

The LIP Reader

IAVCEI (International Association of Volcanology and Chemistry of the Earth's Interior)
Commission on Large-Volume Basaltic Provinces



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Newsletter Production

Judith Haller and Toni Lee Mitchell

Flows on Venus are highlighted in this issue, as are future plans for scientific ocean drilling of large igneous provinces (LIPs). A formal link between our Commission and the Ocean Drilling Program (ODP) has been established; we have been invited to provide scientific input to ODP. Plans for the volume on LIPs are well developed, and all members should plan to attend our Commission's first symposium and field excursion(s) at the 1995 IUGG XXI General Assembly in Boulder, Colorado. The Steering Committee is nearing full quota and is actively guiding the Commission's activities; please contact any of the members listed below for suggestions, contributions, comments, etc. As usual, we welcome your ideas, your input to *The LIP Reader*, and your recruiting of interested scientists to join the Commission.

Commission News

Steering Committee

Members of the Steering Committee include:

Hans Barsczus (Univ. of Montpellier, France)—barsczus@sajou.dstu.univ-montp2.fr
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Full addresses and contact numbers for the above are available over the internet, on diskette, or as hard copy (see below) from Mike Coffin.

Volume on Large Igneous Provinces

The volume on Large Igneous Provinces is coalescing. To date, reviews of the following topics have been proposed (lead authors only are listed): Ferrar Group (D. Elliot); Indochina/S China Sea Neogene-Quaternary volcanism (M. Flower); Columbia River (P. Hooper); Rajmahal Traps and Cretaceous oceanic plateaus in the eastern Indian Ocean (R. Kent); Caribbean-Colombian province (A. Kerr); North American accreted terranes, including Wrangellia (J. Lassiter); Middle Jurassic silicic province of Patagonia and Antarctica (P. Leat); Ontong Java Plateau (J. Mahoney); Karoo (G. Marsh); Parana-Etendeka (D. Peate); North Atlantic Tertiary—Icelandic plume LIP (A. Saunders); Emplacement mechanisms of flood basalt lavas (S. Self); Madagascar province (M. Storey). Negotiations with prospective publishers are underway. Still

lacking are pledged manuscripts on several major LIPs (e.g., Siberian, Ethiopian, and Deccan Traps); potential authors are invited to contact John Mahoney.

Field Excursions/Workshops/Short Courses/Special Meetings

The 1995 IUGG XXI General Assembly in Boulder, Colorado (see "Meetings Schedule" below), has been targeted for the Commission's first field excursion(s). Possibilities being investigated by Nick Arndt and John Ludden include the Columbia River basalts, Wrangellia, and Yellowstone. Please contact any member of the Steering Committee if you would like to run or help organize a special field excursion, workshop, short course, or meeting relevant to LIPs.

Recent Research Summary

Large-Scale Flow Fields on Venus: Comparisons to Terrestrial Flood Basalts

A population of 208 large flow fields (areas $> \sim 50,000 \text{ km}^2$, average $\sim 220,000 \text{ km}^2$, maximum $\sim 1.6 \times 10^6 \text{ km}^2$) has been identified on Venus from the global Magellan radar image data. The population covers a total area of $\sim 4.0 \times 10^7 \text{ km}^2$, 9% of the surface area of this Earth-sized planet. Sources for the majority of these flow fields are coronae (features thought to be the surface manifestations of mantle upwellings impinging against the lithosphere), volcanic shields, and fractures or fissures within rifts and fracture belts. Most flow fields are located within zones of extension; emplacement largely post-dates the onset of extension. Controversy regarding the formation of flood basalts on Earth centers on the relative importance of large-scale mantle upwellings (or plume heads) and lithospheric extension to enhance decompression melting. The association of large flow fields with rifts and fracture belts strongly indicates that lithospheric extension and thinning are necessary for the formation of most flood-scale lavas on Venus. Association with large-scale mantle plumes is also evident for the 15% of all flow fields ob-

served in clusters of coronae and volcanoes or in the large regional rises of Venus. Thus, mantle plumes may be linked to the origin of some of the large flow fields on Venus, but are not necessary for the formation of the vast majority of such features. In addition to being strongly associated with zones of extension, large flow fields on Venus differ from terrestrial flood basalts in their abundance (more numerous, perhaps due to the slightly older average age of Venus), and in their volumes (about an order of magnitude less than terrestrial flood basalts, perhaps due to mantle temperature differences, structure and duration of mantle anomalies). Further interplanetary analysis of these characteristics can lead to a more complete understanding of LIPs in the geological record.

contributed by Kari Magee and Jim Head, Brown University

Summaries of recent research programs are invited—please send your contribution to Mike Coffin or John Mahoney. For the sake of brevity, references are omitted; please contact the contributors directly for more information.

