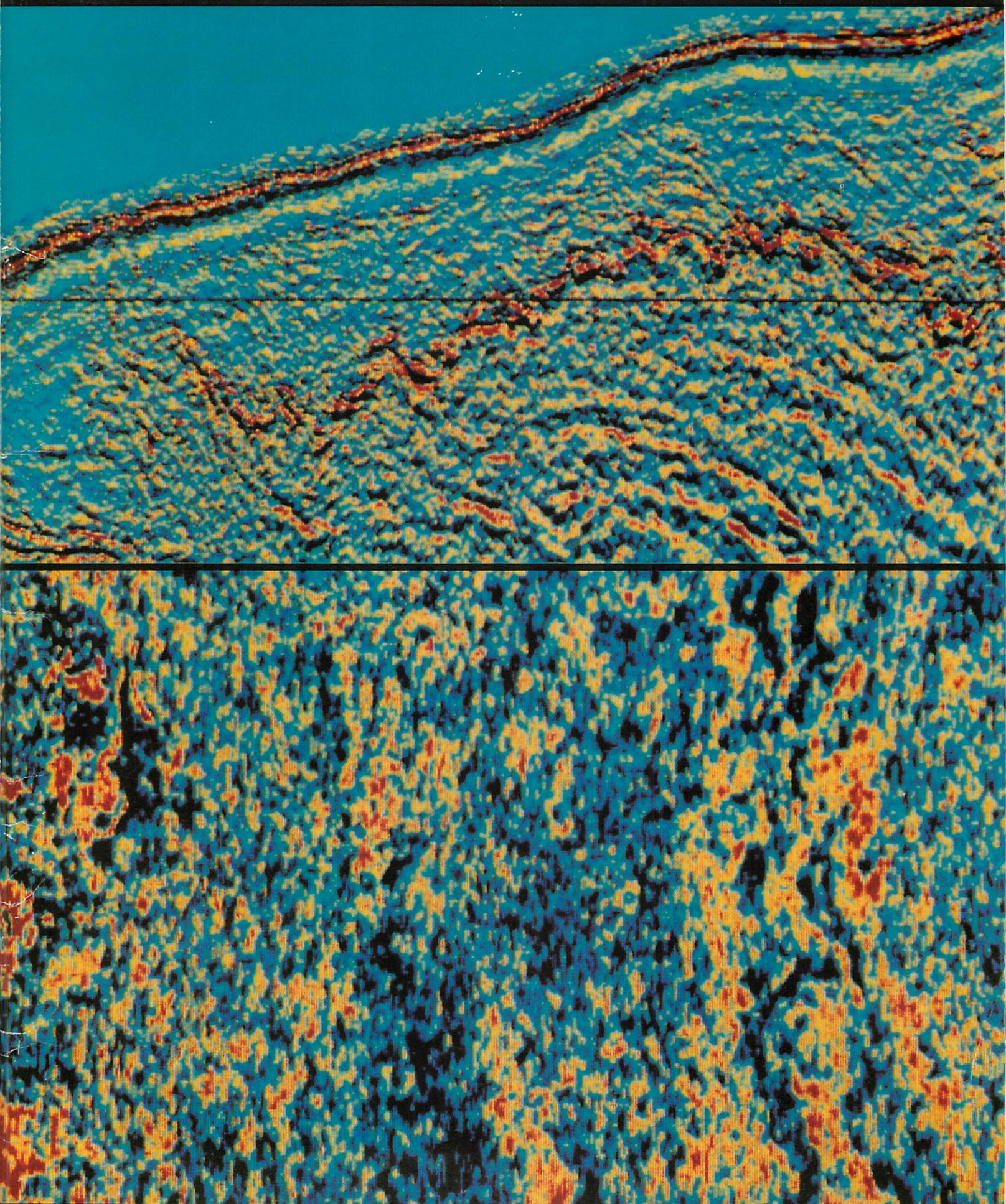
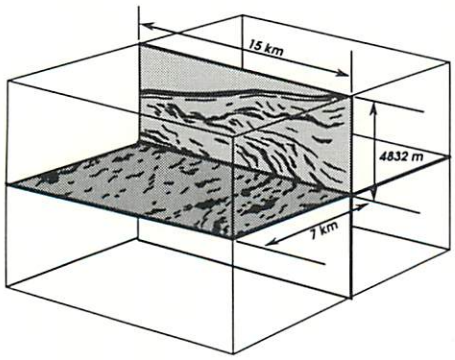
Institute for Geophysics

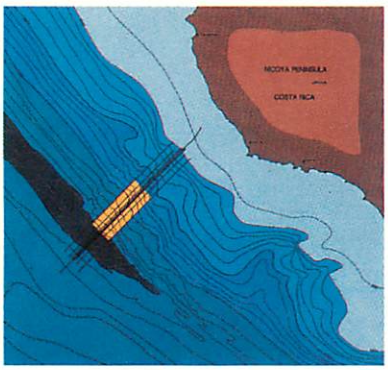


THE UNIVERSITY OF TEXAS AT AUSTIN

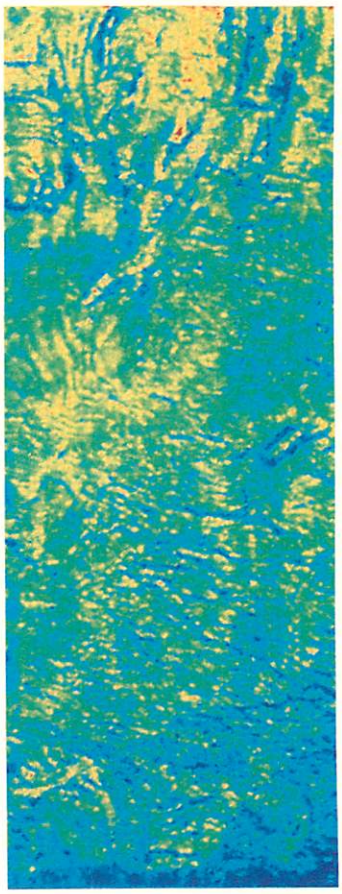
On the Cover:



The cover photo displays a seismic reflection section within the accretionary wedge of the Middle America Trench. This section is from a three-dimensional seismic survey conducted off Costa Rica on the University of Texas research vessel Fred H. Moore *in 1987. The top part, a conventional 15-kilometer vertical section, shows curved arcward dipping reflections within the wedge. The lower portion is a map view showing the intersection (or outcrop) of the reflections along a horizontal slice at a depth of 4832 meters, within a 5 x 15 kilometer area of the wedge. The reflections are major through-going thrust faults associated with the accretion of sedimentary material in thrust packets to the base of the wedge and continental margin of Costa Rica. The horizontal slices are possible because the geophysical survey acquired eighty-eight parallel seismic lines, each 100 meters apart and 22 kilometers long (see location map, lower left). Processing the data on the University of Texas System Cray supercomputer produced a seismic trace every 33 x 50 meters covering a 9 x 22 kilometer area, dense enough to produce the horizontal slices.*

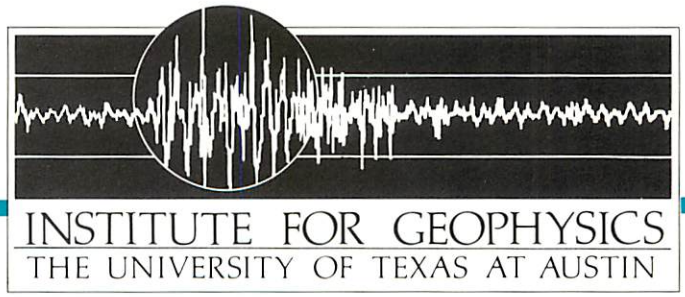


Costa Rica 3D location map.



Dense spatial sampling of the Costa Rica three-dimensional survey (CR 3D) provides accurate geological mapping. The maps above were created from a large data volume covering a 9 x 22 kilometer survey area.

The map on the left is the sea floor depth with 20-meter contours. The Middle America Trench is off the bottom and Costa Rica is off the top. The map on the right shows the amplitude or strength of the sea floor reflection. The blues are low amplitudes and the yellows are higher amplitudes. The lower amplitudes are primarily a result of weak seismic reflections from steep or near vertical scarps. Thus, the amplitude map on the right indicates very small offsets in the sea floor that are not evident in the contour map. The main features evident in the map are (1) steep sides of erosional channels in the top third of the map, (2) steep sides of active mud volcanoes (one is about half-way up the map on the right side), and (3) numerous young linear reverse faults which trend right to left across the map. These faults have less than 20 meters of offset and do not show on the sea floor depth map. The reverse faults are more subdued on the lower left side where the channels funnel more sediment to rapidly smooth the faulted sea floor.



Austin • Galveston

September 1990

Contents

For further information contact:

Director
Institute for Geophysics
The University of Texas at Austin
8701 North Mopac Blvd.
Austin, Texas 78759-8345

Telephone: (512) 471-6156
Fax: (512) 471-8844
Telex: (910) 874-1380 UTIG AUS, or
740-1439 UTIG UC
Omnet: UTIG.Austin
Telenet: [UTIG.Austin/Omnet]Mail/USA
Internet: utig@utig.ig.utexas.edu

Director's Overview

Nearly two decades have passed since the University of Texas at Austin Institute for Geophysics (UTIG) was established in 1972. The first decade was spent in Galveston, but in 1982 UTIG moved its base of operations to Austin, Texas. The purpose of this move was to enhance our ability to interact with other research units and academic departments of the University. One result of the move has been a significant increase in the number of graduate students in residence at UTIG, to an average of approximately thirty. Our interaction with the Department of Geological Sciences, in which most of these graduate students are enrolled, has also increased markedly. There are now fourteen joint faculty appointments between the Department and UTIG. In addition, there is one joint appointment between UTIG and the Department of Marine Science. Less formal relationships have evolved with the departments of Aerospace Engineering, Electrical Engineering, Petroleum Engineering, Mathematics, Computer Science, and Physics. UTIG also interacts with other organized research units of the University, such as the Marine Science Institute, Center for Space Research, Applied Research Laboratory, Bureau of Economic Geology, and the Center for Electromechanics. The UTIG scientific staff, including postdoctoral fellows and joint faculty appointments with other departments, presently numbers thirty-three. Among UTIG, the Department of Geological Sciences, and the Bureau of Economic Geology, over 100 doctoral-level research scientists and professors carry out research on various aspects of the geological sciences, making the University one of the world's largest concentrations of scientists involved in geological research.

UTIG conducts geophysical and geological investigations of the history, structure, and dynamics of the earth's crust and mantle, especially the ocean basins and margins. Disciplinary areas of research interests include seismic reflection and refraction, earthquake seismology, geothermal studies, gravity, geomagnetism, geodesy, and theoretical geophysics. Major topics of current research include ocean margin and plate boundary processes, seismic stratigraphy, global plate reconstructions, contemporary seismicity, earthquake prediction, basin analysis, seismic data processing, paleomagnetism, lunar and planetary seismology, and deep earth processes. Institute capabilities in these types of research extend from problem definition to data acquisition, data processing, and finally, interpretation of results. Development of new methodology and instrumentation for these studies is an integral part of the Institute's activities. Geographical interests range widely from the continents to continental margins, and offshore to the deep oceanic areas. Both passive and active margins are under investigation. We have ongoing programs in the Pacific, Indian, and Atlantic oceans, with a major effort toward understanding the Caribbean region and the Gulf of Mexico. Substantive programs are also being undertaken in the Antarctic.

The activities of staff and students contribute strongly to UTIG's reputation as a major seagoing institution. In the past few years members of UTIG have led or participated in research programs on previously owned ships of the Institute, the *Fred H. Moore* and the *Ida Green*, various ships of the UNOLS fleet, the *Polar Duke*, numerous foreign vessels, and several contract geophysical ships. This mix of ships has allowed us to utilize facilities closely tailored to our needs. To support our seagoing activities, UTIG maintains an engineering staff and staging facility in Galveston, operated in close cooperation with the marine activities of Texas A&M University. Examples of the type of equipment we are able to field include low-fold multichannel systems, an array of active or passive ocean bottom seismometers, and geothermal probes. Further, a formal agreement among The University of Texas at Austin,

Main laboratory at The Atrium, Austin

Dockside Utility Building, Galveston

Geology Building, UT Austin campus

Texas A&M University, and the University of Miami facilitates the sharing of marine facilities and technical capabilities in a more efficient manner. The group has formed SECOR, the SouthEast Consortium for Ocean Research. In the long run, we anticipate that SECOR will develop into one of the leading marine research organizations in the country.

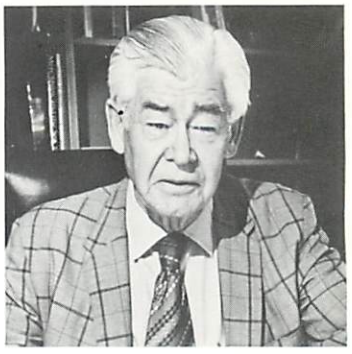
Because of the volume of the data acquired and our 3D processing requirements, we have moved our multichannel seismic processing to the University of Texas System Center for High Performance Computing (CHPC) Cray X-MP/24 computer. With a T1 connection to the computer, we can process seismic reflection and refraction data quickly, easily, and more inexpensively than before. UTIG has installed the Geovecteur software of CGG on the Cray allowing us to process 3D seismic data. GeoQuest interactive software mounted on color Sun SPARC hardware assists in 2D and 3D interpretation. There are about 18 Sun workstations at the Institute, plus numerous Macintosh computers and laser printers. These are interconnected by AppleTalk and Ethernet with national and international connections to Internet and Bitnet. The DEC Vax 11/780 computer with DISCO software, which is shared with the Department of Geological Sciences, remains in the Geology Building.

UTIG is the University's representative and a founding member of the Incorporated Research Institutions for Seismology (IRIS), which now has over 60 member universities. In addition to being one of the eight regional centers receiving event tapes from the Global Digital Seismographic Network, UTIG hosts the IRIS Data Management Center. This Center archives all data from the worldwide digital seismic network. Similarly, UTIG is one of ten member institutions of JOI, Inc. (Joint Oceanographic Institutions, Incorporated). JOI's responsibilities include managing the international Ocean Drilling Program (ODP). Scientific input to ODP is provided by JOIDES (Joint Oceanographic Institutions for Deep Earth Sampling), an advisory structure which includes representatives of the JOI member institutions and six non-U.S. partners (countries or consortia). Beginning in October 1990, UTIG will host the JOIDES Executive and Planning Committee Offices.

The Institute has offices in three locations. The main laboratory is in north Austin near the University's Balcones Research Center. On UT's main campus, there are offices, a computer facility, a high density tape archive, and a paleomagnetic laboratory within the Geology building. The marine activities staging facility remains in Galveston, where marine engineering staff continue to maintain workshops and a core storage facility.

We are encouraged that over almost two decades UTIG has matured into a strong center of research in marine geology and geophysics that has both breadth and depth. We look forward to the future with optimism.

Arthur E. Maxwell



Maurice Ewing

As early as 1892, the University of Texas Board of Regents recognized the need for a marine education program and marine station in Texas. The first University of Texas Marine Station was established in 1900 in the University Medical School at Galveston. Regent George W. Brackenridge provided a steam vessel to serve as its first research vessel. Both the vessel and the station were destroyed in a hurricane in 1900. Later in 1915, Regent Brackenridge made a second attempt at establishing a marine program by donating his 38-meter schooner, the *Navidad*, but again the program was halted by a tropical storm. In 1941 the Marine Science Institute at Port Aransas was founded.

The organization that was to become the Institute for Geophysics was established in 1972 when Maurice Ewing, a native of Texas and founder of the Lamont-Doherty Geological Observatory at Columbia University, moved back to his home state. With a group of his colleagues, he formed the Earth and Planetary Sciences Division of the Marine Biomedical Institute at the University of Texas Medical Branch in Galveston (UTMB). Before his death in 1974, Dr. Ewing established a recognized center of lunar and earthquake seismology and created the first academic program in marine multichannel seismic research.

Building on the solid foundation left by Dr. Ewing, the University of Texas Board of Regents developed a plan to provide the opportunity to conduct advanced research and teaching programs in areas related to Texas natural resources, particularly the oceans and coastal zone. The administration of the Earth and Planetary Sciences Division was transferred to the Marine Science Institute (MSI) at The University of Texas at Austin in September 1974. Dr. Ewing's Galveston group was renamed the Geophysics Laboratory and joined with the Port Aransas Marine Science Lab, also of UT Austin. At the same time, the Department of Marine Studies was established.

Dr. Creighton A. Burk, formerly Chief Geologist of Mobil Oil Company, was the first Director of the Marine Science Institute and the first Chairman of the Department of Marine Studies, both of which he directed from Austin. Dr. Peter T. Flawn, who later became President of The University of Texas at Austin, briefly assumed directorship through March 1979. J. Robert Moore led the Marine Science Institute during the period of March 1979 thru December 1981.

In July of 1975, after the establishment of the Marine Science Institute, J. Lamar Worzel was named Director of the Galveston Geophysics Laboratory. Dr. Worzel expanded the laboratory's staff and widened its areas of research until his retirement in September 1979.

In 1982, the Galveston-based group was separated from MSI and renamed the Institute for Geophysics to better reflect the group's interests. Arthur E. Maxwell was named director at that time. The need for closer proximity to other University groups involved in earth sciences necessitated a move of most of the Institute's activities to Austin in 1982.

1972-1974

University of Texas Medical Branch, Galveston

Marine Biomedical Institute

Division of Earth and Planetary Sciences
Maurice Ewing, 1972-1974

1974-1981

The University of Texas at Austin

Marine Science Institute
Creighton A. Burk, 1974-1978
Peter T. Flawn, 1979
J. Robert Moore, 1979-1982

Galveston Geophysics Laboratory
J. Lamar Worzel, 1974-1978

Port Aransas Marine Lab
Patrick L. Parker, 1973-76
Oswald Roels, 1976-79

1982-Present

The University of Texas at Austin

Institute for Geophysics
Arthur E. Maxwell, 1981-present

Marine Science Institute/Port Aransas Marine Lab
Robert S. Jones, 1984-present

The University of Texas at Austin

In 1876, the Texas constitution decreed there be established a "university of the first class," and in 1883 the University of Texas at Austin was born. Early in its history, the legislature gave the university two million acres of then worthless arid west Texas land to develop. Fortunately for the university, in 1923 the first of many oil fields was discovered there. Under the Texas constitution, profits from the land were consolidated into a Permanent University Fund (PUF), with two thirds allocated to the University of Texas and one third to Texas A&M. The principal cannot be spent, but the income, the Available University Fund, has been used to support construction projects, renovations, equipment, acquisitions, and faculty recruitment. This amount has grown to over 3.0 billion dollars, the second largest U.S. university endowment after Harvard University.

As the academic flagship of the UT System's 14 component institutions, UT Austin has come far from its beginning in 1883, when it had only one building, eight teachers, two departments, 221 students and a 40-acre campus. Today, its main campus, in the state capital of Austin, has grown to over 357 acres that is home to more than 50,000 students, 2,300 faculty and 11,000 staff members. The campus has 118 buildings representing 12.5 million square feet of space with a replacement value in excess of one billion dollars. The University owns several other sites in Austin, including the Balcones Research Center (BRC), a 475-acre tract eight miles northwest of the campus. BRC is a research site for 21 UT Austin science and engineering laboratories.

The UT Austin faculty includes the winner of the 1979 Nobel Prize in Physics, winner of 1977 Nobel Prize in Chemistry, winner of the 1967 Pulitzer Prize in History, and winner of the 1948 Pulitzer Prize in Fiction. Among the distinguished staff are 18 members of the National Academy of Sciences, 28 members of the National Academy of Engineering, 18 members of the American Academy of Arts and Sciences, and 19 members of the American Law Institute.

Research at the University is funded by grants and contracts from governmental agencies, from the Available University Fund, through state appropriations, and from the private sector through gifts from individuals, foundations, and corporations. UT Austin is annually awarded over 130 million dollars in grants and contracts. In addition UT Austin received over 16 million dollars from the Texas Advanced Research Program. That program is the largest competitive state-funded research grant program in the nation supporting basic and applied research. The university has over 1,000 privately funded endowed faculty Chairs and Professorships. This represents the largest number of endowed faculty positions at any U.S. university.

UT is one of three Southwestern members of the Association of American Universities, which is composed of the 58 leading universities in the United States and Canada. The University leads all institutions in the South in the quality of its graduate programs, as well as in the number of doctoral degrees awarded. UT Austin has the sixth largest academic library in the United States with six million volumes, more than four million microforms, over 30 million pages of manuscripts, 317,500 maps, and online access to hundreds of electronic data bases. Since its opening in 1883, UT Austin has awarded more than 312,800 degrees.

Research Activities

R/Vs Fred H. Moore *and* Ida Green

Institute for Geophysics scientists conduct research around the world on land and at sea. Although it no longer operates the research vessel *Fred H. Moore*, the Institute continues to be a major seagoing institution through the use of "ships of opportunity," provided by industry or through the University-National Oceanographic Laboratory System (UNOLS). The summaries of recent field programs that follow are typical of the research projects pursued by UTIG investigators:

The Institute's research vessel *Fred H. Moore* returned to her home port of Galveston in February 1988 after an eleven-month research cruise in the Pacific. The ship traveled over 68,000 kilometers and visited Panama, Costa Rica, Hawaii, Japan, Palau, Australia, Truk, Guam, and Ponape. During the course of the voyage the ship conducted a series of research projects, collecting approximately 11,000 kilometers of seismic data. This was the last research cruise of the *Moore*, which was retired from Institute service in early 1989. Among the accomplishments of the voyage were a 3D seismic survey conducted off Costa Rica and a two-ship seismic experiment conducted in cooperation with a Japanese research ship, the *Tansei Maru*. Both of these experiments were aimed at imaging the deep structure of complex areas of the earth's crust and upper mantle. The Costa Rica survey, led by Thomas H. Shipley, was the first of its kind to be carried out by an academic institution.

R/V Robert D. Conrad

In April 1987, Richard T. Buffler and Eric J. Rosencrantz, with André Droxler from Rice University, conducted a survey aboard Duke University's R/V *Cape Hatteras* to collect high-resolution single-channel seismic reflection data around and across the carbonate banks lying to the southwest of Jamaica on the Nicaragua Rise. This survey was the first of two legs of a cruise designed to study the offbank deep-water depositional and tectonic settings associated with carbonate platform development and periplatform sedimentation on the Nicaragua Rise. They collected a grid of over 2500 kilometers of digital seismic reflection data.

James A. Austin, Jr., Paul L. Stoffa, and Ian W. D. Dalziel are co-principal investigators with John C. Mutter of Columbia University on a research project in the Southern Andes to understand more about continent formation through mountain building processes. In early 1988, Dr. Austin and several graduate students spent two weeks on board Columbia University's research ship *Robert D. Conrad* crisscrossing the Andes mountains via 1100 kilometers of fjords of the Tierra del Fuego region in southernmost Chile and Argentina, where over 900 kilometers of seismic data were collected.

M/V Geco MY

Joseph D. Phillips, Paul L. Stoffa, James A. Austin, Jr., and Yosio Nakamura, of UTIG, and Dale S. Sawyer, of Rice University were involved in a study of the Carolina Trough off the U.S. Atlantic margin in mid 1988. More than 1200 kilometers of deep penetration multichannel seismic reflection data were acquired by the vessel M/V *Geco MY*. Ocean bottom seismometers (OBS's) were deployed along selected profiles using the R/V *Nusc Ranger* as the deployment and retrieval vessel.

In August 1988, E. William Behrens led an American group in charge of sedimentation studies on the U.S.–U.S.S.R. Bering Sea Expedition aboard a 122-meter Russian ship, R/V *Akademik Korolev*. This expedition was a joint Soviet-American interdisciplinary research cruise as part of ongoing work under the U.S.-U.S.S.R. Environmental Agreement. The principal objective was to characterize the contemporary condition of the fundamental oceanographic, hydrochemical, and hydrobiological parameters of marine ecosystems and to assess their assimilative capacity for marine pollution.

TAMU Photographic Service

D/V JOIDES Resolution

During late 1988 Richard Buffler was a participant on board the D/V *JOIDES Resolution* for Ocean Drilling Program Leg 123 in the Argo Abyssal Plain-Exmouth Plateau region off Northwestern Australia. Dr. Buffler conducted a vertical seismic experiment at one of the sites and interpreted seismic data from the drilling areas.

A student cruise in the Gulf of Mexico was conducted in January 1989 by John G. Sclater, E. William Behrens, and Lawrence A. Lawver using the Texas A&M R/V *Gyre*. During the cruise, initial tests of a new, UTIG-developed, state-of-the-art heat flow probe produced the first data to be gathered with this instrument. The Gulf of Mexico heat flow measurements were made in an intensively studied intraslope basin that was also cored and mapped with 3.5 kHz reflection profiling. The cores provided sediment conductivity data to use with the probe measurements for heat flow calculations. The cores also permitted correlations between thermal conductivity and sedimentary and physical properties. Martin B. Lagoe and his students obtained samples for the beginning of a new program of micropaleontological studies in Gulf of Mexico deep-water environment.

N/O Alis

Also in January 1989, Ian W. D. Dalziel served as the organizer and leader of a field trip to Antarctica aboard the R/V *Polar Duke*. This was the first field trip of the 28th International Geological Congress (IGC) and the first IGC field trip ever to visit the Antarctic continent. The purpose of the expedition, which attracted 24 participants from 8 countries, was to study the geology of the Scotia Arc region between South America and Antarctica from a global viewpoint. Prior to the trip, Dr. Dalziel, co-workers, and contributors assembled a 206-page guidebook, subsequently published as part of the 28th IGC series by the American Geophysical Union.

In a three-month cruise during late 1988 and early 1989 aboard the National Oceanic and Atmospheric Administration's (NOAA) ship, R/V *Surveyor*, Lawrence Lawver, David T. Sandwell (now of Scripps Institution of Oceanography), and students collected high resolution, multibeam sonar (Seabeam) data along the length of the Shackleton Fracture Zone and its intersection with Elephant Island. This cruise was part of the Antarctic Living Marine resources program of NOAA.

R/V Polar Duke

Dr. Lawver was the chief scientist on a one-month cruise in early 1989 aboard the R/V *Polar Duke*. Heat flow data were obtained in several basins around the Antarctic Peninsula using the UTIG-developed heat flow instrument. Fifty-four successful heat flow penetrations were made out of 56 attempts on 8 separate profiles. In addition, 6 piston cores and 800 kilometers of bathymetric data were acquired. In addition, Seabeam bathymetric mapping was supplemented with several single-channel seismic lines along the Shackleton Fracture Zone.

The summer of 1989 was a busy one, with field programs in many parts of the world. Yosio Nakamura and Phillip H. Roper carried out an OBS experiment as part of a Project EDGE continental margin transect off the coast of Homer, Alaska. They used a 15-meter Seine fishing boat, the *Northern Light*, as a deployment and recovery vessel for UTIG-owned and developed OBS's in support of industry-operated MCS profiling of the Aleutian arc/trench system.

