of the crust and of the hight heat and fluid flows). The formation of the 2nd type structures is a result of the deformation and partial destruction of former slope piled up structural ensembles.

THE DYNAMICS OF THE OCEAN LITHOSPHERE (IN ACCORDANCE WITH NEW DATA ON THE TRANSOCEAN GEOTRANSECTS)

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The interpretation of the geological and geophysical data received during survey on the Angola-Brazilian and Mascarene-Australian geotransects in the Atlantic and Indian ocean is continued now. But at the present time we can already report next new results about ocean lithospheric dynamics:

1. The asymmetry of the tectonosphere of the Mid-Atlantic ridge within geotransects which are displayed in the various structural levels. The asymmetry revealed in the morphotectonics, the distribution of magmatic anomaly sources, spreading rate; according to seismic tomography data it has very deep roots (hundred km). This asymmetry is connected with absolute movement of divergent boundary of plates and with subhorizontal mantle flow.

2. The regular changes of the roughness of the bottom relief on the Mid-Atlantic ridge flanks and interruptions of the transform faults morphology. These peculiarities are explained by the recurrence of passive mantle upwelling.

3. The intraplate tectonic and magmatic activity in the deep basin of the Atlantic and Indian oceans within geotransects. The most intensive activity revealed in the Central and Warton basins (Indian ocean) where seismoacoustic, magnetic and gravimetric data point to the intracrusts warping and magmatic bodies.

4. Very different first order tectonic segmentation of the mid-ocean ridges within geotransects in spite of likeness of the spreading rate. These differences are reflected in the geoid anomalies and are connected with various mantle flows on the deep levels.

As a whole these results testify the necessity to work out new models of ocean lithosphere dynamics which will provide the interaction of the various scales, ranges and levels mantle flows.

THE EVOLUTION OF THE VOLCANIC AND SULPHIDE ORE FORMATION IN THE MODERN AND ANCIENT MARGINAL BASINS

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Most of the sulphide deposits were formed in the marginal basins. There are two types of basins: related to the splitting of the island arc over subduction zone, and those which formed at a long-distance from a subduction zone. The comparative analysis of the volcanic rocks and ores from the modern and ancient marginal basins show that the evolution of the volcanic and sulphide ore formation differs in these structure types.

Within the splitting island arc the volcanic composition changes from differentiated "island arc" series to specific "back-arc basins" basalt (BABB) or typical "mid-ocean ridges" basalts (MORB). It is connected with the gradual withdrawal of the magma formation zone from the supra-subduction fluid influence area. In the duration of the splitting of the ensimatic island arc the Ural-type of the sulphide deposits changes to the Cyprus-types (proper the Cyprus, Mugodjars, pseudomid-oceans). The splitting of the ensialic island arc is accompanied by the change of the kuroko- and rudnyaltai-types to the filizchai-type. The volcanites from the cyprus- and filizchai-types ore deposits are very similar. But the filizchai-type differs due to the intensive sedimentation.

Within the riftogenic structure, which were formed on the continental crust long at a long distance from the subduction zone, "intraplate" subalkaline rhyolite-basaltic and basaltic rocks change to the MORB. The atasui-type deposits are connected with rhyolite-basaltic rocks, and the bessi-type deposits - with basaltic rocks. With withdrawal of the spreading zone from the continents and with a decrease in the sedimentation, the bessi-type changes to the Cyprus type.

COMPARISON OF THE MATERIAL COMPOSITIONS OF OCEANIC ORES FROM DIFFERENT GEODYNAMIC SETTINGS AND THEIR RELATION TO THE COMPOSITION OF ROCKS FROM THE 1ST AND 2ND LAYERS OF THE OCEANIC CRUST

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Studies of the 7 hydrothermal fields suggest that ores from different geodynamic settings would show disparate characteristic mineral and geochemical complexes. Similar geochemical complexes have been shown also for the basalts from different geodynamic settings. Thus, back-arc basins' ores are richer in Pb, Sb, Cd, Ag, Au, In etc. than those of mid-oceanic ridges. The back-arc N-MORB proved to be enriched by comparison with mid-oceanic ridges' N-MORB in Zn, Cu, Pb, Y, Se, Co and V.

Isotope studies of lead (204, 206, 207, 208) suggest that isotopic compositions of ores from mid-oceanic ridges (TAG und Axial Smt) correspond to those of the depleted mantle, the isotope composition in Guaymas trough with ores forming in a 500 m thick sedimentary sequence to that of the isotopes of pelagic sediments, while Lau and Manus ores have isotopes correlative in composition to that of contaminated crust (mantle + pelagic sediments).

It can, thus, be assumed that disparate mineralogic-geochemical complexes in ores from different geodynamic settings are due to the present of identical complexes in basalts whose chemical compositions are controlled by the tectonics in the region. It, thus, seems promising to build up the scope of the studies by drawing on the collections from other oceanic regions, and conducting more detailed mineralogic-geochemical investigations of ores and rocks.

These data may help prepare a metallogeny chart for various geodynamic zones of the Pacific and Atlantic oceans. In additon, the hypothesis of a direct dependence between the compositions of the ore and the basalts from different tectonic settings may have an important implication for the solution of problems of genesis of ancient deposits such as in the Kuroko, Troodos, or Urals. It may also prove instrumental for the survey and prospecting of this type of deposits.

QUANTITATIVE MODEL OF SUBSIDENCE MECHANISM IN INTRACRATONIC BASINS: ITS APPLICATION TO NORTH AMERICAN EXAMPLES

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We present a possible physical mechanism of earth's crust subsidence and intracratronic basin formation. The mechanism is based on the descent of heavy bodies. Such bodies evolve in the upper mantle through vertical filtration of melt and its accumulation as large magmatic lenses. The subsequent phase transition transforms the basaltic matter of magmatic lenses into denser eclogite rocks. The eclogite lenses sink in the surrounding medium and induce crustal subsidence resulting in the sedimentary basin formation. A bicubic spline finite element method is used for a quantitative analysis of proposed subsidence mechanism. We assume density discontinuities in bicubic spline approximation introducing time-dependent jumps of density. Mathematical modelling involves the crust and upper mantle. The model is applied to Illinois, Michigan, and Williston basins. The subsidence curves derived for the models are in a good agreement with those obtained for the North American basins.

GEODYNAMIC MAP OF THE PAMIRS AND TIEN SHAN AT SCALE 1:1,000,000

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1. A geodynamic map at scale 1:1,000,000 was compiled for the area of the Pamirs and Tien Shan. For compilation of the map a legend by L.P. Zonenshain and L.M. Natapov, elaborated for a similar map of the USSR territory at scale 1:2,500,000 was used. Geodynamic environments are shown by colour on the map and structural and lithologic complexes - by symbols. A saturation of colour was used for age differentiation of similar geodynamic environments.

2. Two large blocks of Earth crust, which might be identified as super-terranes, form the main part of the area in study. The map shows the principal features of their formation.

3. The North Tien Shan super-terrane appeared as a result of collision of island arcs with passive margin and thrusting of North Tien Shan-Kazakh continent over Paleoasia Ocean during later Ordovician. Volcanics of the Early-Middle Devonian active continental margin overlie with sharp angular unconformity all the more ancient rocks. Mid-Devonian and Carboniferous terrigeno-carbonaceous sequences represent a younger shelf of this newly formed continent.

4. Besides the Late Ordovician-Silurian complexes of passive margin, in the composition of the South Tien Shan super-terrane subduction complexes of diverse age are widespread, namely those of accretion prims formation.

5. Collision of the South Tien Shan super-terrane with newly formed North Tien Shan-Kazakh continent is proved by collision complexes shown in the map.

6. The map shows the Pamirs as an accretion folded structure which appeared as a result of merging of Earth crust blocks of diverse origin - continental, island arc and oceanic.

7. The principal difference of this map from other similar maps of the region is interpretation of clearly manifested Oligocene-Quaternary deformations. For the first time disjunctive deformations were differentiated by age and morphology.

NORTHERN BOUNDARY OF THE CENTRAL INDIAN OCEAN INTRAPLATE DEFORMATION: ANALYSIS OF NEW SEISMIC REFLECTION-REFRACTION DATA

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The knowledge of characteristics of the transition zone between the Central Indian Ocean intraplate deformation and undeformed part of the Indian Ocean plate is very important for understanding of tectonics and geodynamics of this unique region. Deep Seismic Sounding (DSS) was carried out during 22nd cruise of the R/V Professor Shtokman in the area of northern boundary of intraplate deformation on meridional profile of 400 km length and on two latitudinal profiles of 50 km length each. Array of 10 Ocean Bottom Seismometers (OBS) and large airgun (30 l) were used for DSS refraction and wide-angle reflection study. Vertical Reflection Seismic (VRS) records were

obtained simultaneously for each shot point by single-channel streamer and shipboard digital recording system. In addition, two meridional and one latitudinal VRS profiles of total length of 380 km were made in this area.

New seismic data were analysed together with seismic reflection and refraction data obtained during previous expeditions of the Institute of Oceanology RAS. The position and direction of the northern limit of the area sediment and basement deformations were corrected, the junction character of deformed and undeformed parts of the Indian Ocean plate and the difference of crustal structures were revealed.

Comparison of seismic results with gravity anomalies derived from SEASAT altimeter measurements shows that northern boundary of intraplate deformation is well correlated with the chain of SW-NE trending anomalies.

Early unknown strong basement deformations buried under horizontal-layering sediments were discovered to the north of intraplate deformation on two meridional VRS profiles. Basement folds have amplitudes up to 2000 m. This folded belt has a width about 40 km and trends parallel to intraplate deformation boundary. Its possible origin and age are discussed.

NORTH CAUCASUS SEDIMENTARY BASIN: STAGES OF DEVELOPMENT AND GEODYNAMICAL HISTORY

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North Caucasus molasse basin is situated between Great Caucasus to the South and Scythian Platform to the North. It is made of the following sedimentary complexes: Triassic, Jurassic-Eocene, Oligocene-Lower Miocene, Middle Miocene - Quaternary. Triassic is located in rift basins. Geodynamical history of these rift basins is still unclear. Jurassic-Eocene sediments form a complex of passive margin, continental rifts and postrift subsidence. Postrift subsidence was interrupted by short compressional phases. Rifting took place during Early Lias, Late Dogger and Early Cretaceous. The largest Jurassic continental rift - Makhachkala paleorift have NNE trending. Makhachkala rift was an abortive rift in the zone of Dagestan rift triple junction.

Oligocene and Lower Miocene fill deepwater Maykop basin with large sedimentary clinoforms. Maykop basin originated in precollision time. It is supposed that Maykop basin formed as a zone of rapid subsidence due to back-arc extension and sharp precollision change in Caucasus subduction system. Recent basin of Tyrrhenian Sea can be considered as an analogue of a more advanced stage of Maykop paleobasin.

Middle Miocene - Quaternary sediments form syncollision molasse basin. Mainly it is originated due to molasse loading. Caucasus was the zone of continental subduction during the collision time (intracontinental subduction type). Comparison of North Caucasus basin (Terek-Caspian and Kuban Basin) and South Caucasus basin (Rioni and Kura basins) led to conclusion that the North Caucasus basin is a retrodeep basin, the South Caucasus basin being a real foredeep basin.

TRIASSIC WEST SIBERIA - SOUTH KARA SEA - PYASINA - KHATANGA RIFT MEGASYSTEM: GEODYNAMICAL APPROACH

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During Late Permian - Early Triassic time a huge megasystem of rifted basins was formed on the territory of West Siberia, South Kara Sea and Pyasina-Khatanga areas. These rifts were characterized by different orientation and were created due to lithosphere stretching which had enveloped very large area. The rifting was accompanied by magmatism. Approximately in the same period the vast Tunguska flood basalt province originated. It means that during this time the huge lithosphere area of about 3000 km x 3000 km was subjected to stretching, rifting and (or) basaltic magmatism.

It is important to emphasize that in the Permian-Triassic boundary the West-Central Siberia region occupied the place in the center of a large semicircle formed by two subduction zones: Novaya Zemlya - Southern Taymyr to the north-west (in current coordinates) and Mongolian-Okhotsk to the south-east. It is obvious that rifting and magmatism in the West-Central Siberia region are geodynamically connected with this subduction semicircle.

It may be supposed that three main reasons for rifting and magmatic activization of the West-Central Siberia region on the Permian-Triassic boundary are 1) lithosphere stretching due to change of geometry of subduction systems in Novaya Zemlya - South Taymyr zone and Mongolian-Okhotsk zone before collision time; 2) global short-term lithosphere plate reorganization; 3) existence of hot mantle plume. All these geodynamic factors could act simultaneously.

DEVONIAN RIFTING ALONG THE EASTERN AND SOUTH-EASTERN MARGINS OF EUROPEAN PALEOCONTINENT

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During the Middle and Late Devonian complex systems of rifts came into evidence along the eastern and south-eastern margins of European paleocontinent (Laurussia). These include the Pripyat-Dnieper-Donets, Peri-Caspian, Volga-Ural, Timan-Pechora, Eastern Barents Sea and Northern Kara Sea rift zones and Kola Peninsula - White Sea and Ukrainian Shield alkaline-kimberlites provinces. In the eastern Barents Sea and the Peri-Caspian Depression rifting proceeded apparently the thinning of the continental crust and the possible opening of small oceanic basins. Evolution of, for instance the Volga-Ural and Timan-Pechora rift systems, reflects repeated changes in the controlling stress field. Devonian rifting was accompanied by locally intense magmatism that is not exclusively confined to the actual rift zones. In general, rifting activity abated during the Early Carboniferous and gave way to the subsidence of post-rift basins some of which contain up to 20 km thick sediments (e.g. Peri-Caspian and Eastern Barents Sea basins).

Origin and evolution of the Devonian Eastern European rift systems that are associated with the eastern margin of European paleocontinent may have been governed by changes of activity along the subduction system of the Uralian ocean. As such their setting bears some resemblance to the Cenozoic rifts of China and Japan Seas. Although back-arc extension appears to provide an attractive model for Devonian rifting along the eastern and south-eastern margins of European paleocontinent, a contribution from mantle plumes to their evolution cannot be excluded.

POSTRIFTING MAGMATIC ACTIVIZATION IN EASTERN PART OF INDIAN OCEAN, PETROGEOCHEMICAL CONFIRMATION

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Investigated basalts, collected in a first cruise of RV "Antares", Odessa State University, from eastern part (Wharton basin, Investigator FZ, near 15°S) of Indian ocean.

The collected rocks have a different genesis.

Some of them were very alterated. Chemical composition in main part of this basalts is remarkable for more enrichment of iron and alkalis with low contents of magnesium and calcium. This is the result of destruction of phenocrysts olivine and plagioclase, and kali capture from sea water. The Upper Cretaceous age is typical for these basalts by magnetic anomaly data.

However, within the samples there are patterns that are not altered, but they have high content of magnesium (SiO_2-49,82; TiO_2-1,18; Al_2O_3-18,03; Fe_2O_3-7,07; FeO-1,47; MnO-0,30; MgO-1,88; CaO-5,90; Na_2O-4,23; K_2O-4,25).

Investigation of these basalts mineralogy supports its original subalkaline nature. These rocks may be applied to product of intraplate activization subalkaline magmatism. This activization had place in Eocene age by preliminary data. The chemical composition of these basalts that picked on the margin part of Investigator FZ looks nearly like composition of basalts from of Afanasiy Nikitin mount but basalts of Wharton are more alkaline.

As a result, it is proposed that the Eocene age magmatic activization enveloped more than 2/3 of all Indian ocean square.

HIGHPRESSURE ROCKS IN OMAN: A METAMORPHIC CORE COMPLEX AFTER OBDUCTION AND ISLAND ARC COLLISION?

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Below the Semail ophiolite, the continental material of the Saih Hatat window forms a stack of nappes affected by a Late Cretaceous high pressure low temperature metamorphism. New P-T calibrations in the deepest units demonstrate that these have been brought to depths of at least 60 km. Between these eclogites and the overlying bluechists facies units drastic metamorphic ommissions are documented. Widespread late metamorphic shear structures show vergences opposed to those of the Late Cretaceous obduction. The Paleocene onlap onto the blueschist facies units witness exhumation processes at very high rates. These data can be explained by the following model: The HP-LT metamorphic overprint in the Arabian margin resulted both from the obduction and arc collision tectonics. The exhumation of the metamorphic units resulted from the inversion of the obducted sole-thrust at the end of Cretaceous time which was followed by an isostatic rebound of the lower plate.

SOME ASSEMBLAGES OF JURASSIC RADIOLARIA FROM PRIMORYE, RUSSIAN FAR EAST

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The results of an analyse of Radiolaria from the Jurassic Pribrezhnaya structural-formation Zone, Primorye (South Sikhote-Alin), allowed to distinguish seven radiolarian assemblages. These have been found in the siliceous formation included in the Gorbushinskaya sediments series of the Pribrezhnaya Zone.

Radiolarian assemblages are:

1. Canoptum dixoni - Late Sinemurian/Early Pliensbachian
2. Canutus giganteus - Late Pliensbachian
3. Unuma typicus/Eucyrtidiellum unumaensis - late Early Jurassic/early Middle Jurassic
4. Dicolocapsa conoformis/Stylocapsa tecta - Late Bathonian
5. Gongylothorax sakawaensis/Guexella nudata - Callovian
6. Hsuum inexploratum - Middle Callovian
7. Gongylothorax sakawaensis/Mirifusus guadalupensis - Late Callovian/Oxfordian.

Some assemblages (Nrs 3, 4, 5 and 7) are the analogues of the radiolarian assemblages from the Jurassic sediments of the North Sikhote-Alin (Tikhomirova, 1988). The index-species of other assemblages (Nrs 1, 2 and 6) spread widely in the sediments of the western North America: Canoptum dixoni in the Kunga Formation, Queen Charlotte Island (Pessagno and Whallen, 1982), Canutus giganteus in the Maude Formation, Queen Charlotte Island, and in the Nicely Formation (Pessagno and Whallen, 1982), so in the Primorye, Russia (Smirnova, 1992), Hsuum inexploratum in the Shelikef Formation, Alaska Peninsula (Blome, 1984).

USING PALEOZOIC RADIOLARIANS TO DEFINE PALEOLATITUDES AND IDENTIFY ALLOCHTHONOUS TERRANES

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By analogy with contrasts in morphology and diversity between living tropical and cold water radiolarians, we suggest the following principles apply to the interpretation of Paleozoic radiolarian morphotypes: (1) Thin-shelled and laticed entactiniids inhabit tropical latitudes; (2) High-diversity assemblages are either low latitude, associated with upwellings or both; (3) Multi-shelled forms derived from differentiation of spongy fabric are most common in cooler or deeper waters; (4) Low diversity assemblages dominated by spongy entactiniids with thick shells are high latitude; (5) Long-spined, winged, recticulate and latticed forms are warm water-open ocean types. An abundance of cowl-shaped forms suggests oceanic circulation; (6) Discoidal spongy forms lacking arms are typically cold water; those with arms - warm water; (7) High diversity radiolarian assemblages characterize warm water settings.

These principles are not applicable to pre-Silurian radiolarians which were dominated by benthic forms and had not evolved sufficient morphologic differentiation to allow analysis.

Evaluation of Late Devonian radiolarian faunas from 21 globally-distributed locations permits recognition of 8 low latitude assemblages, 5 high latitude assemblages, and 4 assemblages from allochthonous terranes. Those from allochthonous terranes in some cases exhibit inconsistency between the diversity and/or dominant morphotypes present and the Devonian paleolatitude at which they occur suggesting substantial translation of those terranes across paleolatitude after their deposition. An example is the Wuzhisan Formation of South China (tropical paleo-latitude in Late Devonian) which has very low diversity entactiniids consistent with a higher paleolatitude origin.

The origination of Paleozoic radiolarians in epicontinental seas as primarily benthic forms has been convincingly argued in recent years. Their progressive adaptation to an oceanic habit begins in the Late Devonian with the acquisition of morphologic attributes such as pervasive bilaterality, rudder-like extensions, wings and other characteristics consistent with a holoplanktic habit. The morphology of Late Permian radiolarians shows them to have been pre-adapted to rapidly exploit the origination of true oceans starting in the Triassic and to shift to the oceanic habit they now occupy.

TRANSPRESSION AND COLLISIONAL STRUCTURES OF THE CHERSKY RANGE

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Tectonic structures of the Chersky Range resulted from the accretion of the heterogeneous Kolyma-Omolon superterrane to the Verkhoyansk passive margin in the Late Jurassic-Early Cretaceous (Parfenov, 1991). Detailed structural observations and paleomagnetic investigations (Neustroev et al., 1992) revealed that the accretion was accompanied by rotation of the Siberian platform which provided a peculiar set of structural forms on the convergent margins typical both of the oblique collision and transgression zones.

The early (Bathonian) structural forms can be traced along the entire Chersky Range. They resulted from the amalgamation of various terranes into a single Kolyma-Omolon superterrane and are represented by thrusts forming duplexes and imbricated fans, as well as by tectonic nappes with clippes and tectonic windows, and the conjugate recumbent folds. The amplitudes of horizontal displacements of individual sheets could probably be of tens of kilometers as derived from different sediment facies of contemporaneous rocks in the allochthons and parautochthon. The next stage (Volgian) evidenced the accretion of the Kolyma-Omolon superterrane to the Verkhoyansk passive margin and was marked by the formations of faults of combined kinematics in the central part of the Chersky Range which were due to the oblique collision. They are represented by north-westerly striking reverse faults with a left-lateral strike-slip component. To the north of the Selennyakh R. the faults are transformed into the north-westerly verging thrusts also with a left-lateral strike-slip component. The direction of the fold axes changes in accordance with the striking of the faults. They deform the earlier thrusts, nappes and recumbent folds. Synchronous with these deformations were thrusts and the associated folds and tectonic melange zones that formed in the inner parts of the Verkhoyansk folded area. The rate of lateral migration of the folding to the west could be 1-5 cm/yr. At the final (post Neocomian) collisional stages, when folding and thrusting could no longer provide reduction of space between the convergent margins, steep reverse faults with left-lateral strike-slip component were formed. The earlier structures were squashed to squeeze out the enclosed rocks. There are antithetic and synthetic brittle-ductile strike-slip faults, axonoclynals, late low-amplitude thrusts, with rare cleavage.

A similar sequence of structural forms characteristic of both the collision and transpression zones could also be expected in other folded areas where the convergence of continental terranes is accompanied by their rotation.

GEODYNAMICS OF THE JUNCTION ZONES OF THE PACIFIC PLATE AND THE CONTINENTAL FRAMING

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One of the problems of plate tectonics is the differences in the junction of the Pacific plate with the Eurasian one and the American continents, framing it on the west and east. It is presumed that on both boundaries, in conformity with the convection model, interaction occurs along the subduction zones; incidentally, the West-Pacific type of junction is characterized by the presence of marginal seas, and along the American continent they are absent (type of active continental margin).

Plate tectonists have no common opinion on the observed distinctions. Interpretations are various: contrary convection along the western boundary or compensating forces of extension, mantle diapirism or relict oceanic nature of marginal seas etc.

The investigation results allowed the authors to introduce the rheological structure of the lithosphere within the continents and oceans from a new angle to show the differences between them, and proceeding from this to explain in a new way the mechanism of horizontal interaction of the Pacific plate with continental ones, the geodynamics of the zones of their junction.

1. According to the made calculations, oceanic and continental plates consist of the upper rigid-elastic and lower viscous-elastic strata. The thickness of the rigid-elastic part of continental plates averages 15-20 km, that of the oceanic plates 25-30 km. The obtained thickness of the rigid component allows the value of compressive strain as theoretically quite likely (35 kbar) for attaining the continental plate's loss of stability and its assuming a sinusoid form.

2. From the point of view of rotation dynamics, the Earth is in the phase of stable equilibrium. Hence, during the convergent interaction of the plates, bordering on the meridional fractures which are the examined zones, westward plates will tend to submerge under the adjacent one with regard to the direction of the planet's rotation, i.e. to be subjected to absorption; this results in the formation of a subduction zone. Such a geodynamic setting is characteristic of the eastern boundary where the thicker, heavier Pacific plate is to a less degree buoyant.

On the opposite boundary of the Pacific plate the subduction of the westward Eurasian plate under it will be hindered by the latter's higher degree of buoyancy, and predominant will be the setting of stress interaction alternating with facies of partial thrusting of the continental margin, and relaxation pauses. According to the above data, the stress interaction (compression) has resulted in the continental plate's bent form, and this is responsible for the formation of marginal-marine troughs.

3. During the relaxation pause, the moving away of the Pacific plate (related to its subduction along the eastern boundary) leads to the opening of the fractures and the segmentation of the Eurasian continental margin. That is the way deep-sea depressions and basins of marginal-marine troughs (Kuril, West Japan Sea troughs etc.) and parallel to the margin intracontinental rift zones (Tanlu, Fen-Wei, Songliao, etc.) are formed.

ACCRETION TECTONICS OF NORTHEAST ASIA: MAIN TENDENCY IN TECTONIC EVOLUTION

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The Middle-Late Devonian rifting resulted in detachment of a number of large blocks from the eastern margin of the North Asian craton. The blocks displaced southerly, towards the Paleo-Pacific in the Late Paleozoic (Omulevka composite shelf terrane, Omolon composite cratonal terrane, Okhotsk cratonal terrane and others). As evidenced by paleomagnetic data they were farthest away from the craton (up to 35°) in the Late Permian-Early Triassic. The Late Triassic was marked by their reverse movement to the craton. At that time, the Alazeya-Khetachan, Kony-Murgal and other island arcs were formed.

In the late Middle Jurassic the collision of the Omulevka and Omolon composite terranes with the Alazeya-Khetachan arc led to a formation of the Kolyma-Omolon superterrane. The superterrane and the North Asian craton collision was marked by a formation of extent granite belts $^{40}Ar/^{39}Ar$ dated at 134-144 Ma. Accretion of the Chukotka composite shelf terrane to Asia occurred in Pre-Albian time and was related to the Canada Basin opening.

A characteristic feature of Northeast Asia are post-accretionary volcano-plutonic belts of different ages. Some of them extend for 2000 km nearby the Pacific border. They are made of gently dipping continental calc-alkaline volcanites and associated granites of magnetite series and unconformably overlie many of the terranes and, some of them, a craton margin as well. The volcano-plutonic belts define the position of active continental margins of Eastern Asia. On the side of the Pacific Ocean they are conjugated with forearc basins and accretionary wedges.

The most ancient Late Jurassic-Neocomian Uda belt occurs in the southeast margin of the craton and overlies the adjacent Okhotsk and Viliga terranes. The Albian-Late Cretaceous Okhotsk-Chukotka belt overlies the Uda belt and extends further northeasterly up to Chukotka. To the east of the Okhotsk-Chukotka belt there are the Maastrichtian-Miocene Kamchatka-Koryak belt, Late Eocene-Quaternary Central Kamchatka belt, and Pliocene-Recent East Kamchatka belt that displace sequentially towards the Pacific Ocean. This displacement of the volcano-plutonic belts and the corresponding active continental margins is due to sequential accretion to the continent of terranes brought by the Paleo-Pacific Ocean crust subducting beneath its margin.

Timing of the terrane accretion is defined by the age of lower horizons of the volcano-plutonic belts. This enables to delineate terrane which were accreted in the late Neocomian (Pre-Albian) (Avekova and Zolotogorskiy displaced continental margin terranes, Kony-Murgal island arc terrane and Talovsk-Pekulney accretionary wedge composite terrane), Albian-late Cretaceous (Alkatvaam turbidite terrane, Mainitskiy island arc terrane and Ekonay accretionary wedge terrane), Late Senonian-Paleocene (West Kamchatka accretionary wedge terrane and South Kamchatka metamorphic terrane and South Kamchatka metamorphic terrane), Early-Middle Eocene (Olyutorka-Kamchatka island arc terrane and Vetlovskiy accretionary wedge terrane) and Oligocene-Miocene (East Kamchatka Peninsulas island arc composite terrane).

"NORMAL" OCEANIC CRUST STRUCTURE OF THE NORTH-WEST PACIFIC PLATE ACCORDING TO MCS DATA

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The structure of "normal" oceanic crust of the North-West Pacific Plate was studied by multichannel seismic method (MCS) by Institute of Marine Geology and Geophysics in 1989. It was revealed that MCS reflection crustal structure is in a good agreement with the refraction model obtained before. The Moho boundary is represented by high-amplitude reflectors at a depth about 7 km under the seafloor, which coincides with a "normal" crustal thickness for the Lower Cretaceous and Jurassic crust of the North-West Pacific. Graditional transition between crust and upper mantle is represented by an "interbedding" of relatively high and low velocity strata in places where the Moho is not recognized clearly.