Previous meetings

Mafic Magmatism through Time Workshop, St. Malo, France, 9-13 May 1994.

workshop. Close to 100 petrologists, geochemists, and geophysicists soon became accustomed to good French food and wine, and to the splendid ocean views from the conference center, as



LIPs were the subject of a lively session at this

they settled down to compare and contrast modern and ancient volcanism and to discuss how any important differences may have arose.

The LIP session started with talks on oceanic plateaus in the Pacific. The opening presentation, by M. Coffin, was a general overview of the petrological and geophysical features of LIPs. He reiterated his conclusions about the vast size of these mainly basaltic eruptions and his startling inferences about the enormous volumes of mantle involved in their formation. L. Kroenke continued with a presentation of the geophysical data that constrain the relationship between the formation of plateaus and the distribution of plates. He emphasized that "plumology" was not a unique interpretation and that a complex interplay of triple junctions and plate motion changes can also help account for the generation of plateaus. J. Mahoney continued with an account of the Ontong Java Plateau, emphasizing the geochemical and isotopic homogeneity of the province, the world's largest. In contrast, M. Pringle discussed Cretaceous OIBs from a relatively restricted area of the west Pacific (SOPITA) which exhibits evidence for just about every postulated mantle reservoir. G. Marriner, returning from last winter's "field" season, emphasized the importance of picrites and komatiites in the Caribbean plateau and the Columbian cordillera, where a section through oceanic plateau crust reveals an abundance of picrites in the lower levels. G. Fitton and A. Saunders presented geochemical results from new ODP drill cores on the East Greenland rifted margin, and F. Frey and D. Weis presented a synthesis of geochemical data from the Kerguelen volcanic province. A comment by G. Czamanske introduced a discussion of continental flood basalts, but lack of time prevented a full discussion of these rocks. A presentation by R. Kent of his inversion modeling of Kerguelen-related Indian Ocean basalts provoked a spirited attack by F. Albarede on the technique. D. McKenzie had barely time to start his defense before the session had to be closed for lunch.

LIPs also featured during the last two days of the meeting when experimental and chemical data were presented and petrogenetic theory was discussed. Notable interventions were K. Gallagher's gallant defense of melting in a wet lithosphere, and M. Cheadle and H. Iwamori's modeling of melt generation and segregation in plumes.

Several important issues emerged from the discussions:

The probability that many ancient greenstones may be fragments of oceanic plateaus and the need to better characterize modern LIPs in terms of volcanic morphology, sedimentology, struc-

ture, and geochemistry. Early continental crust may have been largely derived from accreted plateaus, and originally mafic-ultramafic in composition.

The nature of hydrothermal alteration in oceanic plateaus, and whether the type of alteration preserved in basalts of Archean greenstone belts can help establish whether they formed at a mid-ocean ridge or at a plateau.

The overall composition of oceanic and continental plateaus, and the nature of the primary magmas. While it was recognized that the basalts that constitute the bulk of such sequences had undergone low-pressure fractional crystallization, opinions differed on the extent of fractionation and the degree of interaction with lithospheric wall rocks. As anticipated, the thorny questions of crustal contamination of flood basalts raised its head, and as expected, the proponents of alternative interpretations repeated their arguments and stuck to their guns.

New and interesting data concerned the trace-element and isotopic compositions of the older plateau basalts from Kerguelen. Weis, Frey, and Mahoney confirmed results first presented at IAVCEI Canberra which showed that certain basalts in the older plateau sequences had negative Nb-Ta anomalies, high $^{87}\text{Sr}/^{86}\text{Sr}$ and low ϵ_{Nd} values of the type normally associated with a continental or island arc setting. Although an attempt was made at the meeting to attribute these characteristics to the "lithosphere" (the customary repository of all unexplained chemical signatures), the question deserves more serious discussion.

Our limited understanding of modern LIPs proved a handicap in understanding their evolution through time. That LIPs may represent analogs of ancient greenstone belts is probable. Komatiite magmas in the Caribbean province indicate that the ancient geological record can provide as important a constraint on the modern Earth as modern volcanic environments provide in the ancient record.

contributed by Nick Arndt and John Ludden

The Icelandic Plume and its Influence on the Opening of the NE Atlantic, Reykjavik, Iceland, 4-8 July 1994.