R/V Moana Wave

Yosio Nakamura also conducted a seismic refraction study offshore Oregon in conjunction with a high-resolution seismic survey conducted by Oregon State University. He, along with UTIG technicians, deployed and recovered UTIG ocean bottom seismometers from the fishing vessel *Olympic*.

Cliff Frohlich and Yosio Nakamura participated in the N/O *Alis* cruise in mid 1989 in the south Pacific for the Vasper (Vanuatu Asperity) experiment. The experiment was a joint project with ORSTOM (Office de la Recherche Scientifique et Technique Outre-Mer, recently renamed Institut Français de Recherche Scientifique pour le Développment en Cooperation) of France to study seismicity and structure of the subduction zones in the southwest Pacific, particularly Vanuatu (New Hebrides). As part of the same project, Frederick W. Taylor is involved in a study to determine crustal motion among 17 islands in six island nations in the South Pacific. The strategy of the project is to perform repeated Global Positioning System (GPS) measurements of base lines between islands on different crustal plates to observe and measure active plate movement.

R/V Gyre

Mark A. Riedesel was a cruise participant aboard Scripps Institution of Oceanography research vessel, R/V *Melville*. The purpose of the cruise was to deploy a seismometer into Deep Sea Drilling Project (DSDP) Site 534, south of Bermuda, and an OBS nearby to compare the results from the two recording instruments.

Paul Mann, Fred Taylor, Eric Rosencrantz, and students have a program of geologic mapping and structural and sedimentological analysis of sedimentary basins in the Caribbean and in Central America. As part of this program in mid 1989, Dr. Mann, with Eric Rosencrantz and students, completed SeaMARC II high-resolution side-scan sonar survey of the northern Caribbean plate boundary between Jamaica and Honduras aboard the University of Hawaii R/V *Moana Wave*.

Dr. Mann and his students have mapped extensively in the Dominican Republic, Costa Rica and Honduras, while Eric Rosencrantz and Amos Salvador have an on-going program of investigations on the geology of central and western Cuba. Gulf Oil Exploration and Production Company donated a complete set of field data and company reports to UTIG on the geology of central and western Cuba. These data were collected by the Cuban Gulf Oil Company between 1950 and 1956. The data set is the only one of its kind available outside of Cuba. These data are vital to reconstructing the geology of the Gulf of Mexico, Florida, Bahamas, and Caribbean region. Five major U.S. oil companies funded the synthesis, which will provide the means to better evaluate the hydrocarbon potential of the region.

R/V Cape Henlopen

In June 1989, Thomas A. Davies participated in a cruise on the New Jersey continental shelf aboard a Woods Hole Oceanographic Institution chartered vessel, the R/V *Maritime Explorer*. The objective of the cruise was to obtain piston and vibracores of the surface sediments to determine their nature and properties and thus to better constrain future seismic experiments in the area, as well as to test previous geologic interpretations.

In August 1989, Thomas H. Shipley participated on a cruise in the western Pacific aboard the French research ship, R/V *Le Suroit*, carrying out a pre-drilling survey for the Ocean Drilling Program. This was a continuation of a program that began in 1987 on UTIG's R/V *Fred H. Moore*.

R/V Longhorn

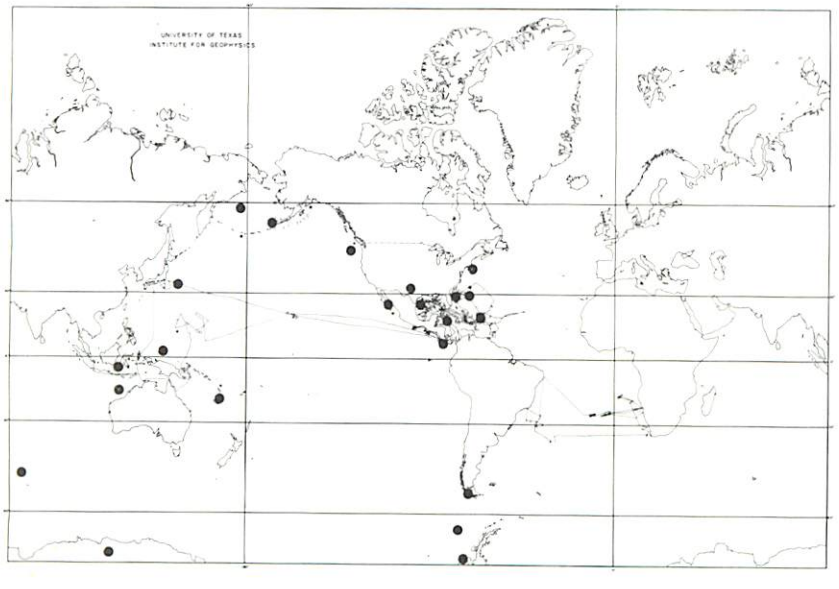
During early September 1989, Richard Buffler and William Behrens of UTIG and William R. Bryant of Texas A&M University conducted a joint student cruise aboard TAMU research vessel *Gyre*. This was a joint project to study the tectonics and sedimentation of the continental margin offshore northern Mexico in the northwestern Gulf of Mexico. The study area includes the continental shelf, slope, and rise off the Mexican state of Tamaulipas along the U.S.–Mexico border. The group received permission from the Direccion General de Oceanografia Naval to work in Mexican waters. Scientific observers from the Mexican Navy participated in the cruise. This was a rare and significant opportunity for a U.S. institution to work in Mexican waters in international collaboration.

Also in September, James A. Austin, Jr. served as chief scientist aboard the University of Delaware's R/V *Cape Henlopen* during a 3D high-resolution seismic reflection survey of the continental shelf and slope off New Jersey using the HUNTEC® deep-towed system owned and operated by Woods Hole Oceanographic Institution. Other UTIG participants included Archie Roberts, Mark Wiederspahn, Donald Dean, and Walter Kessinger.

In June 1990, Jan Garmany performed instrument testing with Conoco Oil Company in Ponca City, Oklahoma. They deployed UTIG OBS's in a highly controlled experiment to test the seismic response of the instrument.

Wulf A. Gose pursues paleomagnetic studies in Mesoamerica in an attempt to better understand the tectonic evolution of this area. He is currently involved in a joint project with scientists from the Universidad Simón Bolívar in Caracas, Venezuela.

The Institute conducts training cruises using the University of Texas Marine Science Institute's research vessel *Longhorn*. Students sail the Texas continental slope performing experiments in salt tectonics, downslope sediment transport, microbenthic habitats, and margin processes. The participants gain hands-on experience in seismic reflection data acquisition and coring techniques, and receive course credit for their efforts.

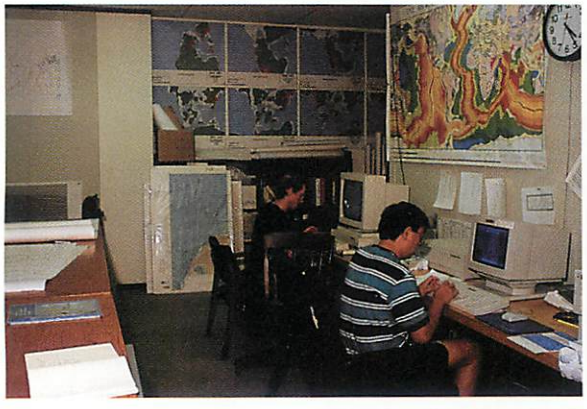


Dots indicate geographic areas of particular interest to Institute researchers.

Data Processing Resources

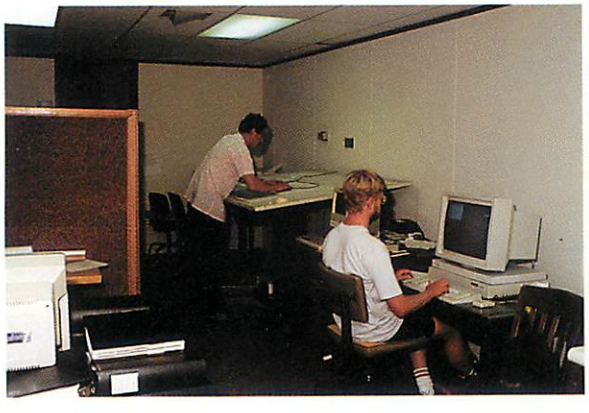
The advent of both very small and very large computers, combined with advances in network technology, sets a trend away from mainframe-based computer systems toward distributed systems that can grow selectively in the areas of greatest need. The UTIG computer system has grown to include personal computers, workstations, and supercomputers. A series of networks interconnects these systems to give the users access to the most suitable level of processing power required for any given task.

At the desktop level is a network of about 60 Apple Macintosh personal computers. The Macintoshes handle almost all word processing and publication tasks, optical character recognition, graphic design, and administrative data processing. Since nearly every office is equipped with a Macintosh, these machines have become an important comunications tool, serving as message and electronic mail alternatives to telephones. Used as terminals to faster systems, the Macintosh can access data from other computers and process it with the wide variety of inexpensive software now available. Several laser printers distributed throughout the building provide desktop computers and workstations with general high resolution black and white graphics and text output. The key to this straightforward interchange is the use of two moderate speed Appletalk/PhoneNet networks. These slower networks are well suited to the amounts of data that these computers usually process and are very inexpensive to install and rearrange. The Appletalk networks are interconnected to the Institute's faster Ethernet and successively larger, more extensive networks.



A work area for a mapping project includes a Macintosh II and a Sun workstation.

The next level in computing capability is a network of eighteen Sun workstations that are used for seismic data processing and interpretation, numerical modeling, software development, and any tasks that require faster processing than the Macintoshes can achieve. The Suns offer the advantages of faster network attachments and more disk space, with larger screens that allow more detailed graphics. A central server provides a 22-million-instructions-per-second compute engine, fast interfaces for plotters, and mass storage. Peripheral equipment attached to the server includes two Versatec plotters and a CalComp pen plotter for mapping and other graphics. The server handles electronic mail and network news services for both Macintoshes and Suns.

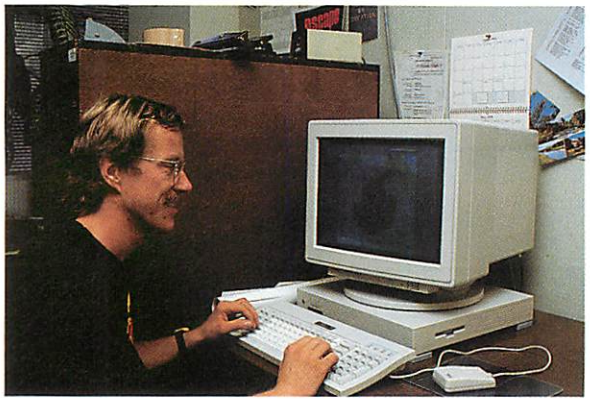


UTIG's data processing facility.

Five Sun SPARCstations running the GeoQuest Systems' IES interpretation software and GeoQuest Technology's AIMS modeling package are dedicated primarily to seismic data processing and interpretation. These Suns can communicate larger tasks via Ethernet and T1 microwave link to the University's Cray supercomputer. Medium-size data sets can be quickly transferred, permitting fast local visualization and rapid turnaround.

An Evans and Sutherland PS330 color vector workstation is also used for interactive visualization. It permits the user to manipulate vectors three-dimensionally on a color screen. Researchers have used this graphics system to examine problems as diverse as ray-tracing and plate tectonic reconstructions.

The most powerful system available to UTIG researchers is the University of Texas System Cray X-MP/24 supercomputer, operated by the Center for High Performance Computing



SPARCstation in use by graduate student.

View of the Sun terminal room at the UTIG laboratory.

(CHPC) and located at the University's Balcones Research Center. The X-MP/24 runs the Cray Operating System (COS) with two processors and 4 million words of memory, a 32-million-word solid-state storage device and 9.6 gigabytes of disk space. The Macintosh and Sun computers are used as control terminals and, more recently, as graphical front ends. The CHPC Cray X-MP/24 will change operating systems from COS to UNICOS during 1990. A Cray SE-14 has been installed to enable researchers to develop UNICOS applications. CHPC also plans to continue to upgrade its facility with the acquisition of a Cray Y-MP/464 planned for 1991. A transparent file migration storage system is managed for the Crays by an IBM 4381 with 25 gigabytes of storage.

Users can access the UT Cray X-MP/24 through any of several computer networks. CHPC is currently part of THEnet/SESQUInet which links to the NSF backbone in Houston, so it is available to NSF users nationwide. NSFnet makes it possible for users to define and submit processing jobs and transfer the resulting compressed plots to almost any location in the country.

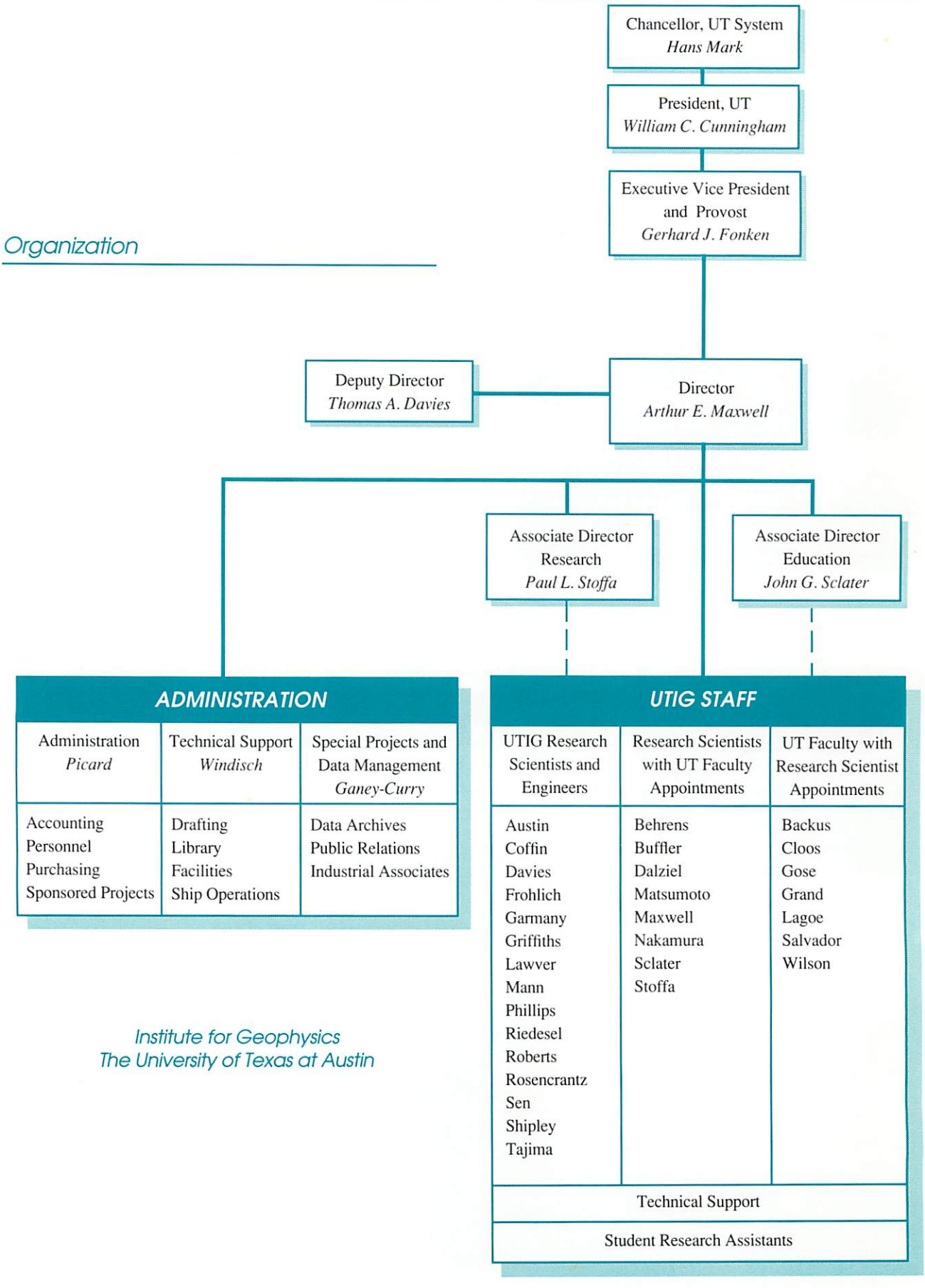
The seismic processing software package used by UTIG on the CHPC Cray is Compagnie Générale de Géophysique's (CGG) Geovecteur which is the most comprehensive 2D and 3D seismic data processing system available for the Cray and provides all types of pre- and post-stack techniques currently in commercial production use. These include various sophisticated static routines for dip move-out, tau-p transformations, pre-stack depth migration and full three-dimensional migration in time or depth. UTIG is currently using the system for conventional and deep penetration crustal programs, two 3D surveys and a high-resolution expanding spread two-ship program. CGG is also in the process of porting Geovecteur to UNICOS. Since Geovecteur will run on either COS or UNICOS by the end of 1990, Geovecteur most likely will continue to be used on the Cray X-MP/24 when CHPC upgrades to UNICOS.

Using Geovecteur, about 2 gigabytes of plot images a week are generated. The plot rasters are automatically transmitted from the Cray to the UTIG Sun 3/280 via a T1 high-speed microwave link at the Institute's laboratory. A more recent acquisition is a 24-inch 400 dot-per-inch color electrostatic plotter for section display driven by UNIRAS, a PostScript interpreter, and locally written rasterizers.

Another supercomputing resource in use over the network is the NEC Corporation's SX-2 supercomputer located at the Houston Advanced Research Center. The DISCO seismic processing package is available on the SX-2 as is the iterative pre-stack migration velocity analysis program MIGPAK. In January of 1991 the SX-2 will be upgraded to a SX-X.

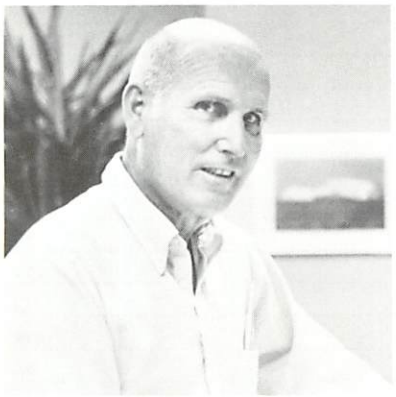
The UT System 's Cray supercomputer.

Organization



Institute for Geophysics
The University of Texas at Austin

Director



Arthur E. Maxwell

Director; Professor, Dept. of Geological Sciences. Ph.D., M.S., Scripps Institution of Oceanography, University of California at San Diego (1959, 1952), B.S., New Mexico State University (1949).

Background

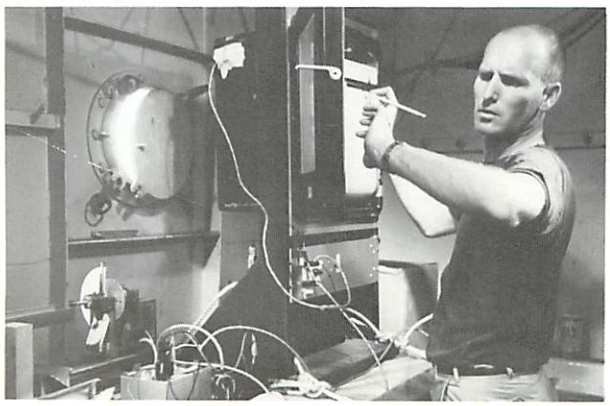
Dr. Maxwell came to The University of Texas as Director of the Institute for Geophysics on January 1, 1982. After graduate work at Scripps, Dr. Maxwell spent ten years (1955-1965) with the Office of Naval Research in Washington, D.C., where he held the positions of Head Oceanographer and Head of the Geophysics Branch. Subsequently, he joined the staff of the Woods Hole Oceanographic Institution as Senior Scientist and Associate Director. During the next seventeen years, he progressed through the positions of Associate Director, Director of Research, and Provost before leaving to join The University of Texas at Austin.

His early scientific work with Dr. Roger Revelle and Sir Edward Bullard produced pioneering results in ocean geothermal measurements. He was co-chief scientist on Leg 3 of the Deep Sea Drilling Project using the drilling vessel *Glomar Challenger*. That voyage produced some of the strongest evidence available at that time to support the now widely accepted hypothesis of sea floor spreading and plate tectonics. Dr. Maxwell has been active in the development of scientific ocean drilling through participation in Project Mohole, the Deep Sea Drilling Project, the Ocean Margin Drilling Program, and the Ocean Drilling Program. Similarly, he advocated and pressed for early support of submersible research using both *Trieste* and *Alvin*. Among his numerous publications, he edited Volume IV, parts 1, 2, and 3 of *The Sea*.

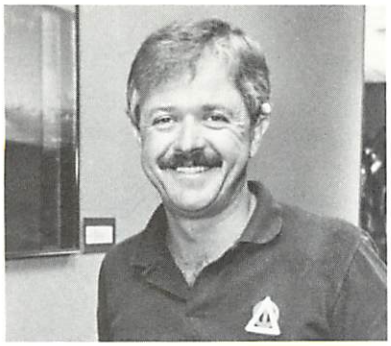
His participation in state, national, and international activities includes the Massachusetts Governor's Advisory Committee on Science and Technology, the National Sea Grant Review Panel, and the Alaska Governor's Commission for Ocean Advancement through Science and Technology. He has chaired both the U.S. National Committee on Geology and the U.S. National Committee for the International Union of Geodesy and Geophysics, in addition to serving on the Finance Committee of IUGG. Dr. Maxwell has served on a number of National Academy of Sciences–National Research Council committees. President Nixon appointed him to The National Advisory Committee on Oceans and Atmosphere from 1972 to 1975, and he has headed the U.S. Delegation to the Intergovernmental Oceanographic Commission. Dr. Maxwell currently serves on the JOI Board of Governors and is Chairman of the JOIDES Executive Committee. He is also on the Academic Advisory Panel for a subcommittee of the Technology Transfer Intelligence Committee of the CIA, and on the Outer Continental Shelf/Environmental Studies Program Committee of the National Research Council.

Dr. Maxwell's numerous awards include the Navy's Meritorious Civilian Service and Superior Civilian Service Awards. He also received the Distinguished Civilian Service Award from the Secretary of the Navy for his work in locating the sunken submarine *Thresher*. He was elected as President of both the American Geophysical Union and the Marine Technology Society. In addition, he received the New Mexico University's Distinguished Alumni Award and the Outstanding Centennial Alumnus Award.

Art Maxwell monitoring equipment aboard a Scripps Institution of Oceanography vessel in his early years as a graduate student.



INSTITUTE FOR GEOPHYSICS
THE UNIVERSITY OF TEXAS AT AUSTIN



James A. Austin, Jr.

Senior Research Scientist. Ph.D., Woods Hole Oceanographic Institution–Massachusetts Institute of Technology (1979), B.A., Amherst College (1973).

Marine Geology and Geophysics

Structural and stratigraphic evolution of various types of continental margins, including carbonate platforms.

Research Interests

Multichannel seismic reflection and refraction data are used to compare and contrast the structure and stratigraphy of passive margins off the east coast of the United States, eastern Canada, Morocco and southwest Africa, as well as convergent margins north of the island of Hispaniola, in the southernmost Andes, and off the West Antarctic Peninsula.

Of major interest is the application of seismic stratigraphic principles to geologic problems, in particular the significance of seismic unconformities in both shallow and deep-water environments and the uniformity of seismic facies in carbonate versus clastic depositional provinces. A second focus is the deep structure of continental lithosphere and the response of continental crust to deformation processes associated with plate fragmentation and convergence.

James A. Austin, Jr. with John Mutter of LDGO maintaining R/V Robert D. Conrad's *seismic cable in Tierra del Fuego, Chile.*

Recent Publications

Corso, W., J.A. Austin, and R.T. Buffler, 1989, The Early Cretaceous Platform off Northwest Florida: Controls on Morphologic Development of Carbonate Margins, *Marine Geology, 86,* 1–14.

Austin, J.A., Jr., B.E. Tucholke, and E. Uchupi, 1989, Upper Triassic-Lower Jurassic Salt Basin Southeast of the Grand Banks, *Earth and Planetary Science Letters, 92,* 357-370.

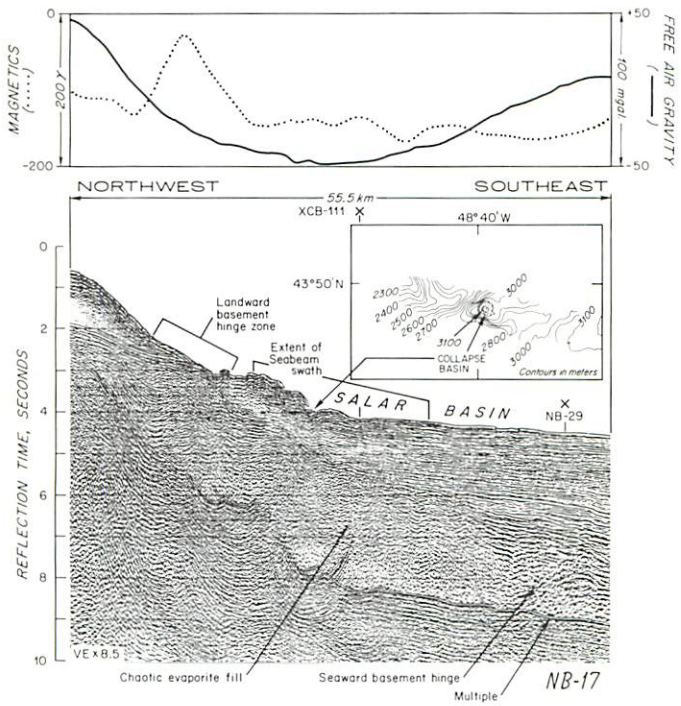
Austin, J.A., Jr., F.W. Taylor, and C.D. Cagle, 1989, Seismic Stratigraphy of the Central Tonga Ridge, *Marine and Petroleum Geology, 6,* 71–92.

Austin, J.A., Jr., W. Schlager, *et al.*, eds., 1988, *Proceedings, Ocean Drilling Program, Scientific Results (Part B), Vol. 101,* College Station, TX.

Sheridan, R.E., J.A. Austin, Jr., M.M. Ball, J.W. Ladd, and H.T. Mullins, 1988, Geology and Geophysics of the Bahamas, *in: The Atlantic Continental Margin: U.S., Decade of North American Geology, Vol. I-2,* Geological Society of America, 329-364.

Austin, J.A., Jr., and D.L. Divins, 1986, Sediment Sound–Velocity Provinces in the Cape Basin: New Results from Multichannel Seismic Reflection Profiles, *Journal of Geophysical Research, 91,* 14,015–14,021.