The detailed inner structure of the oceanic crust is characterized by intensive reflectors coinciding with the tops of layers 2 and 3. Layer 3 is subdivided into the layers 3a and 3b. The relatively clear character of the reflector probably associates with a detachment being caused by difference in the speed of movement between the crust and the upper mantle. The detachment originated just where boundary between brittle and plastic regions was located. The location of more homogeneous plastic layer is in accordance with minimum of strength of rocks curve in the crust lower part. The apparent discrepancy in the seismic image of the reflector between 3a and 3b in north and south parts of the profile can be eliminated by assumption that the "sandwich" character of the layer 3a/layer 3b transition apparently masked this detachment.

The most remarkable features found are the dipping reflectors. They are mainly positioned within layer 3b and dip to the north-west with inclination about 30 degrees. Several explanations may be proposed about these events and the preferred is that dipping reflectors are the result of shear zones caused by different velocity of horizontal movement between upper mantle and upper crust.

NEW DATA ABOUT STRUCTURE OF CENOZOIC SEDIMENTARY COVER OF THE NORTH-WEST PACIFIC PLATE NEAR KURIL TRENCH

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The results of geological interpretation and generalization of single-channel seismic reflection data about structure of Cenozoic sedimentary cover of the Hokkaido rise and NW Basin are discussed in this paper.

The sedimentary cover of this region was formed by Miocene-Pleistocene sediments, which overlay the Cretaceous rocks: Hokkaido rise - basalts with possible interbedding of sedimentary rocks; NW Basin - opaque horizon. The thickness of the latter one increases from 0 in the NW Basin to 400 m at Shatsky rise. A nondepositional hiatus is about 80 m.y.

Drilling data indicate that sedimentary cover is subdivided into lower pelagic and acoustically transparent complex of Miocene age and upper, semiterrigeneous (Hokkaido rise) or semipelagic (NW Basin), acoustically contrast complex of late Miocene-Pleistocene age. More than 90% of cover thickness are Miocene-Pleistocene age. The thickness of Cenozoic cover decreases to east from 500-700 m on Hokkaido rise to 100-200 m in the NW Basin.

The lower complex overlies acoustic basement without discordance. The upper complex have the comfortable bedding of reflectors and progradational structure with downlap (sedimentary cones, ridges, levees of Hokkaido rise) and onlap in the oceanic fault valleys and on their sides (Tuskarora, Hokkaido, e.a.). Sometimes onlap can be seen near the top of complex within Pleistocene sediments. Therefore this complex may be combined in one sedimentary cycle between two tectonic phases in later Miocene and Middle Pleistocene. The duration of this cycle is near 10 m.y. The formation of passive continental margin and region of denudation was connected with first tectonic phase. The formation of active continental margin with trench and outer rise was connected with second tectonic phase.

Progradational structures of cover on Hokkaido rise are formed by turbidity flows on the outer continental foot of Kuril cordillera. They have a trend to SE. The levees of Nakwe Channel are formed by deposits of Sangarsky Canyon and its left tributaries from Hokkaido island; the sedimentary ridges, cones and levees of central part between Tuskarora and Hokkaido fault zones are formed by deposits of Bussol, Diana and Kruzenstern Canyons. Sedimentary ridges of north part are formed by deposits of Avanchinsky Canyon. Configuration of sedimentary structures indicates strong influence of topography with heights of tens-hundreds meters to direction and velocity of subbottom turbidite or nonturbidite flows. The bend of isopaches of NW Basin sedimentary cover to S-SW is probably result of action of a broad, constant subbottom flow around Shatsky rise after late Miocene.

A trench capture of terrigeneous turbidites and increase of hydrodynamic activity of ocean promoted a development of local, channel and area erosion and redeposition of sediments.

SEDIMENTATION AND OIL AND GAS ACCUMULATION CONDITIONS AT THE FERGANA BASIN DURING THE PALEOZOIC AND MESOZOIC-CENOZOIC CYCLES OF GEODYNAMIC EVOLUTION

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The analysis of the Paleozoic cycle of geodynamic evolution showed that the Upper Paleozoic lightly dislocated rocks are the most oil and gas perspective. They are represented by sedimentary rocks, formed at the ancient, long existing Paleo-Tethys shelf (D - C), where near-shore marine and for-delta formations are picked out. These deposits are characterized by relatively low Katagenesis degree and gentle folding. Besides that, oil and gas perspects are connected with thick flysh carbonaceous-terrigeneous, partly volcanic formations of the Middle-Upper Carboniferous and the Permian molasse deposits. These deposits fill foredeeps, are characterized by continuous sedimentation and are represented by thick complex (up to 6 km) of marine and continental molasses, which are favorable for accumulation, organic matter, its tranformation and formation of oil and gas fields of different size.

At the Early-Middle Jurassic stage Talas-Fergana rift zone was formed. It was mainly filled by conglomerates with layers of gritstones, sandstones and clays with different share of effusive deposits. At the same time Central-Fergana basin of graben type developed. Sandy-argillaceous and argillaceous deposits were accumulated here under limnetic-swampy conditions. At the next stageover-rift depression was formed. It was Paleo-Tethys gulf, which connected Talas-Fergana strait with oceanic waters. However, the Late Kimmerian collision led to Talas-Fergana strait closing and regional break in sedimentation (the Lower Cretaceous). Facies content of the Lower Cretaceous deposits is similar to molasse one. New opening of Talas-Fergana rift system occurred after the activization. It was Tethys gulf. At the Late Cretaceous-Paleogene time terrigenous-carbonaceous deposits with gypsum and argillaceous facies 800 m thick were accumulated at Fergana gulf. These rocks were mainly formed under marine conditions of Fergana over-rift depression.

Thus, geodynamic events at the Alpine belt influenced the change of periods of current waters intensification and lull at Fergana gulf. It led to clays, sands and limestones accumulation, which are exclusively favorable for organic matter burial and hydrocarbon generation. However, the Oligocene-Anthropogene collision of Eurasia and Indian plates led to Northern and Southern Fergana thrust zones formation and transformation of over-rift deposits into inversional troughs at the central part of the depression. The terminal collision stage was accompanied by thick (7-8 km) molasse accumulation.

THE COMPARATIVE ANALYSIS OF MAGNETIC PROPERTIES OF BASALTS OF MID-ATLANTIC RIDGE AND JUAN DE FUCA RIDGE

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Amplitudes of the magnetic anomalies on Mid-Oceanic Ridges vary in the wide range: from 500 nT on Mid-Atlantic Ridge (MAR) to 1600 nT on East Padific Rise (EPR). In order to explain this difference of values magnetic anomalies, magnetic properties of two collections basalts are dealt with.

The basalts were sampled by MIR submersibles from Mid-Atlantic Ridge near Kane fracture zone (MAR) and from Juan de Fuca Ridge (JFR).

Natural remanent magnetization (In) of basalts of JFR are three times more than that of MAR basalts. The ferrimagnetic phase of these basalts is unoxidized titanomagnetit. According to results of a X-ray analysis titano-magnetites composition was calculated. The oxidation parameter Z was estimated from Curie temperatures and titanomagnetites composition. Basalts of MAR are more oxidized than basalts of JFR ($Z_{MAR} = 0.51$; $Z_{JFR} = 0.42$).

The different degree of oxidation of studied basalts appear to be main reason causing the difference between the magnetic properties of samples of treated collections. In consequence of oxidation of titanomagnetites of MAR basalts primary thermoremanent magnetization (TRM) was partly replacement by secondary chemical remanent magnetization (CRM) during oxidation that decrease NRM intensity.

Comparison of magnetic properties our basalts with results other investigators obtained from MAR and EPR allow us to separate two at least certain petromagnetic provinces of modern basalts in world systems of rifts Mid-Ocean Ridges. This are area of MAR located 15°N - 26°N having $I_{n\ av} = 10$ A/m and area of JFR having $I_{n\ av} = 30$A/m.

Consideration on the reason that caused the differences of magnetic properties of studied collections of basalts from JFR and MAR, permit to account for observed at times low values of natural remanent magnetization of modern rift basalts, responsible for decrease of the marine magnetic anomalies amplitudes at some sites on Mid-Oceanic Ridges to replacement of TRM by CRM during oxidation.

PALEOGEOGRAPHICAL MAPS OF THE LATER EOCENE - PLIOCENE OF THE PARATETHYS

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Region of research extends from Central Europe to Middle Asia and Tien Shan and from Turkey and Iran to Poland and Middle Volga. It includes all areas covered by marine Paleogene - Neogene deposits of the Paratethys basin. The data concerning the Eastern Paratethys (South Ukraine, Crimea, Caucasus, Volga-Don, Western Kazakh-stan, Middle Asia) will be presented in more details.

From tectonic point of view the region is placed in zone of the contact of the Eastern European platform and Alpian orogenic belt. We would use original interpretation of paleogeography and tectonic history of the Alpine belt proposed by I.G. Scherba.

The goal of the project is to compile 9 lithological-paleogeographical maps of the Paratethys basins and their environments at 1 : 5,000,000 scale, 5 palinspastic reconstructions of the Tethys - Paratethys region (scale 1 : 20,000,000). Explanatory notes to these maps will pool information about hydrology and depth of basins, climate and specific conditions had led to accumulation of mineral resources (industrial manganese, iron, uranium and rare-earthy elements).

TECTONICS OF THE AXIAL PART OF THE MID-ATLANTIC RIDGE BETWEEN 15°20'N and 19°50'N

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The 500-km-long section of the crestal region of hte Mid-Atlantic Ridge (MAR) between the 15°20'N Transform Fault and 19°50'N was studied in the 13th cruise of R/V "Geolog Fersman" (March to June 1993). Bathymetric, magnetic and gravimetric surveys were carried out in the 100-km-wide along-axial zone. Approximately half of this zone had been covered before by long-range side-scan imaging with the "Ocean" sonar.

10 individual spreading center segments 30 to 90 long can be distinguished in the area studied. They clearly differ between each other in their structure and have distinctive mostly non-transform (non-rigid) boundaries. More fine-scale segmentation, with typical length of segments 10 to 15 km, is also seen.

Different structural types of rift valley segments will be discussed in the paper with special reference to their specific features of tectonic and volcanic genesis. Types and evolution of displacement zones will be analyzed, and consequences, referring to probably hydrothermal ore-forming processes, will be discussed.

JURASSIC RADIOLARIANS FROM KINGIVEEM VOLCANO-SEDIMENTARY COMPLEX (KUYUL OPHIOLITES, TALOVKA-PEKULNEY ZONE, NE OF RUSSIA) AS INDICATORS OF PALAEOLATITUDES

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Radiolarian assemblages from cherty rocks of Kingiveem suite had been studied. Their species compositions show the possibility to determine paleoclimatic situation of sedimentation time. The different radiolarian assemblages had been investigated from two areas: Galmovayam river and Talovka river.

Species compositions of Upper Jurassic Galmovayam river assemblages show us their North-Tethyan, or, more possible, Tethyan-Boreal boundary Realm origin: there are Mirifusus spp., Ristola spp., Pantanelliidae are rare, and Parvicingulidae are absent.

Bathonian-Callovian assemblage from the same place contains Parvicingula aff. vera Pessagno et Poisson, and there is not a species-Tethyan Realm's inherent - so probably it has Boreal Realm origin.

Marked number Parvicingula (more than three species and a lot of exemplares) in many Upper Jurassic assemblages of Talovka-river samples under species - low-latitude indicators are lacking allow to suppose Boreal Realm of its sedimentation. Possibly due to better state of preservation, some assemblages of the same place contain Acanthocircus dicranacanthos Squinabol and also contain a lot of Pantanelliidae, widespread only in Tethyan Realm. But other samples have not; they all contain plenty of Parvicingulidae - probably it was South-Boreal Realm.

THE MOLS BJERGE FAULT BLOCK, EAST GREENLAND - AN EXHUMED HYDROCARBON TRAP

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In the northern North Sea and Mid-Norwegian Shelf provinces, the crests of Mesozoic tilted fault blocks are host to major hydrocarbon accumulations. The study of these structures is hampered by the fact that they are located offshore and buried beneath about 2 km of post-rift sediment. Prior to the opening of the North Atlantic, the Mid-Norwegian Shelf Province was situated adjacent to East Greenland, where Mesozoic fault blocks also occur. Tertiary uplift and erosion has resulted in the exposure of these blocks allowing them to be studied at outcrop. The presence of hydrocarbons has also been documented from Mesozoic strata in East Greenland, although no systematic study of hydrocarbon distribution has yet been undertaken.

In this study we document the distribution of hydrocarbons in an exhumed trap in the Mols Bjerge of northeastern Traill. The trap is analogous in scale and form to some of the large hydrocarbon traps in the northern North Sea, such as Brent, Statfjord and Ninian oil fields.

PLATE-TECTONIC ZONATION AND OIL AND GAS POTENTIAL OF THE TURGAY BASIN

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Geodynamic reconstructions of the study area show that formation of the Turgay oil-gas basin is connected with development of various types of plate tectonic structures: passive continental margins, orogens of plate collisions, rifts and over-rift depressions. Genesis of indicated structures is caused by interaction of the Kazahkhstan and East-European plates, the Mugodzhar microcontinent, the Valeriyanov island arc.

Geodynamic evolution of the study area includes three cycles: the ancient (the Middle Riphean-Silurian), the intermediate (the Devonian-Permian) and the late (the Mesozoic-Cenozoic). The typical plate-tectonic elements correspond to each indicated cycles. The Baikonur inversion rift and active continental margin are the main structures of the ancient cycle. The Turgay passive margin and the Central-Turgay marginal-continental rift correspond to the intermediate cycle. The main structures of the late cycle, which have played a decisive role in the formation of the modern tectonic structure, are the South-Turgay intercontinental rift, filled by the Late Triassic-Middle Jurassic sedimentary rocks, and corresponding to it the over-rift depression formed by Late Jurassic-Cretaceous sediments.

Light-dislocated terrigenous-carbonate rock masses of the Late Paleozoic collision orogen of the Kazakhstan plate and Valeriyanov island arc can be picked out into an independent structural stage. These formations formed under conditions of passive margin (the Devonian-Carboniferous) and folds and thrusts zones with cataclastic, listric, olistostromal traps connected with them can be considered as one of the reserves of development of oil-gas prospecting at the study area. The potential of the Mesozoic-Cenozoic strata is connected with the Jurassic-Lower Cretaceous rocks within the zones of anticlinal, lithological and combined traps, which are characteristic to horst-graben zones.

INTRACONTINENTAL YELLOWSTONE AND EAST SAYAN HOTSPOTS: VOLCANISM AND NEOTECTONIC STRUCTURE COMPARISONS

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Although intracontinental hotspot magmatism has been distinguished in Africa, Central Europe, and Eastern Australia, the most definite pattern of hotspot magmatic evolution is believed to be the Yellowstone hotspot in the western United States. We suggest that basaltic volcanism of the East Sayan mountains (western Baikal rift system) is also related to the hotspot activity. Comparisons of these two areas let a new insight into the problem of hotspot evolution in intracontinental environment.

The Yellowstone hotspot track is defined by the time-progressed centers of caldera-forming ignimbritic volcanism, since 16 Ma migrated 700 km northeastward to Yellowstone. Basaltic and rhyolitic lava eruptions preceeded the major caldera-forming event by several million years and followed it for several million years. In the East Sayan area, volcanism was initiated 20-24 Ma and stepwise migrated 120 km westward to the East Tuva volcanic field. The major phase of shifting volcanic activity was represented by olivine tholeiites and hawaiites with minor quartz-normative tholeiites and silicic basalts.

Beside the major direction of migrating volcanic centers, both the East Sayan and Yellowstone areas are characterized by another track of volcanic shift outwards from the regions of the initial volcanic activity, respectively along the East Sayan suture of the Siberian craton and along the Brothers Fault Zone. It is suggested that the major tracks are apparently related to mantle conduit (hot plume) and additional tracks are resulted from lithospheric extension above convectively hitting asthenospheric mantle.

The major hotspot tracks are accompanied with formation of parabolic structures, morphologically expressed with uplift of ranges which are 0.5-1 km higher in respect to surrounding areas. These structures control active faulting and seismicity. Basanites and other highly alkalic lavas have not been found in the inner part of the East Sayan parabolic upraise, but widely recognized in the outer part of it. Olivine tholeiites are a characteristic of the inner part of the Yellowstone parabolic upraise, volcanic rocks of the Brothers Fault Zone are mostly high-Mg alumina basalts.

The northeastward absolute movements of the North American plate with rate about 2.9 sm/year during last 10 Ma is originally established by Morgan on basis of the Yellowstone hotspot track. Available estimations of the absolute motion of the Eurasian plate are contractictory but show in general relatively small rates. Based on the East Sayan hotspot track, the rate of its eastward absolute motion since 20 Ma is estimated to be about 0.9 sm/year.

SPACE - TIME VARIATIONS OF TECTONIC PALEOSTRESS IN THE VOLCANIC FIELDS OF THE BAIKAL RIFT SYSTEM: A REFLECTION OF COMPRESSION IN PLATE BOUNDARIES?

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Temporal variations in the orientation of the principle normal axes have been distinguished in the volcanic areas in both the eastern and western parts of the Baikal rift system based on analyses of joints in older and younger volcanic rocks (techniques by Gzovsky, 1975 and Nikolaev, 1977), orientation of basaltic dikes, and alignment of fissure eruptions.

During the peak of volcanic activity between 6 and 2 Ma in the eastern rift termination (Udokan range), principal extension and compression axes orientated horizontally, respectively, northwest-southeast and northwest-southwest. Dikes stretched east-north-east mainly. In the last 2 My axes of extension and compression rotated clockwise. Dikes changed orientations to west-north-west. A drastic recent change in paleostress has been well identified in the area of Quaternary volcanism. Due to analyses of joints in the young pyroclastic deposits as well as in active faults we inferred a general northeastern extension and northwestern compression.

The western termination of the rift system structurally connected with the Baikal basin through the Tunka rift valley and the East Sayan suture zone of the Siberian craton. Unlike the southeastern suture where extension has been concentrated and rifting has progressed with formation of the Baikal basin, the southwestern suture reactivated as strike-slip fault and played an efficient role in transfer of rift-related paleostress in the lithosphere along the craton edge.

Along the East Sayan suture the Lower-Middle Miocene dikes stretch mainly northeast-southwest. Rare dikes are found to be directed also north-south and east-west. Extension strengths apparently were directed northwest-southeast along the margin of the Siberian craton. Analyses of joints in tuffs and basalts drive to the conclusion that north-north-western, northern, but mostly northeastern orientations of extension predominate. Changes of paleostress are not well timed, because volcanism lasted in the area only up to 11 Ma. It is obvious that clockwise rotation of extension and compression axes took place during or after the quiescence of volcanic activity. In the Tunka rift valley the paleostress field also was not stable. Mid-upper Miocene paleostress field was comparable to the near-cratonic once. Recent extension in the Tunka basin is directed along the strike of the rift valley.

Temporal change of paleostress field and widespread strike-slip faulting of the crust in the Baikal rift system might reflect overlapping of external paleostress resulted from the Indo-Asian collision on the local extensional environment related to deep-seated processes. But involvement of this model does not explain late Cenozoic clockwise rotation of tension tensors in the Udokan range. We speculate relative temporal increase of the paleostress field in Inner Asia, derived from the compressional Pacific-Asia boundary, probably, due to a larger absolute motion of the Pacific plate relatively to the Indian one.

THE GREATEST SHEAR ZONES OF THE CENTRAL EURASIA: GEODYNAMIC ASPECT AND SEISMOTECTONIC IMPORTANCE

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Transcontinental and interregional strike-slip faults and shear zones, manifested by combination of the fold and fault structures, have important role in Late Cenozoic structural pattern of the Central Eurasia. The Baltic-Iranian dextral shear zone extends to 7500 km with strike 310°NW - 130°SE from Uthland peninsula to Oman peninsula. It includes: the Tornquist and the Warta suture lines, the dextral-lateral strike-slip faults of Swentokshir Mountains, the East Carpathian border suture and Northern Dobrudga block, the North Anatolian Fault and the Zagros transpression zone. The Baludjistan-Siberian sinistral shear zone (of 15000 km long) crosses Eurasia in direction 40°NE - 220°SW and includes: the Pakistan-Baikal left lateral folded zone and Baikal Vilyui sinistral fault system. The different fragments of these transcontinental shear zones are of the pre-Cambrian age and existed as ancient weakness zones of Laurasian Protocontinent. During Mesozoic and Cenozoic they were the transform fault zones. The geostructural zones of the Alpine Belt, the degree of their compression and other geological properties change after intersection with these shear fault zones.

Interregional shear zones are the Crimea - Copet Dagh dextral and the Afghanistan - Balhash sinistral fault-folded transpressive zones. They are the border structures between the central part of the Alpine Belt and the "Russian contraforce" of the Eurasian craton, i.e. southern margin of the post-Triassic Eurasian continental plate.

Regular directions of the compressional and the strike-slip structures in the major zones of shear and converging fault zones ("converging fault" is "sodwig" in Russian) show predominate north trending compression during their formation.

Foci of the strong earthquakes and in particular so-called "twin earthquakes" (Boollin, 1989) are located in the shear zones under discussion. Probably, these zones are the original waveguides for the wave of the seismotectonic deformations, that spread out the earthquake foci with rates of 10-60 m/s.

RESEARCH OF THE DEEP STRUCTURE OF THE TRANSITION ZONE FROM THE ASIAN CONTINENT TO THE PACIFIC BY THE SYSTEM OF GEOTRAVERSES

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Research was carried out along three geotraverses i.e. deep sections of the tectonosphere made on the base of complex interpretation of geological and geophysical data. The first geotraverse across the structures of Sikhote Alin, the Japan Sea, Honshu Island and Northwest Pacific Basin was prepared jointly with Japanese scientists. The second geotraverse across North China Plain, the East China Sea, Ryukyu Island Arc, the Philippine Sea, Mariana Island Arc and Northwest Pacific Basin was carried out jointly with Chinese and Japanese specialists. The third geotraverse bêing under preparation now runs across Khabarovsk Basin, Sikhote Alin, Sakhalin Island, the Sea of Okhotsk and Northwest Pacific Basin.

Using seismological, geothermal and electromagnetic methods the asthenospheric layer is distinguished in the upper mantle of the transition zone. This layer is more fully manifested under tectonical active structures, such as interarc troughs and deep basins of marginal seas. In this connection the relation of surface and deep structures is considered for studying of regularities of recent geodynamical processes and profound causes of geological phenomena. The following correlation is noted: upwelling of the asthenosphere to the Earth' crust - formation of magma chambers in the crust - origin of rifts on the surface accompanied by tholeiitic magmatism and formation of sulphide hydrothermal deposits.

THE COMMON TECTONIC BOUNDARIES IN THE LATE PROTEROZOIC - EARLY PALEOZOIC EVOLUTION OF THE NORTH-ATLANTIC, MEDITERRANEAN AND URALS-OKHOTSK MOBILE BELTS

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The presence of the common tectonic boundaries in the Late Proterozoic-Early Paleozoic evolution of the North-Atlantic, Mediterranean and Urals-Okhotsk mobile belts allows to correlate the main tectonic events that are distinguished in the named belts at all main boundaries.

Grenvillian boundary (1100-1000 m.y.) - beginning of the continental rifting stage; uniform tectonic processes everywhere (the West Ukraine - the granitoides of Volyn-Podolya; the Central Kazakhstan - the Issedonian tectogenesis; Kirghizia-syntectonic granitoides in the Middle and North Tien Shan). Late Dalslandian boundary (850-800 m.y.) - beginning of the opening of earlier oceans: Prototethys in Mediterranean belt and Altai-Sayan basin in Urals-Okhotsk one. (The West Ukraine - the tectonic phase in the East Carpathians). Vendian - the maximum opening of the oceans: Prototethys, Yapetus and Central Asian. The origination of the ophiolite and island arc volcanism is established in all these basins. Cadomian tectogenesis (near boundary Vendian/Cambrian) - the earliest closing of the oceans (the most - Perigondwanian part of Prototethys). (The manifestation of the Cadomian tectogenesis is fixed in the Miskhan Massif in Armenia). Salairian tectogenesis (Late Cambrian - the earliest Ordovician) - the clear numerous changes in the general evolution. Most of the basins closes, but at some places (the Urals region) the primary ocean opening only begins. (The earliest regressive changes in the evolution of the Yapetus ocean and its most part - Sea Tornquist - reflect in sedimentary cover of Lithuania and Byelorussia. The general elevation of the western periphery of the East European craton is connected with the closing of Prototethys, relic of which exists in the Marmarosh Massif of the Carpathians in Ukraine. The origination of the island arc in Kazakhstan - Tien Shan basin of the Central Asian Ocean).

The geodynamic connection of similar and contrarywise processes in named mobile belts is evident at all main tectonic boundaries. This connection is caused by the general tectonic rhythm in the great lithosphere plates motions. The named mobile belts represent the natural elements of the global geodynamic system already in the late Proterozoic-Early Paleozoic time.

CONTINENTAL RIFTOGENIC METAMORPHISM

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The discovery of the large distribution of lithospheric spreading structures with the high heat flow on continents has raised a question about a possibility of the manifestation of regional metamorphism within them. First such metamorphism has been recorded (Ivanov, 1978) in the Urals Late Precambrian formations. The further development of the conception of continental paleoriftogenic metamorphism allowed thermodynamic parameters of its manifestation in the Ural to be concretized and a set of typical geological features to be determined. The analysis of the data from other regions (Appalachian-Caledonian Belt, European Hercynides and others) results in conclusion that the riftogenic metamorphism, which is associated with the extension tectonics, is an obligatory element in the prehistory of folded zones. At the same time, many authors continue to relate the products of its manifestations with processes of tangential compression according to the hypothesis of orogenic cycles.

The continental riftogenic metamorphism represents a response of lithospheric plates to the development of deep mantle processes resulting in their thinning and fracture and ccurs not only in riftogenic cover formations, but also below a brittle-ductile transition zone in the middle-lower crust and lithospheric mantle. The deeper products of this metamorphism are complexes of different temperature blastomylonites revealed in the Phanerozoic folded terrains of the Early Precambrian basement blocks and some gabbro-ultrabasite massives. Mineral assemblages in them point often to high pressures and chronological data show the simultaneity of their formation with zonal complexes of riftogenic series. The zonal metamorphism is characterized by low and middle pressures. The complexes of disthene-sillimanite type cannot be linked only with lithostatic loads because of insufficient thickness of riftogeno-depressional series, and so a model has been proposed which takes into account of fluid regime features of extentional plate in zone of detachment.

In spite of the fact that in the last few years more areas of metamorphism manifestions associated with the extension tectonics occur, the problem of continental riftogenic metamorphism in the lithospheric plate tectonics remains less developed and its discussion is well-timed.

RIFT STRUCTURES OF SMALL LITHOSPHERE PLATES OF THE CIRCUM-PACIFIC RING

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Among all modern lithosphere plates of the Pacific Ring, small lithosphere plates play an important role (Okhots, Philippine, Caribbean and Scotia plates). The Okhotsk and Philippine plates are close to the Eurasian plate and produce a complicated accretion structure of the North-West Pacific. The Caribbean and Scotia plates in the East Pacific occupy the intercontinental position (the Antillian type) in the general structure of the mobile system.

Computation of the kinematics of lithosphere plates demonstrates that compression prevailed in the Cenozoic. At the same time, a system of secondary extensional basins as the result of rifting is wide-spread on the above mentioned plates. These rifts constrained by dimensions of the small lithosphere plates are due to interaction between small plates and adjacent large lithosphere plates, or the motion and interaction of separate blocks within small plates in compressive or extensional regimes.

The analysis of rift structures of small lithosphere plates of the Pacific Ring showed that they differ in origin because of geodynamic processes of various scale. There are two types of deep-sea basins in the intercontinental mobile systems of the Antillian type: those which were formed without subduction, and the basins formed by subduction. The basins of the first type are either the result of destruction of large lithosphere plates during the early stage of the evolution of a region before a small plate had been formed, or pull apart basins formed close to transform boundaries between lithosphere plates. The basins of the second type include those formed above the subduction zone (forearc, backarc, interarc basins and grabens).

In the north-western part of the Pacific Ring (Okhotsk and Philippine regions), rifts and deep-sea basins were formed during subduction which resulted in formation of deep-sea forearcs, backarc and interarc basins. Also there are basins which appear to be the result of differential block movements within the plates (Makarov and Derjugin basins).

THE RELICTS OF DIVERGENT MARGIN IN THE CALEDONIDES OF THE BAYANKHONGOR ZONE, MONGOLIA

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The Bayankhongor zone is a system of linear structures to the south-west of the Khangai Range. This system includes the margin of the Central Mongolia Massif and adjacent Caledonides (to the north-east). The pre-Ashgill zoning in the Uldziytgol and the Baidaragingol Rivers basin is a reduced primary structure of the continent-ocean boundary.