The second Arthur Holmes European Research Meeting was held at a time of heightened interest in the causes and effects of the Icelandic Plume. The level of interest in the topic is manifested by several major ongoing geological initiatives, including the Ocean Drilling Program (Leg 152 drilled Early Tertiary basalts on the East



Greenland margin), the British Mid-Ocean Ridge Programme (which includes the Reykjanes Ridge as one of its key research areas) and imminent geophysical experiments (ICE and FIRE), which will investigate the nature of the crust of Iceland and adjacent areas. The meeting attracted a group of some 50 geoscientists, including both internationally-respected authorities and post-graduate research students. Delegates traveled from Britain, Ireland, Denmark, Norway, France, Germany, and the USA, joining a major and influential group from the Icelandic geological community. The presentations covered six main themes: melt generation; the relative importance of plume, MORB, and other magma sources; breakup processes and effects on marginal basins; timing and expression of volcanic and tectonic events; and geochemical and geophysical manifestations of the plume through time and space. The location of the meeting in Reykjavik was vital to the success of the meeting, allowing the delegates to discuss these key topics with direct references to the present-day effects of the plume, both through papers given during the technical sessions and during the conference field trips.

Sessions were open to all disciplines to promote cross-fertilization of ideas. Oral presentations were relatively short (15 minutes) with 5 minutes for questions and comments. Each presentation was accompanied by a poster to promote further discussion during the morning, lunch, and afternoon breaks. The result was a forum in which new data and ideas were discussed openly and vigorously by all the participants. Contributors have been offered the opportunity to publish short papers ("specials") in a thematic set, as part of the Journal of the Geological Society. In the context of the topic of this meeting, it was not felt that the opportunity to publish inhibited individual contributors from presenting new data or innovative ideas. It was widely felt that the meeting was very successful, with many delegates commenting favorably on its format.

contributed by Andy Morton

Synopses of recent meetings are welcomed—please send your ~200 word review to Mike Coffin or John Mahoney.

LIPs and ODP

The Ocean Drilling Program has recently established formal links with major international geoscientific organizations, including IAVCEI's Commission on Large-Volume Basaltic Provinces. This reflects both the broadening of ODP's scientific interests and ODP's increasing internationalization. In September, ODP requested that our Commission assist ODP in revising its Long Range Plan (draft text is available to Commission members—see "Commission Products and Services" below), to which the Steering Committee has responded initially. This commences an ongoing dialogue between ODP and our Commission, to which Commission members are encouraged to contribute. Mike Coffin represents our Commission within the ODP advisory structure, as a member of the Lithosphere Panel, and welcomes input from Commission members.

In December of each year, the Planning Committee of JOIDES (Joint Oceanographic Institutions for Deep Earth Sampling) determines the scientific program for the JOIDES Resolution one year in advance, i.e., in December 1994, the program for 1996 will be planned. The scientific program

is based primarily on input from the four thematic panels of JOIDES—Lithosphere, Tectonics, Ocean History, and Sedimentary & Geochemical Processes—which evaluate drilling proposals twice each year. LIPs fared extremely well in two of the panels' Fall (northern hemisphere) 1994 rankings: the Lithosphere Panel ranked the Caribbean flood basalt province #1, and the Tectonics Panel ranked the Southeast Greenland volcanic margin #2. Next month the JOIDES Planning Committee will decide if and when these two provinces will be drilled—contact Mike Coffin for details.

The Ocean Drilling Program is proposal-driven, and anyone may submit a drilling proposal. Guidelines for writing and submitting proposals may be obtained from Rob Kidd or Julie Harris, JOIDES Office, Dept. of Earth Sciences, University of Wales, Cardiff, PO Box 914, Cardiff CF1 3YE, UK. Telephone 44.222.874.541. Facsimile 44.222.874.943. Internet: joides@cf.ac.uk. Information on ODP's long-range thematic plans may be obtained from the same address.