Angstadt, D.M., J.A. Austin, Jr., and R.T. Buffler, 1985, Late Cretaceous to Holocene Seismic Stratigraphy and Geologic History of Southeastern Gulf of Mexico, *American Association of Petroleum Geologists Bulletin, 69,* 977–995.



A 48-trace, 24-fold seismic reflection profile crossing the Salar Basin, an evaporite-filled depression flanking the southeastern Grand Banks, eastern Canada. The broad gravity minimum pinpoints the basin. The multibeam bathymetric (Seabeam) profile outlines a circular depression in the sea floor interpreted as a collapse structure, perhaps caused by dissolution of the underlying evaporites. The reverberent sequence of reflectors associated with the "U" or Avalon unconformity of late Early Cretaceous age appears to be offset by faults across the landward hinge zone.

Milo M. Backus

Senior Research Scientist; also Dave P. Carlton Centennial Professor of Geophysics, Dept. of Geological Sciences. Ph.D., B.S., Massachusetts Institute of Technology (1956, 1952).

Seismic Exploration

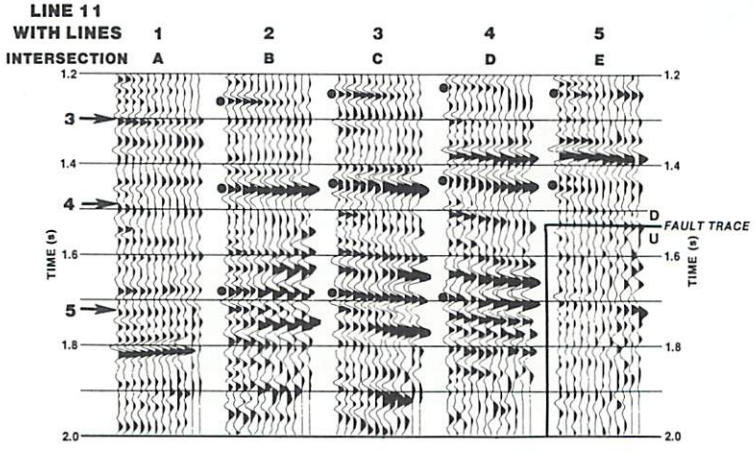
Improvements in seismic processing methods.

Research Interests

Backus and students conduct research primarily in Project SEER, an industry-supported project. The research aims to more effectively use the potentially available information and development-oriented information contained in marine seismic data. As a quantitative goal, an earth model and system model will be developed to reproduce prestack seismic data with a data residual of ten percent or less. Further plans are to characterize the model parameter ambiguity as a function of the acquisition system characteristics, including spatial sampling, offset aperture, and temporal octave bandwidth, as well as prior expectations regarding the multidimensional covariance of the model.

Current research efforts include:

- use of the mute zone data, accounting for first arrival times in the context of diving wave tomography;
- reconciliation of first arrival times and shallow reflection times;
- full waveform reproduction of the mute zone data and the shallow reflection data as applied to high density 3D marine seismic data;
- isolation and utilization of the reflections from steeply dipping sparse reflectors discordant with the bedding plane geometry;
- fault surfaces and diapirs applied to 3D grid data and high-density 3D data;
- accounting for the multidimensional arrival time data from the quasiconformable bedding plane reflectors with a model of bedding plane geometry and propagation velocity;
- studies on the full waveform inversion of seismic data in the context of a locally one-dimensional earth, with a focus on convergence and ambiguity issues for isotropic layers (including unresolved layering) and the further complications for transversely isotropic layers;
- characterization of subsurface geometry (current and past) for a high density 3D data set with a salt dome; and
- the use of amplitude versus offset in hydrocarbon detection and characterization.



Angle-dependent seismic data ties at five line intersections. Note gas reservoirs.

Recent Publications

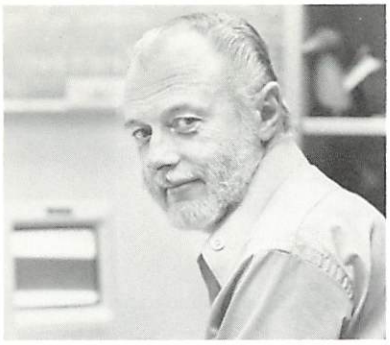
Huston, D.C., and M.M. Backus, 1990, Offset Dependent Mis-tie Analysis at Seismic Line Intersections, *Geophysics*, *54*(8), 962-972.

Simmons, J.L., Jr., and M.M. Backus, 1988, First Arrival Times and Diving-Wave Tomography, *SEG Expanded Abstracts, Society of Exploration Geophysicists*, 1239–1243.

Backus, M.M., 1987, Amplitude Versus Offset—A Review, *SEG Expanded Abstracts*, Society of Exploration Geophysicists, 359–364.

Backus, M.M., A. Garcia, and D. Huston, 1987, On Deconvolution and Inversion in A One-Dimensional Earth, *in:* M. Worthington, ed., *Proceedings of the 1986 EAEG-SEG Workshop on Deconvolution and Inversion*, Blackwell, 208–225.

Backus, M.M., and J.L. Simmons, 1984, Multiple Reflections as An Additive Noise Limitation in Seismic Reflection Work, *Proceedings of the IEEE*, *72*(10), 1370–1384.



E. William Behrens

Research Scientist; also, Associate Professor, Dept. of Marine Science. Ph.D., Rice University (1963), M.S., University of Michigan (1958), B.A., Cornell University (1956).

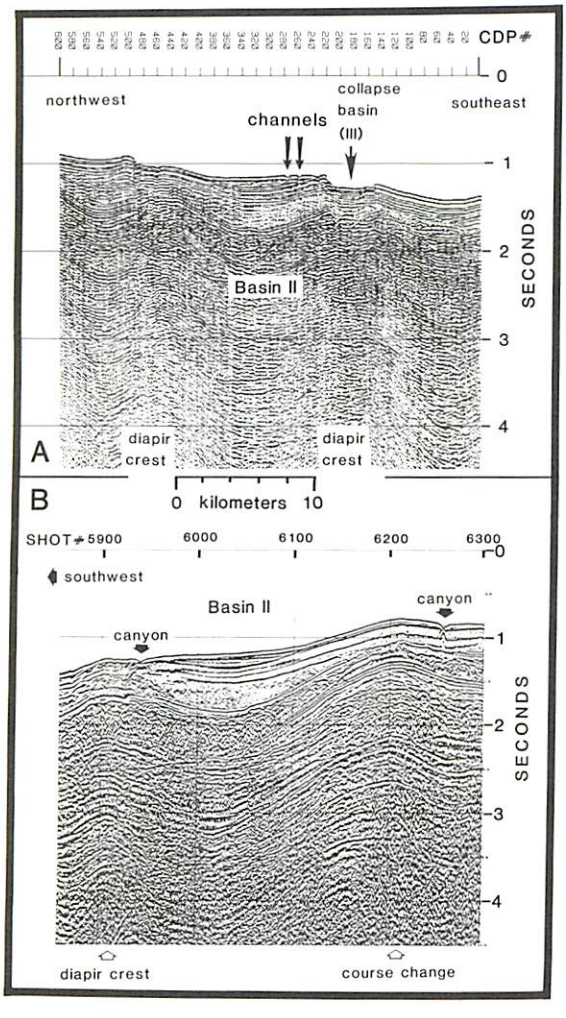
Marine Geology

High-resolution and multichannel seismic reflection data acquisition, processing, and interpretation; continental slope, NW Gulf of Mexico.

Research Interests

The history of the development of continental margins is contained in their sediments. The study of continental slope sedimentary records includes direct sampling and observation of water column physical and chemical parameters, sediment mineralogy, texture, and structures, micropaleontological content, geochemical and isotopic composition, and acoustic characteristics. Remote sensing (marine geophysics) is used to observe sediment thicknesses, stratigraphic relationships of sedimentary units, structural context and style, and acoustic characteristics related to diagenetic phenomena. From a combination of remote sensing and ground truth data, research projects are designed to interpret the history of depositional, diagenetic, tectonic, and environmental conditions and processes that have created the existing features of continental margins. The same tools of sediment sampling and analysis, and seismic reflection profiling apply to the study of the history of deeper oceanic environments.

Multichannel time section showing scales and locations of channels and canyons relative to basin-filling seismic units.



Recent Publications

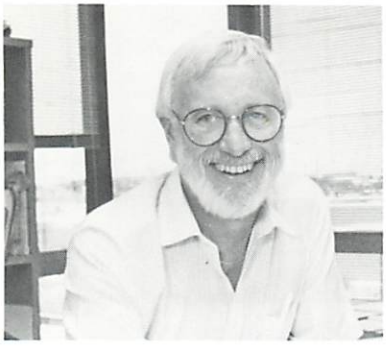
Satterfield, W.M., and E.W. Behrens, 1990, A Late Quaternary Canyon/Channel System, Northwest Gulf of Mexico Continental Slope, *Marine Geology, 92,* 51-67.

Behrens, E.W., 1988, Geology of a Continental Slope Oil Seep, Northern Gulf of Mexico, *American Association of Petroleum Geologists Bulletin, 72,* 105–114.

Behrens, E.W., 1985, Unifite Muds in Intraslope Basins, Northwest Gulf of Mexico, *Geo–Marine Letters, 4,* 227–233.

Stanley, D.J., S.K. Addy, and E.W. Behrens, 1983, The Mudline: Variability of Its Position Relative to Shelfbreak, *Society of Economic Paleontologists and Mineralogists Special Publication 33,* 279–298.

Continental slope, Gulf of Mexico. Weight is being transferred from chain hoist to winch wire in preparation for core lowering. Over 100 piston cores were taken on the continental slope of Texas and western Louisiana with the UTIG R/V Ida Green *as part of the Texas-Louisiana Continental Slopes program.*



Richard T. Buffler

Senior Research Scientist; also Professor, Dept. of Geological Sciences. Ph.D., University of California, Berkeley (1967), B.S., The University of Texas at Austin (1959).

Marine Geology and Geophysics

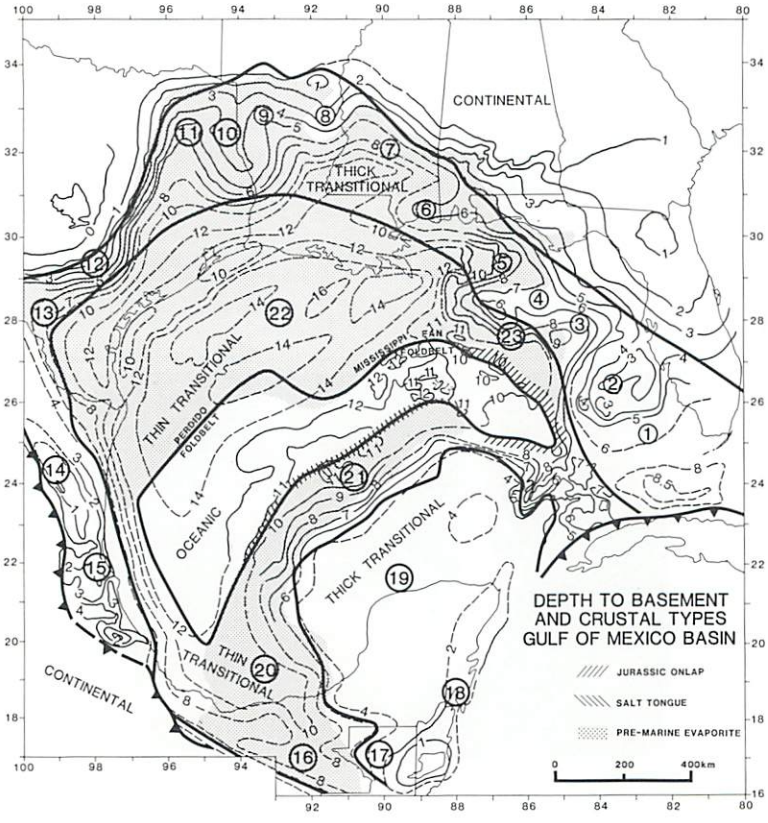
Seismic (sequence) stratigraphy; depositional systems; structural and stratigraphic evolution of ocean basins and adjacent margins.

Research Interests

Research interests involve studying the geologic history of ocean basins and adjacent margins using marine geophysical tools and methods, primarily seismic reflection data. Principles and techniques of seismic (sequence) stratigraphy are applied to interpret the depositional and structural history of the regions. The main focus has been a long-term investigation of the seismic stratigraphy and geologic history of the deep Gulf of Mexico basin and adjacent margins using both UTIG and available industry multifold reflection data. Current Gulf research includes: (1) several major synthesis projects of the Gulf basin, (2) nature, distribution and origin of the crust, (3) Mesozoic seismic stratigraphy of the northeastern Gulf, (4) geologic history and salt tectonics of the Texas-Louisiana slope and adjacent abyssal plain, (5) seismic stratigraphy of the Mississippi Fan, and (6) seismic stratigraphy and geologic history of the southeastern Gulf-Straits of Florida region.

Other areas of study include: (1) sedimentation and tectonics of the northeastern Nicaraguan Rise in the Caribbean Sea, (2) geologic history of the Exmouth Plateau-Argo Abyssal Plain off northwest Australia as a participant on ODP Leg 123, and (3) late Cenozoic tectonics of the western Panama margin.

Below: Map of the Gulf of Mexico showing generalized depth to basement (km) and distribution of crustal types.



Recent Publications

Buffler, R.T., in press, Seismic Stratigraphy and Geologic History of the Deep Gulf of Mexico Basin, *in:* A. Salvador, ed., *The Geology of North America, Vol. J, The Gulf of Mexico Basin*, Geological Society of America, Boulder, CO.

Buffler, R.T., 1989, Distribution of Crust, Distribution of Salt and the Early Evolution of the Gulf of Mexico Basin, *in: Gulf of Mexico Salt Tectonics, Associated Processes and Exploration Potential*, Program and Extended and Illustrated Abstracts, GCS-SEPM Tenth Annual Research Conference, Houston, Texas, 25–27.

Corso, W., J.A. Austin, and R.T. Buffler, 1989, The Early Cretaceous Platform off Northwest Florida: Controls on Morphologic Development of Carbonate Margins, *Marine Geology, 86,* 1–14.

Weimer, P., and R.T. Buffler, 1988, Distribution and Seismic Facies of Mississippi Fan Channels, *Geology, 16,* 900–903.

Winker, C.D., and R.T. Buffler, 1988, Paleogeographic Evolution of the Early Deep-Water Gulf of Mexico and Its Margins, Jurassic to Middle Cretaceous (Comanchean), *American Association of Petroleum Geologists Bulletin, 72,* 318–346. *(This paper was selected to receive the Wallace E. Pratt Memorial Award for the best AAPG Bulletin article in 1988. The award was presented at the AAPG annual convention in San Franciso in June 1990.)*

Mark Cloos

Research Scientist; also Associate Professor, Dept. of Geological Sciences. Ph.D., University of California, Los Angeles (1981), B.S., University of Illinois at Urbana-Champaign (1976).

Structural Geology and Petrology

Tectonic evolution of convergent plate margins, field studies in California and Irian Jaya, Indonesia.

Research Interests

Field, laboratory, and theoretical studies of the structure, metamorphism, geochronology, and sedimentation at convergent plate margins are of interest, with particular emphasis on aspects of blueschist metamorphism and thermal history. The formation of melanges and other chaotic rocks, melange diapirism, dewatering mechanisms for subducting sediment, fluid inclusion and isotopic analysis of mineralized veins in accreted sediments and trench slope basin evolution are under investigation in the Franciscan Complex of California. New research areas include application of fission track methods to tectonic problems and basin thermal evolution, and field studies of the tectonics of Indonesia in the fold-and-thrust belt of Irian Jaya, West New Guinea.

Recent Publications

Cloos, M., 1990, Nicasio Dam Pillow Basalts: Marin County, California: A Fragment from a Seamount Accreted During Franciscan Subduction, *in:* J.J. Bilodeau and S.O. Davies, eds., *Geologic Guidebook to the Point Reyes Area, Northern California,* American Association of Petroleum Geologists 1990 National Meeting, San Francisco, CA, 9–16.

Cloos, M., 1990, Blueschists, *in:* F.N. Magill, ed., *Magill's Survey of Science, Earth Science Series,* Salem Press, Inc., 1561–1569.

Coltrin, G., M.M. Backus, T.H. Shipley, and M. Cloos, 1989, Seismic Reflection Imaging Problems Resulting from a Rough Surface at the Top of the Accretionary Prism at Convergent Margins, *Journal of Geophysical Research, 94,* 17,485–17,496.

Cloos, M., 1989, Subduction Zones, *in:* D.E. James, ed., *Encyclopedia of Geophysics,* Van Nostrand Reinhold and Company, 1246–1255.

Cloos, M., and R.L. Shreve, 1988, Subduction-Channel Model of Prism Accretion, Melange Formation, Sediment Subduction, and Subduction Erosion at Convergent Plate Margins: 1. Background and Description, *Pure and Applied Geophysics, 128,* 455–500.

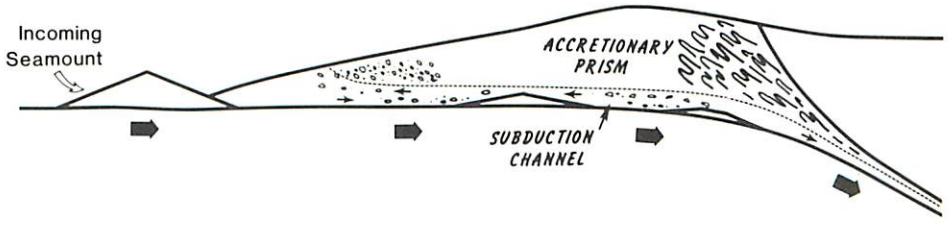
Cloos, M., and R.L. Shreve, 1988, Subduction-Channel Model of Prism Accretion, Melange Formation, Sediment Subduction, and Subduction Erosion at Convergent Plate Margins: 2. Implications and Discussion, *Pure and Applied Geophysics, 128,* 501–545.

Shreve, R.L., and M. Cloos, 1986, Dynamics of Sediment Subduction, Melange Formation, and Prism Accretion, *Journal of Geophysical Research, 91,* 10,229–10,245.

Cloos, M., 1986, Blueschists in the Franciscan Subduction Complex of California, Petrotectonic Constraints on Uplift Mechanisms, *Geological Society of America Memoir 164,* 77–94.

Cloos, M., 1985, Thermal Evolution of Convergent Plate Margins: Thermal Modeling and Re-evaluation of Isotopic Ar-Ages for Blueschists in the Franciscan Complex of California: *Tectonics, 4,* 421–433.

Seamount subduction, dismemberment, and incorporation into offscraped melange.



Millard F. Coffin

Research Scientist. Ph.D., M.Phil., M.A., Columbia University (1985, 1982, 1981), A.B., Dartmouth College (1978).

Marine Geophysics

Structure, stratigraphy, and tectonics of continental margins, plate boundaries, and ocean plateaus and basins using multichannel seismic reflection, refraction, gravity, satellite altimeter, magnetic, and rock sample data.

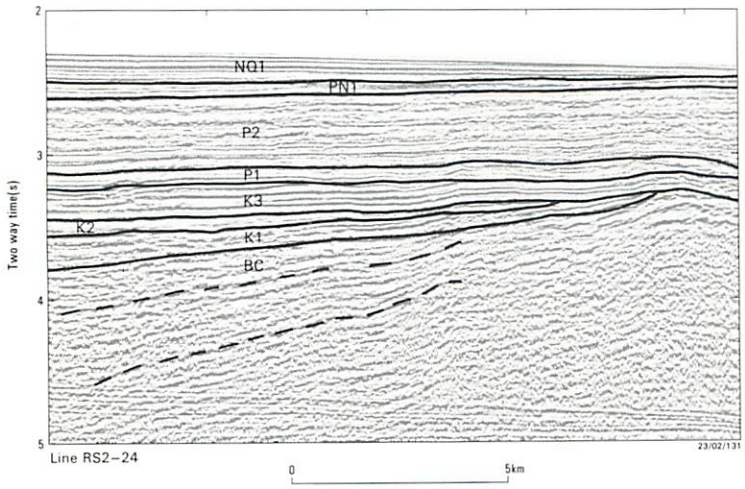
Research Interests

Passive continental margins and plate boundaries are the Earth's major crustal discontinuities. Passive margins contain sediments which record with infinite variation the interaction of subsidence with marine and terrestrial sedimentary processes, and at deeper levels juxtapose oceanic and continental basement and mantle as well as document rifting and transform kinematics. Active margins and other plate boundaries are associated with the most vivid demonstration of Earth-altering forces active on a human time scale, thrusting lithosphere over lithosphere or sliding plate past plate, resulting in earthquakes, volcanism, and complex stratigraphy. Interest in the stratigraphic, structural, and kinematic evolution of passive margins has inspired continuing work on the conjugate Southeast Australia-Lord Howe Rise margins.

R/V Rig Seismic *cruise participants.*

Massive volcanic events created oceanic plateaus, dipping reflector sequences along passive margins, and continental flood basalts. Of these, oceanic plateaus are the least understood, despite being the dominant residual depth anomalies of the sea floor. Studies of plateaus have the potential to reveal spatial and temporal patterns of mantle dynamics, to elucidate the effects of emplacement on the Earth's hydrosphere and atmosphere, and to document the evolution of mature landmasses which subside, Atlantis-style, beneath the sea. Research focuses on the seismic structure, gravity field, and stratigraphy of oceanic plateaus, presently the Kerguelen Plateau in the southern Indian Ocean.

Interpreted 48-trace, 12-fold seismic data from the southern Kerguelen Plateau, southern Indian Ocean. Seven sedimentary sequences overlie a basement complex (BC) that contains dipping reflections. The pattern and character of the basement reflections and the petrology and geochemistry of the volcanic rocks are similar to those of volcanic passive margins. These data were acquired aboard Australia's R/V Rig Seismic.



Recent Publications

Coffin, M.F., M. Munschy, J.B. Colwell, R. Schlich, H.L. Davies, and Z.G. Li, 1990, Seismic Stratigraphy of the Raggatt Basin, Southern Kerguelen Plateau: Tectonic and Paleoceanographic Implications, *Bulletin of the Geological Society of America, 102,* 563–579.

Coffin, M.F., and P.D. Rabinowitz, 1988, Evolution of the East African Continental Margin and the Western Somali Basin, *Geological Society of America Special Paper 226,* 78 pp.

Coffin, M.F., and P.D. Rabinowitz, 1987, Reconstruction of Madagascar and Africa: Evidence from the Davie Fracture Zone and Western Somali Basin, *Journal of Geophysical Research, 92,* 9385–9406.

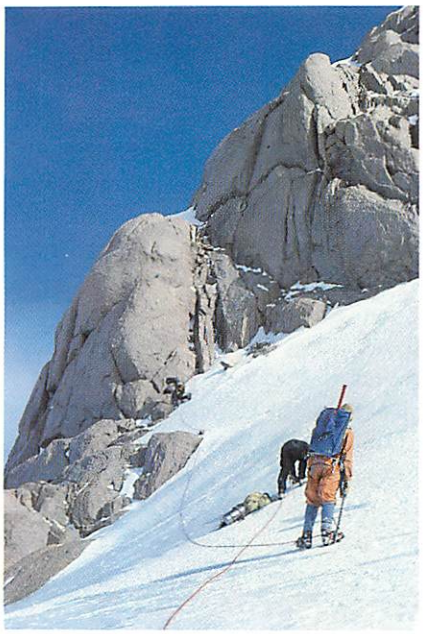
Coffin, M.F., H.L. Davies, and W.F. Haxby, 1986, Structure of the Kerguelen Plateau Province from Seasat Altimetry and Seismic Reflection Data, *Nature, 324,* 134–136.

Ian W. D. Dalziel

Senior Research Scientist; also Professor, Dept. of Geological Sciences. Ph.D., University of Edinburgh (1963); B.Sc., University of Edinburgh (1959).

Tectonics

Global scale tectonic processes, particularly tectonic evolution of the southern continents and ocean basins; cordilleran orogenic processes, particularly tectonic evolution of the southern Andes, Scotia Arc and West Antarctic cordilleras.



Geologic field work, Whitmore Mountains, Antarctica.

Research Interests

Work continues on cordilleran orogenic processes and evolution of southern continents and ocean basins with a full schedule of cruises and field work in the interior of the Antarctic continent. There is almost year-round activity in this region now by UTIG scientists. The first deep seismic traverse sailing through the Andean cordillera in Tierra del Fuego has been completed with co-principal investigators James Austin of UTIG and John Mutter of Columbia. Data are now being processed. Other activities include acting as convener of the Group of Specialists on the Structure and Evolution of the Antarctic Lithosphere of the Scientific Committee on Antarctic Research and serving as Chairman of Tectonics Panel of Ocean Drilling Program.

Recent Publications

Dalziel, I.W.D., 1990, Circum-Pacific Orogenic Processes: A View from the Southernmost Andes and the Antarctandes, *in:* G.E. Ericksen, M.T. Cañas Pinochet, and J.A. Reinemund, eds., *Geology of the Andes and Its Relation to Hydrocarbon and Mineral Resources, Earth Sciences Series, 11*, Circum-Pacific Council for Energy and Mineral Resources, Houston, Texas, 13–22.

Dalziel, I.W.D., 1988, *Tectonics of the Scotia Arc. Guidebook to Field Trip T180 of 28th International Geological Congress,* American Geophysical Union, Washington, DC, 206 pp.

Dalziel, I.W.D., B.C. Storey, S.W. Garrett, A.M. Grunow, L.D.B. Herrod, and R.J. Pankhurst, 1987, Extensional Tectonics and the Fragmentation of Gondwanaland, *in:* J.F. Dewey, M.P Coward, and P. Hancock, eds., *Continental Extensional Tectonics*, Special Publication of Geological Society of London No. 28, 433–441.

Dalziel, I.W.D., S.W. Garrett, A.M. Grunow, R.J. Pankhurst, B.C. Storey, and W.R. Vennum, 1987, The Ellsworth-Whitmore Crustal Block: Its Role in the Tectonic Evolution of West Antarctica, *in*: G.D. McKenzie, ed., *Gondwana Six: Structure, Tectonics, and Geophysics*, Geophysical Monograph Number 40, American Geophysical Union, 173–182.

Grunow, A.M., D.V. Kent, and I.W.D. Dalziel, 1987, Mesozoic Evolution of West Antarctica and the Weddell Sea Basin, New Paleomagnetic Constraints, *Earth and Planetary Science Letters, 86,* 16–26.

Antarctic field camp.

R/V Polar Duke *off the north coast of Isla de Los Estados, Argentina.*

Thomas A. Davies

Deputy Director and Research Scientist; Ph.D., B.A., University of Cambridge (1967, 1964).

Deep Ocean Sediments

Processes of marine sediment formation and distribution; deep sea stratigraphy; sedimentary mass balances; paleoceanography.