The Bumbuger (BZ) and the Uldziytgol (UZ) zones characterize the palaeocontinent. The pre-Riphean metamorphic basement rocks are covered by R_{1-2} terrigenous -carbonate cover in the BZ. The metamorphic aureole, which is connected in space with a body of C_3 potassium granitoids, occurs along north-eastern side of zone. R_3 terrigenous and carbonate deposits are covered unconformably in the UZ, separated by a surface of an overthrust, by C_{1-2} terrigenous-carbonate beds with horizons of aphyric basalts. The brachiopods Acrotretidae are discovered in them. The cover is cut by dolerite sills, being synchronous with basalts. C deposits are a complex of the Bayankhongor basin (BB) passive margin.

The UZ is overthrust on the Bayankhongor ophiolite zone (BOZ). The BOZ ophiolites are conformably covered by greywacks. Magmatic rocks belong to the Tsagannur and the Khairkhan associations. The first association composes a main part of the BOZ, the second, a system of nappes along its south-western margin. The Tsagannur association is represented by a series of horizons within the structure of antiform, where (1) the layered gabbro complex; (2) the sheeted dyke complex; (3) the residual peridotite (dunite-harzburgite) complex; (4) pillow basalts, are observed from the base toward the top. The dunite-harzburgite complex is a relict of the roof of intruded gabbro. The sheeted dyke complex is represented by dolerite bodies, which are conform to the stratification of ophiolite. The dyke swarms in gabbro lie 10-15° steeper than cumulative foliation. Intrapillow limestones contain sponge spicules. The Khairkhan association does not reveal by sheeted dyke complex. The layered gabbro complex contains even gabbro-diorite. Andesite-basalts, dacites and siliceous tuffites are subordinated to basalts. These rocks are intruded by plagiogranophyre veins. Magmatic rocks of the first association are represented by tholeiited. Effusive rocks are similar according to petrochemistry and REE to MORB. Tholeiite and K-enriched subalkaline rocks coexist within the second association. Effusives are correlated with rocks of islands on mid-oceanic ridges. Gabbroids of both associations reveal high-Ti contents. The BB is interpreted as developing like divergent margin. The age of ophiolites with regard for data of P. Kepezhinskas et al. (1991) and according to our data is established as C_{1-2}.

The Sharausgol zone is conjugated with the BOZ by a steep fault. Dolomites, picrobasalts, rhyolite tuffs, cherts with spicules alternate in the section. The formation is interpreted as deposits of a C_1 continental rift. The rifting occurred before the opening of the BB.

Turbidites of the Dzag zone were accumulated in the relict basin synchronously with the time of tectonic accretion during C_3-O_1.

The flat nappes, in which the elements of primary zones have been "sealed" by a terrigenous-carbonate formation during O_3. This is a complex of a passive margin of the primary Hercynian rift basins of South Mongolia. The closure of the Hercynian basins and collision during C_2 caused a compression, which was reflected in the Bayankhongor zone by the formation of linear planar steep structures, north-east-vergent upthrust-overthrusts with conjugated grabens, filled by D-D_1 deposits.

CONNECTION BETWEEN GENESIS OF GRANITES AND METALLOGENESIS IN URALS - TIEN SHAN VARISCAN OROGEN

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1. Most of endogenic ore deposits of the Urals-Tien Shan Variscan orogen formed in the process of collision and granite generation in the Late Carboniferous, Permian and Triassic. They can be classified as: ore deposits formed during the epoch of overthrusting; ore deposits of the post-overthrusting orogenic stage; and postorogenic ore deposits.

All these ores should not be mixed with pre-overthrust ores, replaced together with tectonic units of oceanic and island arc origin, within which they are located (particularly ores of ophiolite complexes and pyrite ores of island arc complexes).

2. Three stages are clearly traced in the formation of collision granites and ores:

a) early collisional, commonly with a distinct geochemical and metallogenic zonation, corresponding to Kuno's law and a clear association of large deposits with transform zones;

b) mature collision with generation of thick batholith pillows at the base of tectonic units with association of large deposits with S-shaped and Z-shaped sinistral and dextral shear structural traps;

c) late and postorogenic granites of subsequent complexes.

3. In areas, where the orogenic belt experiences bending during collision (such as the Aral area and Kyzyl Kum in the Urals-Tien Shan orogen), a major melting of the mantle substance occurs with sublimation of melts in the form of giant drops into the upper mantle and the forming sialic crust; in the course of crystallization of these drops large and the largest ore dopsits with unique ore reserves can form.

THE REMOTE SENSING INFORMATION IN THE STUDY OF RECENT CRUSTAL MOVEMENTS

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1. The use of remote surveying materials makes it possible to obtain not only qualitative, but also quantitative information on the direction, rate and areal distribution of movements along the now acting rupture systems, as well as on the character of the movements proper (extension, shear, compression, rotation, turbulent coiling, swelling, subsidence, curve, sink, explosion).

2. On the basis of remote evidence the settings of incipient riftogenesis are mapped, shears are quite distinct, and the mean rate of displacements along them is determined; the pattern of volcanism, piling and displacement of tectonic blocks at boundaries of plates and microplates is revealed. Using the "flotation" rates of the growing arched uplifts it is possible to determine approximate thicknesses and volumes of granite masses in the Earth's crust.

3. The combination of remote information enables to determine the rates of lithosphere plate and microplate movements and the character of interaction at their boundaries. At the same time, remote information is the main source of data on the latest and modern intraplate tectonic movements, their areal coordination, reflection in relief, dynamic and seismic characteristics.

SUPERDEEP BOREHOLES IN THE URAL BELT AND ADJACENT BASINS: THE ATTEMPT OF INTEGRATED GEOPHYSICAL AND GEODYNAMIC INTERPRETATION

V. Segalovich

The last results of superdeep drilling and modelling of sections of Uralskaya (in the center of Ural Fold Belt, 4.5 km), Kolvinskaya (in the center of Pechora Basin, 7.05 km), Timano-Pechorskaya (the South of Pechora Basin, 6.9 km), Tyumenskaya (the North of West Siberian Basin, 7 km), and other deep boreholes are discussed. They are considered to be the new base for several correlated transregional (up to 2000 km) cross-sections. Besides drilling the region architecture is studied by following methods: 1) In-depth extrapolation (up to Moho) of tectonic units that are found in plane or in boreholes; 2) Geophysical surveys (seismometry) and 3-D computing with original modelling program (gravimetry, magnetometry); 3) Paleogeodynamic reconstructions according to Zonenshain et al. (1984, 1990) ideas accompanied by the author (1992) who has taken into account the separating and horizontal movement of lithoplinthes.

The essential concepts are: 1) Low-Middle Devonian angle and stratigraphic unconformity in Pre-Ural sedimentary cover (Pechorian, Pricaspian basins etc.) corresponds to the first phase Ural collision and diastrophism of the Silurian-Devonian sequences of passive margin; 2) single sheet known as Tagilsky trough is an allochthon and consists of ophiolites and island arc formations. They are overlapped in plane by horizontal movements within the Devonian and moved to the Russian craton within Permian; 3) The Upper-Devonian intrusions in Pre-Ural and the Triassic-Jurassic ones in Western Siberia have the mesoabyssal type, they penetrated simultaneously with overthrusts in the parallel belts.

Correlated geodynamic model of studied region includes the chain of sedimentary basins from Pechora to Precaspian in the West and from Yamal to Turgay in the East. The author supposed splitting (slicing) of the new continental crust to be followed by well-known processes of ocean crust subduction, terrains and arcs accretion and collision of continents occurred. The new-originated plinthes seem to have moved laterally toward the defined directions. The similar models were described for the Himalayas. This process was accompanied with upward (in the Ural) and downward movements (in the sedimentary basins). Foreland and hinterland basins differ; the first are polycyclic and the second are mono-cyclic. In this way the oil-and-gas bearing and metallogenia are discussed.

The paper also discusses the other problems. Those are tectonic aspects of granites genesis, metamorphic belts, the Pre-Cambrian Urals ophiolites, rheomorphic granite-gneiss throughout different terrains where the younger granites opposite to the old matrix. The gravimetrical equivalence of the similar (in composition, up to Moho) crust profiles are shown.

THE CONTINENTAL MARGIN NORTH OF EAST SIBERIAN SEA: SOME GEOLOGICAL RESULTS AND CONCLUSIONS ON THE BASE OF CDP SEISMIC-REFLECTION DATA

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The first CDP seismic-reflection data, obtained by MAGE in 1990, demonstrate a geological structure of the enigmatic continental margin north of East Siberian Sea between 78°-80°N and 156°-164°E, where it faces the Makarov Basin of the Arctic Ocean.

Continental basement of studied part of the East Siberian Sea margin is covered by sediments worldwide. Morphologically, De-Long High, Vilkitsky Depression on the shelf and continental slope are outlined in this area. The thickness of sedimentary cover varies from 1-1.5 km to 8-9 km, increasing generally northward from De-Long High to continental slope. Seismic velocities change from 1.7 km/s in lower ones. Sedimentary cover of the East Siberian Sea continental margin includes Cretaceous (Aptian) - Cenozoic deposits. At least, the eleven acoustic units are correlated and stratified in this cover. Due to seismostratigraphic analysis the turbidite sequences were identified and influx of the sediments from southern sources documented. The submarine-fan deposits form a gigantic progradational sedimentary prism on the north of East Siberian Sea margin.

Probably, the acoustic basement of this continental margin is formed by Paleozoic and Mesozoic rocks, strongly deformed in Late Kimmerian time. The top of continental basement is correlated clearly. The absence of some significant features in general configuration of the basement surface allow to suppose that the East Siberian Sea continental margin is not of Atlantic type, at least in studied area. The present morphology of the north of shelf and slope is the result of the continental-terrace progradation and gravity-driven slope processes since Aptian time. Apparently, the age of the Makarov Basin is no less than 125 Ma.

JUNCTION OF GAKKEL OCEANIC RIDGE AND LAPTEV SEA CONTINENTAL MARGIN: GENERAL FEATURES OF TECTONICS ACCORDING TO THE DATA OF MULTICHANNEL SEISMIC PROFILING

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The first DCP seismic-reflection data, obtained by MAGE in 1990, demonstrate the geological structure of the unique area of Arctic region: between 77°-80°N and 115°-133°E.

Oceanic basement of the Eurasia Basin of the Arctic Ocean and continental basement of the Laptev Sea margin are covered by sediments. The thickness of cover varies from 1.5 km to 8 km, and seismic velocities change from 1.75 km/s in upper unit of the sedimentary section to 4.5 km/s in lower onves. Sedimentary cover of the Laptev continental slope includes Upper Cretaceous-Cenozoic deposits, but the cover of the Eurasia Basin - only Cenozoic. The section of Cenozoic cover consists of three structural units formed by submarine fans. Due to seismostratigraphic analysis data the turbidite sequences are identified.

Studied northwestern segment of the Laptev Sea continental margin is of Atlantic type. The continental basement is formed by Precambrian rocks of the Laptev massif of Siberia. The analysis of oceanic basement morphology is allowed to trace more precisely the set of buried Gakkel Ridge rift at 77°-80°N, which divides the Eurasia Basin into Nansen and Amundsen Basins. The Gakkel Ridge rift is about 55-60 km wide. The width of Nansen Basin changes abruptly from 120 km to 25-30 km, decreasing toward the Laptev Sea, but the width of Amundsen Basin is no less than 100 km.

South of 78.5°N the Gakkel Ridge rift changes ones strike and acquires eastward bend. At 77.5°N between 128°-131°E curving Gakkel Ridge oceanic rift abuts on the Laptev Sea continental margin and ends. At this place the oceanic rift aligns the East Laptev Late Kimmerian horst of the shelf, which is an obstacle for along-strike rift propagation. Probably, tectonic relation between Gakkel Ridge oceanic rift and Omoloysky graben of Laptev Sea continental rift system realizes by means of lateral transform fault in the junction zone of oceanic crust and continental crust.

Tectonic activities of the Gakkel Ridge become exstinct southward. South of 78° N Upper Oligocene-Quaternary deposits cover the oceanic basement of Gakkel Ridge passively, but there is alone youngest funnel-shaped micrograben in the Upper Pliocene-Quaternary unit over the rift zone. The total thickness of Cenozoic sediments in the rift valley of Gakkel Ridge reaches up 6 km. Thus, apparently south of 78°N there was the cessation in tectonic evolution of the Gakkel Ridge oceanic rift and Laptev Sea continental rifts approximately from 30 Ma to 3 or 1 Ma.

COLLAGE ASSEMBLY AND CRUSTAL GROWTH IN THE ALTAIDS

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Collisional type orogenic belts may be classified into three superfamilies on the basis of the attitude and width of their sutures, which seem a function of the size of ocean lost before the collision (measured as length of oceanic lithosphere subducted), namely 1) Alpine type, 2) Himalayan type, and 3) Turkic-type. Of these, the Turkic-type orogens are characterized by the presence of very large subduction-accretion complexes forming very wide (on the order of several hundreds of km) "sutures". Magmatic arc axes migrate into these subduction-accretion complexes from their original positions as they grow and consolidate them by plutonism. Further consolidation occurs when spreading centres are subducted and cause widespread HT/LP metamorphism, in places reaching granulite grade. Changes in slab dip and buoyancy and subduction incidence angle commonly induce complex "out of-sequence" deformations on growing subductions-accretion complexes including major strike-slip shuffling, as do the collision with them of various buoyant entitles such as microcontinental fragments including island arcs, fracture zones, guyots, and large delta complexes.

The growth and collision with one another of giant Turkic-type orogens dominated the evolution of Central and parts of Northern Asia during the Paleozoic. The Ural, Tien Shan, Kazahkhstan, Altay/Sayan, and the Mongol Okhotsk orogenic belts making up the Paleozoic Altaid tectonic collage to the west and south of the Angaran Craton may have evolved along a single magmatic arc. This arc, called the Kipchak arc, rifted in the Cambrian from a combined East Europe/Angaria and became a multiple orocline through the Paleozoic both by strike-slip repetition and actual bending by the rotation and convergence of the by then separated cratons of Eastern Europe and Angaria. During this evolution, growth of a giant subduction-accretion complex in front of this arc added about 5.3 million km^2 new area to Asia, about half of which may be juvenile crustal material. The growth of the giant Altaid subduction-accretion wedges in the Paleozoic may have been favoured by sea-level generally lower than that in much of the Mesozoic because of the persistent Paleozoic Gondwanian ice caps. Continental enlargement and perhaps even growth may thus be aided by widespread continental glaciation.

NEW IDEAS ABOUT SEISMOTECTONICS OF NORTHERN EURASIA

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The new conception of règional seismotectonics is proposed. It is based on the idea of tight interaction of some platform area and orogens as a united dynamic system. According to geological, geophysical, structural and geodynamical data five active geodynamic systems can be located in the Northern Eurasia. These are: European-Mediterranean, Central Asiatic, Baikalian, Kuril-Kamchatka, Arctic (North-Eastern). Their extensions are of about thousands of km widths up to hundreds of km.

The geodynamic systems under consideration are really some kind of crust and mantle inhomogeneities which determines from ancient geological time till now, intensity and speciality of manifestations of tectonical and geophysical phenomena as well as direction of modern geodynamic processes. The main energy sources of these systems are situated in the depth of active influence of folded belts on platform areas are shown by A. Karpinsky (1883).

The new geodynamic approach allows to explain many paradoxes of seismicity and other manifestations of modern geological activity especially of platform areas.

GEODYNAMIC CRITERIA OF OIL-GAS POTENTIAL EVALUATION

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1. Geodynamic criteria of oil-gas potential evaluation include tectonic, lithological-facies, geochemical, thermobaric and fluid-geodynamic indicators of oil-and-gas content. The idea of depending of oil-gas formation on general development of Earth crust lithosphere and interactions of separate lithosphere plates under the influence of divergence, convergence and isostasy processes forms the basis of joint analysis and unification of various geodynamic criteria into united block.

2. Tectonic indicators. Optimal conditions for large-scale oil-gas formation and oil-gas accumulation were formed under conditions of: ancient passive margins transformed by plate collision; relic passive margins (marginal-continental seas); long and intensive dawnwarping at the synrift and epirift structures. The modern geodynamic of a basin and its reservoirs plays a large role in formation and destruction of pools.

3. Geochemical indicators. The depression facies concentrated DOM and formed under conditions of early spreading by formation of passive margins at the continent-ocean limit, of isolated deep-water depression of active margins, of trans-arc basins of extension, of pre-arc basins of destruction type, of deep-water troughs, sometimes not compensated by sediments and located between marginal uplift and forming orogen have the greatest generalization protential. The formation of source rocks with DOM of lake genesis can take place in the basins forming at the rift stage.

4. Lithological-facies indicators. The primary factors (conditions of sedimentation, lithological-facies rock composition, their thicknesses and oth.) play the main role in conservation of the initial porous space and in formation of the secondary porous space. Influence of negative factors (gravitation and oth.), contributing of decreasing porous space is compensated by processes of dilatancy, leaching, recrystallization, solution. These factors contribute to development of the secondary porous space and to improving of filtration and volume reservoirs characteristics. High volume and filtration properties of porous reservoirs and high screening ability of montmorillonite cap rocks are preserved at the great depth.

5. Thermobaric indicators. Thermobaric bowels regime connected with geodynamic conditions of formation and subsequent transformation of sedimentary strata defines a location of katagenesis zones in the section. For example, many deep depressions are characterized with high velocities of sedimentation and low geothermal regime, "prolonger" katagenesis. All these factors with AHBP prove a location not only gas, gas-condensate fields but oil and oil-gas-condensate fields with various HC composition, too. But at the shelf areas (with the various lithological-facies composition of sedimentary section) in the open system with possible withdrawal of new formed HC realization of source potential comes significantly earlier than in the deep water depressions.

6. Fluid-geodynamic indicators. Fluid-geodynamic processes play an important role in HC pools formation. HC generation and its migration from source rock into the reservoirs increase under conditions of hydrothermal energy-mass-transportation. As a result of lithification processes the transportation of united hydrodynamic systems takes place. It leads to separation them into isolated reservoirs at the great depths and at the "rigid" thermobaric conditions. All these factors show that favourable conditions for localization of large HC pools can occur at the great depth as well as partial deterioration of oil-gas content conditions.

STRUCTURE OF THE SOUTHERN PRE-CASPIAN AND SKIF-TURAN PLATFORM JOINT ZONE

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Joint zone of the South-West of Pre-Caspian and Karpinskiy ridge is known in prospecting practice as Karakulsko-Smushkovskaya dislocation zone (KSDZ). Regional seismic works (method of reflected waves and method of common deep point in record interval 20 s.), carried out at KSDZ, allowed to interprete the sedimentary cover and basement structure as well as to follow the character of reflected horizons occurrences, which are correlated with upper mantle rocks. On the base of these investigations together with gravitation-magnetic data, KSDZ is traced along northern bord of Karpinskiy ridge from Karakol monocline at the West of Agrakhamo-Emba fault at the Northern Caspian for 550 km. The sedimentary cover of KSDZ is composed by 3 complexes. They include autochthonous complex, represented by the Paleozoic rocks of Pre-Caspian, sharply submerging southward, and allochthonous complex, that overlap dislocated formations of methamorphed deposits of Pre-Caspian with amplitude 3-5 km at the West and up to 20 km at the East of KSDZ. The Mesozoic-Cenozoic neo-autochthonous covering complex is spread everywhere at Karpinskiy ridge and Pre-Caspian. Position of the cristallic basement top at KSDZ is traced rather surely at record interval 10 s., and it has tendency to submerge southward. Occurrence of reflected horizons, which are correlated with upper mantle top is fixed at 5-7 km higher than at Pre-Caspian and Karpinskiy ridge. KSDZ oil and gas perspectives are mainly connected with its eastern block, where carbonaceous Astrakhan platform developed (D_3-C_2b). Its submerging is proved by seismic survey to 7-8 km deep. Numerous fields at neo-autochthonous complex are probably caused by hydrocarbon migration by deep faults, revealed at allochthonous complex as well as at neo-autochthonous complexes of KSDZ. From plate-tectonic point of view the study zone is collision orogen of Karakul and Astrakhan passive margins, microcontinent of Karpinskiy ridge and East-European continent.

FAULTING AT INTERPLATE BOUNDARIES AND MORPHOLOGY OF SEISMIC BELTS

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Faulting and seismicity are the processes which have their cause-effect relationships and both of them are consequences of the evolution of the lithospheric mobile belts. The lithospheric mobile belts develop at interplate and interblock boundaries of the convergent, divergent and strike-slip (tansform) types.

According to the state of stress and geodynamic conditions, faulting and seismicity vary at the interplate boundaries of different types. The distinctions are expressed in the following: (1) the area of the marginal parts of the interplate boundaries subject to destruction and seismicity; (2) morphology of the zones of high fault density and intensive seismic activity; (3) kinematic and quantitative parameters of faults; (4) the energy required for faulting and seismicity; (5) some regularities of migration of the zones of high fault density and intensive seismicity in the time and space; (6) other indicators.

Thus, the form, the area, and other peculiarities of dynamics of seismic process in time and space are closely related with the type of the interplate boundary, the geodynamic conditions of its development and faulting. The process is similar at different hierarchic levels and can be extrapolated to the block structure of lower hierarchic ranks that is controlled by the seismoactive transregional and regional faults.

CAMPANIAN TO EARLY MAASTRICHTIAN RADIOLARIA FROM CARBONACEOUS LENSES OF THE OLUTUR RIDGE (KORYAK UPLAND, RUSSIA)

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The Olutor Ridge is composed of chert, jasper-like and volcanic rocks. The radiolarian assemblages from these rock types are distinguished by low morphological diversity and throughout the same genera occur. These are limited to the following: Phaseliforma, Pseudoaulophacus, Patulibracchium, Orbiculiforma, Dictyomitra, Clathrocyclas.

We have recently processed by means of different acids the limestone radiolarian- and diatom-bearing samples from the southern part of the Olutor Ridge in order to determine the age of the carbonaceous-containing formation and to provide a basis for the paleotectonic reconstructions of the Vatyn terrane.

The light limestone forms lenses in the chert and contains Spongosaturnalis spinifer Campbell and Clark, Actinomma douglasi Pessagno, Haliomna aff. minor Campbell and Clark, Cromyosphaera vivenkensis Lipman, Kreuzstella vierkantiga Empson-Morin, Phaseliforma carinata Pessagno, Stylotrochus cf. paciferum Lipman, S. aff. nativus Lipman, S. volgensis Lipman, Clathrocyclas ex gr. tintinnaeformis Campbell and Clark, Xitus asymbatos Foreman, X. sp. B Iwata and Tajika, X. sp. C Gorka, Stichomitra livermorensis Campbell and Clark and some new species.

Most of the identified species are similar to those from the Ukelayat flysh (Vasyn et al., 1990) which is exposed west of Vatyn terrane.

Probably chert with limestone lenses is intermediate facies between the Ukelayat trough slope and the Vatyn marginal formation. Moreover, carbonaceous section includes both the Subboreal Siberian type of species and Temperate Pacific (Californian type) species.

THE PALEOBASINS OF SPREADING INTERARC ZONES AND DOUBLE ISLAND ARCS (EVOLUTION AND METALLOGENY)

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TsNIGRI

1. Paleostructures of ancient Ural-Magnitogorsk and Tagil island arc systems based on formational-facial analysis, including modern methods of study the substance (isotopes Sr, Tr, $^{Rb}/S_{12}$ and other distribution) make possible to consider the structure, evolution of magmatism and orogenesis of paleo island arc systems in a different way, enable to demonstrate their structure similarity and the competence to compare with modern island arc systems of World ocean, formation model of which was introduced by D. Karig.

2. Magnitogorsk and Tagil paleozoic Urals geostructures, like modern ones, are represented by split double volcanic island arcs of asymmetrical structure and composed of two island arc belts-west and east, divided by interarc paleobasin. The west belt is represented by relict rear basaltoid arc, the volcanism in which have stopped from the moment of the spreading interarc zone, but the east one - frontal one in which continue to develop actively after the splitting more than 30 million years. In the east arc the role of acid volcanites and the volume of their intrusive comagmates are increased. The change of geochemical specialization of rocks takes place and the role of light Tr and others is increasing that proves the thickness of the Earth crust growing in evolution process of island arc.

3. The interarc basin which divides volcanic belts may be compared with modern spreading behind arc basins. It is a clearly defined asymmetric structure: in its west rim silico-sandy-argillaceous volcanomictal laminated sediments are prevailed while in the east belt-roughly clastic badly sorted volcanoclasters of great width, different clastic sediments with no clear rhythm and limestones of reef origin.

4. In the conditions of interarc basins pyritic ores deposits have developed, and the conditions of the formation are analogues to the accumulation of modern pyritic ores in behind arc basins. Here chromite, iron-manganese, gold-sulfide ores were deposited in silico-terrigenous series of volcanic origin. In island arc situation during several periods of time pyritic deposits have been developed in conditions of low depth of sea basin to be unknown in modern fields of orogenesis. The latest ore formations of island arcs represented by copper-porphyric, iron ore stratiform and scarn, complex copper in stratified gabbroids, gold-adular-quartz, gold-silver deposits and manifestations.

5. A number of metallogenic provinces mainly pyrite-bearing such as: Tuva, Salair, Rudnyi Altai, Eniseysky kjag and some others are of similar structure. Their development is subordinated to the evolution regularity of double or many times splitted island arcs formation divided by interarc basin zone of spreading.

GEOLOGICAL DEVELOPMENT AND GEODYNAMIC CONDITIONS OF THE URALS IN POSTCOLLISIONAL STAGE

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1. At the large part of the Urals an investigation of strain-deformation state of rock massives has been carried out by relevant complex methods.

It was established that collisional stage was characterized by regional compression directed subhorizontal and cross-strike of the main Urals folds.

The direction of regional tension for this stage has ambiguity, because in this period the type of the stress state resembles nearly that one-axial compression which has the same values relative tensional and intermediate stresses.

All the same, in the Northern and Southern Urals subvertical directions for axis tension of regional stress field were established, and showed thrust type of the stress field.

The existence of the large-scale thrusts, the belts of folding and other geological data corresponded with revealed regional stress field.

2.In postcollisional stage the region development has an orientation of compression vector that was inherited from late Hercynian time. With the results that an axis tension became subhorizontal and parallel fold axes, that indicates strike-slip type of tectonic stress field. In such stress field an activity of the north-west and north-east directed faults is maximum.

These faults have different sense of displacement: north-west faults have left-lateral displacement and north-east faults have a right-lateral one.

Vertical separation of faults (its value) and kinematic type (revers fault or normal fault) depend on direction of plane of displacement relative to the regional stress field.

3. Among structures that had been formed in collisional and postcollisional stages local structures were revealed. They have history of deformation that differ from the common conditions of deformation.

For example, Lyapinskiy anticlinorium area is characterized by larger vertical movements. There the sizeable volumes of rocks which have the same type of deformation as in collisional stage as in postcollisional stage were revealed. From the moment structure had been formed to present day subvertical direction compression axis was preserved.

In collision stage such direction of axis relative to diapirism of granite-gneiss dome (Bukanov et al., 1984). In postcollisional stage such direction of axis was inherited.

4. Our investigations have a great practical value.

The tectonophysical conditions of prospects rock crystal deposits are presented for the Northern Urals (Sim, 1983). Rock crystal nests were located at places, where variation of stress state were revealed. Such variations have been considered as a special type of the tectonical unstability.

In the Polar Urals it became possible to give the explanation of the reduction of ore content on different flanks of the Poloishorian fault in the Ray-Izskian ultrabasic massive region (Vasil'ev et al., 1985). This reduction was related to the blocks where tension axis orientation was sharply altered.

In the Southern Urals our investigations the adequate blocks became to indicate for safe location of nuclear wastes, and to estimate possible changes of the geodynamic conditions to near future.

DYNAMICS OF CRYSTALLIZATION NEAR THE ROOF OF A MAGMA CHAMBER TAKING INTO ACCOUNT CRYSTAL SETTLING

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Global plate tectonic processes invoice interaction of mantle plumes with crustal rocks. Numerous geological data suggest that mantle melts are predominant source of heat and, in a number of cases, of important chemical components for crustal granitic magmatism.

Large volumes of melts form isolated pools in the continental crust where interaction of mantle and crust matter occurs. During evolution of melts in the magmatic chambers great diversity of rocks is created.

Heat and mass transfer in a chamber is greatly influenced by convective processes (Huppert, 1980). Convection dictate heat transfer rate in a chamber. The dynamics of magma chamber crystallization and convection has been a controversial subject for the last decade. This contribution is devoted to the consideration of crystallization of basic melt near the roof of a magmatic chamber at the high heat removal. At large heat flux enhanced by fluid circulation crystallization is concentrated in relatively narrow layer near the roof. Crystallization accomplished by crystal settling is considered rigorously similar to the approach of Ribe (1985) and McKenzie (1984) for melt generation problem in the mantle. System is assumed to be two-component with two minerals of fixed composition. First solid phase solidifies in volume while second appears only on Stefan boundary at the eutectic temperature.