Upcoming Meetings

1994

5-9 December:

American Geophysical Union Fall Meeting, San Francisco, California, USA. Information: AGU-Meetings Dept., 2000 Florida Ave., N.W., Washington, D.C. 20009, USA. Telephone: 1.202.462.6900. Facsimile: 1.202.328.0566. Internet: sbell@kosmos.agu.org

1995

4-7 January 1995:

Venus II—Geology, Geophysics, Atmosphere, and Solar Wind Environment, Tucson, Arizona, USA. Abstract deadline: 4 November 1994. Information: A. Schumann, Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721, USA. Telephone 1.602.621.2902. Facsimile: 1.602.621.4933. Internet: amys@lpl.arizona.edu

3-7 April 1995:

European Geophysical Society, Hamburg, Germany. Abstract deadline: 15 November 1994. Information: Philippe Charvis, ORSTOM, O.O.V., BP48, 06230, Villefranche-sur-mer, France. Note Symposium SE 18, "*Geodynamic Processes at Ocean Ridges and Hot Spots*," convened by P. Charvis. Telephone 33.93.76.38.83. Facsimile: 33.93.76.37.68. Internet: charvis@ccrv.obs-vlfr.fr

9-13 April 1995:

European Union of Geosciences, Strasbourg, France. Abstract deadline: 30 November 1994. Information: EUG 8 Office @E.O.P.G., 5, rue René Descartes, Strasbourg Cedex 67084, France. Note Symposium XI-5, "*Magmatism Associated with Active Plumes*," convened by M. Rabinowicz and N. Rogers. Telephone 33.88.41.63.93. Facsimile 33.88.41.17.66. Internet: eug@eopg.u-strasbg.fr

2-14 July 1995:

International Union of Geodesy and Geophysics XXI General Assembly, Boulder, Colorado, USA. Abstract deadline: 1 February 1995. Information: IUGG XXI General Assembly, c/o American Geophysical Union, 2000 Florida Ave., NW, Washington, DC 20009, USA. Note IAVCEI Symposium V1, "*Origin of Large Igneous Provinces*," convened by M. Coffin, N. Arndt, and J. Ludden, scheduled for 6 July. Also note IAVCEI Symposium V4, "*Evolution of Large Volcanic Systems*," convened by J. Pallister, K. Hon, and J. Cole, scheduled for 4 July; and Joint Symposia JS4, "*Geochemical and Geophysical Signatures of Mantle Plumes*," convened by W. White, L. Fleitout, B. Hager, and L. Kellogg, scheduled for 11 July. Potential relevant field excursions include the Columbia River basalts, Yellowstone, and Wrangellia.

16-21 July 1995:

PLUME 2 - Conference, Schloß Ringberg, Tegernsee, Germany. Preregistration deadline: 15 November 1994. Information: Kerstin Lehnert, Max-Planck-Institut für Chemie, Postfach 3060, D-55020 Mainz, Germany. Telephone 49.6131.305260. Facsimile 49.6131.371051. Internet: kerstin@geobar.mpch-mainz.mpg.de

4-8 September 1995:

Third International Dyke Conference, Jerusalem, Israel. Paper deadline: 31 December 1994; abstract deadline: 31 May 1995. Information: Organizing Committee IDC-3 (Dr. A. Heimann), Geological Survey of Israel, 30 Malkhe Yisrael St., Jerusalem 95501, Israel. Facsimile: 972.2.380688. Internet: dikeconf@vms.gsi.gov.il



Commission Products and Services

LIPs on Internet

LIPs have an internet presence, accessible via standard internet tools. The Commission's LIP bibliography of ~1500 references, directory of ~200 members, and digital database of LIP areas (Figure 1 of *Coffin & Eldholm*, Reviews of Geophysics, 1994) are available, as well as the calendar of events, text versions of *The LIP Reader*, and the September 1994 draft of the ODP Long Range Plan.

The internet site is currently set up as a Gopher directory which allows users to log in with anonymous ftp or World Wide Web (WWW) tools, such as NCSA Mosaic. The directory is in the process of being relocated to a workstation at the Institute for Geophysics. When the Institute's Web server is installed, the LIPs directory will be enhanced for WWW browsers. Ideas on how the site could be improved are most welcome. For copies of materials on Macintosh diskette, please send a blank 3.5 inch diskette to Mike.

Anonymous FTP

With ftp, open ftp.cc.utexas.edu, use the login name anonymous and your internet address as a password. Then change directory to /pub/lips. When the changeover is complete, use the same procedure to ftp to gopher.ig.utexas.edu and cd to /research/lips.

Gopher

Using your Gopher client software, open gopher.ig.utexas.edu. Navigate to UTIG Research/LIPS. The old gopher address will continue to work for a few more months.

World Wide Web

The Universal Resource Locator (URL) will be gopher://gopher.ig.utexas.edu:70/11/research/lips.

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