Research Interests

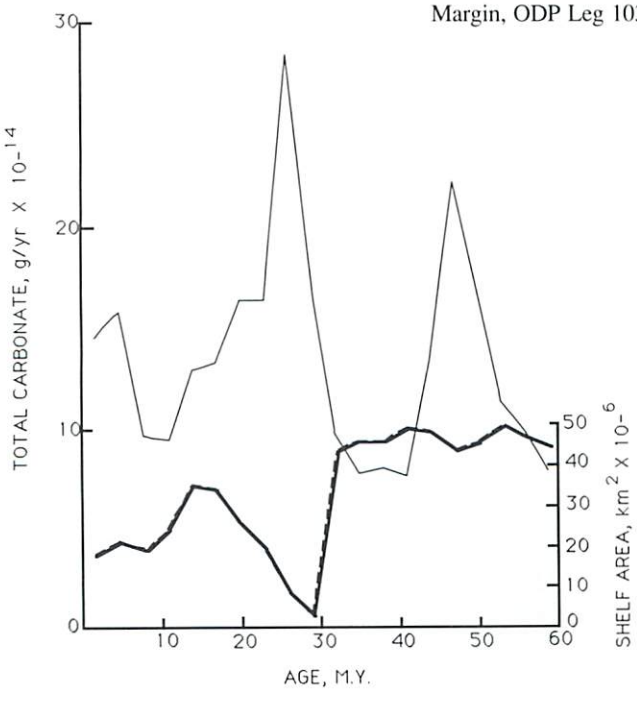
A major outcome of scientific ocean drilling over the past twenty years has been the exciting possibility of developing a truly global view of the Earth's history and surface processes since the Jurassic. Because the deep oceans are the repository for material eroded from the continents, it follows that the sediments of the ocean floor contain information about conditions upon the continents at various times in the past, as well as information about processes operating within the oceans. With this in mind, research has been devoted to using deep sea drilling data and seismic reflection records to understand the distribution of ocean sediments in space and time and to make quantitative estimates of oceanic sedimentation through time. Such quantitative estimates are significant because they reveal information about erosion rates (climate, relief) on the continents. The working hypothesis is that over geologically significant periods of time (i.e., greater than one million years) for the Earth as a whole, the amount of sediment accumulated on the continental shelf and rise and in the deep ocean must correspond to the amount of material eroded from land, plus material added by volcanic activity from deep within the Earth. Application of this simple hypothesis is complicated by the effects of fluctuations in sea level that change the areas of exposed land. Further complications result from the effects of plate tectonics, which change the size, shape, and distribution of ocean basins and, through subduction, continually destroy part of the sedimentary record.

Recent Publications

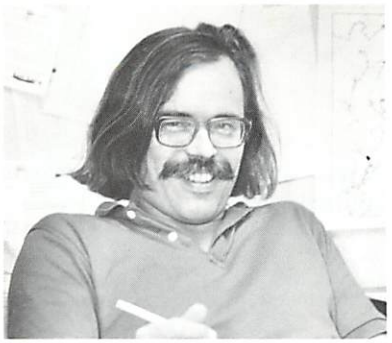
Meyer, A.W., and T.A. Davies, 1988, Clay Mineralogy of Sediments from the Galicia Margin, ODP Leg 103, *in:* G. Boillot, E.L. Winterer, *et al., Proceedings, Ocean Drilling Program, Scientific Results (Part B), Vol. 103*, College Station, TX, 461-476.

Davies, T.A., 1985, Mesozoic and Cenozoic Sedimentation in the Pacific Ocean Basin, *in:* A.E.M. Nairn and F.G. Stehli, eds., *The Ocean Basins and Margins, Vol. 7: The Pacific Ocean*, Plenum, New York, 65-88.

Davies, T.A., 1984-85, Deep Ocean Drilling, *Ocean Science and Engineering, 9*, 381-446.



Graph showing estimates of the total amount of carbonate accumulating in the deep ocean (solid line) and the area of the continental shelves (broken line) over the past 60 million years. Note that at times of low sea level (minimum shelf area) the amount of carbonate reaching the deep sea floor increases substantially. The peak in carbonate accumulation at 45 to 50 million years appears to be related to factors other than sea level change. (Based on Davies and Worsley, 1981.)



Cliff Frohlich

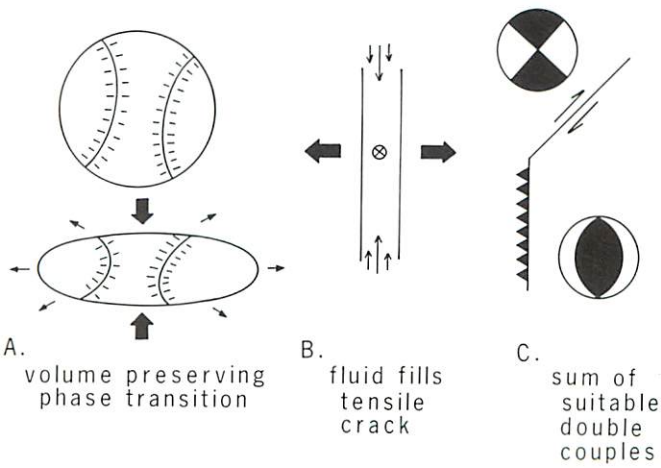
Senior Research Scientist. Ph.D., M.S., Cornell University (1976, 1973), B.A., Grinnell College (1969).

Solid Earth Geophysics

Earthquake seismology; tectonics, synthetic stratigraphy, biomechanics, classical physics.

Above: OBS Recovery, Vanuatu.

Below: Possible models for an earthquake source that is caused neither by slip on a fault nor by an explosion. For one such source, particle motion is inward along one axis and outward along the two normal axes, with no net volume change. This might occur (a) if a phase change caused a spherical volume to become disk-shaped, with no net change in volume, (b) when fluid suddenly fills a tensile crack, or (c) if two double-couple (ordinary) earthquakes occur simultaneously and are suitably oriented as shown. Some deep earthquakes appear to have near-source motions of this type (from Frohlich, Riedesel, and Apperson, 1989).



Research Interests

About one fifth of the world's earthquakes are deep earthquakes, having focal depths greater than 70 kilometers. Because the seismic energy produced by these events comes from a relatively small source region, they exhibit very impulsive seismograms which are ideal for studying earth structure. Deep earthquakes generally occur in association with island arcs, where the earth's lithosphere is subducted into the mantle as an expression of mantle convection. Analysis of locations of deep earthquakes provides some of the best available information concerning the details of subduction. The earthquakes themselves are confined to the cold interiors of the subducting lithosphere. Variations in travel times for the earthquakes can be used to map variations of mantle properties.

In contrast to shallow earthquakes, large deep events commonly produce few or no aftershock events. Studying the spatial and temporal characteristics of related deep events may tell more about the stress fields and mantle materials which produce deep earthquakes.

Other research includes investigation of how uplifted corals record the geographic extent and timing of tectonic activity associated with large earthquakes in subduction zones. Finally, another project is the development of computer programs that begin with topography and parameters describing nearshore sedimentation and build stratigraphic cross sections.

Recent Publications

Frohlich, C., and S.D. Davis, 1990, Single–Link Cluster Analysis as a Method to Evaluate Spatial and Temporal Properties of Earthquake Catalogs, *Geophysical Journal International, 100,* 19–32.

Frohlich, C., M.A. Riedesel, and K.D. Apperson, 1989, Note Concerning Possible Mechanisms for Non-Double-Couple Earthquake Sources, *Geophysical Research Letters, 16,* 523–526.

Frohlich, C., Deep Earthquakes, 1989, *Scientific American, 250*(1), 48–55.

Frohlich, C., The Nature of Deep-Focus Earthquakes, 1989, *Annual Reviews of Earth and Planetary Sciences, 17,* 227–254.

Frohlich, C., and R.J. Willemann, 1987, Aftershocks of Deep Earthquakes Do Not Occur Preferentially on Nodal Planes of Focal Mechanisms, *Nature, 329,* 41–42.

Taylor, F.W., C. Frohlich, J. Lecolle, and M. Strecker, 1987, Analysis of Partially Emerged Corals and Reef Terraces in the Central Vanuatu Arc: Comparison of Contemporary Coseismic and Nonseismic with Quaternary Vertical Movements, *Journal of Geophysical Research, 92,* 4905–4933.

Matthews, R.K., and C. Frohlich, 1987, Forward Modeling of Bank-Margin Carbonate Diagenesis, *Geology, 15,* 673–676.

Frohlich, C. (ed.), 1986, *Physics of Sports: Selected Reprints,* American Association of Physics Teachers, College Park, MD, 210 pp.

Jan D. Garmany

Senior Research Scientist; Ph.D., University of California, San Diego, Scripps Institution of Oceanography (1978), B.S., California Institute of Technology (1972).

Solid Earth Geophysics

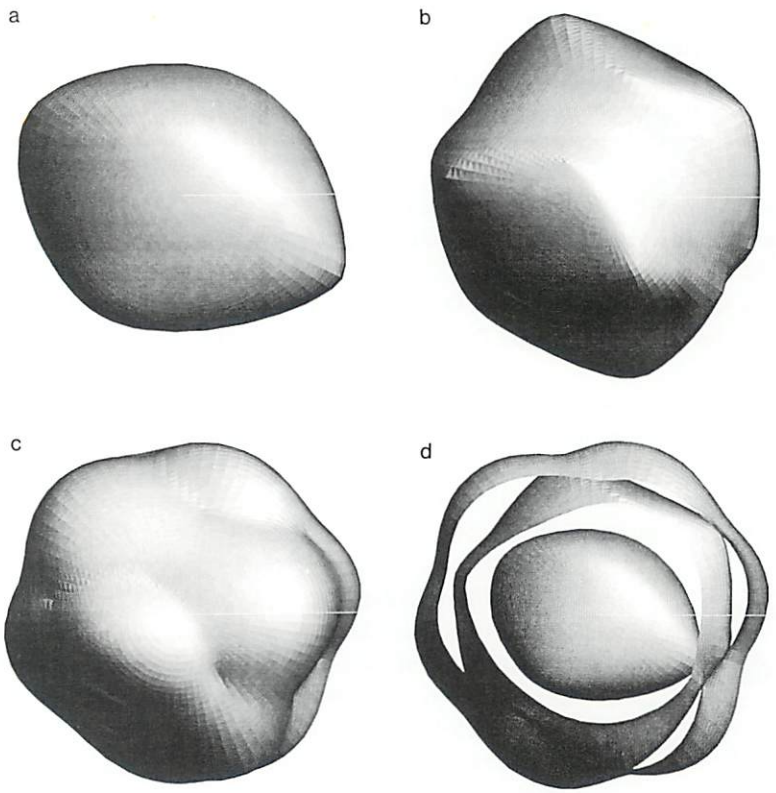
Seismology, inverse theory, formation of the oceanic lithosphere, modeling and inference of the structure and dynamics of the earth.

Research Interests

All knowledge of the earth's structure deeper than a few miles is indirect, and the sharpest tool available for these investigations is seismology. The application of seismology to the inference of oceanic crustal and upper mantle structure can lead to a better understanding of the workings of seafloor spreading. Associated with the generation of new crust are forces which leave a birthmark on the material just below the crust in the form of anisotropy. This property delineates the direction in which the material has been strained over great spans of time. Anisotropy is a key to defining ancient and current deformations of certain regions of the earth and is an important subject of recent investigations. The shallow machinery of the mid-ocean rises and the deep variability of the earth's mantle are dynamic processes that seismology can disclose. Recent work shows that melt may frequently arrive away from mid-ocean ridges, giving rise to melt sills at or near the base of young oceanic crust.

Since the methods of inference are indirect, it must also be determined to what extent the data are adequate to tell us something definite about the earth. This problem occurs in all branches of geophysics and in other sciences and is treated by inverse theory. This broad subject is a significant component of this research with applications to data analysis and experimental design.

The direct modeling of earth dynamics is of increasing importance to this effort. Because the earth is a complicated system, the only hope for such modeling is a computational approach, and more effort is being invested in making this method more practical and applicable.



Above, the slowness surfaces of a fictitious anisotropic solid. Each point on the slowness surface represents a vector in slowness space which, when multiplied by frequency, yields the wave number of a freely propagating plane wave solution of the elastic wave equation. In an isotropic medium, the surfaces are spheres.

(a) Quasi-P surface. These slownesses, being smaller, yield the fastest waves; (b) inner quasi-S surface; (c) outer quasi-S surface. Surface c is the outermost surface and shows the greatest complexity. The surfaces shown separately are at different scales. Note that the dimples in surface c touch the corner-like vertices of surface b; (d) cutaway view of the nested slowness surfaces, showing two of the contacts between surfaces b and c.

Recent Publications

Garmany, J., 1989, Accumulations of Melt at the Base of Young Oceanic Crust, *Nature, 340,* 628–632.

Garmany, J., 1988, Seismograms in Stratified Anisotropic Media: II. Uniformly Asymptotic Approximations, *Geophysical Journal, 92,* 379–389.

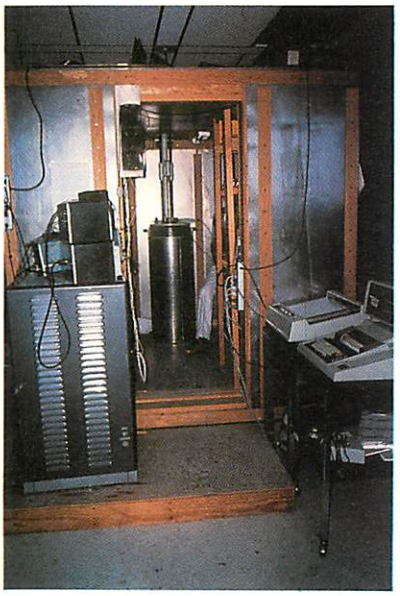
Garmany, J., 1988, Seismograms in Stratified Anisotropic Media: I. WKBJ Theory, *Geophysical Journal, 92,* 365–377.

Wulf A. Gose

Research Scientist; also Senior Lecturer, Dept. of Geological Sciences. Ph.D., Southern Methodist University (1970), M.S., University of Göttingen (1964), B.S., University of Göttingen (1961).

Paleomagnetism

Tectonic evolution of Middle America, the Gulf of Mexico, and the Caribbean area; magnetostratigraphy; salt dynamics.



Cryogenic magnetometer facility.

Research Interests

The tectonic evolution of the Caribbean Basin is still poorly understood. Paleomagnetic data could, in principle, provide a critical data base for evaluating tectonic models, but many of the earlier data are of insufficient quality to be useful. Current research focuses on the southern Caribbean plate boundary zone with the aim of using paleomagnetic data to detail the timing and mechanism of deformation in this shear zone.

Magnetostratigraphic studies form another major line of research. These studies have been used to clarify some long-standing stratigraphic problems in Honduras, to date mammal-fossil-bearing strata, as well as the time of mineralization of Mississippi Valley-type ore deposits, and to identify the Cretaceous-Tertiary boundary. Recently a magnetic reversal sequence was obtained successfully from the anhydrite cap rock of a salt dome (see figure). It was possible, for the first time, to directly date the time of cap rock accumulation and calculate growth rates.

Recent Publications

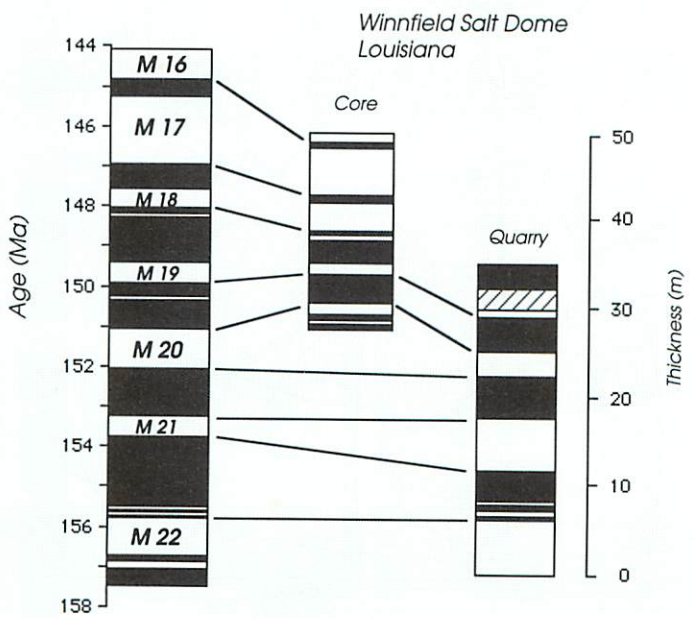
Castillo, J., W.A. Gose, and A. Perarnau, in press, Paleomagnetic Results from Mesozoic Strata in the Merida Andes, Venezuela, *Journal of Geophysical Research.*

Perarnau, A., J. Castillo, and W.A. Gose, 1988, Paleomagnetismo de unidades del Cretáceo en Los Andes y la Serranía de Perijá: implicaciones tectónicas, *Memorias, IV Congreso Venezolano de Geofisica,* 399–405.

Farr, M.R., W.A. Gose, and G.L. Macpherson, 1987, Multiple Chemical Remanent Magnetizations (CRM) in Upper Cambrian Rocks of Central Texas and Their Diagenetic Significance, *XIX General Assembly, International Association of Geomagnetism and Aeronomy,* Vancouver.

Kyle, J.R., M.R. Ulrich, and W.A. Gose, 1987, Textural and Paleomagnetic Evidence for Mechanism and Timing of Anhydrite Cap Rock Formation, Winnfield Salt Dome, Louisiana, *in:* I. Lerche and J. O'Brien, eds., *Salt Dynamics,* Academic Press, 497–542.

Gose, W.A., 1985, Paleomagnetic Results from Honduras and Their Bearing on Caribbean Tectonics, *Tectonics, 4,* 565–585.



Correlation of sea floor magnetic anomaly sequence with magnetostratigraphic results from the Winnfield salt dome, Louisiana.

Stephen P. Grand

Research Associate; also Assistant Professor, Dept. of Geological Sciences; Ph.D., California Institute of Technology (1986), B.Sc., McGill University (1978).

Seismology

Seismic structure of the upper mantle, inversion for lateral seismic variations in the Earth, attenuation structure of the mantle.

Research Interests

Research interests involve determining the seismic structure of the Earth's mantle. This process includes seismic waveform modeling to determine detailed profiles of the upper mantle elastic velocities in various regions. Large scale tomographic inversions applied to travel time data determine the lateral variations throughout the mantle. Recently an inversion for mantle heterogeneity has been completed for the mantle beneath North and South America and the north Atlantic ocean. Seismic wave amplitude studies help determine the Q structure of the shallow mantle and show how it varies laterally. The ultimate goal of this work is to help determine the mineralogy and chemical composition of the mantle, the depth of tectonic plates, and the convection patterns in the mantle.

Recent Publications

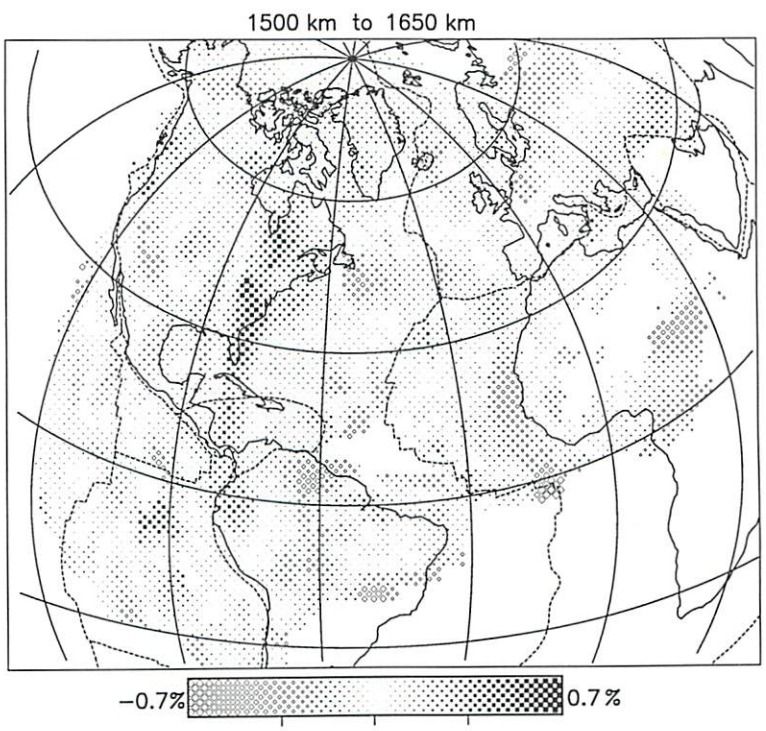
Ding, X.Y., and S.P. Grand, in press, Mantle Q Structure Beneath the East Pacific Rise, *Journal of Geophysical Research.*

Grand S.P., 1990, A Possible Source of Bias in ISC P Travel-Time Residuals, *Geophysical Research Letters, 317*, 17-20.

Grand, S.P., 1987, Tomographic Inversion for Shear Velocity Beneath the North American Plate, *Journal of Geophysical Research, 92,* 14065–14090.

Grand, S.P., and D.V. Helmberger, 1985, Uppermantle Shear Structure Beneath Asia from Multi-Bounce S Waves, *Physics of the Earth and Planetary Interiors, 41,* 154-169.

Grand, S.P., D.V. Helmberger, and L.J. Burdick, 1985, Attenuation Bias Measurements of the Semipalatinsk and North African Test Sites, Woodward-Clyde Consultants Technical Report, WCCP-R-85-01.



This figure shows lateral variations in shear velocity at depths from 1500 to 1650 m determined by a tomographic inversion of shear wave data. Dark symbols are fast regions and open symbols are slow regions. Of particular interest is a linear high velocity feature extending from South America through the east coast of the United States up to Canada.

Kenneth H. Griffiths

Research Engineer; B.S.E.E., Duke University (1968).

Instrumentation

Measurement and processing techniques for geophysical research. Shipboard systems and sensors.

Research Interests

Research activities concentrate on applying modern technology to the solution of geophysical problems. Many of today's problems require measurements that are orders of magnitude more accurate than in the past, so scientists are turning to modern instruments, sensors, and computers to help solve these problems.

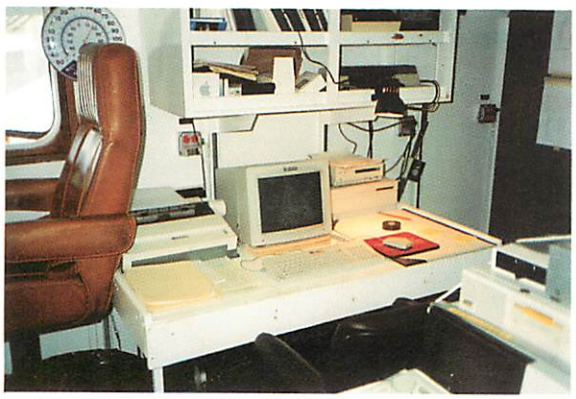
A basic example would be in the navigation of a ship at sea. Less than 20 years ago the uncertainty of ship's position was measured in miles. Today those errors are measured in tens of meters, and we are working to reduce that even further. With this improvement in position information, many more sophisticated experiments become possible.

R/V Polar Duke *dockside at Palmer Station, Antarctica.*

The use of computers has had an equally strong impact on the ability to collect and process vast amounts of data. Without these tools we would be unable to analyze the data collected. Now, by taking the computer to sea, we have substantially improved the acquisition phase. The use of microprocessors has made instruments smaller and more reliable. The improvement in real time information available to the scientists on board ship has aided the decision-making necessary for a successful experiment.

The UTIG Ocean Bottom Seismometer (OBS) is an example of an instrument developed using this new technology. It contains three microcomputers, two of low-power that run continuously and a faster unit that is turned on as needed. The OBS offers substantially more capability than older instruments, yet uses so little power it can remain on the bottom for over a year.

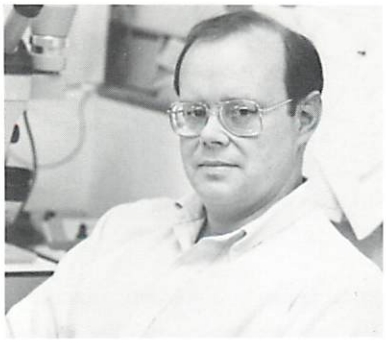
The Institute facilities are well equipped to continue this advance in state-of-the-art measurement and processing. These include capabilities in design, engineering, programming, and construction. Projects have ranged from small, portable instruments to complete shipboard systems. A recent project aboard the R/V *Polar Duke* involved upgrading and operating the seismic and electronic equipment in a series of experiments in Antarctic waters.



Microcomputer system aboard R/V Polar Duke.

Recent Publications

Latham, G., P. Donoho, K. Griffiths, A. Roberts, and A.K. Ibrahim, 1978, The Texas Ocean-Bottom Seismograph, *Proceedings of the Offshore Technology Conference, OTC 3223*, 1467–1476.

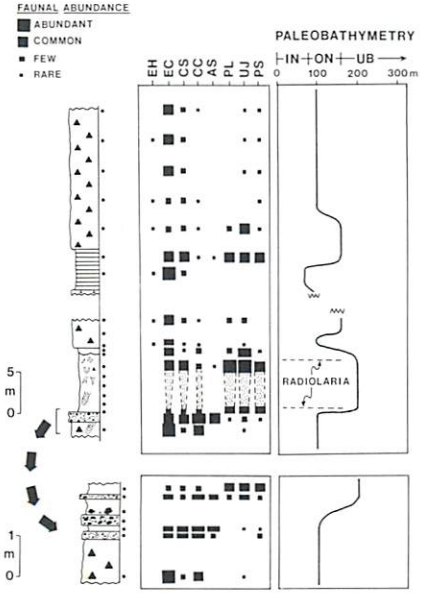


Martin B. Lagoe

Research Scientist; also Associate Professor, Dept. of Geological Sciences. Ph.D., Stanford University (1982), M.S., University of Wisconsin-Madison (1975), B.S., Rensselaer Polytechnic Institute (1973).

Micropaleontology/Paleoceanography

Foraminiferal biostratigraphy; quantitative stratigraphy; Cenozoic climate history.



Detailed lithofacies section and foraminiferal distributions through a sequence of coquina, mudstone and diamictite on Middleton Island, Gulf of Alaska. Foraminifera include Elphidiella hannai *(EH),* Elphidium clavatum *(EC),* Cassidulina *spp. (excluding* C. californica*) (CS),* Cassidulina californica *(CC), agglutinated spp. (AS), plankic spp. (PL),* Uvigerina juncea *(UJ) and* Pullenia salisburyi *(PS). Distribution of these taxa indicate sediment starvation during coquina formation followed by increased water depths and deposition of mudstones and diamictites at outer neritic (ON) to upper bathyal (UB) water depths.*

Research Interests

Research focuses on using the biostratigraphic and paleoenvironmental analysis of foraminifera to address geologic problems. Current research projects using this approach include the analysis of depositional history in Cenozoic active-margin basins in California, the reconstruction of Late Cenozoic climate history and paleoceanography of the North Pacific Ocean based on a study of the Yakataga Formation in the Gulf of Alaska, the relationship between foraminiferal biofacies and organic geochemical facies in both modern and ancient basins, and studies of modern benthic foraminiferal biofacies in the Gulf of Mexico as the basis for high resolution paleoenvironmental models. Working closely with structural geologists, detailed stratigraphic analyses are integrated with the construction of balanced retrodeformable cross-sections to achieve new insights into the tectonic history of central and southern California.