Simple relation connected crystal fraction (e) in any point (z - is vertical coordinate) of the two-phase melt not subject to convection and its composition is obtained:

$$\varepsilon(z) = \frac{b - C(z)}{(1-j)(1-C(z))}$$

where j is ratio of sedimentation velocity to the velocity of solidification front, constant b is determined in accordance with appropriate boundary condition for crystal transport equation. This relation enables us to gain analytical solution of the full problem in the case of constant melt viscosity. While using this relation different qualitative features of solutions for composition and solid fraction content dependent viscosity are obtained. At the large heat removal formation of a stable fractionated layer with low crystal content near the roof is inferred. Crystal flux from the roof into a main volume can induce sedimentary convection in it.

GEODYNAMIC MODEL OF FORMATION OF THE SOUTH KARA BASIN

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From a complex of geologic-geophysic data, in the structure of the Kara Sea shelf are distinctly marked out the Kara massif and the South-Kara basin separated by the North-Siberian threshold which corresponds to the belt of intensity gravity and magnetic anomalies. The thickness of sedimentary cover within the South-Kara basin makes up 7-16 km; the surface of crystalline basement was not established in the central part of the basin and the synrift Permian-Triassic complex lies immediately on the surface of "basaltic" layer. Velocity parameters and thickness of layers in consolidated crust of the South-Kara basin are confidently compared with DSS-data from the North to the West Siberian plate.

In this turn, the anomalous magnetic field of the West-Siberian plate is characterized by the most important features inherent to a spreading-type oceanic crust: lineation, inversion, and symmetry relative to the central Purovsko-Khudoseysky positive anomaly. The analysis of these features showed that the "aborted" Obsky paleo-ocean within basement of this plate is a classical example for a small ocean basin developed according to a model of the propagating rift putting deep down the continental margin. The short-term (Late Permian - Middle Triassic) spreading in this ocean was ceased because of started in the Early Triassic break-up of the Pangea and of the started opening of the North Atlantic. As a most probable reason for spreading in the Obksy paleo-ocean of the West-Siberian plate, apparently, it should be considered the established by paleomagnetic data the Early Triassic turning of the Siberian platform clockwise around the pole of rotation located in the region of Anabarsky Shield. The geologic-geophysical data from the northwestern part of the Siberian platform evidence that the rotation was continued during the Late Triassic to the Jurassic-Cretaceous times, inclusive. The rotation was accompanied by thrusting of the edge of the Siberian platform over the margin of the West-Siberian plate along the Enisei-Kharaelakhsky deep-seated thrust. Along the northwestern flank of this fault the margin of the Siberian platform is overthrusted on the folded Jurassic-Cretaceous deposits of the Enisei-Khatangsky sagging in length of tens kilometers. The rotation of this platform clockwise could be a reason for excitement of the upper mantle in the northern part of the West-Siberian plate, conditioned a spreading in its "aborted" Obsky ocean.

In this turn, the Early Mesozoic crustal extension in the South-Kara basin could be a reason for formation of Kimmerian fold-thrust belt of the Novaya Zemlya put forward into the Barents Sea along the fault system of the North-Siberian threshold and Pay-Khoy-Novozemelsky conjugation. So far as the named system of faults does not find a continuation into the Barents Sea, transforming in the system of the Prednovozemelsky reverse-thrust dislocations, there are all reasons to suppose that these strike slip faults are attributed to a class of transform faults of the "rift-frontal thrust's type". In that way, the offered model allows to tie up into the single geodynamic system of the type "back spreading - frontal thrust" the extension of the crust in the South-Kara basin and the formation of the fold-thrust belt of the Novaya Zemlya.

GEODYNAMIC MODEL OF FORMATION OF THE SOUTH BARENTS BASIN

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From DSS-data within the South-Barents basin it was established a significant, up to a total break thinning of "granitic" layer. However, a question about mechanism and time of active riftogenesis remained to be discussed.

According to CDP-data a characteristic pattern of oblique layered seismofacies of lateral accumulation's type and a correspondence of maximum thickness of the Permian complex to marginal parts of the basin indicate that the beginning of the Permian times within it there already existed a deep-water basin non-compensated by sedimentation. The enormous thickness of Lower Permian clinoforms allow to evaluate the depth of this basin in 3-4 km and to consider a basin of a suboceanic type. On the contrary, the enormous thickness of Triassic complex (6-8 km) confined to a central part of the basin allows to characterize it for that period as an area of avalanche sedimentation. In that way, the depocenter of accumulation of Triassic sediments, formed in place of the Permian non-compensated deep-water suboceanic basin, coincides with an area of "non-granitic" crust only by space and therefore does not define any times of active showings of riftogenesis in the South-Barents basin.

The geodynamic model of formation this basin is supposed in connection with movements along the Trollfjord-Komagelve Fault constrained a development of the Caledonides on the north of the Baltic Shield and on the south-western shelf of the Barents Sea. Two variants of paleomagnetic test of character displacement of allochthonous block of the Varanger peninsula are discussed with respect to other blocks composing the accretionary structure of the Baltic Shield. Model "A" means a significant (>1000 km) right-lateral shift along this fault during the Late Precambrian-Devonian times. But this model is not correct because of essential difference in age of the Butsfjord dykes (~ 640 m.y.) located on the northern side of the fault compared to the age of the Sveconorwegian and Torridonian rock complexes (1100-800 m.y.) - on the southern side. Model "B" reveals a small, but significant enough, difference between the position of pole of Butsfjord dykes, on the one hand, and the position of pole of the Nekse and Fen dike complexes (550 m.y.), on the other hand. This difference may be attributed on account of small differences in age and, hence, of appearing migration of paleomagnetic poles. However, of these differences interpretated in terms of shearing tectonics, they could then be a result of left-lateral shift along the Trollfjord-Komagelve Fault with an amplitude more than 600 km during the Late Precambrian-Devonian times.

The amplitude of left-lateral shift along this fault fully corresponds to the width of "non-granitic" crust area in the basin at the latitude of its crossing by DSS-profile. The Caledonian age of movements along this fault implies the corresponding age of crustal extension in this basin; that the non-compensated character of sedimentation during the beginning of Permian period is explained. The totality of these data allow to suppose that the Caledonian riftogenesis in the South Barents basin was conditioned by clockwise rotation of the Spitsbergen-Varanger block crust around the pole of rotation located to the south of the Franz-Josef-Land.

GEODYNAMICS OF THE LAPTEV SEA SHELF

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By CDP-data (MAGE PGO "Sevmorgeo", 1986) in the central part of the Laptev Sea shelf a development of the system of linear and asymmetric riftogeneous structures with fault amplitudes from some hundred meters to 2 km was established. The times of formation of this rift system are dated by the Paleogene as far as for all the pre-Paleogene parts of sections, the faults, as a rule, are the post-sedimentary units attenuating in acoustically transparent thickness of the Paleogene complex. The Omoloisky graben of this system is a connecting link between the spreading-type Gakkel Ridge and the system of basins of the Momsky rift zone. Along this rift zone a gradual rejuvenation of formation times of extension structures was established: from the Paleogene on the shelf of the Laptev Sea (Omoloisky graben) to the Pliocene on the south-eastern flank of the Momsky system of basins (Momo-Selenyakhsky basin). This regularity is in a good conformity with a diachronous character of the opening of the Eurasian Basin because the pole of relative rotation of the plates EA and SA from beginning of the Eocene (~ 56 m.y.) shifted from the Laptev Sea shelf to the Suntar-Khayata Ridge on the coast of the Okhotsk Sea. However, at present time the system of the Momsky basins is not "alive" seismological structure. Its activity was ceased about 2-3 m.y. ago when the pole of relative rotation transferred to a place of its modern position to the south of the Bour-Khaya Bay. As a reason for such a sharp return of the pole of rotation to the coast of the Laptev Sea was an inclusion into the plate configuration the additional Okhotsk Sea plate, separated from the EA plate about 2-3 m.y. ago.

The features of structure of riftogeneous basins in the most marginal part of the eastern Laptev Sea were studied by means of seismic surveys (SMNGR PO "SOYZMORGEO", 1991). The Cretaceous age of half-grabens confined by listric faults with an eastern dip of fault planes is a good conformity with an age and kinematics of right slips along the north-western flank of the South Anyui suture. This suture connected with an opening of the Amerasian Basin represents a trace of the closed Late Jurassic Anyui ocean, the bed of which was subducted under two island arcs of opposite polarity. The main reworking of early subduction dislocations of this suture occurred between the Hauterivian and Aptian as a result of collision of the East-Siberian and Chukchi blocks of the EA and NA plates. The features of dislocation structure of this stage of the evolution of the South-Anyui suture testify to right shearing deformations oriented along the stretching of this suture. The upper age boundary of movements along this suture is determined by the times of formation of unconformable shearing in the Okhotsk-Chukchi volcanogenic belt, formed in a rather narrow time interval from Aptian to Albian with a maximum in 100 m.y. (Late Albian). In that way, to the beginning of the Late Cretaceous times the movements along the South-Anuisky suture were to be blocked up by the Okhotsk-Chukchi volcanogenic belt. Hence, the synrift complex of filling grabens in the most marginal part of the Laptev Sea shelf ones should date by the Hauterivian-Aptian that is by times of the most intensive movements along this suture.

PETROGENESIS CONDITIONS IN THE SUPRA-SUBDUCTION ZONES

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Results of study of modern island arcs of the West Pacific in comparison with Vendian-Cambrian ophiolites of the South Siberia are cited. With the help of melt inclusion investigations petrogenesis conditions of the boninites bearing primitive island arcs (Uzu-Bonin Arc - Pacific; Kurai ophiolites - Altai Mountains) and more developed island arcs (Kurile Arc - Pacific; Kuznetsky Alatau ophiolites) are reconstructed.

Temperature of homogenization (T_{hom}) of the primary melt inclusions in clinopyroxenes from Altai Mountains boninites reaches 1230-1290°C in the majority of experiments. The same temperatures (1230-1290°C) were estimated for inclusions in orthopyroxenes from Uzu-Bonin Island Arc boninites, whereas the clinopyroxenes from these rocks are characterized by lower homogenization parameters (1220-1260°C). Obtained T_{hom} are in good agreement with the data on other island arc boninites: Tonga Arc - 1150-1290°C (Danjushevsky, Sobolev, 1987), Mariana Arc - 1200-1280°C (Geology of the Philippine Sea Floor, 1980).

On variation diagrams, compositions of homogenized melt inclusions from the studied pyroxenes fall exactly within the boninites fields. An obvious reduction of MgO content in the boninite melts of the Altai Mountains and Izu-Bonin Island Arc was found for SiO_2 growth. Enrichment melts in FeO causes increase of TiO_2 from 0.18 up to 0.35 mas.%. The data on the ancient and modern boninites are in full agreement. If FeO increases, SiO_2 content in the melt inclusions of the ancient rocks decreases. Altai Mountain and Izu-Bonin Island Arc boninites are similar by K_2O and Na_2O contents in the melts.

Clinopyroxene crystallization temperatures (T_{hom} of the primary melt inclusions) decrease regularly along side cross-section of Shikotan Island (Kurile Arc) magmatic association: peridotites (1340-1380°C) - gabbro (1270-1300°C) - dykes (1230-1260°C) - lavas (1210-1265°C). In Kuznetsky Alatau ophiolites we have wide interval of clinopyroxene crystallization temperatures in dyke complex (1150-1280°C) and more local in gabbro (1220-1280°C). As a whole, this information is rather close to the Shikotan data.

Thus, the analysis of the melt inclusions in the minerals proves that the rocks from the ancient ophiolites and from volcanic complexes of the modern island arcs are very close in the conditions of their genesis. In particular, the boninite pyroxenes were crystallized at 1230-1290°C from the "boninite" melts with low TiO_2 and relatively high MgO and SiO_2, characterized by a significant differentiation of the magmas by enrichment in FeO. The reported data allow to make a valid reconstruction of paleogeodynamic conditions of the formation in supra-subduction zone of Vendian-Cambrian ophiolite complexes of the South Siberia.

GEODYNAMIC MODEL OF THE MODERN STRUCTURE OF THE RJAZAN-SARATOV BASIN

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The modern structure of the Rjazan-Saratov basin (RSB) was revealed. Several formal characteristics of the relief of the basin's surface were analyzed: heights, drops of heights, density and orientation of linear elements of the relief and also qualitative parameters: design of the river system, and general character of the relief. As a result several blocks of different size were defined. RSB is situated on the territory of the two largest blocks. Their border (A) stretches along Oka and Tsna rivers. To the west from this border (A) the borders of block coincide with the edge of the ancient RSB.

To the East from the border (A) structure was mapped which reminds the ancient RSB only in general. It forms a large arch skirting a giant Tocmov swell. In the west of the modern structure it does not repeat the ancient RSB but the other one which borders with it in the North. Going to the East the modern structure is situated on the south of the ancient basin. And only in the East end the modern structure coincides with the ancient one.

Restoring the modern geodynamic situation we supposed that the design of the linear elements of the relief can be identified with the design of rifts appearing as a result of geodynamic tension. The western part of the RSB has a uniform design of rifts. The design of rifts is greatly changed near the border (A). We can see predominance of meridianal rifts there. In the eastern part of the basin the design of rifts is changed again. The design of rifts there coincides with general orientation of the structure. The restored design of rifts shows that there is no distinct orientation of geodynamic tension in the western part of the basin. This fact witnesses the extreme stability of the western part of the basin. The design of rifts in the eastern part of the basin shows a predominance of geodynamic tension in either north-east or south-west direction.

INDICATORS OF POSTCOLLISIONAL EXTENSIONAL PROCESSES IN FOLDED SYSTEMS OF THE SOUTHERN SIBERIA (RUSSIA)

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High-grade metamorphic blocks or massifs of various size, surrounded by low metamorphic rock series, are important constituents of folded systems of the southern Siberia. The massifs are traditionally believed to be the fragments of tectonically dismembered and reactivated basement of the Siberian paleocontinent, or fragments of basement of microcontinents. Critical reinterpretation of geological materials makes it possible to consider some of these massifs as metamorphic core complexes of Cordilleran type.

Studied in detail in Cordillera (Crittenden et al., 1980) core complexes were found later in other areas: in Himalaya, in Alpine Corsica and Greek Cyclades, Alaska and other places. Core complexes are considered as indicators of post or late collisional (accretional) asymmetric extension. Usually their formation is accompanied by contemporaneous sedimentation in restricted narrow basins and voluminous magmatism of various types.

Two relatively narrow stripes with metamorphic core complexes are distinguished. Western stripe, composed by Late Precambrian-Early-Middle Paleozoic series include core complexes with assumed Early Paleozoic age of formation. Eastern area is composed mostly of Late Paleozoic-Mesozoic volcano-sedimentary series with abundant intrusions of various origin.

Paleozoic metamorphic core complexes include Gargan and Shuthulai massifs of the East Sayan, Dzhebash massif of the West Sayan, Chulyshman, Teletsk, Tongulak and Katun-Chuia massifs of the Gorny Altai. Composition of these massifs may be essentially gneissic (Gargan), gneissic with amphibolites and marbles (Shutulai), volcanic-sedimentary (Dzhebash) or essentially pelitic (massifs of Gorny Altai). In marginal parts low-dipping blasto-mylonites are usual, superimposed on metamorphic rocks as well as on surrounding volcanic-sedimentary series. Metamorphism of complexes vary from high greenschist to amphibolite facies with usual occurrence of zonal metamorphism of And-Sill type. Ages of protolith vary from Late Archean to Early Paleozoic. Age of tectonic exposure of core complexes is Early-Middle Paleozoic, being in a good agreement with proposed Late Cambrian-Ordivician collisional processes in the marginal parts of the Siberian craton (Berzin, Dobretsov, 1993).

Mesozoic metamorphic core complexes of the northern Mongolia and southern Buryatia usually compose relatively narrow elongated massifs among Late Paleozoic and Mesozoic rock series. They have essentially gneissic composition with rare layers of marbles and amphibolites. The dip of foliation in flanks and in central parts of complexes rarely exceeds 30-40°. Available age data show relatively wide interval - 260-120 Ma with rare older values. Formation of these complexes is supposed to be connected with closure of Mongol-Okhotsk ocean in Late Permian-Early Triassic in the west, changing to Middle-Late Jurassic eastward.

LOWER AND MIDDLE JURASSIC RADIOLARIA OF THE SOUTH SIKHOTE-ALIN

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A number of the samples containing well-preserved radiolarian fauna has been collected from the Lower and Middle Jurassic sediments of the Okrainka Formation, South Sikhote-Alin, Russian Far East. The samples with Radiolaria can be correlated in most cases to the samples containing ammonites and Retroceramideae.

1. The lower part of the Okrainka Formation sediments contains Upper Pliensbachian ammonites such as Articeras cf. alganianum (Appel) and "Dactylioceras" cf. polymorphum in the Poperechka River basin, Amaltheus stokesi (Sov.), Arieticeras japonicum Mals., A. aff. alganianum (Appel), "Dactylioceras" polymorphum Fuc., "D." simplex Fuc., Fontanneliceras cf. fontanelenllense (Gemm.), Protogrammoceras cf. serotinum (Bett.), and Peltarpites sp. in the Izvilinka River basin. A following radiolarian assemblage correlated to the Upper Pliensbachian has been found in the sediments from these localities: Canutus indomitus Pess. et Whallen, C. giganteus Pess. et Whallen, Bagotum maudense Pess. et Whallen, B. modestum Pess. et Whallen, Droltus sp., Eucyrtidiellum unumaensis Yao, Unuma typicus Ichikawa et Yao, Stichocapsa cf. tigiminis group Yao, St. cf. Convexa Yao, Zhamoidellum sp. A sp. nov., Cyrtocapsa kisoensis Yao, Orbiculiforma aff. sakaii Mizutani, Tripocyclia sp., Tetrabs sp.

2. The middle part of the Okrainka Formation sediments contains Upper Aalen-Lower Bajocian Retroceramidae: Mytiloceramus ussuriensis (Vor.) and Bositra buchi (Roem.) in the Sokolovka River basin, M. aff. ussuriensis (Vor.) and M. cf. skorodi (Vor.) in the Izvilinka River basin. The following radiolarian assemblage has been found in the sediments from these localities: Lupherum officerense Pess. et Whallen, L. cf. nitidium Pess. et Whallen, Hsuum sp., Archaeodyctiomitra sp., Cyrtocapsa kisoensis Yao, C. cf. mastoidea Yao, Stichocapsa japonica Yao, Unuma echinatus Ichikawa et Yao, Tricolocapsa fusiformis Yao, T. cf. plicarum Yao, Williriedellum sp. A. group Matsuoka, Gongylothorax oblongus Yao, and Amphibrachium sp.

3. Well-preserved Radiolaria have been collected in the Sokolovka River Basin from the middle part of the Okrainka Formation sediments with Lower Bathonian Mytiloceramus sokolovskiensis I. Kon., M. ex. gr. kystatimensis (Kosch.), and Bositra buchi (Roem.): Cinguloturris carpatica Dumitrica, Stichocapsa convexa Yao, Unuma echinatus Ishikawa et Yao, Podocapsa cf. amphitreptera Foreman, Cyrtocapsa mastoiea Yao, Williriedellum sp. A group Mats., Zhamoidellum micamense Aita, Tricolocapsa plicarum Yao, Stylocapsa lacrimali Mats., S. lecta Mats., S. oblongula Kosher, Napora sp., Hagumastra transversa Blome.

4. In the Levaya Antonovka River Basin, the samples with Radiolaria have been collected from the layers with Mytiloceramus cf. planus I. Kon. Some samples have been collected from the over- and underlying beds. The radiolarian assemblage from this locality is: Archaeodictyomitra rigida Pess., A. vulgaris Pess., A. cf. suzuki Aita, A. cf. apiaria (Rust), Pseudodityomitra sp. D Yao, Hsuum maxwelli group Pess,. Eoxitus ahimaensis (Baumgartner), Ristola decora Pess. et Whallen, Eucyringium cf. niobese Tan., Stichicapsa japonica Yao, Protonuma costata Hoizer, Zhamoidellum ovum Dum., Z. micamense Aita, Z. ventricossum Dum., Williriedellum sp. A group Mats., Tricolocapsa yaoi Mats., T. plicarum Mats., T. capitata Tan., Gongylothorax favosus Dum., Stoylocapsa oblongula Kosher, Triactoma blackei (Pess.).

According to the Dr. I. Konovalova mention, Mytiloceramus cf. planus indicates the Lower Bathonian. The radiolarian assemblage from this locality appears to be slightly younger than one from the Sokolovka River Basin.

THE DYNAMICS OF THE OCEANIC MANTLE MELTING: EVIDENCE FROM THE PRIMARY MAGMAS INVESTIGATION

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Theoretical models (e.g. McKenzie 1985) and SIMS analysis of clinopyroxenes in abyssal peridotites (Johnson et al., 1990) suggest efficient extraction of small volumes of melt from mantle sources, indicating the existence of ultra-depleted melts. However, primitive MORB's are not even close to the required compositions. This raises a question: Do the ultra-depleted melts ever exist in the oceanic mantle, and if so where are they hidden?

We have discovered such melts, trapped as inlcusions in the magnesium-rich olivines (Fo 89-91) at 9°N Mid-Atlantic Ridge and Reykjanes Ridge, Iceland. They were analysed by a Cameca IMS-3F ion probe at WHOI for REE and Sr, Zr, Ti, Cr, V and Y. Characteristic features of these melts are very high Ti/Zr ratios (200-600), and usually low $(La/Sm)_n$=(0.04-0.40) accompanied by major element composition (Ca,Al) typical for primitive MORB. Modelling both trace and major (Ca,Al) element compositions of inclusions show that neither batch nor ideal fractional melting models explain the observed characteristics. A "continuous" fractional melting model (e.g. Langmuir et al. 1977), whereby a constant amount of melt fractions is retained in the residuum satisfactory produce all the salient feature. Starting with a depleted mantle source, the model produces melts with observed chemistry, when a maximum of 1-3% of the melt is retained in the residuum. In all cases matrix glasses and bulk rocks represent mixing products significantly less depleted than inclusions. The abundant occurrences of the ultra-depleted melts and our modelling indicate that the mechanism for MORB genesis is a continuous fractional melting, and hence various extent of mixing of melt fraction defines chemical characteristics of erupted basalts.

STRUCTURE OF THE DAGESTAN THRUST BELT, THE NORTH-EASTERN CAUCASUS, RUSSIA

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Boreholes and seismic data in the foothills zone of the north-eastern Caucasus obtained during the last decade in the course of petroleum exploration reveal considerable differences between the surface and subsurface structures of the area. The new data suggest that this zone may be viewed as a buried thrust belt. The allochthonous assemblage of the belt is formed mainly by stacked north-verging thrust sheets made up mostly of Mesozoic carbonates and sandstones bounded at the top and bottom by conjugated detachment surfaces. The thrust sheets are interpreted to be inserted into the clastic section of the Terek-Caspian foredeep along the base of Oligocene-Early Miocene mud-stones. The blind subsurface thrusts have been active since the late Miocene time until recent. Strata above and below the allochthonous unit are characterized by independent styles of deformation. The slightly deformed foredeep clastics create hinterland-facing monocline that is passively uplifted by underthrust thrust sheets. These rocks mask the subsurface structures. The interpreted geometry of the thrust belt front implies its shortening of about 20-40 km.

It appears that mechanical weakness and lower value of density of the overpressured Oligocene-Lower Miocene Maykop Formation (2.28-2.44 g/cm^3 vs. 2.42-284 g/cm^3 of the underlying competent Mesozoic rocks) prevented transmitting of the compressional stress across it. This rheological heterogeneity of the sedimentary section is thought facilitated subsurface thrusting.

The new interpretation of the regional structure offer a petroleum exploration play consisting of structural traps within the buried antiform stacks. Regionally, oil and gas bearing upper Cretaceous and upper Jurassic carbonate rocks involved in thrust sheets are considered as primary prospecting targets.

WHICH MODEL FOR THE EVOLUTION OF THE CARLSBERG RIDGE BETWEEN 20 AND 45 MA (ANOMALIES 6 TO 22) ?

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The Africa plate is separating from India-Australia along the Carlsberg (CAR) and Central Indian (CIR) ridges. Until recently these two ridges were regarded as a single plate boundary the evolution of which was characterized by fast spreading up to anomalies 18/20 and slow spreading since this time. During both periods the spreading rates decrease northwestwards from the Indian Ocean Triple Junction to the Owen Fracture Zone. The observation of a compressive deformation zone in the Central Indian Basin has led to the reexamination of the compatibility of decreasing spreading rates along the ridges with a single plate boundary and demonstrated the existence of differen-tial plate motion, spreading variations can be expected to have occurred during the slow spreading period and to have been recorded in the magnetic field on each side of the two ridge axis.

The spreading history of the Carlsberg Ridge was very poorly constrained (only anomalies 5 and the series 22-27 had been identified) until 1990, when the interpretation of a high resolution Russian survey carried out from 1980 to 1988 revealed a complete sequence of anomalies from 1 to 31, which indicated constant spreading rate and direction from anomaly 1 to 13. However, this model calls for a major change in spreading direction after anomaly 13 time instead of anomaly 18 as observed in the conjugate Central Indian and Madagascar basins on either side of the Central Indian Ridge. Comparison of observed profiles from these two basins with profiles from the Arabia and Somalia basins, respectively, shows that the magnetic sequences are similar and that the series 13-24 can be reinterpreted as 20-24.

We have tested this second model by comparing the younger anomalies to synthetic magnetic anomalies computed with a slower spreading rate. The series 6-13 of the first model containing low amplitude variations can be reinterpreted as series 6-20 created at a ultra slow half spreading rate of about 8 mm/a. The consequences of both models on the evolution of the NW Indian Ocean are discussed.

SEDIMENTARY BASINS OF CONTINENTAL MARGINS: SEDIMENTATION, DEFORMATION, OIL AND GAS POTENTIAL

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Sedimentary basins of ancient and modern continental margins are notable for their heterogeneous structures and complex geological histories. Within this basinal set the specific interest present deep-sea marine basins - relics of ancient Tethys Ocean. Sedimentary infilling forms several "floors", characterized by heterogeneous structure - these being divided by the intervals of respectively uniform and calm occurrence. The first of them had been formed during activation of tectonic movements, mainly affecting zones of framing, when new depocenters of great terrigeneous mass accumulation were laid. The second ones met the periods of tectonic calmness, when re-distribution of the matter and fluids within basinal entrails had been hardly manifested. Large sedimentary depocenters are commonly bent for deltas and subsea fans. Accumulation of thick sedimentary formations had taken 1-2 m.y.; after being merged altogether they formed large depressions. Accumulation of the poorly condensed sediments had been accompanied by subsidence of underlying beds to the significant depths and release of great quantities of fluids from clayey rocks to collector horizons. Within the entrails, zones of abnormal pressures arise. Then the moment comes, when fluidal pressure within the reservoir increases so that this results in rupture of source rocks. The pulp formed makes its way upward to the surface. As the result, diapir clayey and salt structures arise; and if fluidal flow is particularly great, then mud volcanoes and salt domes appear. Such formations were found in the residual seas of the Tethys Ocean; within southern Caspian Depression, Genova Gulf of the Ligurian Sea, in the western Black Sea Depression and almost commonly before the front of deep-sea fans. In addition, in the basins located at junctions of platforms or plates with recent ridge-folded buildings of the Alpian Belt, the arise of heterogeneities within sedimentary cover is accompanied by formation the echelonment system of anticlinal uplifts, characterized by upthrust origin. Such structures are observed on continental slopes of the Crimea and north-western Caucasus. Numerous diapiric structures of clayey origin and folds have been found in the Ionian Sea. In breccia from mud volcanoes, as well as within near-fault zones, complicating anticlinal uplifts, gas-hydrate accumulations were discovered and the enrichment of fluids by various metals, which testifies to the movement of fluids from the entrails to basinal surface. All this is indicative of the self-organizing mechanisms of re-distribution fluids (including oil-gas ones) between different structural "floors" of sedimentary basins, which to a great deal pre-defines the position of oil-gas accumulation zones.

GEODYNAMIC RECONSTRUCTION OF THE EARLY PROTEROZOIC UNAHINSKY GREENSTONE BELT (STANOVAYA REGION OF THE ALDANIAN SHIELD)

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The authors have determined the greenstone belt in the lower Unaha River Valley. It has been called the Unahinsky Belt. Detailed studies of the geological structure of the belt and also petrographical, petrological and geochemical features of rocks have permitted to draw a number of inferences.

1. The Unahinsky greenstone belt was formed in Early Proterozoic (2.1-1.94 milliard years ago). Its constituent structural-substantial complexes are of significantly volcanogenic composition with predominance of metabasites. They were subjected to progressive metamorphism of epidote-amphibolite facies, probably in synchronism with regressive metamorphism of a basement. There is a regular alteration of the rock composition in the belt from mostly basic-ultrabasic one in the lower part to predominance of metaandesites and metapelites in the upper part of the section.

2. The internal structure of the belt is specific. It is distinguished from the frame granulites by more compressive folding and fault tectonics and often by the direction of the banding, especially in southern blocks. The folds of regional compression, which are most preserved in the northern part of the belt, have the north-western strike in

conformity with the linear folding of the granulites. The later folding, which complicates these structures, is predominantly connected with overlap faults prevalent in the southern part of the belt. On early stage of the belt formation its structural-substantial complexes as well as the granulites were folded according to north-eastern compression. Then this pattern of deformations gave way to submeridional one and the overlap faults with mass transition from south-east to north-west resulted in formation of the shingle-overlap zone in the southern part of the belt and in complication of the structure of the belt.

3. The analysis of petrological-geochemical features of the basic volcanites of the belt, examination of its internal structure permit to determine the main stages of formation. The Unahinsky greenstone belt was initially formed as a rift structure on the earth crust of the continental type - supracrustal rocks of granulite facies of metamorphism with fragments of gray-gneissic basement. It was confirmed by the presence of continental rift basalts in the belt section. Then the rift stage gave way to spreading of ocean floor and the process of the greenstone belt formation has been completed by subduction accompanied by formation of basalts of island arc series, by collision of microplates and creation of compressive folded-overlapped structure of the belt.

4. The position of the Unahinsky greenstone belt in the structure of the Stanovaya region and also its role in Precambrian history permit to consider the belt as one of the large suture structures, which divide geoblocks of the region - Early Proterozoic terrains.

GEODYNAMIC MODEL OF EVOLUTION OF THE PRE-CASPIAN SEDIMENTARY BASIN

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The Pre-Caspian basin is one of the largest world basins in terms of sedimentary infilling. Its area exceeds 500 thousand km^2 and thickness of the sedimentary cover in its inner part (Central Pre-Caspian graben) is 20 km. In the south and east the central graben is bounded with the system of the Aktyubinsk-Astrakhan basement protrusions.

Morphological features of the basement surface reflect the structure of the crystalline part of earth's crust. The Aktyubinsk-Astrakhan belt of protrusions is characterized by the development of continental crust whereas its margins and the central Pre-Caspian graben - suboceanic type. Such features are controlled by geodynamic evolution of the region.

The most significant period in its development falls on the Riphean. In the early Riphean on the margin of East-European continent the Pachelmsky rift had been laid open to the side of the Pre-Uralian ocean. The late Riphean period corresponds to the epoch of compression and closure of that ocean. An intra-craton basin bounded in the South by Baikalide mountain structures and filled-in by products of their erosion had been formed along the outer edge of the collision zone in the region of the Central Pre-Caspian graben. In the Vendian the territory of the Pre-Caspian basin developed as a passive continental margin with shallow sea sediments. In early Paleozoic the Ural and Southern-Embian rifting systems have been laid consequently. The territory of modern Pre-Caspian basin is a part of the large negative structure which is a marginal sea basin and which comprised the inner trough and peripheral continental slope divided with the arch-chaped system of islands. The Devonian-Artinskian period is characterized by definite cycles in sedimentation. Periods of the non-compensated subsidence (in some part of the territory) changed into epochs of thick accumulations which filled the depression earlier.

In the basin multi-stage reef systems have been forming parallel to the accumulation of relatively deep marine sediments of non-compensated type. The marine basin reached maximum deep in the Artinskian time. It was preceded by a general upthrusting of folded marginal structures: Urals, Southern-Embinsky uplift and Karpinsky ridge. The amplitude of desceding tectonic movements at the Devonian-Artinskian time was more than 4 km. The compensation of the formed Pre-Caspian deep marine basin had fallen to the Kungurian when the accumulation of salts of 5 km thickness took place.

.During the Mesozoic-Cenozoic in the territory of the Pre-Caspian depression sediments of epicontinental basins had been accumulated.

ORIGIN OF DIAMONDS AND THEIR PREDICTION FOR THE KOLA PENINSULA

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A lot of new geological, geochemical and isotopic data on diamondiferous rocks and diamonds allow to suggest a new model of their generation. In accordance with new original points of view based on the plate tectonic ideas diamondiferous and related rocks were originated due to melting and differentiation of earlier Proterozoic heavy (ferrous) pelagic deposits subducted about 2-1.8 b years ago under the Archean continental shields. Because of the melting temperature of the sediments saturated with water (about 600° C) is lower than the mantle temperature (about 1300° C), the subducted pelagic sediments were being melted at the depth of 50-80 km and were forming the chains of longliving magmatic differentiated chambers under the Archean shields along subduction zones of Svekofennian time.

The deepest chambers of diamondiferous melts were formed close to the base of continental lithosphere at the depth of 200-250 km. The diamonds in these deep magmas saturated by vapor components were crystallized due to dissociation of carbon oxide in the presence of carbonhydrates formed from organic matter of the former oceanic sediments. The reaction is followed by heat emanation and is resulted in the carbon crystallization.

The magmatic density after their liquation and separation of ferrous components is lower than the density of continental lithosphere. So, in the periods of breaking and crushing of the continents the deep magmas were rising up to the Earth surface formed the intrusions and diatrems of exotic rocks.

Accounting the proposed model of diamond origination, the concrete criterions of diamond rock forecast are formulated. On the base of these criterions and facts of geological structure and tectonic evolution of the Baltic Shield the forecast of diamondiferous rock location in the Kola peninsula is done.

PALEORECONSTRUCTIONS OF CONTINENTAL DRIFT IN PROTEROZOIC TIME

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The estimations of numbers of mantle convective cycles, carried out in our work, showed that for geological history of Earth at least four times in its mantle one-cellular convective structures have originated: at first in the time of formation of Earth core about 2.7-2.6 billion years ago; then 1.9-1.8; 1.1.-1.0; and 0.3 billion years ago.

During working of the one-cell convective structures above downgoing mantle flows continents before separate had coming together and formed the unified continents. The first such supercontinent, formed 2.7-2.6 billion years ago we named Monogea (V.E. Khain and N.A. Bozhko independently called it Pangea-O). According to geological data the existence of second supercontinent in the end of early Proterozoic was suggested by G. Stille who named it as Megagea. The third supercontinent formed in middle Riphean as a result of Grenville orogeny we called Mezogea. The existence of the more known supercontinent Pangea was substantiated by A. Wegener according to paleoclimatic and geological data at the beginning of 20th century.

For Procambrian time the paleomagnetic data are not reliable, therefore at paleoreconstructions we used these date only for the very late Vendian, but for more earlier time we selected the climatic indicators: tillites and tilloides as evidence of high-latitude cold climates and redcolours as indicators of low-latitude, humid warm ones. Fitting of coast lines of ancient continents for all Proterozoic reconstructions was carried out according to exhibition of the same age orogeny phases on adjacent platforms.

As a result 8 global reconstructions of spatial arrangements of continents and oceans in Proterozoic from 2.7 billion up to 550 million years ago were carried out.

INHOMOGENEITIES IN THE DEEP STRUCTURE OF THE PHILIPPINE SEA

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Any theories concerning the evolution and dynamics of transition zones must be constrained by our knowledge of the variation in deep structure.

The Philippine Sea consisting of a series of deep-water basins and shallow ridges, and is surrounded by belt of deep-sea trenches and island arcs. The deep structure of the region is complicated and differentiated with blocks of suboceanic, continental and transitional types of the crust. The understanding of mechanism of the segment interactions is an important part of geodynamic models.

The results of seismic refraction profiles made in the Philippine Sea (1959-1991) are present on the schematic structure section crossing of the sea along the latitudes: 18-19; 24-25; 29-32. The seismic refraction profiles were made with the various technique observation and the methods interpretation. For many years marine seismic refraction profiles have been interpreted in terms of a small number of layers separated by planar interfaces and constant seismic velocity in each layer being assumed. Trend in recent interpretation suggests that an alternative physical model of the crust in which the velocity is allowed to vary continuously with depths.

The structure sections crossing the Philippine Sea are composed from the of individual profiles with help interpolate of the seismic date (velocity-depth). Homogeneous layering of crustal models is replaced by a velocity gradient. Mean crustal velocities (inclusive water) were computed from each profile where a mantle event was recorded. The region average result is 6.0+0.3 km/s. A geographical plot of mean crustal velocities indicates a random spatial distribution of values (maximum - 6.3 km/s in east Philippine basin, minimum -5.6 km/s below ridges). The deep structures of the tectonic zones are asymmetrical. High mantle velocities (8.5-9.0 km/s) as well as low crustal ones are observed on the eastern margins of deep basins. Total crustal thickness is shown to be thinner in the eastern part of basin, approaching only 3.5 km. The seismic velocity structure of the Philippine basins, obtained from the long-line data, show existence of the velocity gradients below the discontinuity M. Velocities at the mantle are found to be 7.9-8.1 km/s at depths 29-30 km velocities increase up to 8.39-8.55 km/s. The discontinuities M. that are identified on the crustal base are deformed sustaintially, that is associated with the crustal compression and faulting. The detailed seismic data show that the crust and upper mantle below of the Mariana Arc have a confusing appearance. The much of the variability gradient velocity-depth in zones junction of the tectonic structures show to the possibility of the faulting and tectono-magmatic processes.

Inhomogeneities of the deep seismic structures seems to be much greater than expected from plate tectonic theory. Having several possible models for the formation of marginal sea, that cannot be explained by plate tectonics alone, that their origin is controlled more strongly by inhomogeneous structure and flow in the asthenosphere.

GEOLOGY AND GEODYNAMICS OF OPHIOLITES OF THE NORTH-EAST OF CENTRAL KAZAKHSTAN

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The author defines the term "ophiolites" as a single volcano-plutonic series of acid-middle-basic-ultrabasic rocks of sub-layered structure in original unbroken bedding which are formed as a result of sequential development of complementary effusive and plutonic complexes. In the modern terrane structure of the Central Kazakhstan North-East Caledonides, the rocks of early-Paleozoic ophiolite associations of different age occupy different geotectonic position: dismembered ophiolite associations compose prefolded consedimental packets of nappes "sealed" into late-Ordovician olistostromes (Agyrek-Kosgombai-Talpak and Maisor-Baiakhmet zones) or they form post-folded sheets overthrusted dislocated complexes of Paleozoic which are also closely conugated with Ordovician olistostromes (Bogimbai-Angrensor zone); pseudo-stratified Karaulchekinsk association occurs in the basement of Paleozoic section but it is also overthrusted alongside with it.

Basaltoids of ophiolite zones have no chemical analogues among gabbroids of serpentinite melanges and they correspond according to their petrochemical composition to island-arc tholeiites, shoshonites and volcanites of alkali and calc-alkali series, i.e. they do not correspond by chemical equivalents of basalts of median-oceanic ranges. Basaltoids, packet of nappes are not more ancient by the age relatively to monotonous siliceous strata, but they are synchronous or even younger, i.e. the classical scheme of ophiolite triad structure is disturbed in the zones of dismembered ophiolites of Kazakhstan and consequently they do not belong to the single association.

Diabases and keratophyres are in serpentinite melange in the form of blocks or lumps and this fact casts some doubt on their belonging to the complex of parallel dykes. Only the presence of sill complex has been reliably established in Kazakhstan ophiolites and it determines the specificity of Kazakhstan ophiolites.

Ophiolite basite-hyperbasite complexes of Kazakhstan judging by their petrogeochemical composition of rock-forming and accessory minerals are not early-oceanic ones, i.e. they do not belong to passive melanocratic basement where volcanites and siliceous-terrigenous sediments have accumulated, but they are later than "overlapping" them volcanites in the pseudo-stratified ophiolite sections. The figures of the absolute age (470-480 mln years in Talpak massif) also indicate this fact.

Ophiolites of Maisor-Baiakhmet, Bogembai-Angrensor zones as well as massifs of Talpak and Karaulchek correspond to ophiolites forming in supra-subduction zones of Jh.A. Pirs according to character of stratification, crystallization sequence, petrochemical composition of rock, rock-forming and accessory minerals.

IMPLICATIONS FOR CANADA BASIN DEVELOPMENT FROM THE CRUSTAL STRUCTURE OF THE SOUTHERN BEAUFORT SEA-MACKENZIE DELTA AREA

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A more complete understanding of the structure of the southeast margin of the Canada Basin near the Mackenzie Delta has emerged with the acquisition of a number of crustal reflection and refraction profiles since 1986. Incorporating these surveys with the existing industrial reflection seismic data base has given an excellent overall picture of the crustal and upper mantle structure. Regional potential field data are used to extrapolate the seismically-constrained crustal features to infer constraints on the planview of the continent-ocean crustal transition in the southern Beaufort Sea. The present margin was formed in the Jurassic-Cretaceous and comprises a complex pattern of rifted and transform faulted crustal segments. Variations in the along strike gravity signature are attributed to the degree of continental crustal thinning and the thickness of the postrift sediment, complicated by the existence of fracture zones. The change in the width of the continent-ocean transition zone suggests an interaction between pre-existing crustal features controlling the formation of the margin. Applying these results to the remainder of the Canadian polar continental margin, it is inferred that this margin consists of a number of 250-350 km long streched crustal segments separated by possible fracture zones. The orientation of the analogous transform fault identified in the southeastern Beaufort Sea offers the possibility of kinematic constraints on models of ocean floor development within Canada Basin.

A MODEL OF EVOLUTION FOR THE CARPATHIAN-BLACK SEA SEGMENT OF CONTINENTAL MARGIN OF TETHYS OCEAN IN EARLY MESOZOIC

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Based on the present scientific conception there have been carried out the data systematization and analysis on stratigraphy, tectonics and magmatism of triassic rock masses, occurred within the boundaries of south-western and southern margins of the East-European craton and adjacent areas. Triassic deposits do not form continual nappe, but are located in separate regions. Three types of geodynamic situations have been determined during which the deposits were being formed. One of them is characterized by Triassic accumulation of germanic type (the Baltic Sea syneclise, Pidlesk-Lithuanian depression, Missiysk platform), the second one is that of Alpine type (the Carpathians, Pannonian depression), and the third one covers Northern part of the Black Sea area, the Crimea and the Caucasus foredeep. Triassic deposits fill here single isolated sublatitudinal, known in references as "Cimmerian (regenerated) depressions". Their length varies from 200-300 to 500-600 km, and width does not exceed 100 km. From the north and the south they are bounded by fissures. All of them stretched along the southern border of the East-European land mass from the Dobrudzha to the Caspian Sea. The Triassic succession has different filling and thickness (from 1000 to 3000 m). The lower part of the succession is composed of terrigenous rock mases, the middle part - carbonaceous-volcanogenic, and the upper part - carbonaceous-volcanogenic-terrigenous ones. This region was established to be situated under the influence of the Atlantic and Tethys riftogenesis that were connected with the Post-Permian period of the Pangeian disintegration. As the result of the tension regime influenced by them complex horst-graben relief rose there. It determined peculiar character of accumulation, location and composition of Triassic deposits in this region. The latter ones were strained in Late Triassic and Early Jurassic (Early Cimerian folding stage).

UPPER MANTLE DENSITY INHOMOGENEITIES ALONG THE CREST OF EAST PACIFIC RISE

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Variations of the topography along the crest of East Pacific Rise (EPR) imply that equilibrium depth of newly formed oceanic lithosphere is not a function of age alone and assume a density variations in the upper mantle along the ridge crest. To constrain the distribution of density variations we have analysed gravity anomalies along the EPR crest. In order to compute the residual gravity anomalies, which could be regarded as a reflection of variations in the vertical distribution of density along the crest of the EPR in the astenosphere and mantle, we exclude from the gravity anomalies, averaged for a grid 1° x 1°, the long-wave components (λ >1000 km), and then the gravitational influence of water depth and crust thickness. Computed residual gravity anomalies along the EPR crest show the variations of low density zones distributions under the ridge crest. Low density zones are deeper under the shallow regions of EPR crest than under the deep regions. We have considered such a variation as a manifestation of matnle temperature variations along the EPR. We assume that under the shallow regions geotherm inersect solidus deeper at the mantle than under the deep regions. As a consequence, density decreasing because of melting is initiated deeper at the mantle under the shallow regions of EPR. Interpretation of the residual gravity anomalies indicates mantle temperature difference up to 150° between shallow and deep regions of EPR.

GEODYNAMICS AND PALEOVOLCANIC ACTIVITY OF THE MAGNITOGORSK PALEOVOLCANIC BELT (SOUTH URAL)

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The Magni togorsk belt is regarded to be one out of four largest belts of the South Ural. According to the most recent data on this region (among them stratigraphical, isotope geochronological and geochemical, geodynamical, etc.) the following principal model of this region development were offered.

The belt's history started in lower Devonian, from formation of Benioff zone of eastern inclination, situated on the western boundary of the Ural paleocean, and formation of the Irendyk Island Arc (I. A.). Volcanic activity centers migrated eastward, and calc-alkaline series appeared insted of I. A.-tholeiitic. In Eifelian this arc spreads on two parts, and double island arc with inner spreading zone appeared. In Givetian under the Eastern I. A. subvertical Benioff zone of western inclination was formed. Until the Givetian both I. A. volcanic belts were active, but it was a decrease in the activity of paleovolcanoes in western part of the I. A.

In the Eastern part of this belt it was a continuous volcanic activity until early Carboniferous. Centers of volcanic activity migrated westward, i.e. from frontal part to the back of I. A.. Collapse of the innter I. A. basin coexisted with the crust growth and changes in roks types: from tholeiitic to calc-alkaline to shoshonitic. As a result of collision of I. A. and Eastern Ural microcontinent in Carbonian-Permian, sediments of the accreation prism were melted and granite massives were formed. Serpentinite melange pushed off along Eastern (frontal) zone of the I. A.. In lower Carbonian in the western part of I. A. the local secondary spreading zone appeared marked by high-Ti-shoshonite basalt layers.

Belts formation history was concluded by "late I. A." lamproitic dykes in lower Mesozoic.

THE MID-ATLANTIC RIDGE (0°-15°N): TECTONIC, PETROCHEMICAL AND GEOCHEMICAL ASPECTS OF ITS SEGMENTATION

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A complex geodynamic regime accompanied the Atlantic opening in its near-equatorial area separating the Sothern and Central provinces at the early stages of their rifting. The latter had affected not only the tectonic pattern of the region, but also its magmatic activity.

The Ridge is dissected distinctly into segments of different order (1 to 4). Segments ofthe 1st order are from 100 to 300 km long and embrace the ridge parts divided by extended transform faults spaced of 15-35 miles apart from each other. Crustal discontinuities bounding segments of 1 to 3 orders, are reflecting by local depth maximum. It schould be noted, that the length of inter-rift fault parts exceeds that of the ridge segments.

The magmatic regime of the region is characterized by the occurrence of two extended geochemical anomalies bounded by Sao Paulo-Sao Pedro, Cape Verde-Maraton fracture zones attributed to the segments with relatively uplifted bottom of the rift valley (depth to 3000 m). Their formation seemed to be related to the polybaric melting of diapirs within various depth ranges. The ridge area in the vicinity of its eastern transect with the Romanche fracture zone is of a special interest. It is a region of abundant magmatism of Na-type related to the shallow-depth polybaric melting of a poorly depleted mantle of the lherzolite type on the Sao Paulo Is. Magmas of this type are accompanied by alkaline magmatism reflecting the low degree of the mantle melting at great depth. Central segments of the region with block pattern and distinct rift valley are characterized by a stable magmatism which does not differ from that of the Central and Southern provinces of MAR.

GEODYNAMICS OF THE ALPINE AND PACIFIC BELTS MECHANICAL-MATHEMATICAL MODELLING

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Active margins of Pacific type are characterized by the next morphological features: subduction zone, deep trench, island arc, back-arc sea. For simulation of behavior of lithosphere in the process of collision zones evolution the mechanical-mathematical models of medium of different rheology were used. The velocities of medium of lithosphere got from decision of mechanical equations can be used in the quation of heat conductivity. Modelling gives possibility to calculate P-T parameters distribution in the layers of sedimentary cover, crust and upper mantle in the process of paleo-reconstruction of the geological structures. The existing of stretching zones in back-arc seas can be explained by upwelling of mantle diapirs as a result of geothermal effect and raising of asthenosphere in the process of collision of deep mantle flows. Correlation between lithospheric plates collision zone and place and velocities of deep flows collision defines the angle of subduction. Mechanical-mathematical modelling shows that in the process of evolution of back-arc zone above raising mantle diapir the structure of superficial swell is changed by structure of deep depression. The material of the ancient continental crust from back-arc area is involved into subduction zone. Form of downwelling plate is determinded by correlation between densities and viscosities of collision lithospheric plates and asthenosphere. Stretching and compressing stresses in subduction plate depend on correlation of gravity and viscosity strengths in media. If density of subduction lithosphere becomes high due to metamorphism and the matter of lithosphere has high viscosity and has no time to sink into deep mantle, the stretching stresses can arise in some parts of lithospheric plate.

COMPLETE CLASTATION OF SOME SULPHIDE MOUNDS ON THE BOTTOM OF THE URALS PALEOCEAN

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Clastogenetic ores are broadly known for all sulphide deposits of the Urals. Clastogenetic ores are composed of roof and outer parts of the sulphide mounds which are similar to modern black smokers (Sibuy, Molodyojnoye, Oktyabrskoye etc. deposits). In addition to it some sheeted vein deposits are filled only by clastogenetic ores. Alexandrinskoye sulphide deposits belong to the type last mentioned. It is situated in Eastern Magnitogorsk Island Arc zone. It fills local depression zone, in rift trough fragment of North-Eastern trend. Rocks there are represented by rhyolite and basalt formations. Downward by inclination ore body are splitted into parts.

As a result of lithological and facies analyses, some lithodynamical flows composed by breccia of sulphides were determined. The largest flow fills sub-meridional graben and is overlain by rocks of mixed (volcanogenic and sedimentary) composition. There it has its maximal thickness, reaching 35 meters. Wings of this flow represented by distal turbidity: sandstone and alevrolite zoned and stratabound ores, similar to those of Kuroko deposits.

While studying the core, lithological facial 3D diagram of the ore body was established. This diagram shows sedimentation rhythms. In most of the rhythms the following zones of submarine weathering are found.

The first, full oxidation zone (iron hat), represented by hematite and barite. It compose upper part of the ore body.

The second, leaching zone. This zone consists of pyrite sandstones, with barite and quartz cement. Galena and non-luminescent Fe-sphalerite are also present.

The third, cementation zone, or zone of secondary sulphide enrichment. It consists of ores, rich in chalcopyrite and pyrite, sometimes with major influx of bornite, sphalerite with yellow luminscence in UV, tennantite-tetrahedrite ores, chalcocite, gold.

These ores are richer in valuable component and mineral composition than those of the other deposits of the Urals.

Under the ore deposit there are major halo of disseminated ores and ore veins. This halo was obviously a result of dissolution of clastogenetic ores and deposition of sulphides. For different deposits the ratio between disseminated and massif ores vary, the same applies to thickness of iron hat. This property could be helpful for pyritic-copper deposits classification.

The origin of Alexandrinskoye deposit is probably due to submarine hypogene processes, turbidity currents, and submarine avalanches. The source of material was a sulphide mound, situated to the North from deposit. Due to steep angle of a slope the original sulphide mound, which was a source of an ore matter, ceased to exist.

So, steep angles of a slope might cause full destruction of sulphide mounds. For clastogenetic ores concentration depression in paleorelief are necessary. On hypsometrically higher parts primary halo in form of ore veins, etc. are present. Presence of iron hat and secondary enrichment zone proves that submarine chemical weathering processes were linked to sulphide mounds destruction.

THE GEODYNAMIC DEVELOPMENT OF THE ROSS SEA RIFT, ANTARCTICA

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The Ross Sea Rift, Antarctica, extending some 3000 km in length and approximately 1000 km in width, forms one of the major active rift systems on earth. Based on the available onshore and offshore data, the rift is characterized by deep sedimentary basins, strongly alkaline volcanism, a thinned continental crust and one very pronounced rift shoulder. This means it is strongly asymmetric with the deepest basin in front of the 3000 m high rift shoulder which is formed by the chain of the Transantarctic Mountains.

The rift character of the whole Ross Sea depression is clear and pronounced only for the last period of its development. Onshore, volcanism starts around 40 Ma as does the uplift of the Transantarctic Mountains. Offshore, there are volcanic plugs pearcing the sediments up to the surface and there is a late tectonic feature, the Terror Rift in the Victoria Land Basin close to the Transantarctic Mountains. The stratigraphic record as far as calibrated by drill holes covers about this same late period of time.

The Ross Sea basins, however, contain an additional large lower part of the sedimentary section which stratigraphically may comprise the lower Tertiary, the Cretaceous or even older parts of the Mesozoic. Based on onshore observations of pull-apart structures and strike-slip components as well as on the analysis of the system of mid-oceanic ridges in the adjacent ocean it is concluded here, that the transtensional features in the early record of basin formation may be due to strike-slip processes related to a major continental shear. There is evidence that this continental shear zone acted as a transform fault connecting two segments of symmetric oceanic spreading, the Southeast Indian Ridge between Antarctica and mainland Australia and the Pacific-Antarctic Ridge between Campbell Plateau/New Zealand and Marie Byrd Land. While in both these areas, according to marine magnetic anomalies, active spreading commenced during the late Cretaceous (100 Ma), space problems preclude such an early separation for the intervening Tasmania/Ross Sea splinter in which both continents remained attached to each other during this time. Thus, a system of continental shear zones could result in transtensional basin formation on the continent and continental shelf of Antarctica.

This model fits the time constrains provided by marine magnetic anomalies and volcanic, structural and thermal events onshore. It has a well known equivalent in the continental transform fault offsetting Svalbard from NE-Greenland between the spreading zones of the polar North Atlantic and the Arctic Eurasian Basin.

RECENT ADVANCES IN ARCTIC DEEP-SEA DRILLING (ODP Leg 151)

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The permanently ice-covered regions of the Arctic and sub-Arctic marine basins are in the focus of modern environmental research because they are expected to respond early and clearly to future environmental change. Part of these expectations are based on a stratigraphically very spotty record of upper Cretaceous and Paleogene pelagic central Arctic pre-Glacial deposits and numerous Upper Cenozoic conventional gravity and piston cores. The older samples document the existence of a temperate, fully marine Arctic Ocean with productive surface and oxygen-deficient deep waters, whereas the younger ones are the result of depositional environments under a highly variable, but permanent marine ice cover whose properties are poorly known. As a first major effort of the Nansen Arctic Drilling Program (NAD), the Ocean Drilling Program (ODP) allowed its drill ship -the JOIDES RESOLUTION- to venture into the marginal Arctic Ocean to the North of Svalbard to obtain the first, long, stratigraphically undisturbed and complete Upper Cenozoic sediment sequences of the Arctic Ocean proper.

Recent deep-sea drilling (ODP Leg 151) as part of the North Atlantic-Arctic gateway program has been carried out on the central Iceland Plateau, along the East Greenland continental margin, in Fram Strait and on the Yermak Plateau (Arctic Ocean). The combined seven drill sites provide for an almost complete middle Eocene to Quaternary record of paleoenvironmental change from non-glacial Paleogene to glacial Late Neogene conditions. Prominent characteristics of this change can be highlighted as follows:

-Siliceous biogenic and clayey Eocene sediments are typical for the depositional environment in the young and narrow Norwegian-Greenland Sea which shows considerable similarity with equivalent North Sea deposits (Site 913 off E Greenland).

-Oligocene and Miocene shallow and deep-water depositional environments in and around the juvenile Fram Strait are characterized by pelagic and hemipelagic mostly terrigenous, organic-rich pre-glacial sediments (Sites 908 and 909).

-Cyclical variations of the physical properties of the sediments following Milankovitch frequencies have been observed in pre-glacial and glacial Neogene and Quaternary sediments documenting the correlation of the variabilities of depositional environments to paleoclimate.

-Large, terrigenous, ice-rafted components imbedded in a relatively finegrained clayey and silty matrix signal onset and variability of northern hemisphere ice covers, in the late Miocene over the Iceland Plateau, during the Pliocene in Fram Strait and on the Yermak Plateau.

-Stratigraphic changes in abundance and lithology of the ice-rafted components suggest differential onset, development and dynamics of the continental ice sheets bordering at times the Norwegian-Greenland Sea and the Arctic Ocean.

DISTRIBUTION AND DEVELOPMENT OF ACCRETIONARY SYSTEMS IN NORTHWESTERN FRAMING OF THE PACIFIC OCEAN

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1. The accretionary system of the Chersky Range consists of the following tectonic zones (terranes): microcontinents, represented by Paleozoic and Early Mesozoic sequences, the Uyandino-Yasachnen island arc of Middle-Late Jurassic age and the Triassic-Jurassic In'yali-Debin zone, regarded to be faulted wedging zone of the continental lithosphere (foot of the continental slope).