A research project being initiated at the Institute with Tom Davies and John Sclater will focus on the Mesozoic and Cenozoic paleoceanographic history of the Indian Ocean. New paleogeographic and paleobathymetric maps of this area will be used to study a number of problems concerning sediment history and the environmental significance of microfossil distributions. The ultimate goal is a new depositional and paleoceanographic synthesis for the Indian Ocean. An additional project, done in cooperation with Tom Davies and James Austin, is an analysis of late Quaternary sediments and foraminifera from piston cores on the New Jersey continental shelf, in which the results will be integrated with seismic studies in the area.

Recent Publications

Lagoe, M.B., C.W. Eyles, and N. Eyles, 1989, Paleoenvironmental Significance of Foraminiferal Biofacies in the Glaciomarine Yakataga Formation, Middleton Island, Alaska, *Journal of Foraminiferal Research, 19,* 194-209.

Eyles, N., and M.B. Lagoe, 1989, Sedimentology of Shell-Rich Deposits (Coquinas) in Glaciomarine Facies of the Late Cenozoic Yakataga Formation, Middleton Island, Alaska, *Geological Society of America Bulletin, 101,* 129-142.

Lagoe, M.B., and R.P. Thompson, 1988, Chronostratigraphic Significance of Late Cenozoic Planktonic Foraminifera from the Ventura Basin, California: Potential for Improving Tectonic and Depositional Interpretation, *Journal of Foraminiferal Research, 18,* 250–266.

Davis, T.L., and M.B. Lagoe, 1988, A Structural Interpretation of Major Tectonic Events Affecting the Western and Southern Margins of the San Joaquin Valley, California, *in:* S.A. Graham, ed., *Studies of the Geology of the San Joaquin Basin: Pacific Section, Vol. 60,* Society of Economic Paleontologists and Mineralogists, 65–87.

Lawrence A. Lawver

Research Scientist. Ph.D., University of California at San Diego, Scripps Institution of Oceanography (1976), B.S. Stanford (1970).

Marine Geophysics

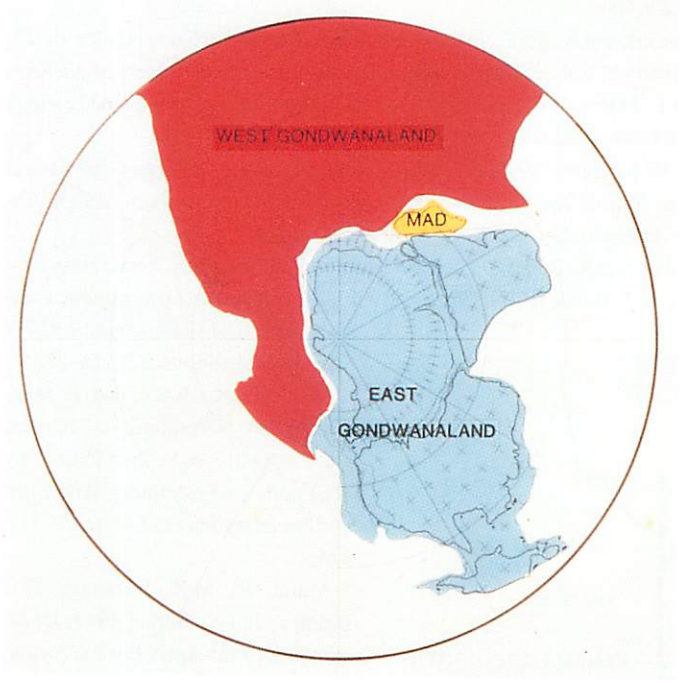
Heat flow studies in marginal basins, plate tectonic reconstructions of polar regions, tectonic evolution of Southeast Asia and the Western Pacific.

Research Interests

As knowledge of the Earth increases, the need to develop new ways of looking at vast amounts of data increases. Computer graphics, along with the increased power of micro- and mini-computers, enable the use of time-varying tectonic scenarios rather than the simple snapshots of a few years ago. Evolutionary processes are described through the use of animation techniques.

Global databases that cover most of the major plate motions for the last 160 million years are used to define the problem areas of plate tectonics. The break-up of South America/West Antarctica/New Zealand/Australia/East Antarctica and the agglomeration and extension of Southeast Asia are two of the fundamental remaining problems. Paleomagnetic data, heat flow, over-the-ice geophysics, and computer graphics aid in understanding the break-up and evolution of the Antarctic region. Much of the evolution and development of Southeast Asia involves subducted or collided terranes, but there is a wealth of oil exploration data that is used to understand the development of this region. In addition, heat flow, marine magnetic, and seismic data are acquired during cruises to the Antarctic Peninsula in the Ross Sea region, as well as over-the-ice traverses in West Antarctica. The tectonics of Southeast Asia, satellite gravity interpretation involving the margins of Antarctica, and the neotectonics of the northern Gulf of California are also studied. Future plans include temperature measurement of the Antarctic ice sheet to determine recent global warming trends.

Results of first phase break-up of Gondwanaland. First phase stretching may have begun as early as the Triassic and resulted in the movement of Madagascar (MAD) away from a tight fit with East Africa. It also produced the Mozambique Ridge and seaward dipping reflectors off the Explora Coast of East Antarctica that were later truncated during the seafloor spreading second phase of Gondwanide break-up. The first phase also produced extension between North New Zealand and the Lord Howe Rise as well as transtension along what is now the Transantarctic Mountain Range. The transtension allowed the intrusion of the Ferrar Dolerites which are dated at about 175 Ma (See Lawver et al., *in press, for details).*



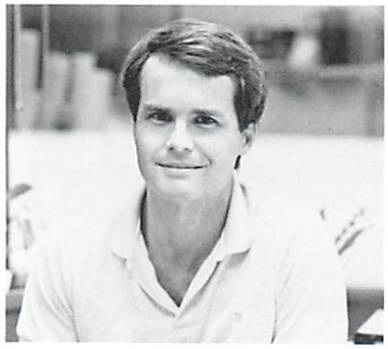
Recent Publications

Lawver, L.A., D.T. Sandwell, J.–Y. Royer, and C.R. Scotese, in press, Evolution of the Antarctic Continental Margins, *in:* M.R.A. Thomson, J. Thomson, and J.A. Crame, eds., *Antarctic Earth Science,* Cambridge University Press.

Lawver, L.A., R.D. Müller, S.P. Srivastava, and W.R. Roest, 1990, The Opening of the Arctic, *in:* U. Bleil and J. Thiede, eds., *Arctic versus Antarctic Geology,* Advanced NATO Symposium volume, Kluwer Publishing Co., Amsterdam, 29-62.

Mayes, C.L., L.A. Lawver, and D.T. Sandwell, 1990, Tectonic History and New Isochron Chart of the South Pacific, *Journal of Geophysical Research, 95*(B6), 8543–8567.

Barker, P.F., and L.A. Lawver, 1988, South American-Antarctic Plate Motion Over the Past 50 Ma, and the Evolution of the South American-Antarctic Ridge, *Geophysical Journal, 94*(3), 377–386.



Paul Mann

Research Associate. Ph.D., State University of New York at Albany (1983), B.A., Oberlin College (1978).

Caribbean Regional Geology and Tectonics

Structural and stratigraphic field mapping, particularly of sedimentary basins; integration of onshore field observations with offshore marine geophysical data.

Research Interests

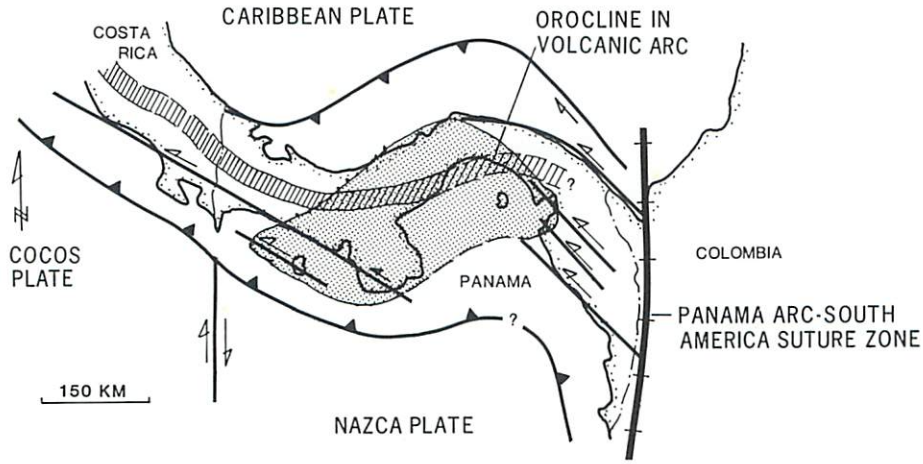
Recent research centers on the tectonics of Cenozoic strike-slip and convergent margins in the Caribbean region. The goal of this work is to relate plate margin structure and sedimentary basins to controlling, relative plate motions. The emphasis is placed on integration of onshore and marine data sets. Methods of study include combined structural, sedimentologic, and biostratigraphic field studies of critical onshore areas, and acquisition and interpretation of offshore, seismic reflection and sidescan sonar data.

Work continues in different areas but focuses on several general questions:

- What are the tectonic effects of normal subduction and collision on forearcs (Plio-Pleistocene of western Panama-Costa Rica, Eocene-Miocene of Hispaniola)?
- Why do compressional and extensional jogs form along strike-slip faults (Pleistocene of Cayman Trough, Miocene-Pleistocene of Jamaica and Hispaniola)?
- How do large offset strike-slip faults abruptly terminate (Eocene-Pleistocene of Cayman Trough; Neogene of Hispaniola and Honduras)?
- What are the structural events which accompany collision of an intraoceanic island arc with a platform or continent (Eocene of Cuba and Hispaniola; Plio-Pleistocene of eastern Panama)?
- How do thrust-bound ramp basins evolve in convergent strike slip settings (Neogene of Hispaniola)?

Eocene olistoliths, Rio Ocoa Formation, Hispaniola.

Proposed model for Caribbean-Nazca plate boundary zone in Panama. Ruled area indicates extent of late Neogene volcanic arc. Dotted area indicates postulated zone of normal faulting separating two strike-slip zones.



Recent Publications

Mann, P., C. Schubert, and K. Burke, in press, Review of Caribbean Neotectonics, *in: The Geology of North America, Vol. H, The Caribbean Region,* Geological Society of America.

Corrigan, J., and P. Mann, 1990, Forearc Response to Subduction of the Cocos Ridge, Panama-Costa Rica, *Geological Society of America Bulletin, 102,* 628-652.

Mann, P., and E. Rosencrantz, 1988, Fault-Termination Effects of a Large-Offset Transform: Integration of Marine and Onshore Data from the Western Cayman Trough, *Eos, Transactions of the American Geophysical Union, 69*(44), 1449.

Mann, P., G. Draper, and K. Burke, 1985, Neotectonics of a Strike-Slip Restraining Bend System, Jamaica, *in:* K.T. Biddle and N. Christie-Blick, eds., *Strike-Slip Deformation, Basin Formation and Sedimentation,* SEPM Special Publications, *37,* 211–226.

Mann, P., K. Burke, and T. Matumoto, 1984, Neotectonics of Hispaniola: Plate Motion, Sedimentation, and Seismicity at a Restraining Bend, *Earth and Planetary Science Letters, 70,* 311–324.

Mann, P., M.R. Hempton, D.C. Bradley, and K. Burke, 1983, Development of Pull-Apart Basins, *Journal of Geology, 91,* 529–554.

Toshimatsu Matsumoto

Senior Research Scientist; also Professor, Dept. of Geological Sciences. Ph.D., B.S., Tokyo University (1961, 1951).

Earthquake Seismology and Volcanology

Study of circum-Caribbean using land-based seismograph networks; induced earthquakes associated with dam loading; seismicity gaps as earthquake precursors.

Costa Rica, remote seismic station

Research Interests

Recent research activity concerns the study of microearthquakes observed from high-gain networks installed in Costa Rica, Guatemala, the Dominican Republic, and Ecuador. These networks originally were installed to assess the seismic risks associated with hydroelectric projects, but they are providing valuable databases for detailed analysis of local and regional tectonics.

Recent Publications

Matumoto, T., T. Terashima, M. Perez, F. Luciano, and J. Sanchez, in press, Induced Seismicity Observed in the Vicinity of Tavera Reservoir, Dominican Republic, *Seismological Society of America Bulletin.*

Guzman-Speziale, M., W.D. Pennington, and T. Matumoto, 1989, The Triple Junction of the North America, Cocos, and Caribbean Plates: Seismicity and Tectonics, *Tectonics, 8*(5), 981-997.

Ohtake, M., T. Matumoto, and G.V. Latham, 1980, Evolution of the Prediction of the 1978 Oaxaca, Southern Mexico, Earthquakes Based on the Seismicity Gap, *Earthquake Prediction, Maurice Ewing Series, Vol. 4,* American Geophysical Union.

Matumoto, T., M. Ohtake, G.V. Latham, and J. Uman, 1977, Crustal Structure in Southern Central America, *Seismological Society of America Bulletin, 67,* 121-133.

Ohtake, M., T. Matumoto, and G.V. Latham, 1977, Seismicity Gap Near Oaxaca, Southern Mexico as a Probable Precursor to a Large Earthquake, *Pageophysics, 115,* 375-385.

Matumoto, T., and G.V. Latham, 1976, Aftershocks of the Guatemalan Earthquake of February 4, 1976, *Geophysical Research Letters, 3,* 599-602.

Arenal volcano, Costa Rica

Earthquake damage, Guatemala

Yosio Nakamura

Senior Research Scientist; also Professor, Dept. of Geological Sciences. Ph.D., Pennsylvania State University (1963), M.S., B.S., Tohoku University (1956, 1958).

Geophysics

Terrestrial and extraterrestrial seismology; structure and tectonics of earth, moon, planets, and satellites; marine seismic measurements.

Research Interests

The Earth is but a planetary body at a specific stage of its evolution. Observations we make of the Earth face the inescapable limitation of the particular environment and conditions in which we find our Earth today. It would not be possible to conduct a controlled experiment to test various hypotheses by subjecting the whole Earth to a different environment or placing it in a different evolutionary stage. Fortunately, however, there are several other planetary objects nearby in vastly different environments from ours, and they provide us with some quite valuable information.

Texas OBS

One such object close to us is the Moon. The extensive data collected during and following the Apollo lunar landing project by a network of seismic stations on the Moon gave us the first direct seismic observation of an extraterrestrial object. Contrary to most earlier expectations, the Moon was found to be not so dead after all. Over 12,000 moonquakes were observed during the eight years of the network operation. Many of them were very deep, about halfway to the center of the Moon, but a small number of rather strong quakes occurring at shallow depths were also detected, suggesting continuing tectonic activity. From the recording of these seismic events, a detailed internal structure of the Moon could be inferred.

The lunar seismic network also detected a large number of meteoroid impacts on the Moon. The nature of these very small members of the solar system provides clues as to the evolution of the solar system.

The Earth remains an interesting planetary body. The vast floor of the ocean, which was not easily accessible until recently, is now readily available to direct observation with ocean-bottom seismic stations. The ocean-bottom seismometers have now been developed sufficiently so that extensive collections of high quality seismic data can be acquired both in seismic exploration of the sub-ocean structures and in earthquake studies.

Recent Publications

Frohlich, C., R. Louat, and Y. Nakamura, in press, Earthquake Activity in the Southern Vanuatu Arc Recorded by the Texas Digital OBS, *Marine Geophysical Research.*

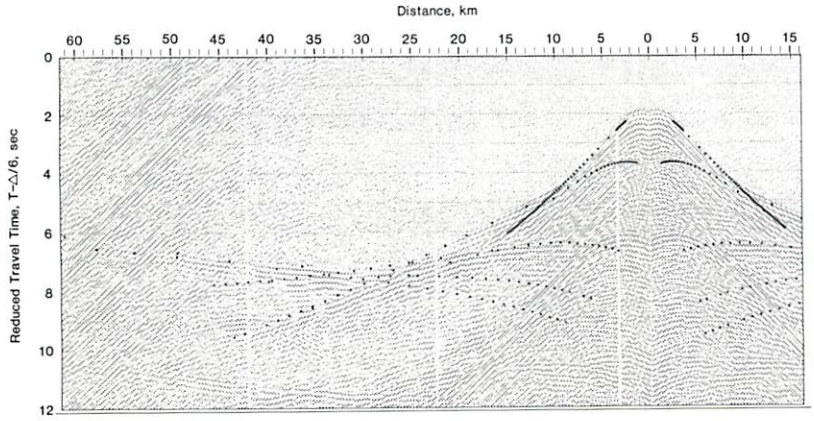
Oberst, J., and Y. Nakamura, 1989, Monte Carlo Simulation of the Diurnal Variation in Seismic Detection Rate of Sporadic Meteoroid Impacts on the Moon, *Proceedings of the 19th Lunar and Planetary Science Conference,* 615-625.

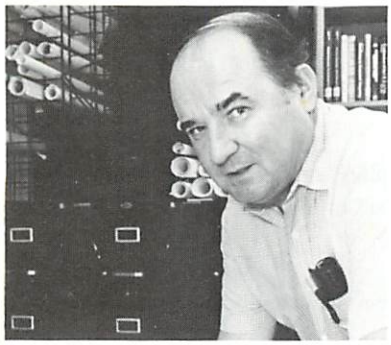
Nakamura, Y., D.S. Sawyer, F.J. Shaub, K. MacKenzie, and J. Oberst, 1988, Deep Crustal Structure of the Northwestern Gulf of Mexico, *Transactions, Gulf Coast Association Geological Society, 38,* 207-215.

Ebeniro, J.O., Y. Nakamura, D.S. Sawyer, and W.P. O'Brien, Jr., 1988, Sedimentary and Crustal Structure of the Northwestern Gulf of Mexico, *Journal of Geophysical Research, 93,* 9075–9092.

Nakamura, Y., P.L. Donoho, P.H. Roper, and P.M. McPherson, 1987, Large-Offset Seismic Surveying Using Ocean-Bottom Seismographs and Air Guns: Instrumentation and Field Technique, *Geophysics, 52,* 1601–1611.

A large-offset seismic record section obtained using an ocean-bottom seismograph.





Joseph D. Phillips

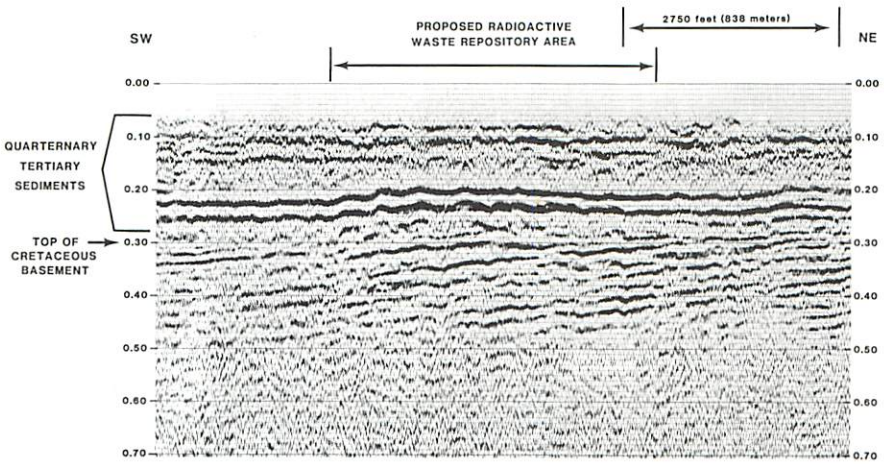
Research Scientist. Ph.D., M.A., M.S.E., Princeton (1966, 1964, 1963); B.A., Rutgers (1961).

Seismology and Geomagnetism

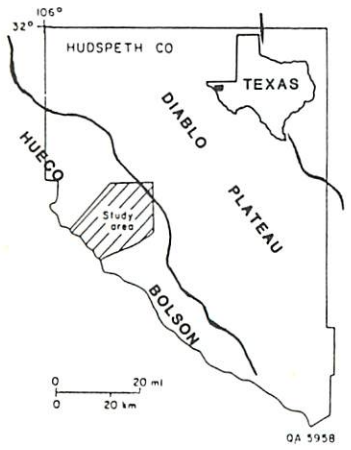
Deep earth structure; plate tectonic evolution of ocean basins and continental margins, seismo-acoustic imaging, aeromagnetics, paleomagnetism, vertical seismic profiling.

Research Interests

Primary research activities can be divided into three categories. The first area concerns understanding the detailed structure of new oceanic crust as it forms along the spreading ridge axes. This work involves the development and use of aeromagnetic multibeam sonar bathymetry, bottom photography, and seismo-acoustic navigation techniques for determining the morphology and volcano-tectonic processes active along the mid-Atlantic Ridge.



High resolution VIBROSEIS multichannel seismic reflection section near proposed Texas Low–Level Radioactive Waste Repository site: Fort Hancock, Hudspeth County, Texas. Shot point/common depth point interval is 27.5 feet (8.38 meters). Two–way travel time is given in seconds. Approximate depth to southwestward–dipping Cretaceous basement rocks is 700 feet (213.4 meters). Below: Location map showing site.



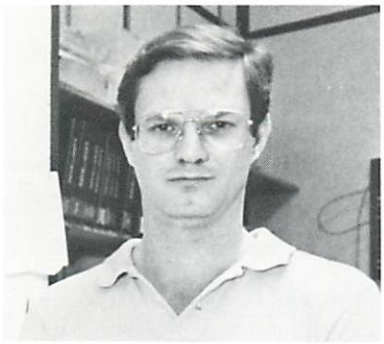
Recent Publications

Phillips, J.D., and H. Winkler, 1987, Vertical Seismic Profile Experiment, ODP Site 642, Leg 104, *in:* O. Eldholm et al., *Proceedings, Ocean Drilling Program, Initial Reports (Part A), Vol. 104*, 198–213.

Phillips, J.D., 1987, Vertical Seismic Profile Experiment, ODP Site 504B, Leg 111, in: K. Becker et al., *Proceedings, Ocean Drilling Program, Initial Reports (Part A), Vol. 111*, 124–152.

Phillips, J.D., and D.F. Dean, 1987, Multichannel Common Depth Point Mapping of Ocean Water Mass Interfaces (N.W. Atlantic), University of Texas Institute for Geophysics Technical Report TR-47, 20 pp.

Phillips, J.D., and D.F. Dean, 1986, Preliminary Seismic Reflection Study of the Fort Hancock Area in Hudspeth County, TX, Final Report for the Texas Low-Level Radioactive Waste Disposal Authority Contract IAC (86-87)-0994, University of Texas Institute for Geophysics Technical Report TR-45, 46 pp.



Mark A. Riedesel

Research Associate. Ph.D., M.S., Scripps Institution of Oceanography, University of California, San Diego (1985, 1980), A.B., Princeton University (1977).

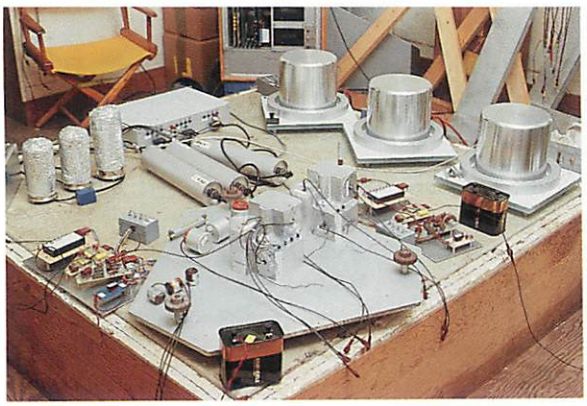
Seismology

Low-frequency seismology, seismic sources, ocean bottom seismology, seismic instrumentation.

Research Interests

Observational seismology uses digital data and seismic instrumentation. A significant amount of research has been in low-frequency seismology, particularly very long-period source characteristics. An additional interest in marine seismology employs ocean bottom seismographs (OBS) to study microearthquakes on mid-ocean ridges. Seismometers have recently been tested for use in a new generation of OBS.

The work in low-frequency sources has been carried out with Professor Thomas H. Jordan, now at M.I.T. A moment tensor inversion technique was developed which gives stable results across the frequency band from 1 to 11 mHz, allowing the frequency dependence of the source to be examined. Low-frequency source studies also give valuable information on the total size of an event and about the average properties of the source mechanism which cannot be measured using higher frequency techniques. Examining most of the large earthquakes that have occurred between 1977 and 1984, it was found that none show significant frequency dependence, but several intermediate and one deep event have statistically significant non-double-couple components in their moment-rate tensors. This means that, at least at low frequencies, these events have source mechanisms more complex than a dislocation on a planar fault, which is a simple model that describes most earthquakes quite well. These earthquakes at higher frequencies are being looked at to determine if they are due to complex rupture on non-planar surfaces, or might be due to a more unusual mechanism such as a volume-preserving phase transition. These studies will also investigate the information that can be gained about low-frequency precursors of earthquakes by examining the relationship between the characteristic time of an event, τ_c, and the difference, Δt, between the centroid time and the *P*-wave origin time for the event.



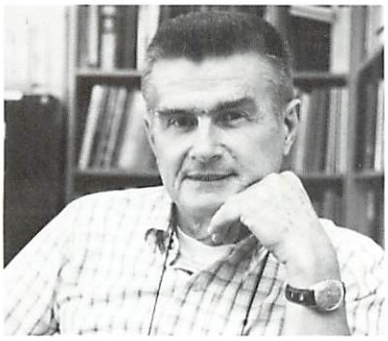
The experimental set-up for testing the low-frequency response of seismometers for use in Ocean Bottom Seismographs. The models of seismometers shown include Streckeisen (large square cylinders) and Guralp (vertical cylinders covered with foil) very long period sensors and 1 Hz, 2 Hz, and 4.5 Hz geophones (all on the triangular platform)

In an initiative sponsored by the Office of Naval Research the low-frequency seismic noise on the sea floor will be studied. For this project, ONR is sponsoring the construction of a new generation of ocean bottom seismographs that will have a greatly expanded recording capacity compared to previous models. Sensors are being tested in this project to determine the ultimate low-frequency capabilities of some existing commercially available seismometers. When these instruments are complete, experiments will be conducted to measure the seismic noise field on the sea floor. Such measurements are necessary to assess what types of seismographs are best suited for use in ocean bottom seismic stations and to determine if such instruments need to be placed in boreholes to return useful data.