Microcontinents, which are fragments of the Arctic continental plate, came into contact with the Siberian continent in the early Cretaceous together with the Uyadino-Yasachnen arc being accompanied by collision. The result of the latter was, in particular, disappearance of the Alazeyan and the South-Anyuy oceanic basins, the formation of the Yana-Kolyma granite belt with gold, lead-tungsten and complex ore mineralization.

2. The Eastern Chukchian accretionary system (from the Pegtymel' district to the Providence Bay) is for the most part covered by volcanics of the Okhotsk-Chukchian belt, though characterized by the collision of the structures of the Koryak Upland with those of the Chukchian continent. The collision zone is marked by ultramafics, volcanic-sedimentary complexes of Triassic and Jurassic age, with remnants of Tethyan fauna, pre-Albian volcanics and granitoids of the subduction and obduction nature. The collision took place at the end of the Cretaceous.

3. The Koryak-Kamchatka accretionary system consists of successive accretion of structural zones, beginning with the Senonian-Maastrichtian up to the middle-late Miocene. It is composed of two continent-marginal volcanic belts (West-Koryakian and Apuka-Vyvenkian), the Vatyn and Govenian island arcs in the Olyutor superterrane, and of island arc fragments in the Maynits, Khatyrian and other zones of the Koryakian superterrane. The island arcs and volcanic belts are separated by marginal sea complexes with Cretaceous and Cenozoic fauna. Some zones include accretionary prism containing ophiolites, oceanic sediments and subduction melange.

4. Former active margins of the north-western Pacific are now represented by a combination of packets of allochthonous plates, attributed to different paleoclimatic areas. Within the Indigirka-Kolyma region we are investigating a collisional collage, whereas in the Koryak-Kamchatka - the accretionary one. This accounts for differences in the structural plan, metallogeny, in intrusive magmatism occurrences etc. Therefore, collision joints are also variable in certain parameters, in the cases, when they mark continent-continent contacts, or when they fix attaching island arc one to another or to margins of continental massifs.

5. Extremely scattered paleomagnetic data suggest that the basins with Tethyan fauna, which inhabited them in the late Paleozoic, Triassic, Jurassic and Cretaceous, was recorded south of 40° and have moved to the north and northwest for more than 2000 km.

OBSERVED STRAINS AND TILTS AT BAIKAL RIFT ZONE (FROM OBSERVATIONS WITH EXTENSOMETERS AND TILTMETERS)

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The mechanism of the deformational processes in the south-western flank of Baikal rift zone was studied on the basis of several years of observations of the earth surface tilts and strains. Observation equipment was installed in the underground gallery at Talaya station (coordinates are 51.68°N and 103.65°E). Set of quartz tidal tiltmeters recorded the information from 1985. Three components of extensometers recorded the information from 1990. We have found that time variations of tilts and strain had periodical nature. Vector tilt diagram of the period 1985-1992 had cycles nature and had half-period time near 5-7 years. The Tilt traverse for the period 1985-89 is 8.0 sec of arc to NNE, for the period 1990-1993 is 6.3 sec of arc to SSE, for the period 1985-1993 is 7.3 sec of arc to NEE (80°N). We have determined additional strain in main axis from strain observation (N-S, E-W, 332°N). Main axes were near azimuth NE-SW and NW-SE at the period 1990-1992. This result corresponds to seismological data of this region. We have found that maximum additional stress per year was 5×10^5 Pa ($E=5 \times 10^{10}$ Pa). We have found the correlation of tilt velocity and turning-point of vector tilt diagram and the reorientation of stress axis with the local seismicity and geological structure (Main Syan Fault).

FLUID CORE RESONANCE MEASURED BY EARTH TIDES OBSERVATIONS AT SIBERIAN STATIONS

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The observational study of the fluid core resonance (FCR) is important in geophysics, because they may provide a constraint for the possible range of the physical quantities related with the phenomena occurring at the core-mantle boundary (CMB). In this paper, we discuss the resonance parameters which were estimated from the data obtained from the group of gravimeters installed at the Novosibirsk station, from the group of gravimeters installed at the Irkutsk station, from the group of tiltmeters, gravimeter, three components of extensometers installed at the Talaja station (Baikal rift zone, ζ =51.68°, λ =103.65°). Tidal analyses were performed on the many year data at each station. Observed tidal diurnal amplitudes (O_1, K_1) show the frequency dependence which is expected from the resonance at a nearly diurnal free wobble (NDFW) of the earth.

Observed resonance frequencies are 15.0782 ± 0.0037°/h from nine independent determinations and 15.0759 ± 0.0017°/h from determinations with three components of extensometers. Precise determinations with the group of 4 gravimeters at the Novosibirsk station and the group of 3 extensometers at the Talaja station show the mean size 15.0755 ± 0.0004°/h. Final determination indicate that resonance is closer to a frequency of (1 + 1/436) cycles/day (a core flattening 1/370 or 9.3 km). There are differences from calculated frequency (Wahr 1981, 1989) of (1 + 1/460) cycles/day (a core flattening 1/392). Our results are a comparison with different observational studies and models.

COMPARATIVE CHARACTERISTICS OF THE MIDDLE MIOCENE HIATUS IN THE PHILIPPINE SEA (BASED ON THE DSDP AND ODP DATA, LEGS 59 AND 126)

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Development of the notion of the middle Miocene hiatus scale requires careful ecosystem analysis. Among biostratigraphic methods, it is worth noting importance of nannofossil and foraminifera analyses, and significant lag of radiolarians.

The elaboration and application of statistical methods made it possible to reveal discontinuous character of highly sensitive radiolarian fauna in the Miocene Philippine basin. The high rate of radiolarian evolution allowed to restore the boundaries of the main stages of their development, which were reflected in the new zonal scale for Cenozoic of the Philippine Sea.

The used material were DSDP and ODP Sites of the deep-sea Neogene sections of the central and northern parts of the Philippine Sea: Kyushi-Palau Ridge (Hole 448), Pareze Vela basin (Hole 447) and Aogashima canyon (Holes 792, 793). Within the areas under discussion, three hiatuses have been distinguished during the period from 13.2 to 8.5 Ma B.P. However, the hiatuses are separated not only in space but in time as well. In the paper we discuss the boundaries of the zone CN 7 (nannoflora), the zone N 17 (foraminifera), validity of Diartus pettersoni zone, and possibility of application of the obtained results to the geodynamic model.

ACTIVE FAULTS OF EURASIA

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The Project TT-2 "World map of major active faults" (chairman V.G. Trifonov) was confirmed in 1989 as a part of the International Lithosphere Program. The objectives are to compile the World map in scale 1:10,000,000, the maps of continents in scale 1:5,000,000 and maps of some seismic regions in scale 1:1,000,000 or 1:500,000 with the Explanatory Notes and the Catalogue of major active faults of continents. The maps show the location, age, sense and rate of motion and reliability of identification of the faults not older than 100,000 yrs, as well as Middle Pleistocene faults. The map of Asia and the large part of the map of Europe have been compiled and the first results are discussed here. One of them is the predominance of the strike-slip component of motion over the vertical one for the majority of interplate and intraplate large active faults of Eurasia. It has occurred because the strike-slip motion is more efficient than the thrust, the reverse and even the normal ones. Complicated structural changes conditioned by motion on the intersected interplate strike-slip faults are discussed with analysis of the crossing area of the North Anatolian and the East Anatolian fault zones. Contribution of seismicity to faulting is different for active faults with the impulse, the creep and the impulse-creep regimes of recent motion depending on physical properties of rocks of the Earth's crust. Different geological techniques for estimating the motion regime, the magnitudes and the average recurrence intervals of Holocene strong earthquakes are discussed. All active fault zones are seismic, but some specific parts of the zones are the most dangerous ones. They are: crossings of strike-slip faults as well as "pseudo-crossings", that are the areas with different trends of active faults in different layers of the Earth's crust; areas of an echelone location of active faults to each other; and segments of the fault zones, composed by ultrabasic rocks, in the collisional mobile belts.

INTERACTION OF THE MANTLE CONVECTION WITH CONTINENTAL AND OCEANIC PLATES

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The structure of thermal convection in the mantle including continental and oceanic plates has been modeled numerically. Continental lithosphere is specified as a region whose viscosity is three orders greater than compared with the underlying mantle. The oceanic lithosphere is modeled by temperature dependence of viscosity. The lower boundary of the lithosphere is defined as a surface of constant viscosity corresponding to the temperature of solidus. The main conclusion of the paper is that the descending mantle flow beneath a fixed continent appears to indicate unstable state of the thermal convection in the Earth.

2-D MODEL OF MANTLE CONVECTION WITH MOVING CONTINENTS

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Two 2-D models for interaction of moving continents with the mantle are presented. The first one is based on the solution of Stokes equation for viscous uncompressible liquid in the variable curl - stream function. Continents are modeled as rigid thermoconductive regions. Velocity of continents is accepted to be equal to velocity of viscous liquid flow, averaged along lower boundary of the continent. The equations for viscous liquid are solved for whole numerical area except continents, where the equation of thermoconductivity is used. Temperature and heat flow continuity is used to adjust solution on the boundary. The second method is based on self-consistent solution of Stokes equations, written in natural variables (velocity, pressure and temperature), and continental motion equations. The continents are modeled as higher viscosity areas with infinitely thin solid crust. The continent velocity is taken equal to mean velocity of viscous area. Despite the significant difference between the methods and the models, the results demonstrate similar characteristic times of global reorganization of mantle streams and of divergence of the continents. In both models were obtained the regions of anomaly high heat flux between subduction zones and moving continents, which can explain the mechanism of forming of marginal basins.

COMPUTER SIMULATING ISOBARIC CRYSTALLIZATION PROCESSES OF THOLEIITIC MELTS, SOUTHOURN MID-ATLANTIC RIDGE

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We have applied the mathematic method to estimate the fractioning conditions of primary melts from South Part of Mid-Atlantic Ridge. For a great number of samples the averages of cluster groups have been compared with fractioning lines of primary melts under different pressure. The groups were obtained by the application of one of the cluster analyses techniques worked out at the Department of Geology (Moscow University). We used this method successfully for the MAR and EPR tholeiitic melts. In this case the relative standard deviations did not extend 5% for each element. The fractioning lines of primary melts were evaluated by COMAGMAT program (GEOKHI RAS,

Ariskin et al.). Some melt compositions used as primary were obtained by different melting models and experimental ones.

Using the technique of comparison of average glass compositions of cluster groups with fractionation lines of primary melts the conditions of tholeiitic melts differentiation have been estimated. The retrieval of glass compositions was about 200 analyses - our data and from literature - and included samples that had been dredged predominantly along the rift valley and rarely from ridge flanks (1°-46°S). The retrieval was considered in general because some segments of MAR were poorly sampled.

The results of mathematical simulation have shown the following:

1. There are 8 cluster groups representing two parallel trends of crystallization. These trends mainly resulted from various initial contents of Na, K, Ti and Ca and are well explained by various degrees of melting of the depleted oceanic mantle. The melts resulting from greater melting extent are predominating at the northern part of SMAR (1°-11° S), and at 22°-25° S.

2. Both types of primary melts were crystallized at depth about 12 km that was typical for all Central part of MAR (15°-33°N).

3. The single cluster consists of glasses that are enriched in K and other lithophile elements. They are distributed near hot spots (Ascension, Tristan da Cunha).

TECTONIC STRUCTURE AND ORIGIN OF THE VETLOVSKY COMPLEX OF EASTERN KAMCHATKA

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Accretion of terranes is thought to represent the growth of continental crust in the Pacific rim. Detailed investigations of internal structure of accreted terranes will potentially allow to reconstruct tectonic history at the continent-ocean boundary. There are very specific accretionary complexes among such accreted terranes which include tectonic units originated in different tectonic settings.

We report here the results of our recent study of the Vetlovsky complex of Eastern Kamchatka. Vetlovsky complex is exposed within the Vetlovsky Zone which extends through the whole Kamchatka Peninsula from the Karaginsky Island in the north to the Petropavlovsk Fracture zone in the south. The Vetlovsky Zone separates arc-derived units of the Ozernovsko-Valagisky island arc terrane from the Cretaceous-Early Paleogene terranes of the Eastern Peninsulas of Kamchatka.

Our major conclusions resulted from the comprehensive geologic study of the Vetlovsky complex and are as follows:

1. Vetlovsky complex includes various rock associations with clear increase in the total amount of carbonaceous-siliceous sediments and tholeiitic basalts from north to south.
2. Vetlovsky complex comprises rock units ranging in age from Late Campanian-Maastrichtian through Late Maastrichtian-Danian to Paleocene-Eocene.
3. Structurally it includes a package of imbricated thrust sheets characterized by an extremely complicated internal structure. The multi-stage deformation of the complex is recorded in widespread megamelange zones.

We infer from our data that the units of Vetlovsky complex were formed within the fore-arc and inter-arc basins.

We suggest that during the Maastrichtian-Early Paleocene the accretionary prism in front of the Ozernovsko-Valagisky arc was formed. The final emplacement of the Vetlovsky complex is related to mix up rocks of accretionary prism and different parts of the crust of inter-arc basin of Early Paleogene age during the Middle Eocene collision between the Ozernovsko-Valagisky and Kronotsko-Shipunsky island arc systems.

THINNING OF THE CONTINENTAL LITHOSPHERE BY UPPER MANTLE CONVECTION

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Evolution of the continental lithosphere is one of the key questions of the plate tectonics and involves structural and compositional transformations of the upper layers of the Earth. The basic structural elements of the lithosphere seem to form in the active margins, more dramatic events being under collision of the continents of their segments. Processes of the transformations are less pronounced in the intracontinental areas and determined mainly by exogenic factors at the upper boundary of the lithosphere and by action of the mantle flows on the base thereof.

In present paper the action of the thermal upper mantle flows on the intracontinental lithosphere was examined with the help of numerical modelling. Lower boundary of the lithosphere is coincided with isotherm 1200°C for a "young" post-cambrian lithosphere and with 1400°C for ancient craton.

As a result of time-space lithospheric thickness variations determined by convective flows were obtained. Moreover, the influence of the dynamic relief of the lithospheric bottom on the convective structure under various conditions in the upper mantle and at their base was examined.

Numerical results were compared with the evolution of some recent intraplate active zones (Appalachian, Sierra Nevada, Baikal, Altay-Sayan).

MANIFESTATION OF THE INDUCED SLAB MANTLE FLOW IN SURFACE MOVEMENTS AND ITS ROLE IN COLLISIONAL PROCESSES

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The distinctive feature of continental collision seems to be an existence of the two tectonic regimes. There is continental subduction with the limited descending of the moving continental plate into the mantle and continental obduction.

Numerical modelling of mantle processes in the collisional zones suggests conditions of existence of the regimes. The thickness of the moving continental lithosphere is a main factor in choosing between them. Continental subduction is preferable when a thickness of the moving plate is no more than 200 km. Such a regime seems to be in India-Asia collision zone. Induced slab mantle flow leads to continental obduction when a thickness of the moving plate is not less than 300 km. Such a situation was given in Africa-N. America collision during late Mesozoic.

Interaction of the induced slab mantle flow with continental lithosphere of an active margin may be responsible, as modelling shows, for the creation of the intracontinental subduction. Such subduction of the continental lithosphere Kunlun under north part of the Tibetan Plateau was suggested to account for geochemical aspects of basic Cenozoic magmatism by Arnand et al. 1992.

EVOLUTION AND TECTONIC OF THE KOMANDORSKY BASIN (BERING SEA) DUE TO THE STUDY OF ANOMALOUS MAGNETIC FIELD PATTERN

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Magnetic data collected in 8 cruises of RV "Vulkanolog" and R/V "Dmitriy Mendeleev" in Komandorsky Basins were treated and summarized. A map of anomalous magnetic field of the basin was constructed.

Our results do not support linear anomalies detected tentatively by Cooper et al. 1976. Relying on investigation of magnetic field anomalies pattern we traced the major faults known before seismic reflection data. In addition to this we traced two faults in the central part of the basin on a base of shifts in the field pattern and typical anomalies.

A series of linear magnetic anomalies 5-6 was revealed and identified in northern, central and southern segments of the basin that corresponds to the age of the crust of 23-9.5 Ma, being in agreement with the heat flow investigation results.

According to identified anomalies the spreading rates were calculated, being about 0.48 cm/y (north), 0.98 cm/y (center) and 2.5 cm/y (south). Also the poles of rotation were obtained. Poles of the northern and central segments are found to be closely related, but the pole of the southern part is located separately.

The direction of magnetic lineation of the southern segment is close to that of the Vitus Arch, the extension structure revealed by Cooper et al. 1992 in the Aleutian basin. We supposed that these two structures have related evolution.

Paleoreconstructions were done. We suppose that about 40-50 Ma the Bowers and Shirshov Ridges were united the eastern edge of paleoarc which remnants exposed on the Govena Peninsula and Karaginsky Island, when the opening of southern segment began, with the Bowers Ridge overriding the Aleutian Basin. Spreading in the central and northern segments started about 23 Ma and ceased at 9-9.5 Ma, while some volcanic activity remained in the central and southern segments.

THE DIFFUSE SPREADING RATE AND THE COMPOSITION OF THE LITHOSPHERE IN THE BACK-ARC BASIN AFTER GEOTHERMAL DATA (TYRRHENIAN SEA)

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The Tyrrhenian Sea is supposed to be a back arc basin in the result of the removal of the Calabrian block from the Corsica-Sardinia block and the withdrawal of the Benioff zone to the south-east. The central part of the Tyrrhenian Sea has the oceanic type of crust and is underlain by tholeiitic basalts.

Linear magnetic anomalies have not been discovered here and this is the reason why the direction and the rate of spreading are defined.

The heat flow of the Tyrrhenian Sea is very high and amounts to 120 ± 45 mW · m^{-2}. This is twice as much as the Earth's normal heat flow (60 mW · m^{-2}) and approximately 1.5 times more than in the western and eastern parts of the Mediterranean Sea. High levels of heat flow point to the high tectonic activity of the Tyrrhenian region. Magnaghi, Vavilov and Marsili seamounts here are characterized by a very high heat flow of 350 mW · m^{-2} with a mean-square declination of 70 mW · m^{-2}. We found by way of analysis that the heat field of the seamounts and the young rift zone of the Red Sea have a similar structure. For this purpose we used the geothermal data obtained during the 12th cruise of RV "Vityaz", as well as the published data. On the basis of a comprehensive geological-geophysical analysis of the geothermal and geomagnetic fields of the Tyrrhenian Sea a conclusion is reached concerning its formation due to the diffuse spreading processes. Magnaghi, Vavilov and Marsili seamounts are related to centers of sea-floor spreading. The opening rate of the Tyrrhenian Sea of about 4 cm · y^{-1}, as calculated by geothermal data, is well in compliance with the early Tortonian development stage of the Tyrrhenian region in general. This is in good accordance with geological data. It has been established that the Tyrrhenian back-arc basin, which is characterized by diffuse spreading, features heat flow patterns relative to the sea-floor age that are similar to other ocean areas. From the analysis of geothermal data it is shown that Magnaghi and Marsili seamount areas are underlain by the harzburgite lithosphere, whereas Vavilov seamount area by the lherzolithopyroxenite one.

IMPORTANT RADIOLARIAN EVENTS OF THE NORTH WESTERN PACIFIC REGION

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Based on the stratigraphic distribution of the radiolarian taxa, bioevents during Late Permian - Cretaceous in the Koryak-Kamchatka region can be identified. The most significant bioevent occurs between Later Permian - Middle Triassic. It is the extinction of all Paleozoic forms and the appearance of Triassocampe and after Canoptum, which are typical Nassellaria. The next bioevent was between the T. deweri zone and T. nova-S. dispiralis. All the species of the Yeharaia became extinct at the top of T.deweri zone. The first Sethocapsa appeared at the end of T.nova-S.dispiralis zone. At the boundary Triassic-Jurassic the Capnuchosphaeridae, Triassocampe and many specific Saturnalidae became extinct. Another important bioevent occurs between the C.triassicum zone and P.simplum zone. The new genus Parahsuum appeared at that time. Nevertheless, all Triassic-Earliest Jurassic radiolarian Pacific faunas show high endemism as noted by R.Hori. They can be called Triassocampe-Canoptum-Pantanellium type or Bipedis-Parahsuum-Acathocircus type. The latter, probably from Pliensbachian time (Laxtorum jurassicum zone), the first appearance of genus Parvicingula occurs, high diversity of Hsuum, Laxtorum, Bagotum took place. These events can be traced globally among elsewhere Circum-Pacific Rim (North and Far East Russia, Japan and North America). More distinct radiolarian faunal changes among multicyrtids occur in middle Bajocian time with the first appearance of genera Xitus, Dictyomitra and Amphipyndax. All asymmetric genera such as Bagotum, Canutus, Droltus get extinct at the end of B.moudense zone simultaneously with appearance of above-mentioned new genera. This event coincides with occurrence of plankton foraminifera and probably can be correlated with the global changing in world ocean circulation - the opening of the Atlantic seaway. Just from this bioevent radiolarian faunas acquire pandemic character as our data show. Before Bajocian time perhaps it was time when the main transition from benthonic radiolarians or hemiplankton shallow-water ones to planktonic took place. In class Foraminifera benthos and plankton forms exist up to the present. It is considered by T. Gorbachik, D. Rauser-Chernousova and some others, that first attempts of the creation of planktonic Foraminifera went on during Late Paleozoic and Triassic-Earliest Jurassic, but the appearance of plankton in Foraminifera is dated by Middle Jurassic (Bajocian) age. This data is in a good agreement with our point of view on Radiolarian plankton appearance.

Next important events took place at end of M.fragilis-M.guadalupensis zone (it is extinction of genus Hsuum and appearance of Pseudodictyomitra) and between Dibolachras tytthopora zone and Cecrops septemporatus-Mirifusus chenodes zone (the extinction of genus Parvicingula and appearance of genus Thanarla). Probably all these bioevents could be joined with significant tectonical processes, for example such as continental spreading and accelerated movement of terranes.

MODEL OF SEDIMENTARY BASIN FOR THE DOMANIK-TYPE DEPOSITS: NEW VERSION

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Domanik has a special position in terms of paleogeographic conditions. There are many models for Domanik-type basins. One of the last was elaborated by Dr. A. Ormiston (1993) from USA Amoco. It shows that interest to this problem is high and many aspects of phenomenon Domanik-type basin formation are still unclear. Oil of the Russian plate is mostly associated with Devonian Domanik-type rocks (for instance, Pripjat, Timan-Pechora and Volga-Urals regions). In the USA the Chattanooga Formation is of similar age and source rock character to the Domanik Shale of the Russia Volga-Urals province (Masters, Mast, 1987). The primary source of hydrocarbons is Domanik organic shale, bituminous limestone and phthanite.

Ukhta Domanic (60 m) is represented by gray to black phthanite and siliceous bituminous limestone with little admixture of clay. Content of CO approaches to 20 %. Contact of Domanik with the underlaying light clay is transgressive and begins with a stratum (about 0.5 m) composed of small pteropod and goniatite shells. The middle most productive part has a very thin-flischoid structure and sometimes resembles radiolarites. Among radiolarians there were identified middle Frasnian sphaeroid-like Entactinia cf. additiva Foreman, Astroentactinia paronae (Hinde), A. cf. crassata Nazarov, A. cf. stellata Naz., A. aff. tantilla Naz., Haplentactinia inaudita Naz., H. arrhinia For., H. rhinophyusa For., Polyentactinia circumretia Naz., P. kosistekensis Naz., Tetrentactinia cf. gracilispinosa For., Entactinosphaera grandis Naz., E. assidera Naz., E. echinata (Hinde), E. nigra (Hinde), E. variacanthina For., and spicula - like forms Paleoscenidium cladophorum Deflandre, Palaeothalomnus sp., Ceratoikiscum spinosiar-cuathum For. Diversity of Radiolaria, isotopic data from brachiopod shells and presence of corals in the neighboring areas indicate very warm-water conditions of Domanik basin. There are a lot of microalgae Tasmanites in Domanik. Recent bacteroids and microalgae occur in abundance within vacuoles in the cytoplasm of living Radiolaria (Anderson, Matsuoka, 1993). Old algae may have had symbiosis with Radiolaria too and could have existed far from the coastline. Maximum of Tasmanites is fixed in areas of deep faults (Timan-Pechora, Pyrgidan and Urengoy depressions). Synchronous mass extinction of radiolarians and microalgaes can be explained by sudden sharp transgressive-regressive events. The absence of Foraminifera is regarded by A. Ormiston (1993) as a result of anoxia just like we observed in sediments of the Bonarelli level. The best preservation of radiolarians and algae is also owing to anoxia.

The upper part of Domanik is cross-bedded and consists of siliceous limestone plentiful of micro- and macro-faunas or polydetritus limestone (Maksimova, 1970) and obviously shows a regressive character.

Bashkirian Domanik (30 m) has a similar structure and differs only by having phosphatic materials and rare admixture of glauconite, while Tatar one (20 m) is distinguished by abundant brachiopods present in lower and upper parts. To the north of Ukhta, the Kogva and Kolva Domanik (10-130 m) contains an intraformational sandstone and siltstone, indicating the approaching to possible islands and it is overlain by bituminous limestones with lenses of reef limestone debris. South-western Saratov Domanikoid has organic-rich clay shale (13 m), while the Pachelma one (to 40 m) is characterized by bituminous clay with Liorhynchus, covered by laguna Famennian deposits. The western Tambov-Tula coeval level (40 m) is represented only by bituminous limestone and clay. Kaluga and Moscow ones are clay-carbonaceous (5-38 m) with admixture of organic matter. They are often underlain by sulphate complex with reworked spheroid-like radiolarians to form indicative of shallow shelf. Pripjat Domanik differs by numerous shallow-water spongy radiolarians too.

Thus, Domanik basin was relatively shallow-water marginal sea, partly separated by the island arc and the barrier reef from Yapetus. The coeval volcanism confirms active character of marginal Domanik basin.

LATE CRETACEOUS RADIOLARIA OF THE RUSSIAN PLATE AND COMPARISON WITH THE SAME FAUNAS OF SOME TETHYAN AND PACIFIC REGIONS

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Albian to Early Campanian Radiolaria were studied in 30 samples from 9 sites located in Moscow, Kaluga and Bryansk districts of the Russian plate. About 50 species were picked out from siltstone and clayed marles. One of them was described as new.

Albian to Early Paleocene Radiolarian were investigated in more than 2000 samples from Russian Pacific Rim (Koryak Mountains, Kamchatka, Sakhalin). All samples were chemically attacked by HF acid and all well-preserved radiolarians were picked out. In total 270 Radiolaria were identified to the species or subspecies level, 16 of them new. Albian-Campanian Radiolaria were analyzed in 18 samples from DSDP Site 305, 307, 310, 465, 466, 585 located in Pacific ocean. About 100 species were distinguished to the species or subspecies and 1 genus and 3 species were described as new.

Albian to Maastrichtian Radiolaria were studied in 40 samples from the Crimea, Great, Lesser Caucasus and Cuba of the Tethyan region. The vertical ranges of the 120 species were identified, 7 of them new.

All of these faunas show many morphological changes of importance for paleoecological reconstructions. The size of the fauna is considerably varying. Radiolarians of the Russian plate are greatest in size and have highest percentage of spongious species. This phenomenon was previously observed in the late Cenozoic fauna (Bluford, 1988) and recent (Gorbunov 1979) of the shallow water margin basin. Besides, for the Russian plate assemblages it can be explained presumably as a result of diagenetic processes and gravimetric law. Other characteristic features of this fauna are: none spinous or the shortest of spines and cyrtoid species compose often high percentage of the total thanatocoenosis.

The fauna of Pacific region is more diverse and abundant. There are high latitude, moderate and low latitude assemblages among Pacific radiolarian faunas. All these faunas are characterized by not very large an average size of species. High and mid latitude faunas of the Pacific rim are similar to those of the Russian plate. This type of fauna exhibited strong dominance of Dictyomitra and Clathrocyclas in the Pacific rim region or Dictyomitra and Stichomitra in the Russian plate samples among cyrtoid forms and Orbiculiforma and Pseudoaulophacus or Histiastrum and Euchitonia respectively among discoid radiolarians. The sculpture of walls in all species (genera Amphipyndax, Paronaella, Patulibracchium and others) is very simple.

The low latitude fauna of Pacific region and Tethyan fauna are very diverse and demonstrate the different size forms with complicate walls. They are distinguished having long and thin spines.

In spite of qualitative difference the faunas of these far regions have the common or close species which could be used as a stratigraphic guide fossil. The following species were found most consistently and often frequently or abundantly in the whole sequences: Pseudodictyomitra pseudomacrocephala and Holocryptocanium barbui in late Albian-early Cenomanian, Archaeospongoprunum bipartitum, Dictyomitra striata in Turonian-Coniacian, Pseudoaulophacus floresensis, Orbiculiforma quadrata, Dictyomitra kozlovae, D. torquata in Santonian-Campanian, Orbiculiforma renillaeformis, Dictyomitra andersoni in Maastrichtian, Stylosphaera goruna, Eucyrtidium granulata in Early Paleocene.

RADIOLARIANS IN THE CENOZOIC DEPOSITS OF THE FAR EAST OF RUSSIA AND THEIR PALEOENVIRONMENTS

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Radiolarian assemblages from the Cenozoic deposits of the Far East (Kamchatka, Sakhalin, Komandor and Kurile Islands) have been studied. The Cenozoic sequence in this area consists mainly of thick clastic and siliciclastic rocks with abundant benthic fossils indicative of shelf paleoenvironments. The investigation of Radiolaria included analyses of radiolarian assemblages preservation features and distribution depending on the diagenetic transformation of organic opal or on transgressive-regressive cycle phases, as well as systematic composition and geographical distribution of heterochronous radiolarian assemblages.

The deposits under consideration are classified into three zones on the basis of the prevalence of one or other form of silica, namely, the organic opal zone, the opal-CT zone, and the quartz (chalcedony) zone. The radiolarian skeletons from the first zone are well-preserved. In the deposits of two other zones skeletons are severely corroded and are well-preserved only in calcareous concretions. The characteristic feature of the assemblages from the deposits of opal-CT and quartz zones is the high percentage (40-60%) of one or two species with relative large massive skeletons.

The definite regularity of the changes in the systematic composition of radiolarian assemblages can be traced within sedimentary cycles. Three ecological types of associations have been distinguished. The "neritic" type is characterized by the poor systematic composition and the predominance of Discoidea and Larcoidea. Associations of this type are found at the beginning and end of the cycles, composed of coarse-grained rocks (sandstones, siltstones). The "intermediate" type is characterized by greater species diversity. The "nearly oceanic" type belongs to the most deep-water part of the cycle with prevalence of diatomite. The following genera are inherent in this type: Pseudodictyophimus, Siphocampe, Cornutella, Ceratocyrtis, Peripyramis, Artostrobus, Lithomitrella, Tricolocapsa.

According to the analyses of geographical distribution of heterochronous radiolarian assemblages the Paleogene assemblages are known only in Eastern Kamchatka (Eocene-Oligocene) and Komandor Islands (Oligocene), the Lower Miocene assemblages have been found in Eastern and Western Kamchatka. The most widely distributed assemblages is that of the Middle-Upper Miocene with Lychnocanium nipponicum magnacornum. The Pliocene deposits have scarce radiolarians.

Comparison of systematic composition of the Cenozoic associations of the Far East with those of other regions has shown the affinity of the Eocene assemblages of the Far East with California, Oligocene assemblages of the Far East to the Norwegian Sea and the Sea of Labrador, Miocene assemblages of the Far East with Japan and California.

PALEOZOIC HISTORY OF NORTH CASPIAN DEPRESSION

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North Caspian depression began its formation in the Devonian on an uplifted passive margin of East European continent, which was situated near equator latitude.

At that time the continent, including North Caspian depression, suffered splitting and stretching (Dneper-Donets aulacogen, system of Kama-Kinel grabens etc.). Geophysical data analysis show that at the base of the depression there is a rifting zone, which seems to be a branch of the rifting system including Dnieper-Donets aulacogen. Along another branch removal of continental crust blocks which now appear in basements of Scythian and Turan plates.

Rifting resulted in opening of continental crust and formation of strait oceanic basin similar to Red Sea's rift. At the beginning of the Upper Devonian this basin was partially filled up by syn-sedimentary coarse clastic deposits. In the Frasnian, Carboniferous and Early Permian a subsidence and deposition of sediments occurred over extinct branch of rift system.

In the central, most subsided part of the depression deposition was dominated by siliceous and terrigenous sediments in the setting of non-compensated subsidence. Clastic sequences of Devonian-Early Carboniferous accumulated in the east of the depression, similar to Zilairskaya formation, were transported from the mountain country in the area where now the Urals are situated. On the slopes of the depression calcareous sequences were accumulated. Their structure inherited tectonic features of the basement (from where platforms and ledges originated). In mid-Visean, Early Moscovian and Late Carboniferous the basin was shrinking and formation of carbonates was replaced by accumulation of terrigenous sediments partially compensating the subsidence of the basin. That occurred because eustatic oscillations of the level of ocean, with which the basin communicated in the northeast and southwest. Along the fringe of calcareous margins of strait deep-water basin barrier rifts were being formed (Sarpinsky trench, Tugarakchan) and limestones were substituted by thick deltaic sequences.

The motion of blocks of Scythian and Turan caused thrust deformations in the south and south-east of the depression, separated the basin and led to evaporation and formation of salts, which filled deep-water poorly compensated depression. By that time a near-Caspian part of the continent moved to upper latitudes (30°) with arid climate.

QUANTUM GEODYNAMICS AND NEW TECTONIC PLATE MECHANISM

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The analysis of Vernadsky idea about depth planet substance state in entrails from a position of modern physics results in revision necessity of all rheological models using for description of depth geodynamics. "Explosive unstability" of substance (begin with 50-60 km depth) for description its dynamical properties and interactions with physical fields assumes using modern physics fields similar to geometrical models of common relativity theory from one hand and to mathematical apparatus of quantum field theory from the other hand. New conception of equilibrium matter unstability in which limits the problem of inertia field of microquantum nature is developed, structure catastrophe theory, theory of degenerated states and symmetry deformations (phase transitions) are the base of pointed approach.

In connection with depth geodynamics the model was developed consisting of: 1) geometrical description of equilibrium state of Earth substance in which modern astrophysical models were used: 2) reemission systems of inertia field in the Earth connected with equilibrium loss and which have macroquantum dynamics.

In particular it appears the picture of wave inertia field emission from Earth core with complicate mechanism of its reemission in asthenosphere zone. In this case on asthenosphere shell (150-200 km depth) periodically it is formed slowly rotatable frameworks of steady wave inertia fields jumping to seismic (dynamical) and structure (state) field in upper horizons. Such formations can serve as movements mechanism of lithosphere plates. Naturally wave inertia field framework in asthenosphere shell resonates with geodynamical nonlinear wave plates structures providing its stiffness frame and carries its creating forces organized by inertia field. In essence we have the analogue of laser generator on dynamical grids where asthenosphere is nonlinear element.

Such model can be applied to plate tectonics of different ranges and scales. Pointed components to emission of different physical fields can serve by important geophysical addition to modern tectonic of lithosphere plates.

Plate tectonics can be considered as appearance of macroquantum structure of geosphere both on Earth radius and on angular coordinates. Quantization of the earth's crust on radius corresponds to its horizontal stratification and strata separated by boundaries of unstable physical chemical substance states along which it is possible relative strata movement. Quantization on angles defines in strata integral geodynamical elements (plates) separated by geodynamical unstability zones.

THE MAIN MORPHOLOGICAL FEATURES OF THE PALEOCEAN RELIEF

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Paleobathymetric maps make it possible to get an idea of the paleorelief of the ocean bottom for different geological periods. The maps have been drawn 1:40 000 000 for some ages: 10, 20, 35, 50, 70, 100 Ma B.P. based on method developed by Institute of Oceanology. Isobaths are at 1000 m interval (500 m in places). The idea of this method is to determine the paleodepths of the real relief for different geological times. The methodological part was subject to lengthy discussions.

As study of the maps make it possible to establish the morphological features of the large elements of the bottom relief, the lateral movements and changes in their intoconnected location. Reflecting the present day structure this method makes it possible to evaluate and reproduce the ancient and burried forms and trace their evolution in geological time. A comparison of a number of maps shows that a change in the geodynamic position results in a change in the basic forms of the relief: on the one hand in a redistribution of areas and volumes deep-sea basins, on the other hand - shallow large rises. Thus it has been shown that the simultaneities with the lengthen of certain branches of the MOR in the North Atlantic an opening of in Eocene occurs in the Norwegian Sea together with a formation of deep-sea basins. In the Pacific we can see a gradual disappearence of ocean basins in the subduction zones the formation of new structures and subsequent eastward movement of the basic system of ridges and northward movement of the big rises.

In the course of geological history the structures undergo a more or less important evolution which leads to the changes in their configuration and the degree of fragmentation including a change in the sea level. The paleo-bathymetric maps reflect the basic stages of the formation and desintergretion of large highs, created in different geological times within the MOR but which are not seen in the present day bottom relief. This can be proven by the rise which existed in the Cenozoic in the Atlantic Ocean and which connected the Rio-Grande Rise and the shallow Walvis High. In the Indian Ocean we have reconstructed the Lemuria High bordering on the Oligocene/Eocene which split into the Kerguelen and Broken Rigies whilst in the Pacific Ocean we have reconstructed Pacifica High in Oligocene time including the Nazca and Tuamotu Ridges.

We have found and traced on a number of maps distant migrations of large rises covering hundreds of kilometers Shatsky Rise, Hess, Magellan, Manichiki and Ontong-Java. These rises have existed in the Pacific Ocean since the end of Mesozoic. They were formed much later and moved toward the North in accordance with the movement of the Pacific plate, whose morphological elements are transforming into a lower bathymetric position.

Thus the paleobathymetric maps provide a clear picture of the World ocean bottom in different geological times as well as the evolution of the ancient relief forms besides they are an important part of the research connected with paleoceanological problems and the movement of the lithospheric plates.

RADIOLARIANS AND RADIOLARITES: FROM PRIMARY PRODUCTION TO PALEOGEOGRAPHY

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Radiolarites are used as environment indicators. But of which environment? Moreover, in literature, one commonly meets opposition between calcareous and siliceous sediments. Is this correct for the initial palaeoenvironment? Backtracking from the geological message to the biological signal of the initial environment implies a proper knowledge of different filters which have tangled it and of the actors which generated the signal.

Siliceous plankton

Radiolarians are planktonic organisms and as such obey to the common rules of the planktic life: abundance/absence of nutrient. For decades one has evoked the necessity of a minimum silica content in sea water to allow these organisms to precipitate their skeleton, to develop and to profuse. Consequently geologists considered logical to find abundant radiolarians in rocks close to ophiolites. Nevertheless, no data supports this view in Recent Ocean. Indeed, radiolarians are not the most abundant oceanic ridges in Present oceans. Whereas they profuse in peripolar and equatorial belts, on some western sides of continents: where the overall plankton (phyto- or zoo-) is luxuriant which is to say where nutrient is abundant and close to the surface. There is no opposition in the way of life between siliceous and calcareous organisms.

Siliceous sediments

After its death the only remain of the organims is its test, the cytoplasmic envelope being soon disorganized and the skeleton submitted to the agressivity of the world. The dissolution is stronger in surface. Moreover, the non-existence of a Silica Compensation Depth explains that a radiolarian can deposit at 1000 m as well as at 10,000 m; the dangerous zone for its dissolution being surface waters (till ca. 500 m). There is opposition of "behavior" between siliceous and calcareous organisms for their depth of dissolution.

Siliceous skeletons are often nearly absent in sediments except under high productivity zones. Indeed if the original signal is depictable in sediment, its variations are strongly enhanced and several times exaggerated. All occurs as if the siliceous signal was preserved only above a threshold from which tests remains abundant. In moderate productivity zones for instance: one-third to half of the surface production reaches the bottom while in zones of high productivity, two-third are deposited. On a global scale, one generally estimates that less than 1% of the biogenous silica are founds in geological archives.

Siliceous rocks ex. of Mesozoic radiolarians

Radiolarian tests are made of opal-A which is highly instable and is successively transformed in opal-CT then in quartz. These two transformations are made in liquid stage (one can here understand the importance of the risks for a radiolarian with so delicate and elegant morphology to disappear before it reaches posterity) this explains both the relatively small numbers of radiolarians which preserve their form and the frequent concentration of silica as nodules. These transformations are associated with a very important porosity diminution. This porosity variation is coupled with a major decompacting factor which has to be considered when reconstruction of sedimentary piles are proposed. One may generally estimate one has to multiply by a factor 5 the present thickness of the rocks. Application of this factor to Tethyan radiolarites leads to the following thicknesses of deposits for cherts : 20 cm (mean present thickness : 4 cm, factor : 5) and for shales : 1 cm (mean present thickness : 0.5 cm , factor : 2). By that way, 100 m of radiolarites, a common thickness for that series in Tethys, corresponds to an original thickness of approximately 450 m.

The silica phase in most siliceous rocks is transformed from opal-A through opal-CT to quartz during progressive diagenesis. The transformations are principally controlled by temperature and time. This explains that quartz predominates in older rocks (Mesozoic to older) and opal-CT in Cenozoic (porcelanites, tripoli ...). Host rock lithology, together with the porewater chemistry, also plays an important role. The presence of carbonate tends to enhance the opal-A to opal-CT transformation, whereas the presence of clay tends to retard it. For a primary alternation with slight lithologic variations, an onset of the opal-A to opal-CT transformation can be different, depending on the lithologies. The beds with an early onset of this transformation import silica from the beds in which the transformation is retarded or inhibited. Local redistribution of silica between the contrasting lithologies is possible during the opal-CT to quartz transformation, whereas the redistribution seems more restricted during the opal-CT to quartz transformation. Field evidence also suggests the formation of chert nodules and pinch and swell beds by additional silica cementation within the opal-A zone, especially within calcareous siliceous rocks. Silica redistribution during the opal-A to opal-CT transformation enhances the variations in composition between originally clay-rich and clay-poor layers. The majority of siliceous rocks lose their porosity by mechanical compaction, and by chemical compaction and reprecipitation associated with the opal-A to opal-CT transformation.

One estimates that 30 to 40 Ma are necessary for a transformation from opal-A to quartz in zones of high sedimentary rate, and 60 to 70 Ma for those with a moderate sedimentation rate. For Tethyan radiolarite, the quartz stage was hence reached around Lower-Mid Cretaceous which explains (1) irregular levels because incomplete lithification, only porcelanites stage being reached during the Tithonian tectonic phase (which structure Hellenides) (2) the difficulty to date cherts associated with ophiolites of inner zones, tectonically deformed before the outer zones (i.e. Pindos-Olonos zone) where dating is relatively easier.

Why Tethyan radiolarites

Most radiolarites are Tethyan (those which do not have an unknown origin!). They have been compared to red clays of deep oceans. One presently knows this is a non-valid comparison. Their only common point being their color (their deposit below the CCD being not systematic).

Were they deposited in large or small basins? The problem of large basins is most of them disappeared. On the other hand some radiolarites were deposited in small basins. The important requirement is a strong upwelling. One may compare localities with radiolarite with the present Owen and Somalia basins, Gulf of Baja California ... all places of active upwellings, in connection with ocean but only partially.

ORIGIN AND CONTROL OF HIGH LATE CENOZOIC GLOBAL OCEAN SEDIMENT FLUXES

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A major increase in rates of sediment accumulation has occurred in young geological times, during the Pliocene and Quaternary. Several explanations for the increase in sediment accumulation have been offered: 1) many different areas of the world have recently experienced uplift, increasing the sediment supply, 2) the continuous meridional shifts of climate zones during the Late Cenozoic-Quaternary has increased global weathering rates, 3) the increased sediment supply is the result of glaciation, and 4) sea level changes in response to glaciation increased the rate of sediment recycling from the continental shelves into the deep sea. To these we can add another possible explanation: 5) continuous change in the profiles of rivers caused by isostatic response to sea level changes, and, near the ice sheets, to ice loading. There are no reliable estimates of the relative importance of these different processes nor is it clear whether these processes are truly responsible for the Pliocene-Quaternary increase in sediment accumulation.

Our initial assessment of the relative importance of each of these processes leads us to hypothesize that the isostatic-imbalance due to glaciation and deglaciation during the last 3 m.y. is the most important driving force behind the global increase of sediment erosion during the late Cenozoic and Quaternary. A local effect of glaciation in Scandinavia and Siberia was the formation of a peripheral bulge around the ice cap. This may have altered the course of rivers resulting in increased erosion on land and a subsequent increase in sediment flux to the adjacent ocean basins. On a global scale, the lowering and raising of eustatic sea level due to building and melting the Northern Hemisphere ice caps would result in the movement of asthenospheric material across the continent-ocean boundary. During rapid deglaciations asthenospheric material would flow from the ocean basins to the continental margins more rapidly than isostatic adjustment could occur. This may have caused short-term uplift along continental margins increasing the flux of sediment to the deep sea.

CENOZOIC STRUCTURE OF TIEN SHAN, CENTRAL KYZYL KUM AND THE PAMIRS

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An unusually intensive Cenozoic folding occurred in the region as a result of collision of Indian and Eurasian continents besides Paleozoic deformations. So Paleozoic deposits, as Meso-Cenozoic mantle have suffered plastic deformations. A grade of deformation depends on competence of deposits independently of their age.

Cenozoic structure is continuously developing in space and time and with shrinking of the area the motion accelerates from the Oligocene to the present day. There are clearly manifested general structural regularities expressed in intimate paragenetic connection between slipping and thrusting. Movement takes place along great steep slip fault formation of fold-thrust structures with elements of rotation. Thus, the similar structural features are repeated, what resulted in appearance of similar structures in diverse parts of the region.

There are very great dextral slips in the region - Talaso-Ferganscky and Kyzyl-Kymsky of northwestern direction and Gisaro-Kobshaalsky of east-west direction. Folded systems conditioned by motion to northwest and west with synchronous counter-clockwise rotation are associated with them. Thus, gentle thrusts have also slipping gradient. Analyses of similarity of structures show that the structure of Chatkalo-Kuraminsky region, associated with Talaso-Fergansky slip, is similar to the structure of southwestern Gissar, which appeared as a result of dextral motion along Gissaro-Kokshaalsky slip. In a cross-section these folded and faulted structures are fan-like. Arc-like structure of Central Kyzyl-Kum is similar to the structure of the Pamirs. Kyzyl-Kum slip is similar to Karakorum dextral slip, along which advancing of the Pamirs' arc and its counter clockwise rotation to the north occur. So, Cenozoic slipping and folding and faulting deformations are characteristic not only for the southern edge of Eurasian continent, but are spread far inside it. Drilling has shown large development of gentle Cenozoic thrusts in Central Kyzyl-Kum.

Cenozoic deformation seem to affect mainly upper parts the Earth crust, what can be undirectly evidenced by relatively shallow earthquake focuses. Most of them (up to 85%) occur up to 15 km deep.

Analyses of Cenozoic structure should be taken into account for prognostication of oil deposits and for interpretation of postmineral deformations. In many cases upper parts of ore bodies were cut off and moved away in Cenozoic.

EARTHQUAKE RAYLEIGH-WAVE-SCOPY OF THE SOUTH KASPIAN LITHOSPHERE

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Propagating through the lithosphere earthquake Rayleigh wave undergoes velocities dispersion and scattering on inhomogeneities. Therefore it contains two independent kinds of information about the medium. Both of them are jointly realized by the Rayleigh-wave-scopy (RWS) method. The tomographic dispersion processing produces velocity areal distributions for different periods. It generates a local dispersion curve for any point of an explored region and then shear velocity section for this point - by means of inversion. The sufficient number of velocity sections make it possible to draw the maps for the corresponding velocity boundaries. Experimentally found possibilities to use the initial stages of scattering (when energy does not deviate considerably from the shortest path) let the medium blocks which differ in thickness or absorption be detected. An adequate number of epicenters and seismic stations in and near the region provide a relative detailness. This investigation is an areal extrapolation of data from the DSS profiles worked out earlier. The preliminary results are as follows.

Two regions anomalous in low frequency scattering parameters are delineated. According to velocity sections their low velocity layer increases abruptly to 35-40 km, a 15-km portion of its base having a lowered or a very low velocity, while the top of the mantle velocity is anomalously high. The low-velocity layer thickness just outside the both regions is reduced to 20-25 km, the lowered velocity portion of it ceases and the mantle velocity becomes less than normal. The two deepest zones of the basin's bottom coincide with the both anomalous regions just as the bulk of numerous bottom mud volcanoes. The discussed regions are anomalous in wave higher frequencies which, probably, point to a stronger absorption in the sedimentary layer up to 3-5 km and less. All the sections show the 5-7 km layer with the basalt velocities overlying the mantle.

TRACES OF CALEDONIAN STRIKE-SLIP FAULTS IN CENTRAL KAZAKHSTAN

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As it is well known the structure of the central Kazakhstan Paleozoids, consisting of numerous 1100 Ma micro-continents, Early Paleozoic island arc terranes, and ophiolite-bearing Early Paleozoic accretionary complexes, forming oroclinal bends, is a result of multiple tectonic accretion occurred here during the Late Ordovician, the Early Silurian, the Middle Devonian, the Early and the Middle Carboniferous, and the Late Permian - Early Mesozoic. The modern structural style is determined mainly by the Early Variscan structural zoning which has been slightly disfigured when Late Paleozoic - Early Mesozoic strike-slips, revealing sometimes giant displacements up to 70 km and even 100 km, have been occurred. However, even the traces of Caledonian strike-slips may be found regardless strong reworking of basement and wide development of Variscan molasses, masking the structure of the basement. The displacement along these strike-slips seems to be remarkably greater, being 200 km and more in some cases (without regard for boundary faults of the Kazakhstan block, which might be the greatest strike-slips).

The seeming mosaic-like basement structure is an evidence of presence of such strike-slips. There are three major Caledonian strike-slips. The most important line is a Western-Eastern domain boundary, going along eastern foot of the Erementau Mts and further to the west of the Aktau-Mointy microcontinent. The face-to-face junction of main structural directions is revealed along this boundary, which represents evidently a trace of Late Ordovician or Early Silurian largest sinistral (?) strike-slip. Another strike-slip of such type is the Early Silurian Tselinograd fault, revealing 150 km dextral displacement of Early Paleozoic structural zones. The Middle Devonian Katarasan dextral strike-slip is a third fault, displacing for 200 km the primary single Tekturmas - North Balkhash ophiolite suture. Some traces of strike-slip displacements should be marked out along ophiolite sutures, where kinematic indicators of strike-slip ductile deformations are present.

The presented data allow to propose transpression as a leading mechanism of Early Paleozoic basins closing and further deformation of structures in central Kazakhstan.

STRUCTURAL-GEODYNAMICAL MODEL OF THE CRIMEA AND SEISMICITY

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In order to corroborate paleomagnetic reconstruction in the piedmont part of the Crimea the Mesozoic suture, reflecting subduction of the considerable fragment of Tethys ocean crust and collision of subcontinental terrane of the Mountain Crimea with an active south margin of the Euro-Asian continent has been singled out. The fragments of the ophiolites - the basic rocks, the ultrabasites and the radiolarites, 2-3 km zone of dynamometamorphism, and to the south - Bitak molasse foredeep are connected with the suture. Still more to the south an existence of a band of tectonic polymictic volcanogenous-sedimentary autoclastic melange has been substantiated. The dip of the fault fissure had been proved as N-N-W under the angle of 30° by complex of the data. Today, position of the Second and the Third ridges of the Crimean mountains, displacement of modern gorges and also separate the epicenters of the earthquakes are connected with the dislocation zone of piedmont suture. It testifies to its inherited activization in our days, although the main activity took place from the middle Jurassic to Lower Cretaceous inclusive. It makes it possible to single out the piedmont seismogenous zone along the suture.

The second large fault, determining the Crimean geodynamics, is connected with the south-Crimean seismofocal zone in the Black Sea water area. The ideas of its steep south dip are incorrect. The fault fissure dip, judging by seismic prospecting data, is 20-40°. The fracture is interpreted as rear underthrust of the rear spreading of the Black Sea ocean crust under the Crimean orogen, which is connected with Adzharo-Trialetskaya convergence zone.

In the Plain Crimea the north-Crimean Paleozoic suture, with the southern dip, separating the Scythian plate from the East-European platform, has been outlined. The suture dip to the south is substantiated by existence of shelf complexes of Paleozoic margin at the south slope of the platform and by existence of magmatic complexes of the active margin in the basement of Scythian plate. Subsequent inherited movements along this fracture led to formation of gently sloping asymmetrical folds chain in Mesozoic and Cenozoic. The thrust is active at present, that is recorded by epicenters of weak earthquakes. It is singled out as the North-Crimean seismogenous zone.

The analysis of destructions owing to the most powerful Crimean earthquakes makes it possible to draw a conclusion about mainly horizontal displacements of the Earth's crust. With all this mainly high buildings of sublatitudinal strike, perpendicular to the displacement direction along thrusts are disturbed. That is why it is necessary to locate buildings under construction sub-meridionally.

GEODYNAMICS OF THE CRIMEA AND ADJACENT ACQUATORIES

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Crimean tectonics have been traditionally interpreted from the stands of the geosyncline theory as fold-block type, and in recent years as thrusting types with predominant dip of fracture fault-planes toward the South. Constructed geological maps and sections were unbalanced and therefore geometrically incorrect. Data reinterpretation based upon the theory of actualistic geodynamic and balance of movements gave way to create the new geodynamic model of the region. Base of this model is selection of sutures formed by subduction of Tethys oceanic crust and continental crust fragment accretion.

The oldest one is the North Paleozoic suture, singled out from geophysical data in the Plain Crimea. It has southern dip, because toward the north Paleozoic shelf deposits are amagmatic. The suture separates Scythian Plate from Euroasian one. Inherited movements acted along the fracture at the end of Mesozoic and Cenozoic formed thrusts of the southern dip, detected at the east as Main Azovian, and at the west as Sulinsko-Krymsky. They are accompanied by gentle linear asymmetrical folds and sheets.

The base of Mesozoic tectonics is presented by Middle-Jurassic - Lower Cretaceous Submontane Suture. The fracture does not dip toward the South as it was considered earlier, but gently pitches to the North, what is substantially different to the geodynamic model of the region. The suture is accompanied by ophiolitic association, intensive folding and melange. It was detected from geophysical data along the Third Ridge of the Crimean Mountains from Sevastopol to Feodosia delineating Crimean Mountainous terrain. The Northern dip Crimean-Caucasus thrust-suture branches off from this zone near the city Stary Krym. Lower Cretaceous magmatism and volcanism is accounted for the activity of this suture in the North-Crimean depression.

Cenozoic geodynamics is defined by the South-Crimean seismofocal zone. It is delineated by South-Crimean and Northern Black Sea thrusts with gentle dip of the fault planes to the North. The zone is situated at the base of the continental slope and defined by seismic and consists of sheets and asymmetrical folds. It is similar to subduction zone, but poorly defined (no trench, volcanism and others). Retrothrusts branch off from this zone. The biggest of them is South Azovian with gentle dip 20 degrees to the South. Crimean geodynamics is the result of accretion and collision of continental and subcontinental crust fragments near the Euroasian border line.

BIMETASOMATOSIS AND OPHIOLITE GEODYNAMICS IN THE NORTHWESTERN PACIFIC FRINGING

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Bimetasomatic contact-reactional units emerge at different stages of formation of ophiolite suite both in high (T=900°C) and low (T=160°C) temperature conditions realized respectively during 30-40 km deep magmatic rock intrusions into serpentinite and at the contacts of ultramafic and brecciated volcanic-sedimentary rocks. The deepest bimetasomatic layers composed of olivine, bronzite and diopside formed at the contact of magmatic dyke-like lhertzolite bodies and apoharzburgite serpentinites due to ultrabasic magma intrusion into the mantle ultramafies having suffered the pseudomorphic serpentinization.

At the concluding stage of discrete formation of banded rock series ranging in depth from 20-30 to 10-12 km the following different temperature bimetasomatic layers formed: 1. apogabbronorite (T=900°C) composed with bronzite, diopside and the pargasitic hornblende; 2. apolherzolite (T=550-700°C) typically comprising diopside, pargasitic hornblende, grossular, andradite and herzinite; 3. aposerpentinite, including antigorite, lizardite, pentlandite, chromespinellide. High-temperature mineral associations were formed by polycyclic intrusion of basic (gabbro-noritic) magma into lherzolite, verlite and apodunite-harzburgite serpentinite bands through the dyke channels.

The generation stage of the sill-dyke complex formed at the expense of rocks of the dyke series and the enclosing banded and dunite-harzburgite series coincided with that for large group of low- and medium-temperature rodingites. Noteworthy is that Ca and other chemical components necessary to form rodingites were derived from the magmatic rocks and magmatic-related fluids. The Ca-enriched hydrothermal solutions circulating through contact zones resulted from early plagioclase albitization occurring in diabases. The formation of rodingites at the expense of effusive-tuff rocks of the spilite-kerathophyre complex lie above the dyke series to serpentinite protrusion in early post-volcanic environments. At the contact of serpentinites with turbidites and hemipelagites in fore-arc flyschoid complexes associated with ophiolites there emerged bimetasomatic layers comprise either prenite or xonotlite (T=160°C) and chlorite.