Recent Publications:

Riedesel, M.A., and T.H. Jordan, 1989, Display of Moment-Tensor Solutions and Their Uncertainties, *Bulletin of the Seismological Society of America, 79,* 85–100.

Riedesel, M.A., T.H. Jordan, A.F. Sheehan, and P.G. Silver, 1986, Moment-Tensor Spectra of the 19 Sept 85 and 21 Sept 85 Michoacan, Mexico, Earthquakes, *Geophysical Research Letters, 13,* 609–612.



Archie Roberts

Research Engineer; M.S, B.S., Massachusetts Institute of Technology (1951, 1950).

Oceanographic and Geophysical Engineering

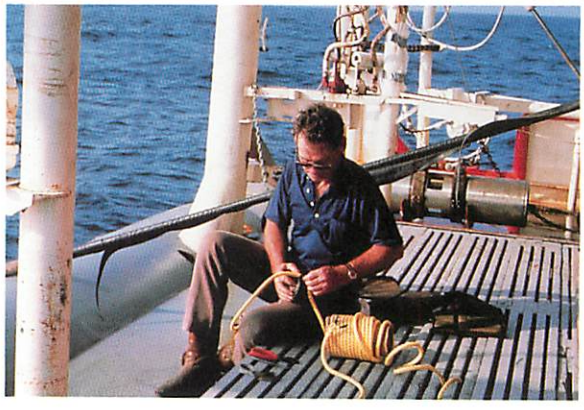
Development of equipment and techniques for improving the Institute research capabilities.

Professional Interests

The Technical Support Group is directly or indirectly associated with most of the research projects of the Institute. Currently the emphasis has been on multichannel seismic exploration, ocean-bottom seismic instrumentation and planning.

Instrumentation design for marine projects is critical not only in terms of basic function and reliability but also in respect to instrument compatibility with the shipboard environment. This is especially true of over-the-side and ocean bottom instruments, which are more at risk in deployment and recovery than during quiescent periods of data acquisition. Historically such instruments have had to conform to the relative inflexibilities of the ships from which they were launched. Wind, weather, and the inherent clumsiness of oceanographic vessels provide fertile ground for innovative systems design wherein past experience at sea plays a the major role. No two vessels are alike. Each has flaws to be accommodated in the general and specific instrument application. Flexible design, innovative handling systems, and consistent maintenance are the essence of good technical support for science at sea.

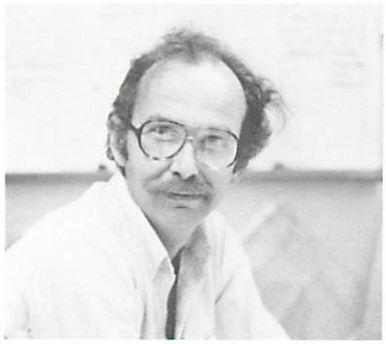
Airgun technician David Divins making repairs underway.



A jack-of-all-trades, the late George Pearcy splices buoy bridles.

Student cruise participants recovering air gun.

Technical support staff completing cable deployment.



Eric Rosencrantz

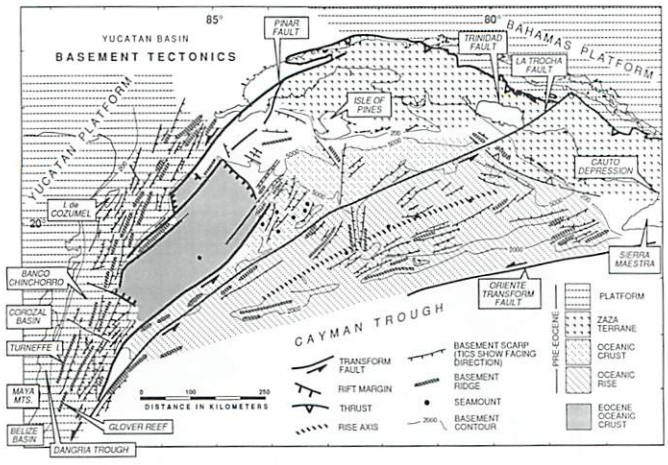
Research Scientist. Ph.D., State University of New York at Albany (1980), B.A., University of Vermont (1975).

Tectonics

Tectonics and geology of the Caribbean; global tectonics.

Research Interests

Current research focuses on the geology and tectonics of the Caribbean region, with an emphasis on the Caribbean basins. Although these basins and adjacent rises comprise about 80% of the region, their geology is relatively unknown in relation to that of the Caribbean islands and land masses. Tectonic reconstructions tend to view the basins as being relatively simple in structure and as having largely passive roles in the evolution of the region. However, integrated studies of the basins, which include examining seismic reflection, seismic refraction, magnetic, heat flow, and gravity data plus geological information, show that the crust and overlying sediments of these basins have complicated structures and tectonic histories. For instance, a full survey of Yucatan Basin seismic reflection data suggests that the basin may contain remnants of three plate suture zones, as well as a sunken island arc and a small oceanic rift basin. A reexamination of the Cayman Trough magnetic anomalies indicates that the basin rifted much earlier than previously suspected, and that it opened at slow spreading rates. High-resolution seismic reflection profiling on the Nicaragua Rise west of Jamaica indicates that Pedro and Walton Banks are remnants of a much larger carbonate platform which broke up and subsided in Miocene (?) time.



Tectonic interpretation of Yucatan Basin geology as based upon seismic reflection profiling.

This research approaches the Caribbean in three ways. The first is to continue to gather observations about the basins through standard methods such as seismic, magnetic and gravity profiling, dredging, coring, measurements of heat flow, etc. The second approach is to develop and apply new geophysical applications to the region, such as deep seismic reflection profiling, aeromagnetic mapping, satellite gravity mapping, and side-scan mapping of bottom topography and reflection character. The third approach is to compile and examine existing data about the region. Viewed as a whole against a tectonic framework, existing information will often provide valuable insights as to regional tectonic reconstruction.

Recent Publications

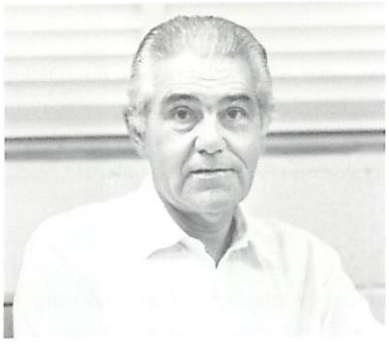
Rosencrantz, E., in press, Structure and Stratigraphy of the Yucatan Basin, Caribbean Sea, as Shown by Seismic Reflection Profiles, *Tectonics*.

Rosencrantz, E., J.G. Sclater, and S. Boerner, 1988, Basement Depths and Heat Flow in the Yucatan Basin and Cayman Trough, Northwestern Caribbean: Implications for Basin Ages, *in:* J.A. Wright and K.E. Louden, eds., *Seafloor Heat Flow*, CRC Press, Boca Raton, FL, 257–276.

Bowland, C.L., and E. Rosencrantz, 1988, Upper Crustal Structure of the Western Colombian Basin, Caribbean Sea, *Geological Society of America Bulletin, 100,* 534–546.

Rosencrantz, E., M.I. Ross, and J.G. Sclater, 1988, The Age and Spreading History of the Cayman Trough as Determined from Depth, Heat Flow and Magnetic Anomalies, *Journal of Geophysical Research, 93,* 2141–2157.

Rosencrantz, E., and J.G. Sclater, 1986, Depth and Age in the Cayman Trough, *Earth and Planetary Science Letters, 79,* 133–144.



Amos Salvador

Senior Research Scientist; also Morgan J. Davis Professor in Petroleum Geology , Dept. of Geological Sciences. Ph.D., Stanford University (1950), B.S., Central University of Venezuela (1945).

Geology, Stratigraphy

Geology of the Gulf of Mexico basin and Caribbean area, stratigraphic principles and procedures, petroleum geology, energy resources.

Research Interests

A major thrust of this research is the reconstruction of the geologic evolution of the Gulf of Mexico Basin and the Caribbean area by means of detailed paleogeographic/lithofacies maps of intervals of time as small as the available information allows. The paleogeographic reconstruction will be made in two sets of maps: one depicting present position, and another following selected reconstructions of land and sea areas. The first set of maps will be an inventory of information: lithologic composition, thickness, environment of deposition, record of intrusive and extrusive igneous activity, evidence, nature and extent of discontinuities in the stratigraphic record, etc. The second set of maps will test the proposed reconstructions of the historical evolution of the Gulf of Mexico Basin and the Caribbean area. If the assembled paleogeographic/lithofacies data do not fit the reconstruction, the evolutionary model will have to be changed to fit the basic geological evidence.

A second field of research interest involves the development of principles and procedures of stratigraphic classification and nomenclature, which includes coordinating the revision of the International Stratigraphic Guide (1976) as chairman of the International Subcommission on Stratigraphic Classification of the IUGS International Commission on Stratigraphy.

Recent Publications

Salvador, A., 1987, Late Triassic-Jurassic Paleogeography and Origin of Gulf of Mexico Basin, *Bulletin of the American Association of Petroleum Geologists, 71*, 419–451.

Salvador, A. (as Chairman of International Subcommission on Stratigraphic Classification), 1987, Unconformity-Bounded Stratigraphic Units, *Geological Society of America Bulletin, 98*, 232–237.

Salvador, A. (as Chairman of International Subcommission on Stratigraphic Classification), 1987, Stratigraphic Classification and Nomenclature of Igneous and Metamorphic Rock Bodies, *Geological Society of America Bulletin, 99*, 440–442.

Salvador, A., 1985, Chronostratigraphic and Geochronometric Scales in COSUNA Stratigraphic Correlation Charts of the United States, *Bulletin of the American Association of Petroleum Geologists, 69*, 181–189.

John G. Sclater

Associate Director and Senior Research Scientist; also Shell Companies Foundation Distinguished Chair in Geophysics, Dept. of Geological Sciences. Ph.D., University of Cambridge (1966), B.S., Edinburgh University (1962). Fellow, Royal Society of London; Member, National Academy of Sciences; Rosenstiel Award (1979); Bucher Medal (1985); Shell Distinguished Professorship (1983-88).

Marine Geophysics

Paleographic and paleodepth reconstructions, subsidence of the ocean floor, modeling of continental deformation, heat flow in the Gulf of Mexico, theoretical soil mechanics.

Research Interests

Areas of current interest include modeling of deformation by block faulting, theoretical soil mechanics and the heat flow through the Gulf of Mexico.

Recent Publications

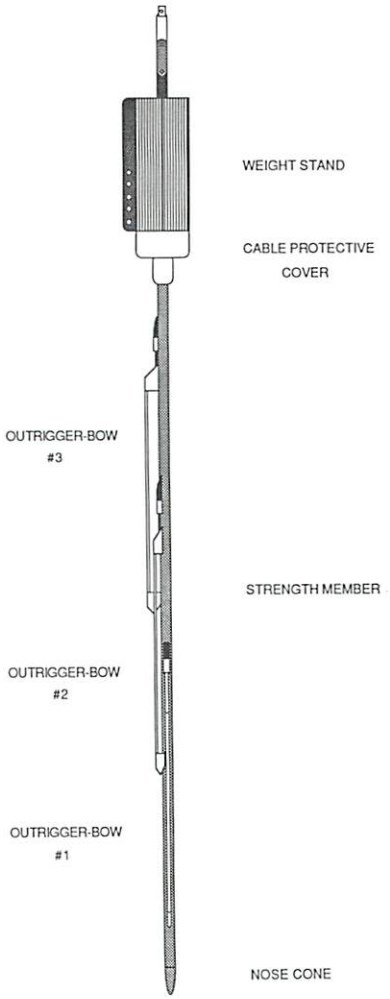
Sclater, J.G., and B. Célérier, 1989, Errors in Extension Measurements from Planar Faults Observed on Multichannel Seismic Reflection Lines, *Basin Research, 1,* 217–221.

Sclater, J.G., and M. Shorey, 1989, Mid–Jurassic through Mid–Cretaceous Extension in the Central Graben of the North Sea, Part 2: Estimates from Faulting Observed on a Seismic Reflection, *Basin Research, 1,* 201–215.

Kautz, S.A., and J.G. Sclater, 1988, Internal Deformation in Clay Models of Extension by Block Faulting, *Tectonics, 7* (4), 823–832.

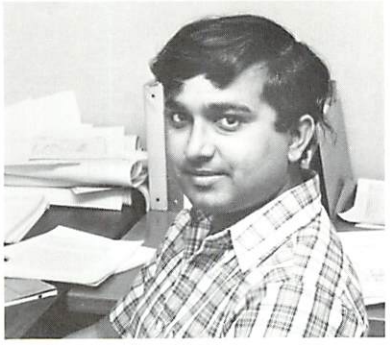
Sclater, J.G., and B. Célérier, 1987, Extensional Models for the Formation of Sedimentary Basins and Continental Margins, *Norsk Geologisk Tidsskrift, 67,* 253–268.

A schematic diagram of the multi-outrigger-bow heat flow probe.



Left: Closeup showing heat flow instrument being deployed off the R/V Polar Duke *in Antarctic waters.*

Right: View looking aft of weight stand and heat flow instrument in preparation for deployment.



Mrinal K. Sen

Research Associate. Ph.D., University of Hawaii at Manoa, Hawaii Institute of Geophysics (1987), M.Sc., B.Sc., Indian School of Mines (1979,1977).

Seismology

Wave propagation in complex media; seismic data processing and analysis; strong ground motion and underwater acoustics.

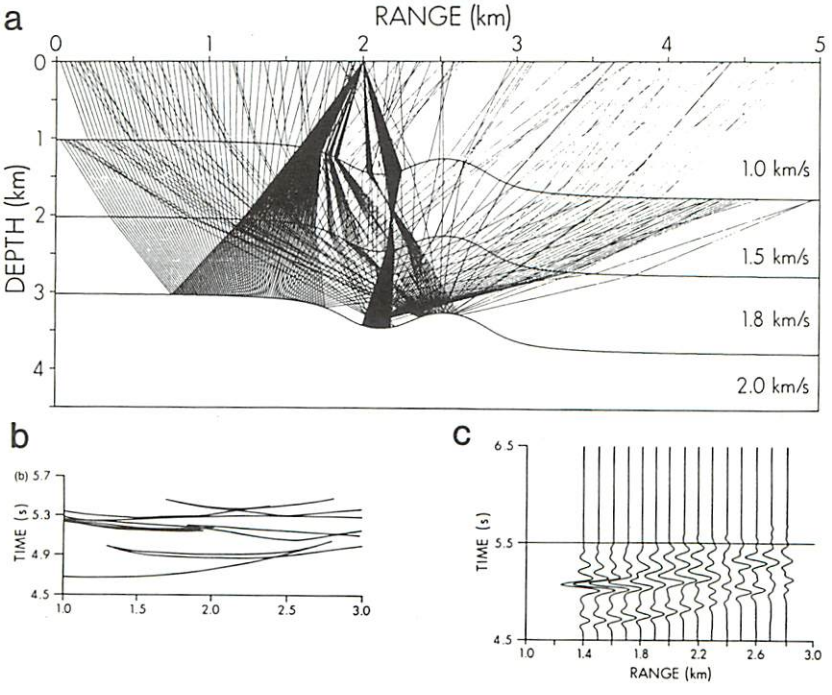
Research Interests

Current interests include three related areas of seismology: developing algorithms for seismogram synthesis in laterally heterogeneous media using numerical-analytical techniques, study of weak and strong ground motion due to earthquakes in the Los Angeles Basin, and developing methods for prestack migration and inversion of seismic data.

A new technique for calculating synthetic seismograms based on elastic Kirchhoff-Helmholtz (KH) integral was developed as a doctoral dissertation topic. The method uses a multiple Huygen's construction and evaluates the response of a single generalized ray by summing over all possible paths either in configuration or in phase space. On the other hand, the reflectivity method has been very successful in modeling wave propagation in stratified media. Work is progressing on developing an algorithm for a reflectivity method that will be valid in laterally inhomogeneous media. In this new technique, reflection and transmission operators will be constructed by using multifold path integral formulations.

Prestack migration and non-linear inversion methods and their application to exploration seismic data are of major interest. The pre-stack migration method is an extension of the split-step Fourier method by Stoffa et al. (1990) originally applied to stacked data. This method is available for migration of common shot gather, slant stacked shot gathers, and data in CMP coordinates. The non-linear inversion method is an application of simulated annealing or heat bath inversion method. The forward modeling is being done in frequency-ray parameter domain and is therefore very rapid. A new cooling schedule has been found that rapidly finds the global minimum of the misfit function. The results from these methods are very encouraging, and extensive research in this area is continuing.

Example of computation of synthetic seismograms (MFPI) (a) model and ray diagrams, (b) travel-time curve, (c) synthetic seismograms.



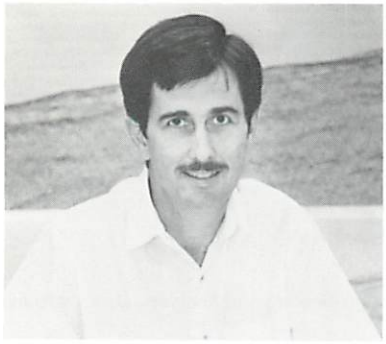
Recent Publications

Sen, M.K., and L.N. Frazer, in press, Multifold Phase Space Path Integral Synthetic Seismograms, *Geophysical Journal International.*

Sen, M.K., 1990, Deep Structural Complexity and Site Response in the Los Angeles Basin, *Proceedings of the Fourth U.S. National Conference on Earthquake Engineering, Vol. 1,* Palm Springs, CA, 545-553.

Sen, M.K., L.N. Frazer, N.R. Chapman, and S. Mallick, 1988, Analysis of Multipath Sound Propagation in the Ocean, *Journal of the Acoustical Society of America, 83*(2), 588-597.

Sen, M.K., and L.N. Frazer, 1987, Synthetic Seismograms Using Multifold Path Integrals, II. Computations, *Geophysical Journal of the Royal Astronomical Society, 88,* 647-671.



Thomas H. Shipley

Senior Research Scientist. Ph.D., Rice University (1975), B.S. California State University at Hayward (1971).

Marine Geology and Geophysics

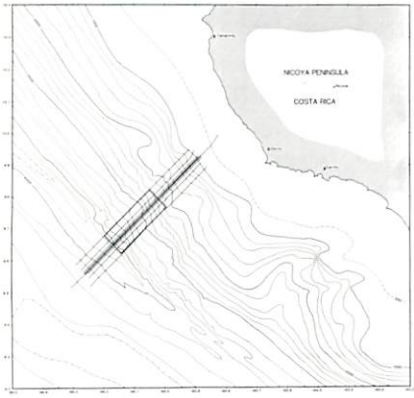
Convergent margin processes, marine stratigraphy, seismic reflection methods, marine geology.

Research Interests

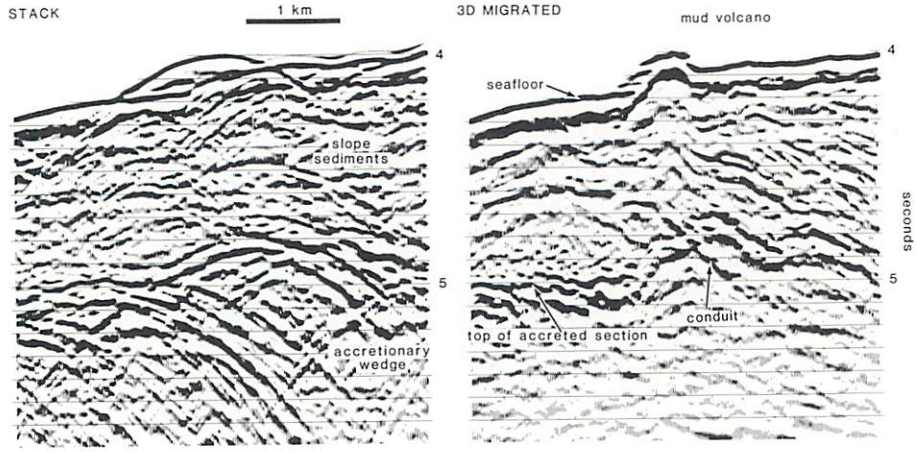
Multichannel seismic reflection data have proved a powerful tool to investigate modern convergent margin accretionary processes. However, observations of the geometry and velocity structures along convergent margins remain difficult. In an effort to improve seismic imaging, we collected a three-dimensional seismic reflection data set of the accretionary margin off Costa Rica along the Middle America Trench. These data are providing the ability to map the structure of a 3D volume. These data, when combined with more regional swath mapping and high resolution seismic surveys, provide information on the processes involved in margin growth.

Fluids introduced into the accretionary wedge by underthrusting of sediments and porous oceanic crust greatly influence effective stress and styles of deformation. A frontier area of investigation is to better characterize the fluid budget and migration paths within accretionary wedges. Seismic velocity is particularly sensitive to fluid content and is useful if there is sufficient resolution. Efforts to trace a sequence of sediments through the cycle of deformation associated with convergence are now concentrated in areas such as the Nankai Trough, off southwest Japan, where we recently conducted a high resolution velocity experiment utilizing a wide aperture seismic array (expanding spread profiles).

Costa Rica 3D data set.



Seismic section illustrates internal structure of accretionary wedge off Costa Rica. Reflective conduit is pathway for fluids and entrained sediments to reach the sea floor where a mud volcano is forming.



Recent Publications

Shipley, T., P.L. Stoffa, and D.F. Dean, 1990, Underthrust Sediments, Fluid Migration Paths and Mud Volcanoes Associated with the Accretionary Wedge off Costa Rica: Middle America Trench, *Journal of Geophysical Research, 95*(B6), 8743-8752.

Laguros, G., and T.H. Shipley, 1989, Quantitative Estimate of Resedimentation in the Pelagic Sequences of the Equatorial Pacific, *Marine Geology, 89,* 269–277.

Moore, G., and T. Shipley, 1988, Mechanisms of Sediment Accretion in the Middle America Trench off Mexico, *Journal of Geophysical Research, 93,* 8911–8927.

Shipley, T.H., and R.T. Buffler, 1987, Continental Margin of Costa Rica, *in:* R. von Huene, ed., Seismic Images of Modern Convergent Margin Tectonic Structure, *American Association of Petroleum Geologists Studies in Geology Series 26,* 33–36.

Mayer, L.A., T.H. Shipley, and E.L. Winterer, 1986, Equatorial Pacific Seismic Reflectors as Indicators of Global Oceanographic Events, *Science, 233,* 761–764.

Moore, G.F., T.H. Shipley, and P.F. Lonsdale, 1986, Subduction Erosion Versus Sediment Offscraping at the Toe of the Middle America Trench off Guatemala, *Tectonics, 5,* 513–523.

Shipley, T.H., and G.F Moore, 1986, Sediment Accretion, Subduction and Dewatering at the Base of the Trench Slope off Costa Rica: A Seismic Reflection View of the Decollement, *Journal of Geophysical Research, 91,* 2019–2028.

Paul L. Stoffa

Associate Director and Senior Research Scientist; also Wallace E. Pratt Professor in Geophysics, Dept. of Geological Sciences. Ph.D., Columbia University (1974), B.S., Rensselaer Polytechnic Institute (1970).

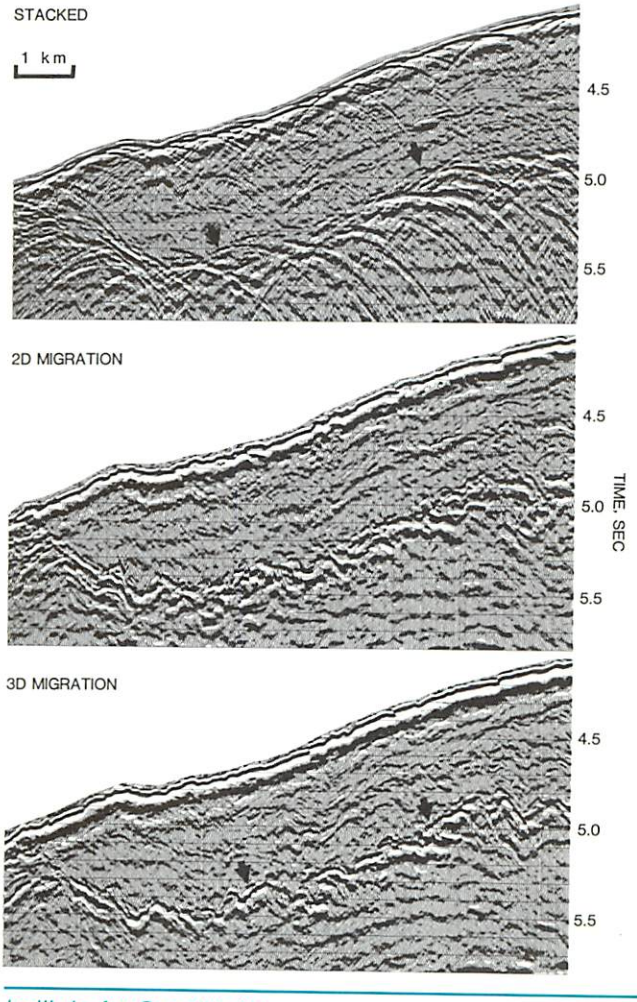
Marine Seismology

One- and two-dimensional signal processing, acoustic and elastic wave propagation, multichannel seismic acquisition and processing systems, modeling and inversion of geophysical data.

Research Interests

Answers to many complex geologic problems often can be obtained from seismic measurements. Understanding tectonic processes at both active and passive rifted continental margins requires knowledge of their deep geological structure. Research has been focused on developing new seismic data acquisition and processing methods that can be used to address these and other specific geologic problems; for example, mapping the transition from continental to oceanic crust requires the ability to probe beneath large accumulations of sediment to depths often in excess of 15 to 20 km. A seismic survey was conducted in the summer of 1988 using a long towed array of 6.0 km and a powerful source array of over 10,800 cu. in. The objective was to penetrate the entire sedimentary section in the Carolina Trough off the east coast of the United States. Seismic reflections from two-way times of 12 seconds and greater were recorded and imaged at a location that is coincident with the Brunswick Magnetic Anomaly. In another program offshore Japan, two ships acquired high-resolution expanding-spread and split-spread seismic profiles using a high frequency water gun as a seismic source. These data were transformed to the τ-p domain and analyzed to provide detailed velocity depth information for this active margin. Offshore Costa Rica a 3D survey was designed and 96-channel seismic data were successfully acquired. This data set was processed recently using the University of Texas System Cray X-MP/24. In support of these projects, 2D and 3D pre- and post-stack migration methods have been developed that account for vertical and lateral velocity variations. Also, programs for interactive velocity analysis in the τ-p domain for 1D and 2D structures using workstation technology have been developed and are being used in the interpretation of the seismic data acquired in these programs.

Stacked 3D data collected over the accretionary wedge offshore Costa Rica. 32 lines of 512 traces from the 3D data volume were used to compare 2D and 3D split-step migrations. Each line has 512 traces with a spacing of 33 m. The line spacing was 50 m. Top: Portion of stacked dip line in the middle of the 32 line data volume. Center: Same line after 2D split-step migration. The depth–migrated data were resampled to time for comparison. Bottom: Same line, after 3D split-step migration of the 32 line data volume. Arrows indicate the top of the accretionary prism.



Recent Publications

Stoffa, P.L., J.T. Fokkema, R. de Luna Freire, and W. Kessinger, 1990, Split-Step Fourier Migration, *Geophysics, 55*(4), 410-421.

Stoffa, P.L. (ed.), 1989, *Tau-p: A Plane Wave Approach to the Analysis of Seismic Data*, Kluwer Academic Publishers Group, Dordrecht, The Netherlands.

LASE Study Group, 1986, Deep Structure of the U.S. East Coast Passive Margin from the Large Aperture Seismic Experiment (LASE), *Marine and Petroleum Geology, 3*, 234-242.

McCowan, D.W., P.L. Stoffa, and J.B. Diebold, 1984, Fan Filters for Data with Variable Spatial Sampling, *IEEE Transactions on Acoustics, Speech, and Signal Processing*, ASSP-32(6), 1154-1159.

Fumiko Tajima

Research Scientist. Ph.D., M.S., B.S., University of Tokyo (1982, 1972, 1970).

Global Seismology

Earthquake sources; seismicity; long-period surface waves; seismological data base.

Research Interests

Earthquake source process and seismicity provide information about the mechanical condition of fault zones. The starting data set for this study was presented in "Global Survey of Aftershock Area Expansion Patterns" (Tajima and Kanamori, 1985). Based on this work, source characteristics of major subduction events are being studied. Similar techniques are applied to study the earthquake source process and near-source structure in the Gulf of California incorporating the results with regional tectonics.

Another area of interest is long-period surface wave propagations dealing with Global Digital Seismograph Network (GDSN), GEOSCOPE, and IRIS records. The records demonstrate various anomalous properties of surface waves that propagate through the laterally heterogeneous and anisotropic Earth. These anomalies are considered key elements for studying upper mantle structure, the pattern of mantle convection, and the mechanism of mantle.

Earthquake seismology is an observational science for which a well-organized database of high quality records is essential. The database accessible from our Sun workstation network includes the National Earthquake Information Service seismicity catalogue and Global Digital Network records. These data allow a wide range of seismological study.

Recent Publications

Tajima, F., L. Ruff, H. Kanamori, J. Zhang, and K. Mogi, 1990, Earthquake Source Processes and Subduction Regime in the Santa Cruz Islands Region, *Physics of the Earth and Planetary Interiors, 61,* 269-290.

Tajima, F., and I. Kawasaki, 1989, 3D Particle Motion Trajectories: Direct Observation of Love-Rayleigh Coupling, *Geophysical Research Letters, 16,* 1051–1054.

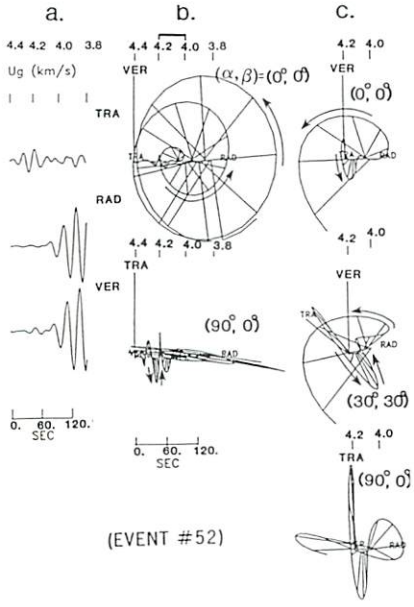
Tajima, F., and B. Célérier, 1989, Possible Focal Mechanism Change During Reactivation of a Previously Ruptured Subduction Zone and Stress Tensor Implications, *Geophysical Journal, 98,* 301–316.

Moriyama, T., F. Tajima, and T. Seno, 1989, Unusual Zone of Seismic Coupling in the Northern Bonin Arc: the Hachijo-Oki 1972 Earthquakes and Related Seismicity, Special Issue on Subduction, *Pure and Applied Geophysics, 129,* 233–261.

Tajima, F., and J.D. Garmany, 1987, Surface Wave Amplitude Anomalies: Is Reciprocity Valid? *Physics of the Earth and Planetary Interiors, 47,* 267–287.

Tajima, F., and H. Kanamori, 1985, Aftershock Area Expansion Pattern and Fault Zone Heterogeneities in Subduction Zones, *Geophysical Research Letters, 12,* 345–348.

Tajima, F., and H. Kanamori, 1985, Global Survey of Aftershock Area Expansion Patterns, *Physics of the Earth and Planetary Interiors, 40,* 77–134.

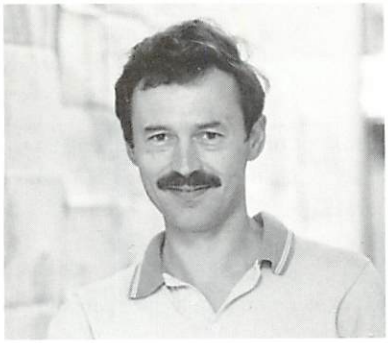


Seismic traces observed at station HON from an event which occurred in the west coast of the North American continent.

(a) Waveforms of band-pass filtered surface waves in the period range between 20 and 30 s. The tick marks above the tranverse component show the arrival times of waves with specified group velocities Ug (e.g., 3.8, 4.0, 4.2, 4.4 km/s).

(b) 3D particle motion trajectory constructed from the waveforms in (a) for the view with angles $\alpha = 0$ ° and $\beta = 0$ ° (top) and that for $\alpha = 90$ ° and $\beta = 0$ ° (bottom). To aid in tracing the time history, lines are drawn from the trajectory to the corresponding points of the time axis every 3 s (also note the arrows to trace the motion).

(c) Same as in (b) but in a narrower time window (indicated with a brace above the tick marks in (b); e.g., $4.0 \leq Ug \leq 4.2$ km/s): (top) for the view with angles $\alpha = 0$ ° and $\beta = 0$ °; (middle) for $\alpha = 30$ ° and $\beta = 30$ °; (bottom) for $\alpha = 90$ ° and $\beta = 0$ °. The amplitudes are normalized to the maximum in each picture. Note that the fundamental Rayleigh waves show a clean retrograde elliptic motion.

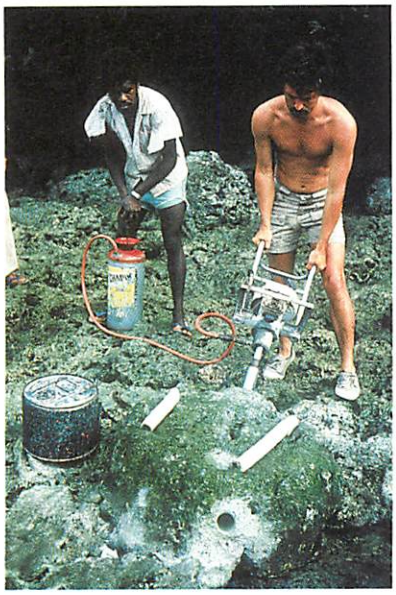


Frederick W. Taylor

Research Scientist. Ph.D., Cornell University (1978), M.S., Brown University (1974), B.S., University of North Carolina (1971).

Neotectonics

Studies of Quaternary and contemporary crustal motions using coral reefs and the Global Positioning System (GPS) in the Caribbean and South Pacific.



Above: Core sampling in the Santo Islands. Below: The South Pacific is an area of rapid plate movement. In 1988 and 1989 a crustal motion network of Global Positioning System (GPS) receivers was established on several islands in an area that encompasses two subduction zones of opposite polarity and two zones of seafloor spreading. The network was set up to perform repeated measurements on baselines between islands on opposite plates to monitor the divergence or convergence between them. The photo shows equipment at the GPS site on Maewo Island.

Research Interests

Neotectonic deformation is important to the evolution of convergent plate boundaries and strike-slip fault systems. For example, vertical movements may precede, accompany, or follow earthquakes and provide clues useful for earthquake prediction. Geophysicists normally study vertical movements using instruments (tiltmeters, tide gauges, leveling, etc.). However, corals and reefs have recorded vertical tectonism ranging from a few centimeters to hundreds of meters on time scales from one year to millions of years.

On the one–thousand– to one–million–year time scale, vertical deformation of emerged coral reef terraces approximately documents paleosea surfaces. The heights of emerged reefs represent the net sum of all the large and small vertical deformations and sea level changes which have occurred since the reef died. By dating fossil corals by ^{14}C or $^{230}Th/^{234}U$ methods, the deformation rates can be inferred and used to interpret the significance of modern vertical movements. On the one-to one hundred-years time scale, shallow-living coral heads serve as natural tide gauges that record ongoing vertical movements. Because corals have annual growth bands (similar to tree rings) it is possible to count growth bands inward from the living coral surface to determine when tectonic or sea level movements occurred and affected coral growth.

Guided by previous coral reef studies, GPS benchmarks are being installed in the Tonga-Fiji-New Hebrides arc system. Annual occupation of these sites will measure contemporary plate motions and vertical and horizontal intra-arc motions. These results will be combined with deformation histories from coral reef studies to understand the relationship of increments of deformation and the tectonic evolution of arc systems.

Recent Publications

Taylor, F.W., R.L. Edwards, G.J. Wasserburg, and C. Frohlich, 1990, Seismic Recurrence Intervals and Timing of Aseismic Subduction Inferred from Emerged Corals and Reefs of the Central New Hebrides (Vanuatu) Island Arc, *Journal of Geophysical Research*, 95(B1), 393-408.

Austin, J.A., F.W. Taylor, and C.D. Cagle, 1989, Seismic Stratigraphy of the Central Tonga Ridge, *Marine and Petroleum Geology*, 6, 71-92.

Edwards, R.L., F.W. Taylor, and G.J. Wasserburg, 1988, Dating Earthquakes with High Precision Thorium-230 Ages of Very Young Corals, *Earth and Planetary Science Letters*, 90, 371–381.

Edwards, R.L., F.W. Taylor, J.H. Chen, and G.J. Wasserburg, 1988, High Precision Thorium-230 Dating of Corals Using Thermal Ionization Mass Spectrometry: Applications to Paleoseismology, *in:* A.J. Crone and E.M. Omdahl, eds., *Directions in Paleoseismology*, U.S. Geological Survey Open File Report 87-673, 30.

Taylor, F.W., C. Frohlich, J. Lecolle, and M. Strecker, 1987, Analysis of Partially Emerged Corals and Reef Terraces in the Central Vanuatu Arc: Comparison of Contemporary Coseismic and Nonseismic with Quaternary Vertical Movements, *Journal of Geophysical Research*, 92, 4905–4933.

Clark R. Wilson

Senior Research Scientist; also Professor and Chairman, Dept. of Geological Sciences. Ph.D., M.S., Scripps Institution of Oceanography, University of California (1975, 1973), B.A., Revelle College, University of California, San Diego (1970).

Geophysics

Geodesy, seismology, upper mantle thermal history, exploration geophysics, geophysical time series.

Research Interests

Polar motion and the length of the day are both causes of changes in the earth's rotation. The National Aeronautics and Space Administration Crustal Dynamics Project has funded this research for several years. The work also involves studies of time variations in the Earth's gravity field due to air and water redistribution, as seen in the orbital anomalies of the geodetic satellites LAGEOS and Starlette. Future work along these lines will utilize satellite-based climatological and sea surface altimetry data to supplement ground-based observations. In addition to these space-geodesy investigations, various NSF and industry-sponsored projects are underway, including studies of mineral zoning in mantle rocks as a clue to upper mantle thermal history, and in methods of quantitative estimation of subsurface properties from seismic data.

Recent Publications

Gutierrez, R., and C. Wilson, 1987, Seasonal Air and Water Mass Redistribution Effects on LAGEOS and Starlette, *Geophysical Research Letters, 14,*(9), 929–932.

Hinnov, L., and C. Wilson, 1987, An Estimate of the Water Storage Contribution to the Excitation of Polar Motion, *Geophysical Journal of the Royal Astronomical Society, 88,* 437–459.

Wilson, C., 1986, The Abel-Fourier Method of Hankel Transformation: Applications to Seismic Data, *Geophysical Prospecting, 34,* 545–568.

Wilson, C., 1985, Discrete Polar Motion Equations, *Geophysical Journal of the Royal Astronomical Society, 80,* 551–554.

UT graduate student Roberto Gutierrez (right) in Terlingua, Texas, measures the elevation of the horizon with a Brunton Compass at the location of a National Geodetic Survey benchmark being inspected by graduate student Young Sun Nam (center), as Professor Yosio Nakamura looks on. This location was examined as a possible site for a Global Positioning System (GPS) survey point to measure tectonic motion in West Texas. A low horizon is required to assure unobstructed reception of the signals broadcast by the GPS satellites. GPS receivers are capable of detecting changes in horizontal positions with an accuracy of 1 centimeter between benchmarks separated by more than 100 kilometers. The level of earthquake activity and evidence of active fault scarps in West Texas suggest that displacements of the order of a centimeter are taking place over periods of several years.

Administrative Staff

Patricia E. Ganey-Curry

Project Coordinator

Special projects and data management; management of data archives; liaison to industry and Industrial Associates program; public relations; industry project coordination. B.S., Texas A&M University (1978).

Eleanor P. Picard

Assistant to the Director

Coordination of all Institute business operations, including personnel, accounting, purchasing, and administrative support services; monitoring, analysis, and forecasting of Institute expenditures; contract and grant administration, including preparation of proposal budgets and coordination with The University's Office of Sponsored Projects, with funding agencies, and with other university groups.

Charles C. Windisch

Technical Coordinator

Coordination of science needs with technical services within the Institute for Geophysics, with outside resources in industry or in the University-National Oceanographic Laboratory System. Development and application of exploration technology to problems in basic research. B.S., Columbia University (1960).

Joint Oceanographic Institutions, Inc.

Joint Oceanographic Institutions, Inc. (JOI), a consortium of ten major U.S. oceanographic institutions including the University of Texas, was established to facilitate the organization and operation of major national and international oceanographic programs. Members of JOI are University of California, Columbia University, University of Hawaii, University of Miami, Oregon State University, University of Rhode Island, Texas A&M University, University of Texas at Austin, University of Washington, and the Woods Hole Oceanographic Institution.

Although now involved in many national oceanographic endeavors, initially, JOI served as the prime contractor to the National Science Foundation for the Ocean Drilling Program (ODP). This program is a successful international scientific venture to explore one of Earth's last frontiers, its ocean basins, where our planet's structure and history are recorded. The global scope and new ideas of this basic research program have sparked world-wide cooperation among scientists and their countries. The program is one of the world's largest studies of our dynamic earth. ODP is sponsored by the U.S. National Science Foundation, the principal funding agency, along with international partners Australia, Canada, the Federal Republic of Germany, France, Japan, the United Kingdom, and the European Science Foundation, a consortium of 12 European countries.

ODP scientific objectives are set by a special committee of JOI known as the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES), an international group of major oceanographic institutions from the sponsoring countries. JOIDES scientists review and approve plans and proposals for drilling. The principal instruments of JOIDES are an Executive Committee and a Planning Committee. The Executive Committee, made up of senior managers of member institutions, provides overall management and policy guidance. Planning Committee members are senior working scientists named to represent their national or institutional research community. The Planning Committee is assisted by a network of advisory panels and working groups. The activities of JOIDES are coordinated by the JOIDES office.

UTIG presently hosts the JOIDES Office. During this period, Arthur Maxwell will serve as Chairman of the JOIDES Executive Committee and James Austin as Chairman of the JOIDES Planning Committee. Many UTIG scientists are actively involved in JOIDES panels and committees and have participated aboard the drill ship *JOIDES Resolution*. In addition, from 1985 to 1989 UTIG hosted the office of the JOI/U.S. Science Advisory Committee (USSAC), co-chaired by Thomas A. Davies. USSAC is the steering committee for the U.S. Science Support Program, a national program of support for U.S. scientists involved in work related to the ODP.

IRIS Data Management Center

The Institute houses the Data Management Center component of IRIS DMS (Data Management System). Incorporated Research Institutions for Seismology (IRIS) is a non-profit corporation formed in 1984 to foster major research efforts in the earth sciences, including development and deployment of a new, permanent global digital seismic network, a portable regional network, and a national seismic data management system. The members of IRIS represent more than 60 universities with interests in seismology, including The University of Texas at Austin. IRIS is funded by the National Science Foundation and has headquarters in Arlington, Virginia. The facility utilizes the resources of both the Institute and the University of Texas System Center for High Performance Computing (CHPC), located at the Balcones Research Center.

IRIS is the first research organization providing routine access to continuous global seismic data. The IRIS system must handle data at a rate that will grow to more than one terabyte a year. The collection process begins at the recording stations, a network of geographically distributed locations where seismograms are recorded on magnetic tape. Before reaching the archives in Austin, Texas, data collection centers at the U.S. Geological Survey's seismology laboratory in Albuquerque, or Scripps Institution of Oceanography, La Jolla, California reformat the seismograms and check data quality. When the data meet specifications set by the centers, the data are sent to the archives in Austin for permanent storage. From there, they can be accessed by IRIS researchers. To study an earthquake, an IRIS user may retrieve several hundred million samples from the IRIS archives. Accessing the archives in Austin and requesting the right data take only a few minutes. Before the DMS systems were developed, it took from several months to years to receive the data.

Timothy K. Ahern
Senior Research Fellow

Sue K. Schoch
Computer Programmer

Becky L. Wofford
Systems Analyst

the IRIS CONSORTIUM

Sources for UTIG Support

Federal Agencies

National Aeronautics and Space Administration (NASA)
National Science Foundation (NSF)
Ocean Drilling Program (TAMU-ODP)
Office of Naval Research (ONR)
National Geophysical Data Center (NGDC)
United States Geological Survey (USGS)

State of Texas

The University of Texas at Austin
Texas Advanced Research Program (TARP)
Texas Advanced Technology Program (TATP)
Texas Low-Level Radioactive Waste Disposal Authority (LLRWDA)
University of Texas Research Institute (UTRI)

Industrial Organizations

AGIP Petroleum
Amerada Hess Corporation
Amoco Production Company
Amoco Production Company, International
Arco International Oil and Gas
British Petroleum Development Limited
C G G
Chevron Oilfield Research Company
Chevron Overseas
Chevron USA, Inc.
Conoco Inc.
Cray Research Inc.
Elf Aquitaine Petroleum
Energy Graphics
Enron Oil and Gas Company
Enserch Exploration
Esso Inter-America
Exxon Company International
Exxon Company, USA
Exxon Production Research Company
Fairfield Industries
GECO Geophysical Co.
Geophysical Services, Inc.
Geosource Marine
Kerr-McGee Corporation
Landmark Graphics
Marathon Oil Company
Mobil Exploration and Producing Services Inc.
Mobil Research and Development Co.
Oil Data
Pecten International Co.
Pennzoil Exploration and Production Co.
Petro Canada
Petrofina Delaware, Inc.
Phillips Petroleum Company
Primary Fuels, Inc.
Santa Fe Energy Operating Partners
Shell Development Company
Shell Offshore, Inc.
Shell Oil Company
Standard Oil Production Company
Sun Exploration and Production Co.
Teledyne Exploration
Tenneco Oil Exploration and Production
Texaco Inc.
Texaco Overseas Holdings Inc.
Texaco USA
TGS Geophysical Co.
Union Exploration Partners, Inc.
Union Texas Petroleum
UNOCAL
ITT Antarctic Services, Inc.

Other Universities

Cornell University
Lamont-Doherty Geological Observatory (LDGO)
Louisiana State University (LSU)
Rice University
University of California at San Diego (UCSD)
University of California at Santa Cruz (UCSC)
Hawaii Institute of Geophysics (HIG)
Texas A&M University (TAMU)
University of Southern Florida (USF)

Other

American Chemical Society (ACS)
Houston Advanced Research Center (HARC)
Incorporated Research Institutions for Seismology (IRIS)
Instituto Nacional de Electrificacion—Guatemala (INDE)
Joint Oceanographic Institutions, Inc. (JOI)
National Geographic Society (NGS)
Petroleum Research Fund (PRF)

Sponsored Projects

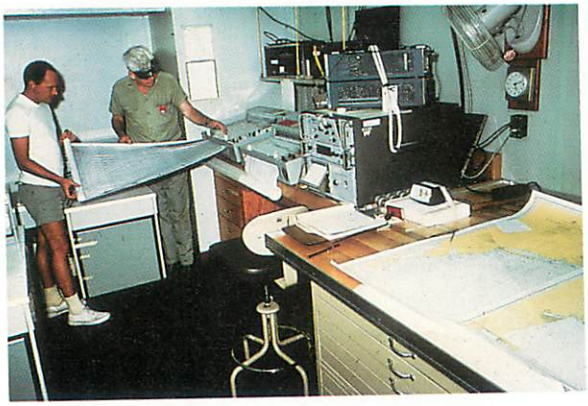
September 1985 through May 1990

Sponsor	*Investigator*	*Project Title*
ONR	Austin	Crustal Structure and Evolution of South Atlantic Passive Continental Margins
NSF	Austin	Multichannel Seismic Reflection Study of the Ocean–Continent Crustal Transition Southeast of the Grand Banks
JOI	Austin	Ocean Drilling Program Leg 101
JOI	Austin	JOIDES Atlantic Regional Panel
JOI	Austin	Workshop to Develop Scientific Drilling Initiatives in the South Atlantic and Adjacent Ocean
ONR/WHOI	Austin	Three–Dimensional Huntec Survey of the Hudson Fan
ONR	Austin	A 3–D Huntec Survey of the New Jersey Shelf
Industry	Behrens	Continental Margin Seismic Stratigraphy and Sedimentation in a Framework of Complex Salt Tectonics
Industry	Buffler	Basement of the Gulf of Mexico
ACS	Buffler	Seismic Stratigraphy and Depositional History of the Mississippi Fan Complex, Northern Gulf of Mexico
Industry	Buffler	Seismic Stratigraphy of the Mississippi Canyon Area
Industry	Buffler	Gulf of Mexico Stratigraphic and Structural Synthesis
TARP	Buffler	Seismic Stratigraphy and Geologic History of the Gulf of Mexico Basin
ODP	Buffler	Evolution of the Exmouth Plateau Argo Abyssal Plain off Northwest Australia—ODP Leg 123
ACS	Buffler	Late Cenozoic Basin Development and Tectonics of the Western Panama Pacific Margin
TAMU	Buffler	Seismic Stratigraphy and Regional Tectonics of the ARGO Abyssal Plain/Exmouth Plateau Region off NW Australia
NSF	Dalziel	Workshop on the Antarctic Lithosphere
NSF	Dalziel	Tectonic Development of West Antarctica and its Relation to East Antarctica
NSF	Dalziel, Austin, Stoffa	Multichannel Seismic Study of the Deep Structure of a Cordilleran Orogen: the Southernmost Andes
NSF	Dalziel	Kinematic Evolution of the Scotia Ridge, Antarctica: A Study of Orogenic Processes at Convergent Plate Margins
NSF	Dalziel	28th International Geological Congress: Field Trip on the Tectonics of the Scotia Arc
NSF	Dalziel	Tectonic Evolution of the Antarctic Sector of the Pacific Margin: Mesozoic and Paleozoic Development of Marie Byrd Land
JOI	Dalziel	JOIDES Tectonics Panel
NSF	Dalziel	Workshop to Prepare a Detailed Plan for United States Participation in Antarctica Geoscience Transects
JOI	Davies	Operation of the JOI U.S. Science Support Program Coordinating Office
NSF	Frohlich, Tajima	Systematic Study of Aftershocks and Source Rupture Process of Deep Earthquakes
NSF	Frohlich	Evaluation of Spatial and Temporal Clustering in Earthquake Catalogs
ACS	Frohlich	Rheological Constraints on Fault Behavior from Numerical Modeling Using Seismicity, Creep and Pore Fluid Observations
NSF	Frohlich, Nakamura	Ocean Bottom Seismograph Study of the Structure and Dynamics of D'Entrecasteaux Ridge Subduction
NSF	Garmany	A Study of P to S Conversions at the Moho

NSF	Garmany	Asymptotic Methods in Anisotropic Wave Propagation
NSF	Garmany, Frohlich	Short Period Analysis of Mantle Reflection and Deep Earthquake Sources
Various	Garmany, Nakamura	Ocean Bottom Seismometer Upgrade Project
Conoco	Garmany, Nakamura	Field Test of Seafloor Seismograph Response
Cray Research	Garmany	Generalized Reflectivity Methods for Laterally Heterogeneous Anisotropic Media
NSF	Gose	A Paleomagnetic Study of Cretaceous Sedimentary Rocks in Venezuela
ACS	Gose	Paleomagnetic Investigations of Salt Dome Growth Rates
ITT/ANS	Griffiths	Engineering Support Onboard the R/V *Polar Duke*
NSF	Lawver	Marine Heat Flow Around West Antarctica
ODP	Lawver	Tectonic Evolution of the Weddell Sea Region–ODP Leg 113
Industry	Mann	Stratigraphy and Structure of the Jurassic Passive Margin in Cuba
NGS	Mann	Geologic Studies on the Caribbean–Nazca Plate Boundary in Panama
Industry	Mann	1:100,000 Geologic Compilation Map of the Southern Dominican Republic with Accompanying Stratigraphic Atlas
Industry	Mann	Data Integration–Enriquillo–Azua Basin, Dominican Republic
ACS	Mann	Paleozoic Clastic Sediment Dispersal
NSF	Mann, Rosencrantz	SeaMARC II and Seismic Reflection Study of Strike–Slip Tectonics along the NW Margin of the Caribbean Plate
PRF	Mann	Paleogene Clastic Sediment Dispersal and Basin Development within the Greater Antilles–Bahama Platform Collision Zone
NSF	Mann, Taylor	Quaternary Vertical Movements within a Strike–Slip Restraining Bend: A Geologic and Isotopic Dating Study of Emerged Coral Reefs in Hispaniola
INDE	Matsumoto	Seismic Study in the Vicinity of Pueblo Viejo–Quixal Hydroelectric Project
NSF	Maxwell	Ship Operations Support
Industry	Nakamura	Gulf of Mexico Seismic Refraction Study
UTRI	Nakamura	Seismological Study of the Asperity of the South Hebrides
NASA	Nakamura	Meteoroid Environment Near the Earth–Moon System
LSU	Nakamura	Participation in Offshore Louisiana Seismic Survey
Rice U.	Nakamura	EDGE Program Gulf of Alaska Seismic Survey
Industry	Nakamura	Direct Observation of Converted Shear Waves Using Ocean Bottom Seismographs
OSU	Nakamura	Offshore Oregon Seismic Survey
TX LLRWDA	Phillips	Feasibility Study of High Resolution Seismic Methods for Low–Level Radioactive Waste Disposal Site Evaluation: Hudspeth County, Texas
NSF	Phillips	Seaward Dipping Reflectors off Norway: VSP Experiment Leg 104: Site 642 Data Processing and Interpretation
ODP	Phillips	Oceanic Crust Studies of Costa Rica Rift–Site 504B–ODP Leg 111: Vertical Seismic Profile, Data Acquisition
JOI	Phillips	Vertical Seismic Profile Experiment LIS to SEG–Y Format Conversion of Field Data Tapes ODP Leg 111
NSF	Phillips	Vertical Seismic Profile (VSP) Experiment on ODP Leg 111, Site 504B–Data Processing and Analysis
TATP	Phillips	Determination of Rock Properties from Wide–Aperture Seismic Profiles: Proposed Low–Level Radioactive Waste Disposal Site in Texas
NSF	Riedesel	Studies of Earthquake Source Properties Using Low–Frequency Seismic Waves
ONR	Riedesel	Sensor Evaluation and Comparison Tests for a New Generation of Ocean Bottom Seismographs
UCSD	Riedesel	Ocean Bottom Seismometer Recovery Operations on Leg 3 of the Tortuga Expedition
IRIS	Riedesel, Tajima	Data Management System for the IRIS Mass Storage Facility
NSF	Frohlich, Riedesel, Garmany	What Causes Non–Double–Couple Earthquake Sources in the Mantle
LDGO	Rosencrantz	Synthesis of Multichannel Seismic Reflection Data from the Venezuelan and Colombian Basins, Caribbean Sea