The composition and regular combination successive continuous vertical series of deep to subsurface bimetasomatic structures in lateral series reflect the geodynamic environments of ophiolites in the course of the mantle matter diapiric uprise. The matter was saturated by ultramafic and mafic magma intrusions at different depth under extension conditions existing in the uprising diapiric dome. The uprise was associated with discrete poly-stage metamorphism manifestations including those due to the boulder block motions of the shifts type and stress deformations.

THE PLIOCENE-QUATERNARY BASINS OF THE EASTERN MEDITERRANEAN: SEISMOSTRATIGRAPHY, STRUCTURE, GEODYNAMICS

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The Eastern Mediterranean is a region where the structures of various genesis and age are joined. In spite of numerous investigations in this region many vague questions still remain. In this report we discuss the peculiarities of the microplate structure of the Levant Sea and adjacent areas. The base of this paper is the complex interpretation of the geological-geophysical data, including the analysis of the geophysical fields, seismic reflection data (inclusive seismo-acoustic materials of several cruises of RV "Academician Petrovsky") and "Moscow University" in Mediterranean Sea in 1986/89). In the geodynamic modelling the paleomagmetic and seismology data were used including the analysis of the field of density of the earthquakes with a low density (M<4). Below there are some results of these investigations.

There are 3 seismofacial units in the Plio-Quaternary complex, which is underlain by Messinian evaporates or older sediments. All these units are in accordance with stratigraphical boundaries into Pliocene-Quaternary. This report presents several schemes and maps: thickness and bottom structure of the N_2-Q sediments, structure of the seismic horizons into N_2-Q section and others. As a result the scheme of the Pliocene-Quaternary basins was worked out, which allows us to make division of these basins with respect to their origin and genesis. For example Adana depression may be a back-arc basin (prevailing force of compression) and Sizilia and several other depressions, situated southward of Cyprus, have shift-graben features with prevailing force of tension).

Geodynamic analysis showed that the Pliocene-Quaternary time is characterized by the crushing of the convergent/collision zone to several microplates. The main of them are Anatolian, Lavantian and Sinai microplates. In their turn these microplates may be divided into smaller structures (including terrains). The latter have all features of microplates like different vectors and velocities of horizontal displacement. Our model provides for multilayer plate-tectonic conception. It is possible that the origin of the complex structure of the Eastern Mediterranean is connected with the wedging of subduction zone in the eastern part of Hellenic arc, with its dividing to Crete and Cyprus segments (through 32-degree fault) and with rotation of Cyprus counter-clockwise during Neogene-Quaternary times.

GEOCHEMICAL FEATURES OF THE CENOZOIC VOLCANICS FROM THE ANADYR DEPRESSION

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In the Anadyr intermontane depression the Cenozoic effusives are represented by two types of volcanic associations: basaltic and andesitic. The compositions, intermediate between the rocks of tholeiitic and moderate-alkaline series of the continental rifts are predominant among the lavas of the basaltic association. They are marked by low K, Rb, Ba contents and high Cr, Ni ones. Low K/Ti x Ba+Sr/Cr+N and Rb/Sr, K_2O/Na_2O values indicate the simple composition of the melts, which generate the considered basalts. The high-titanium basalt of the lower sheet of the volcanics from the Aleksandrovsk uplift are typical of the moderate-alkaline series rocks. They are enriched with K, Rb, Sr, Zr, Y and light REE.

The andesitic association, observed within the Nizhneanadyr ring structure of the Aleksandrovsk uplift, forms the common series of the calc-alkaline series differentiates. They are marked by an increase in total alkalinity, K, Rb, Li, light lanthanoids contents in the andesitic lavas as opposed to the andesite-basaltic ones.

Primitive and subalkaline basalts are associated with the grabens and near-fault depressions, formed in the zone of tectonic extension within the region of Laramide collision. The younger volcanic association of the Nizhneanadyr ring structure is composed of the rocks of calc-alkaline series, which are typical of the volcanogenic belts of the active continental margin of North-East Russia.

CRITERIONS FOR ESTABLISHING THE REGULARITIES IN DISTRIBUTION OF PALEOHYDROTHERMAL FIELDS IN THE PALEOZOIC MARGINAL SEAS IN THE URALS AND SIBERIA

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Relicts of paleohydrothermal fields formed in the marginal seas are established in the Urals and Siberian Paleozoic volcanic structures. They are shown in local areas of synchronous submarine hydrothermal sediments and products of their destruction concentrating in definite stratigraphic levels and common structures. Sometimes many paleohydrothermal systems are fixed.

In under-ore strata, paleohydrothermal fields are fixed as bed-like zones of metasomatites, indicative of former high temperature hydrothermal reservoirs. In ore-host strata, they may be outlined by area of sulphide and iron oxide sediments and products of bottom acid leaching. In the sedimentary strata covering hydrothermal formations "steaming "envelopes and hydrothermokarst in carbonate rocks are distinguished. On the supra ore volcanic strata levels, buried ore-bearing structures are indicated by presence of ore and metalliferous rocks xenolithes in lavas and intrusive bodies, and xenogenous ore-clasts among volcaniclastic deposits.

In the Sayan-Tuva marginal basin, hydrothermal fields have been established in two structure types. Linear depression (of tens of km) with predominance of hydrothermal siliceous rocks are typical. Sometimes olistostromes and ophiolitic melange are present in the bases of these depressions. In the local grabens and peripheral parts of deep depressions parallel to carbonaceous-siliceous and volcaniclastic rocks, beds of pyrite and pyrrhotine-pyrite ores accumulated. In the flanks of rifts cutting continent slopes of the marginal sea hydrothermal fields are productive for copper lead-zincous ores. At this place there were volcanic ridges with ore-bearing grabens between them. Judging by abundance of sills and dikes they formed in local spreading condition. Sulphide ore deposition occurred in 2 or 3 levels and was accompanied by silica-ferrous hydrothermalites.

In backarc basins of the Urals paleoocean, hydrothermal fields with large sulphide ore bodies occur in local spreading zones, cutting rhyolite-basaltic volcanic edifices. Most parts of them occurred in the central, the highest, part of island arc segments, rarely near cross faults fixed by systems of parallel basaltic and rhyolitic dikes. In many fields ore formation occurred in several levels with superposition of hydrothermal alteration zones on earlier formed sulphide deposits. Places of hydrothermal alteration outcrops are shown by relicts of vents in the sulphide hills and accumulation of nearhydrothermal fauna (vestimentiferans, vezicomyides and archeogastropods).

MECHANISM OF SHORT-PERIOD PULSATION OF OCEANIC SPREADING

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The earth crust in the rift area is simulated by a two-ply resilient tectonosphere packet. Lithosphere is accepted as more rigid and thermally "inert" compared to the asthenosphere.

The basic features of the packet evolution are: momentary (with respect to the period) convectional heat-dissipation from the edges of the expansion crack when an axial crevice takes place; soldering of the expansion crack; slow heating from the inner heat; accumulation of the thermoelastic stresses (Laplas-tension of the lithosphere, virtual pure bending of the packet).

When model's parameters have base values, pulse duration is about 5300 years and the full energy of the packet accumulated during the cycle is equal to 0.77×10^9 joule per one linear meter of the rift axis.

Geophysical corollary:

a) relative horizontal displacements of strata along their edge are connected with the jump of absolute volumetric strain there. This jump is caused by a strong Laplas-tension of lithosphere shell,

b) existence of compression structures in the lower horizontal rift areas with a simultaneous tension in the upper ones is the result of the virtual thermal pure bending packet operation,

c) bisymmetrical with respect to the axis strips of heat flux minimum from the bed are connected with the redistribution of the conducted heat when the packet is creviced,

d) thermoelastic stresses from equivalent More-stress which makes 90% of lithosphere tensile strength.

Conclusions:

1. The main role in the plate crevice is played by the "inner" factor - i.e. thermoelastic stresses. Thus crevice and transportation of plates should be strictly separated according to the complex of strength causing them.
2. Phenomenological approach to the examination of the process crevice does not need a construction of any auxiliary mechanisms, the latter in its turn need some explanation.
3. The constructed model is a tearing hunting system. It is neutral to the way of energy influx to the rift area and can hold any hierarchic standard of tectonics on the divergence borders when one respects the accepted rheology of tectonosphere packet.

ACCRETIONARY TECTONICS AND GEODYNAMICS OF KAMCHATKA

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Kamchatka is situated between Kurile and Aleutian island arcs and Koryak accretionary system and therefore it has specific features typical of island arc and young accretion belt simultaneously. In the last years, tectonic structure of this region has been the subject of intensive study. It has been proven, that Cenozoic volcanic and sedimentary formations cover very complex basements which consist of the system of tectonic nappes and sheets. These terraines are composed by volcanic, volcano-sedimentary, terrigenous and metamorphic formations of Mesozoic-Lower Cenozoic age.

Rocks of Mesozoic-Lower Cenozoic age are compatible with complexes of different parts of island arcs and marginal basins. Oceanic complexes occurred very seldom as mainly blocks in serpentinite melanges and olistostromes.

Paleotectonic maps for Upper Cretaceous age were reconstructed the presence of margin of Asia continent, Iruney marginal basin, Ozernovsko-Valaginsky island arc. There are also the Kamchatka Cape and Kronotsko-Shipunsky composite terraines departed off Ozernovsko-Valaginsky island arc by Vetlovsky suboceanic basin.

The discrete processes of the accretion of Kamchatka continental rim have continued for a long time, showing Early Cretaceous, Early Paleocene, Middle Eocene and Later Miocene episodes. Early Paleocene and Middle Eocene were more considerable, when the collision of perioceanic Ozernovsko-Valaginsky island arc with Asia margin, tectonic closing of Iruney and Vetlovsky basins and collision of Kamchatka Cape and Kronotsko-Shipunsky composite terraines occurred.

One fuzzling feature of Cenozoic development of the region is the migration, beginning in the Oligocene and continuing to the present, of both extensional and compressional activity from NW to SE. Destructive processes have been manifested against the back ground of a general growth of a continental crust, periods of the extension and compression are intermittent. Volcanic belts (Koryak-Central-Kamchatic {P3-N1} and Eastern-Kamchatsky {N2-Q}) and grabens have been formed during periods of extensions and migrated to the Pacific Ocean. Displacements of the Cenozoic volcanic belt are accompanied by jumps of the subduction zone locations.

KIMBERLITE FIELDS OF THE SIBERIAN PLATFORM: HOT SPOT TRACES

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The joint analysis of geological and paleomagnetic data revealed that on the Siberian platform the kimberlite position in space of each (out of three) Phanerozoic epoches of kimberlite formation agrees with paleokinematics of the plate in terms of hot spots hypothesis. The kimberlite fields are local areas of magmatic activity related to the effect of mantle plumes on a moving lithosphere plate (hot spot traces). Synchronous occurrences of magmatites and paleomagnetic poles produce regular sequences (tracks) in space. The tracks of paleomagnetic poles and kimberlite fields tend to lie along the minor circles outlined around the common Eiler pole. Such an agreement is common for different epoches even when some paleokinematic parameters of the plate differ sharply, which is hard to explain without referring to the hypothesis of hot spots. The main results of the study are the following.

1. Intrusion of kimberlite magmas on the Siberian platform corresponds to a particular paleokinematic regime marked by the apparent polar wander paths. The Middle Paleozoic (355-340 Ma), Early Mesozoic (225-210 Ma) and Middle Mesozoic (150-140 Ma) epoches of kimberlite formation correlate with time intervals of the directed plate drift in the geological past. In addition to these intervals a similar paleokinematic regime is defined from paleomagnetic data in the Cenozoic (50 to 70 Ma) and Silurian (400-440 Ma) but less reliably in the Ordovician and Cambrian time. They are considered as the epoches of possible kimberlite formation and conform with the data of chronological prediction (F.F. Brachfogel, 1984, 1993).

2. Each epoch of kimberlite formation is characterized both by specific kinematic parameters of the plate drift (angular and linear rates, coordinates of pole rotation) and particular spatial position of deep mantle plumes. These factors display the complexity of spatial relations of different age kimberlites. The efforts to relate all kimberlite occurrences to plate motions over the same hot spot cause contradictions. This may be regarded as the evidence of drift and mantle plume relationship with the structure of more large-scale convective flows in the mantle. Its reconstruction may cause the change of paleokinematic regime of plates and origination of the new system of hot spots.

3. Paleomagnetic and geological data were used to calculate the kimberlite field tracks (Zhitkov, 1988, 1992). The coordinates of 7 tracks and paleokinematic parameters have been evaluated, in particular the direction and the value of the age variation along the tracks. These estimates lie beyond precision of available dates but in principle they may be checked.

4. Known and predicted occurrences of polychronous magmatism are confined to intersection of different age tracks of kimberlite fields.

This study shows that the hypothesis of hot spots may be applied to investigations of deep intraplate magmatism, the Siberian platform being an excellent study area.

ON THE HISTORY OF CONVERGENCE OF THE EAST-SIBERIAN AND NORTH CHINA PLATES (PALEOMAGNETIC DATA)

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The first efforts to reconstruct paleogeographic relationships between the Siberian and North-Chinese platforms were undertaken about three decades ago. However, the history of their convergence is still problematic. New paleomagnetic data provide knowledge important for: (i) construction and analysis of time sequences of paleomagnetic poles for both cratons; (ii) study of paleomagnetism of the same age rocks on both sides of linear tectonic structures of the latest (Mesozoic) tectono-magmatic reactivation (Mongolo-Okhotsk suture); (iii) the study of microplate paleomagnetism including the terranes at present filling the space between these structures.

Available paleomagnetic data on the plates are represented as Apparent Polar Wander Paths (time sequences of paleomagnetic poles). Generalization is made by giving each particular determination to geological age, arranging by the time sequence, averaging by a sliding window of 30 million years with 10 m.y. steps. The data on the Siberian platform are more representative relative to other structural units. The divergence of migrating pole trajectories is significant till Late Paleozoic. The Jurassic is marked by identity of paleomagnetic directions for both plates. Thus, the time of collision is limited.

In addition to data on the plates, the newly obtained paleomagnetic directions of foldbelts and adjacent terranes are analyzed separately. The paleomagnetic poles for Vendian-Early Cambrian of the southern termination of the Siberian platform (Baikal area, Bodaibo, Patom and Bokson lithologo-facial zones) are close in latitudes (30-40°S) but display a wide scatter (up to 100°) in longitude magnitudes. These divergences seem to be due to local and regional tectonic factors. Significant (to 20°) difference in the latitude is the case only for Vendian of the Baikal-Vitim zone, which is the evidence of different paleogeographic interrelated positions of the structures compared. The Middle-Paleozoic poles are already conformable to the Siberian ones. The tendency as to subsequent accretion of structures and widening of the East-Siberian continent to its convergence with the North-Chinese plate is evident.

The latest paleomagnetic results are considered in terms of reference objects of the Western and Eastern (Amurian block) Trans-Baikal area. Successive broadening of the Siberian platform boundaries is due to accretion of folded structures from the south. The Permian poles obtained from sedimentary and volcanogenic rocks in the Khilok River basin are analogous to the East-Siberian and are totally different from the North-Chinese ones. Later the Carboniferous and Permian poles of the Amurian block were at a distance from synchronous measurement for both plates. Paleomagnetic data on the Jurassic deposits of the Western and Eastern Trans-Baikal area agree with each other and data with data for both plates.

NEW DATA ON MAGMATIC GEOLOGY OF SOUTH NEW HEBRID ARC (HUNTER FRACTURE ZONE) AND ADJACENT NORTH FIJI BASIN

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The detailed dredging survey of the southernmost part of the New Hebrid Arc (NHA) including the Hunter Fracture Zone (HFZ) and Ridge (HR) and the adjacent area of the North Fiji Basin (NFB) was carried out by RV "Academik Alexander Nesmeyanov" in 1990. The new data on magmatic geology of this region are evidence for an exceptionally diverse spectrum of magma types. The rocks studied belong to island arc basalts (IAT), mid-ocean ridge basalts (MORB), ocean island basalts (OIB), calc-alkaline lavas (CA) and boninites (BON) as it is evidenced by major element and REE geochemistry.

The low part of the northern slope of HFZ seems to be the most complicated area. The volcanics of all mentioned types (except for CA) are sampled here from the same dredge holes. The close association of them with various gabbros and tectonized ultramafics is revealed. Boninites are strongly deformed and occur as breccia. In our opinion, this pattern may be interpreted as a large melange body related to pull-apart basin development. The latter was first recognized here by Maillet et al. (1989) as a result of propagating of NFB spreading center (0-5 m.y.) into NHA. The rocks mixed in melange seem to be related to previous (Miocene) stage of NHA development when the westward subduction was accommodated in the Vitiaz Trench.

The volcanics that belong to IAT, CA and BON are common for the upper part of HFZ slope (Hunter Ridge). The latter occurs as a typical pillow. MORB and OIB as well as ultramafics are infrequent but significant. This structure is an extension of NHA and some rocks show a geochemical similarity to lavas from Matthew and Hunter Isl. The origin of these rocks is related to the Pliocene - recent stage of NHA development with an eastward oblique subduction in the New Hebrid Trench.

The adjacent part of NFB consists of MORB lavas with a predominance of E-MORB type.

The close assemblage of contrasting magma types (OIB and MORB versus BON, IAT and CA) reflects an interaction of subduction related and non-subduction components through all involved magmatic history of this ridge-arc junction, and its complex geodynamics.

IMPULSES OF THE ABSOLUTE PLATE MOTION DURING THE LAST 150 M.Y. AND THEIR CORRELATION WITH CHANGES OF THE GLOBAL SEDIMENTATION RATE

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Two years ago we speculated that hot-field tectonics governs the global geodynamics of the Earth. This conclusion was confirmed by comparison of the change of the velocity of the absolute motions of the lithospheric plates and change in time of the accumulation rate of sedimentary and volcanic rocks on the continents and in oceans during the last 150 m.y. of the geological history (Ronov, Khain, Balukhovsky, 1979, 1986).

Impulses of absolute motions of the plates containing big continents and oceanic plates were calculated according to the hot spots frame for 150, 135, 119, 85, 66, 53, 37, 17, 5 and 0 Ma. Using these data of the changes of the impulses of absolute motions of plates with continents and oceanic plates were constructed and an integral curve of the global change was obtained of absolute plate motion. Maximal values of these movements are established for the chronological interval 119-85 m.y. - 80 x 10^{22} kg · cm/y. A gradual decrease of these values up to 5 m.y. ago appears to the beginning of Pliocene. In the Pliocene-Quaternary time the value of absolute motion of lithospheric plates increase. The curve of impulses of plates motion is similar in general with the curve of change of the tectonic activity on the spreading systems (Zonenshain, V.V. Khain, 1989).

The comparison of the global change impulses of absolute relate motion with change of volcanic activity on continents and oceans (Ronov, Khain, Balukhovsky, 1979) and the main rate of the sedimentation on continents, their margins and in the oceans as well as change of the erosion rate of the continental block for the last 150 m.y. (Ronov, Khain, Balukhovsky, 1986) points to the correlation of the general trend. Two maxima could be distinguished. The first, Cretaceous peak coincides with the increase of volcanism on continents, their margins and oceans. The second, less expressed, is synchronous with the sharp increase of the sedimentation rate, erosion rate of the continental blocks and the velocity of their general uplift.

TECTONIC SETTING AND PLATE TECTONIC EVOLUTION OF THE NORTH MELANESIAN SEAS

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The North Melanesian seas are part of the system of small oceanic basins that developed in a complex zone of interaction between the Australian and Pacific plates. This zone is marked now by the New Britain-New Hebrides subduction system on the west and by the Tonga-Kermadec subduction system on the east. Both systems seem to have had a more or less stable position in the absolute, hot spot releated frame, but predecessors of the New-Britain-New Hebrides system changed polarity al least twice during the Cenozoic, from north-dipping subduction to south-dipping and vice versa. Each time during these polarity reversals, island arc and attached oceanic crustal fragments accreted to the Australian continental margin, and simultaneously new back-arc basins opened. Among young basins, the Manus, North Fiji and Lau Basins are typical back-arc basins, but the Woodlark Basin opened in front of the New Britain-New Hebrides subduction system and is now propagating westwards into the Papua New Guinea margin. This very complicated structure and evolutionary pattern is a good example for understanding the structure and development of older orogenic belts.

HOT FIELDS AND DEEP GEODYNAMICS OF THE EARTH

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The intraplate magmatism occurrences are observed in two large regions (up to 10 000 km in diameter), the Pacific and the African and in two smaller areas (2000-3000 km in diameter), the Central Asian and the Tasmanian. These regions are considered as occurrences of hot fields in the mantle, whereas the regions lying between them are the expressions of cold fields in the mantle. Large-scale anomalies coincide with the hot fields: topographic swells, uplifts of the "asthenospheric table", inferred heated regions in the lowermost mantle according to seismic tomographic images, geochemical anomalies et al.

Occurrence of intraplate magmatism on the Earth surface and the tectonic activity of the Earth are connected with the deep processes, occurring mostly at the core-mantle boundary. Obviously, these deep processes are caused by the evolution of the Earth as a whole. The plate tectonics is typical only of the upper mantle and near-surface horizons. The endogenous geodynamics is related to deep processes, first of all at the core-mantle boundary. This is a typical feature of all terrestrial planets. One of the main mechanisms of core energy transformations is uplift of the mantle plumes from the core-mantle boundary with the rate no less than 100 cm/year, i.e., an order higher than the convection rate in the mantle. This accounts for quick changes of tectonic activity of the Earth. At the moment, it is established, that the tectonic activity in the Middle Cretaceous was twice as high as at the present.

The tectonic activity and volume of the intraplate magmatism are connected with the deep processes at the core-mantle boundary. It is believed that these processes started during the early stages of the Earth development, but the features of the magmatism occurrence changed in the process of the evolution of the Earth.

BAIKAL - MONGOLIA TRANSECT AND ACCRETION OF THE ASIATIC CONTINENT IN PALEOZOIC

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This is the third transect that traverses the Baikal fold area and fold belts of Mongolia. The transect runs north-north-westwards and passes near the cities of Irkutsk and Ulanbaatar.

The crustal thickness along the transect varies from 40 to 47 km and has average P-wave velocity of 6.4 km/s, that is typical of continental crust. The crust is composed mainly of Precambrian blocks (microcontinents) separated by suture zones which contain strongly eroded fragments of Phanerozoic island arcs, fore- and back-arc basins, and accretionary wedges.

Djida and North Khentei zones in the northern segment of the transect belong to an Early Paleozoic fold belt. The Djida zone is made-up of fragments of accretionary wedge and fore-arc basin, thrust northward over the Precambrian Khamardaban massif. The North Khentei zone involves fragments of a back-arc basin, thrust over Kyakhta old massif, which separates these two zones. The Kyakhta massif must have been a sialic core of an island in an oceanic island arc. This assemblage of terranes had accreted to the Siberian platform in the Late Ordovician-Silurian. The Khamardaban massif may have accreted already in the Late Proterozoic.

In the southern segment of the transect, fragments of an oceanic island arc were found: the South Khentei zone, thrust southward, and the Mandaloov zone, thrust northward over the North Goby microcontinent. The suturing here occurred not earlier than the Late Ordovician.

In the Middle and Late Paleozoic, the Mongolia-Okhotsk ocean persisted between the Siberian continent and North Goby microcontinent. From the Devonian to Permian the oceanic lithosphere beneath the Siberian continent, the southern part of which was an active continental margin, and the Khentei deep was a fore-arc basin. Somewhere the Early Triassic this segment of the Mongolia-Okhotsk ocean had closed. Note that in Khangai area (west of the transect) the ocean closed in the Early Permian, and in Trans-Baikal area (east of the transect) it closed only in the Late Jurassic. It means that suturing occurred gradually north-eastward as a result of rotation of the North Goby microcontinent. In the Devonian a fragment of Paleotethys existed south of the accretion-enlarged North Goby microcontinent whereby the oceanic lithosphere subducted northward below this continent. In the Early Carboniferous the continent collided with South Goby microcontinent. After that the subduction zone was displaced south of South Goby microcontinent which must have underwent a collision with the China platform at the end of Permian - beginning of Triassic. Around the 100°E the collision took place in the middle Permian, so here we are also dealing with migration of collision in time along suture zone, that is indicative of rotation of the continents.

THE SPREADING ON THE MID-OCEAN RIDGE CRESTS AND IN THE MARGINAL BASINS: A COMPARATIVE ANALYSIS

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We compiled the large scale morphotectonic charts of the various spreading zones areas on the mid-ocean ridge crests and in the marginal basins. The quantitative characteristics of the morphotectonics including the parameters overlapping spreading centers and deviations of the lineations were calculated. The changes of these characteristics depending on spreading rate were analyzed. Non-linear changes of the various parameters depending on increase of the spreading rate was revealed. As a whole it was shown that the transition from slow spreading to fast spreading regime in the marginal basins occur when spreading rate reaches 4.0-4.6 cm/year while this transition on mid-ocean ridges occur when speading rate is 6.4-6.8 cm/year.

The peculiarities of the both types of spreading zones magmatism were analyzed and it was shown that in wide opening marginal basins as on mid-ocean ridge crests initial melt is the product of depleted mantle (N, T-types MORB). The evolution of the melt occur in the condition of low P_{O_2} and P_{H_2O} (the Fenner's trend). The primitive Ol- and OL-Pl-basalts predominate in these areas, the ferrobasalts, ferroandesites and rhyolites are rare. The differential Pl-Cpx-basalts (E-type MORB) are revealed within the rifts triple junctions of the marginal basins.

The influence of the supra-subduction fluids determines the transition character of the volcanism (relationship of incoherent elements, the type and extent of the evolution) between N-MORB and island arc magmatic rocks. The volcanism of the narrow extension troughs and island arc is often very similar and occur in accordance with the Bowen's trend.

The heterogeneity of the morphotectonic and volcanism of the spreading zones on the mid-ocean ridge crests and marginal basins are connected with a difference of thermal regime of the lithosphere and dynamics of the spreading.

IMPULSE SOURCES OF ENERGY IN HOT FIELDS

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The hypothesis of the existence on the Earth of four large fields, incorporating a number of hot spots, in which magmatic belts outburst onto the surface, has been developed by L.P. Zonenshain and M.I. Kuzmin (1992). Formation of these fields is linked with convection in the lower mantle, while formation of hot spots is related to the plumes rising from great depths. In this connection, however, the problem of impulse sources of energy is still not solved as only the phase transitions in the mantle are considered. Based on the empiric and experimental results and data of physico-chemical simulation the idea is put forward that this source is represented by the chemical concentrators of energy (CCE), their composition including the following volatile elements (H, N, C, O, F, S, Cl, P, Hg, As etc.).

No thermodynamic hindrances take place, when CCE are formed in the Earth mantle. Only under high pT conditions they are stable and occur in different aggregate states (solid, liquid, gaseous) during the time when equilibrium is distorted that cause their detonation at different depths with an immediate release of enormous energy store.

The individual chemical compounds (different nitrides) refer to CEE, which have been reproduced experimentally and via modelling by G.Yu. Shvedenkov (1992) and S.V. Vosel et al. (in press). The synthesis of azides, having an extremely high concentration of energy, is possible. Their composition represents easy fusible elements, like Hg, Pb and others. The same group includes heavy hydrocarbons similar in composition to oil which may be stable below the Moho discontinuity, as was shown by E.B. Chekaljuk (1971) and O.V. Esterle (1992). Another CEE group contains the compounds formed by isomorphous replacement. Thus, according to Freund et al. (1980) and Kadik et al. (1986), the atomic carbon is in the solid solution in olivine and periclase. Nitrogen, after Vosel et al. may replace oxygen in the crystal lattice of the same olivine.

The detonation of accumulated CEE portions has a number of fundamental effects. On the one hand, the thermal shock results in the impulse melting of mantle rocks. Due to high temperature the most refractory minerals, olivine included, participate in melting bringing to formation of ultrabasic or basic melts with large amounts of Mg, V, Cr, Ni and Co. The geochemical paradox of co-existence of high concentrations of potassium and incompatible elements (Rb, Ba, Sr, TR etc.) is explained by a supply of the latter together with volatile components from the Earth mantle. The CEE detonation brings to formation of carbonatite, kimberlite and alkaline basaltoid explosion pipes. The explosion processes accompany volcanism (e.g. Krakatau and El Chichon volcanoes). Another consequence of CEE detonation are seismic shocks occurring in deep fault zones.

Thus, CEE may account for many phenomena taking place in hot spots and field of the Earth and other planets of the Solar system. This hypothesis can be applied to explain geological phenomena, in particular it presents evidence for the same cause and time of tectonic and magmatic processes. It needs to be experimentally verified and physico-chemical modelling as well.