Rice U.	Rosencrantz	Periplatform Sediments and Environments in the Deep Surroundings of Carbonate Banks on the Tectonically Active Nicaragua Rise
Industry	Rosencrantz, Salvador	Investigations on the Geology of Cuba, Central and Western Cuba
USF	Rosencrantz	Processing of High Resolution Seismic Reflection Data from Carbonate Platforms of the Nicaragua Rise
LDGO	Sclater	Predrilling Site Surveys in the Central Indian Ocean and the Ninety–East Ridge
NSF	Sclater	Compilation of Topographic, Magnetic and Altimetric Data and Plate Reconstruction in the Indian and Southern Oceans
TARP	Sclater	The Thermal Structure Around Salt Diapirs on the Continental Slope off the Texas Gulf Coast
Industry	Sclater, Lawver	Paleoceanographic Mapping Project
NSF	Sclater	Compilations of Topographic, Magnetic, Deflection–of–the–Vertical, and Satellite Derived Gravity Field Data and Plate Reconstructions: The Indian and Contiguous Southern Oceans
NASA	Sclater, Tajima, Lawver	A Seismo–Tectonic and Seismic Slip Characterization of the Ocean–Continent Transition in the Region of the Gulf of California
ONR	Shipley	Development of Seismic Facies Analysis Techniques for Prediction of Lithofacies, Sedimentary Processes and Chronostratigraphic Datum in the Deep–Sea Environment
NSF	Shipley	SeaMARC II and Seismic Reflection Study of the Panama–Costa Rica Collision Zone.
NSF	Shipley	Cretaceous Volcanic Sequence Jurassic Crust in the Western Pacific: A Seismic Reflection Study
NSF	Shipley	Detailed Investigation of Subduction Processes in the Middle America Trench
NSF	Shipley, Stoffa	Japan–United States Cooperative Study of the Relationship between Sediment Physical Properties and Subduction
NSF	Shipley, Stoffa	Three–Dimensional Seismic Imaging of an Accretionary Wedge: Costa Rica
ODP	Stoffa	ODP Underway Navigation
Cray Research	Stoffa	Frequency–Wave Number Synthetic Seismogram Generation in Laterally Heterogeneous Media
Cray Research	Stoffa	3–D Seismic Modelling using the Split–Step Fourier Method
Cray Research	Stoffa	Angle of Incidence Pre–Stack Direct Depth Migration
NSF	Stoffa, Phillips	Vertical Seismic Profiles (VSP) Experiment Leg 104: Site 642 Data Acquisition
NSF	Stoffa, Sawyer, Phillips, Austin	A Deep Penetration Reflection Seismic Study at the Junction of the Blake Plate Basin, Carolina Trough, and Southeast Georgia Embayment
Cray Research	Stoffa	Interactive Pre–Stack Direct Depth Migration Velocity Analysis
TARP	Stoffa, Garmany	Nonlinear Elastic Inversion for the Background P–Wave and S–Wave Velocities
ACS	Stoffa	Non–Linear Inversion of Seismic Reflection Data for the Background P & S
Cray Research	Stoffa	Plane Wave Split–Step Fourier Migration and Velocity Analysis
NSF	Stoffa, Shipley	Inversion of Nankai Trough High Resolution Two–Ship Profile
HARC	Stoffa	Develop and Evaluate Seismic Processing Algorithms
Landmark Graphics	Stoffa	3D Subsurface Model Definition University Partnership Grant Program and Seismic Modelling Using an Interactive Seismic Workstation.
NSF	Tajima	Comparative Study of Seismic Rupture Modes
NSF	Tajima	Study of Anomalous Wavetrain Associated with Long–Period Spheroidal Mode Overtones
NSF	Tajima	Variation of Source Processes in a Subduction Zone: Possible Reactivation of a Decoupled Fault Zone
NSF	Tajima	Effects of Anisotropy Observed from Surface Waves
NSF	Taylor	Monitoring Crustal Motion in the Southwest Pacific Using the Global Positioning System (GPS)
NSF	Taylor, Tajima	Seismic Ruptures and Coseismic Vertical Deformation from Lifting Reef Corals
Cornell U.	Taylor	Collecting and Drilling Emerged Coral Reefs on the Huon Peninsula, Papua, New Guinea
NSF	Taylor	Paleoseismic Histories of Southwest Pacific Plate Boundaries from Precise Mass Spectrometry

Educational Programs



Students perform a variety of research tasks during a training cruise on the R/V Fred H. Moore.

While all of the work of the Institute is directed toward research, graduate student training is an important component of these activities. The Institute itself does not award degrees or offer formal classes for academic credit; rather the Institute maintains close relationships with the Department of Geological Sciences and the Department of Marine Science. These academic departments conduct teaching activities and award advanced degrees. The Institute maintains its affiliation with these departments through cooperative programs and joint faculty appointments. Approximately one third of the research staff hold joint appointments in the Institute and the Department of Geological Sciences or the Department of Marine Science. Many geophysics graduate students at UT and other universities take advantage of the opportunity to work with the staff and the facilities of the Institute.

Students participate in a variety of research projects, including:

- development and application of new approaches to the acquisition, processing, and interpretation of seismic reflection and other geophysical data;
- application of geophysical data to problems in stratigraphy and structure;
- exploration geophysics, instrumentation design, multichannel seismic data acquisition, processing, and modeling;
- worldwide seismic reflection and refraction field studies;
- global seismology, seismicity, seismotectonics, and earthquake hazard;
- earthquake seismology, earthquakes associated with reservoir impounding, fluid injection, and other man-made phenomena;
- nature of the earthquake source, intermediate depth, and deep focus earthquakes;
- ocean bottom seismometer instrumentation, operation, and data analysis;
- plate tectonics, paleomagnetism, worldwide paleogeographic and paleodepth reconstruction;
- heat flow, subsidence, deposition, and tectonic history of continental basins and shelves;
- Arctic and Antarctic basin studies;
- crustal strain measurements from satellite geodesy;
- studies of the earth's gravity field and geoid anomalies from satellite observation;
- theoretical seismology;
- neotectonic studies/contemporary crustal motion;
- biotectonics and biomechanics;
- underwater acoustics; and
- extraterrestrial seismology.

The Palisades Geophysical Institute has established the Maurice Ewing and J. Lamar Worzel Graduate Student Fellowship Program in Geophysics at UTIG. The fellowships are named after the late Maurice Ewing, renowned oceanographer and founder of the Institute for Geophysics, and J. Lamar Worzel, long-time colleague of Ewing, Director of the Marine Science Institute Geophysical Laboratory at Galveston from 1975 through 1979 and current president of the Palisades Geophysical Institute. It is a privilege to be the recipient of this educational tribute to Ewing and Worzel, both of whom made extraordinary pioneering contributions to solid earth and marine geophysics. Four or five students receive full fellowships under this program each semester.

Research Assistantships are awarded each semester by the University departments and the Institute for Geophysics. Applicants having special interests or qualifications for a research assistantship should contact an appropriate member of the faculty directly or notify the Graduate Advisor when applying for financial aid. Research Assistantships carry a stipend equivalent to a teaching assistantship.

Fellowships supported by NSF, The University of Texas, and several industries are awarded each year.

How to Apply

Inquiries about fellowships, scholarships, and assistantships should be addressed to:

Chairman, Fellowship Committee
Institute for Geophysics
The University of Texas at Austin
8701 North Mopac Blvd.
Austin, Texas 78759

or:

Graduate Office
Department of Geological Sciences
The University of Texas at Austin
Austin, Texas 78712

or:

Graduate Office
Department of Marine Science
The University of Texas at Austin
P.O. Box 296
Port Aransas, Texas 78373

Student Cruise Program

The Institute operates a student training program with one or more cruises per year. Since the program began in 1982 the Institute has conducted 14 student cruises. Both graduate and undergraduate students get hands-on experience in marine multichannel seismic data acquisition, coring, refraction, instrumentation, and biological sampling. Most students take the cruises for elective credit in Marine Science or Geology. In the photo above, student training cruise participants on the R/V *Fred H. Moore* return to port.

Student Interests

The theses and dissertations listed below include UTIG data and/or were completed under the supervision of UTIG research staff:

Adamek, Scott Harper: Earthquake Studies in the Panama-Costa Rica Region. MA, The University of Texas at Austin, 1986.

Albertin, Martin L.: Interpretations and Analysis of Guaymas Basin Multi-Channel Seismic Reflection Profiles: Implications for Tectonic History. MA, The University of Texas at Austin, 1988.

Angstadt, David M.: Late Cretaceous, Recent Stratigraphic and Geologic History of Southeastern Gulf of Mexico. MA, The University of Texas at Austin, 1983.

Babalola, Olufemi O.: Seismic Stratigraphic Analysis and Tectono-Depositional Evolution of the Unimbricated Ellesmerian Sequence (Mississippian to Lower Cretaceous), National Petroleum Reserve, North Slope, Alaska. MA, The University of Texas at Austin, 1984.

Bertagne, Allen John: Seismic Stratigraphic Investigations—Western Gulf of Mexico. MA, The University of Texas at Austin, 1980.

Boerner, Sean: Experimental Investigation of Packed Spheres under Extension: Application to Sand Box Experiments. MA, The University of Texas at Austin, 1989.

Bowland, Christopher Lee: Seismic Stratigraphy and Structure of the Colombian Basin, Caribbean Sea. MA, The University of Texas at Austin, 1984.

Burbach, George VanNess: Intermediate and Deep Seismicity and Lateral Structure of Subducted Lithosphere in the Circum-Pacific Region. PhD, The University of Texas at Austin, 1985.

Cagle, Clinton D.: Seismic Stratigraphy of the Central Tonga Arc, SW Pacific. MA, The University of Texas at Austin, 1986.

Castagna, John Patrick: Methods for the Analysis of Sonic Log Waveforms. PhD, The University of Texas at Austin, 1983.

Cedraro, Rodulfo Prieto: Seismic Stratigraphy and Depositional Systems of the Platform Area, Northeastern Venezuela. PhD, The University of Texas at Austin, 1987.

Coltrin, Donald George, Jr.: Seismic Reflection Imaging Problems Resulting from a Rough Surface at the Top of the Accretionary Prism at Convergent Margins. MA, The University of Texas at Austin, 1987.

Corrigan, Jeffrey Delon: Geology of the Burica Peninsula, Panama-Costa Rica: Neotectonic Implications for the Southern Middle America Convergent Margin. MA, The University of Texas at Austin, 1986.

Corso, William: Development of the Early Cretaceous Northwest Florida Carbonate Platform. PhD, The University of Texas at Austin, 1987.

Davis, Scott Daniel: Investigations of Natural and Induced Seismicity in the Texas Panhandle. MA, The University of Texas at Austin, 1985.

Davis, Scott Daniel: Investigations Concerning the Nature of Earthquake Aftershocks and Earthquakes Induced by Fluid Injection. PhD, The University of Texas at Austin, 1989.

de Zoeten, Ruurdjan: Structure and Stratigraphy of the Central Cordillera Septentrional, Dominican Republic. MA, The University of Texas at Austin, 1988.

Dobbs, Steven Lawrence: Linearized Inversion of Plane Wave Seismograms. MA, The University of Texas at Austin, 1987.

Dumas, David Byron: Seismic Structure Around Salt Dome Formations. MA, Rice University, 1975.

Dumas, David Byron: Seismicity of West Texas. PhD, The University of Texas at Dallas, 1981.

Dunbar, John A.: Kinematics and Dynamics of Continental Breakup. PhD, The University of Texas at Austin, 1988.

Ebeniro, Joseph O.: Structure and Crustal Type of the Northwestern Gulf of Mexico Derived from Very Large Offset Seismic Data. PhD, The University of Texas at Austin, 1986.

Ebeniro, Joseph O.: Surface Wave Studies in the Gulf Coast Area. MA, The University of Texas at Austin, 1981.

Esguerra, Orlando Forero: Eocene of Northwestern South America. MS, University of Tulsa, 1974.

Farrelly, John James: Depositional Setting and the Evolution of the Pliocene-Basal Pleistocene Section of Southeast Trinidad, West Indies. MA, The University of Texas at Austin, 1987.

Faust, Michael Jess: Seismic Stratigraphy of the Middle Cretaceous Unconformity (MCU) in the Central Gulf of Mexico Basin. MA, The University of Texas at Austin, 1984.

Feely, Mary H.: Seismic Stratigraphic Analysis of the Mississippi Fan. PhD, Texas A&M University, 1984.

Finn, Christopher Jude: Estimation of Three-Dimensional Dip and Curvature from Reflection Seismic Data. MA, The University of Texas at Austin, 1986.

Gahagan, Lisa Marie: Mapping of Tectonic Features in the Ocean Basins from Satellite Altimetry Data. MA, The University of Texas at Austin, 1988.

Gamboa, Luis A.: Marine Geology of the Brazilian Continental Margin and Adjacent Oceanic Basin Between the Latitudes of 23° and 37°S. PhD, Columbia University, 1981.

Giltner, John Patrick: Application of Extensional Models to the Northern Viking Graben, North Sea. MA, The University of Texas at Austin, 1987.

Greene, Jeremy Theodore: Reflection Enhancement of Bubble Pulse and Scattered Noise Attenuation in the North Atlantic Transect Multichannel Data Set, Nares Basin. MA, The University of Texas at Austin, 1983.

Guzman, Marco S.: The Triple Junction of the North America, Cocos and Caribbean Plates. MA, The University of Texas at Austin, 1985.

Heubeck, Christoph: Geology of the Southeastern Termination of the Cordillera Central, South Central Hispaniola, Dominican Republic. MA, The University of Texas at Austin, 1988.

Horvath, Peter: Analysis of Lunar Seismic Signals—Determination of Instrumental Parameters and Seismic Velocity Distributions. PhD, The University of Texas at Dallas, 1979.

Huerta, Raul: Seismic Stratigraphic and Structural Analysis of Northeast Campeche Escarpment. MA, The University of Texas at Austin, 1980.

Huston, Daniel Cliff: Interpretation of Seismic Signal and Noise through Line Intersection MIS-TIE Analysis. MA, The University of Texas at Austin, 1987.

Ingram, Gregory Dean: Some Approaches to the Analysis and Interpretation of Wide-Angle Bottom Loss Data. MA, The University of Texas at Austin, 1981.

Kautz, Steven Arthur: The Importance of Cryptic Extension in Scale Models of Normal Faulting. MA, The University of Texas at Austin, 1987.

Kim, Woo Han: Gaussian Beam Synthetic Body Wave Seismograms Using IPGT Method with Optimum Beamwidths. The University of Texas at Austin, 1987 (?).

Laguros, George Andrew: Seismic Stratigraphic Analysis of Sedimentation Processes in Pelagic Carbonate Sequences of the Equatorial Pacific: Deep Sea Drilling Project 574. MA, The University of Texas at Austin, 1987.

Lawton, Jeffrey Louis: Earthquake Activity at the Kodiak Continental Shelf, Alaska, Determined by Land and Ocean Bottom Seismograph Networks. MA, The University of Texas at Austin, 1982.

Liaw, Hong Bing: Seismic Velocity Modeling from an Ensemble of Earthquakes. PhD, The University of Texas at Dallas, 1981.

Lin, Tung-Hung Thomas: Seismic Stratigraphy and Structure of the Sigsbee Salt Basin, South-Central Gulf of Mexico. MA, The University of Texas at Austin, 1984.

Long, John Michael: Seismic Stratigraphy of Part of the Campeche Escarpment, Southern Gulf of Mexico. MA, The University of Texas at Austin, 1978.

Lord, Jacques Passerat: Seismic Stratigraphic Investigation of the Deep Eastern Gulf of Mexico. MS, Rice University, 1986.

Mayes, Catherine Lynn: Tectonic History and New Isochron Chart of the South Pacific. MA, The University of Texas at Austin, 1988.

Meador, Karen J.: Geologic Evolution of the Northern Newfoundland Basin. MA, The University of Texas at Austin, 1988.

Musgrove, Lee: Geophysical Investigation of the Southern Angola Basin, Southeast Atlantic Ocean. MA, The University of Texas at Austin, 1982.

Newman, Jerry Savrda: Site Surveys of the Central and Southern Ninetyeast Ridge for the Ocean Drilling Program, Leg 121. MA, The University of Texas at Austin, 1987.

Nwaochei, Ben Nnaemeka: Geophysical Investigations of the Nicaraguan Rise. PhD, Rutgers University, 1980.

Oberst, Peter Jürgen: Meteoroids near the Earth-Moon System as Inferred from Temporal and Spatial Distribution of Impacts Detected by the Lunar Seismic Network. PhD, The University of Texas at Austin, 1989.

Oldham, David Martin: F-K Migration of Multichannel Seismic Data from the Yucatan Basin, Caribbean Sea. MS, Texas A&M University, 1987.

Onstott, Gregory Erle: Processing and Display of Offset Dependent Reflectivity in Reflection Seismograms. MA, The University of Texas at Austin, 1984.

Pew, Elliott: Seismic Structural Analysis of Deformation in the Southern Mexican Ridges. MA, The University of Texas at Austin, 1982.

Phair, Ronald L.: Seismic Stratigraphy of the Lower Cretaceous Rocks of the Southwestern Straits of Florida, Southeastern Gulf of Mexico. MA, The University of Texas at Austin, 1984.

Renkin, Miriam L.: Age, Depth, and Residual Depth Anomalies in the North Pacific: Implications for the Thermal Models of the Lithosphere and Upper Mantle. MA, The University of Texas at Austin, 1986.

Rosenthal, David Bruce: Distribution of Crust in the Deep Eastern Gulf of Mexico. MA, The University of Texas at Austin, 1987.

Ross, Malcolm Ingham: Maganom. A Computer Program for the Modeling and Interpretation of Marine Magnetic Anomalies. MA, The University of Texas at Austin, 1987.

Sanchez-Barreda, Luis Antonio: Geologic Evolution of the Continental Margin of the Gulf of Tehuantepec in Southern Mexico. PhD, The University of Texas at Austin, 1981.

Seekatz, Jeffrey Guy: Stratigraphic and Structural Features of Part of the Sigsbee Escarpment. MA, The University of Texas at Austin, 1977.

Shih, Tai-Chang: Marine Magnetic Anomalies from the Western Northern Philippine Sea. PhD, The University of Texas at Austin, 1978.

Shorey, Mark David: Estimates of Extension in the North Sea Central Graben from Analysis of High Quality Seismic Data. MA, The University of Texas at Austin, 1987.

Sicking, C. J.: Sampling Requirements for Reflection Seismograms in Geophysical Data Acquisition. PhD, The University of Texas at Austin, 1980.

Simmons, James Layton, Jr.: Traveltime Inversion for a 3-D Near Surface Velocity Model. MA, The University of Texas at Austin, 1987.

Stark, Tracey Joseph: Information Extraction from Deep Water Seismic Reflection Data: LASE Line 2. PhD, The University of Texas at Austin, 1986.

Testarmata, Margaret M.: Magnetostratigraphy of Eocene-Oligocene Vieja Group. Trans-Pecos Texas. MA, The University of Texas at Austin, 1978.

Treadgold, Galen Edward: Modelling and Interpretation of the Oceanic Crustal Structure North of the Puerto Rico Trench. MA, The University of Texas at Austin, 1985.

Tsai, Ching-Chang James: Limitation of Marine Seismic Profiling for Deep Crustal Reflections and Reduction of Water Bottom Multiples and Scattered Noise from the Rough Basaltic Basement. PhD, The University of Texas at Austin, 1981.

Underwood, Michael B.: Franciscan and Related Rocks of Southern Humboldt County, Northern California Coast Ranges. PhD, Cornell University, 1984.

Usmani, Tariq U.: Seismic Stratigraphic Analysis of the Southwestern Abyssal Gulf of Mexico. MS, University of Houston, 1980.

Walters, Robert Derek: Seismic Stratigraphy and Salt Tectonics of Plio-Pleistocene Deposits, Continental Slope and Upper Mississippi Fan, Northern Gulf of Mexico. MA, The University of Texas at Austin, 1985.

Weimer, Paul: Depositional Processes and Evolution of the Mississippi Fan. PhD, The University of Texas at Austin, 1989.

Winker, Charles David: Late Pleistocene Fluvial–Deltaic Deposition Texas Coastal Plain and Shelf. MA, The University of Texas at Austin, 1979.

Wood, Becky Leigh: Development of a Structural Framework from Seismic Reflection Data. MA, The University of Texas at Austin, 1988.

Wood, Warren Theodore: One and Two Dimensional Seismic Velocity Inversion in the Domain of Intercept Time and Ray Parameter: An Example in the Nankai Trough. MA, The University of Texas at Austin, 1989.

Zemlicka, George: Source Process Study with the Inclusion of the Effects of Near-Source Bathymetric Structure for Submarine Events in the Gulf of California. MA, The University of Texas at Austin, 1988.

Support Staff

Gerald J. Billish
Geophysical Field Technician III

M. Judeene Blankenship
Administrative Assistant

Larry A. Cook
Library Assistant III

Donald F. Dean
Research Scientist Associate II

Ona Del Vento
Accountant II

Lisa M. Gahagan
Research Scientist Associate II

Judith A. Haller
Administrative Associate

Ann H. Jessen
Administrative Assistant

Denise S. Kakas
Research Scientist Assistant

Angelina L. Kennedy
Senior Administrative Associate

Wayne L. Lloyd
Drafting Technician IV

Deborah Lyle-Dysart
Administrative Assistant

Brenda R. Meng
Senior Procurement Officer

Toni L. Mitchell
Administrative Assistant

Kathryn A. Moser
Administrative Associate

Charlene W. Palmer
Administrative Assistant

Anita S. Rodriguez
Accountant I

Phillip H. Roper
Geophysical Field Technician III

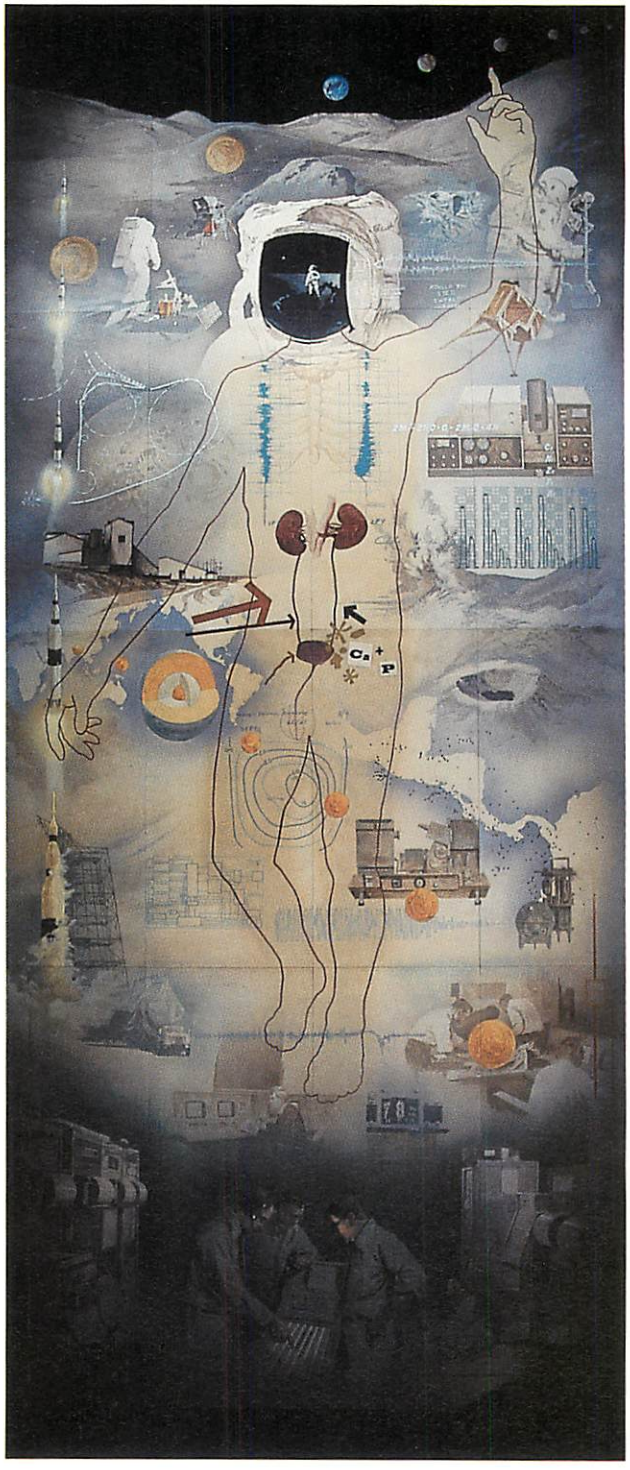
Leroy B. Rudder, Jr. (Retired)
Senior Procurement Officer

Steffen Saustrup
Research Scientist Assistant

Raul D. Serenil
Supv., Data Processing

Mark Wiederspahn
Senior Systems Analyst

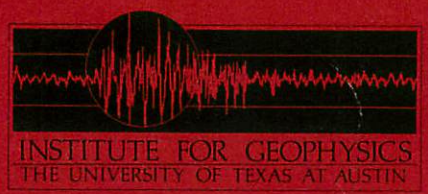
Max Woyke
Stores Clerk II



A grant awarded by the Doherty Foundation and matched by the Board of Regents of the University of Texas System provided a pair of monumental murals for display in the atrium of Maurice Ewing Hall in Galveston. The murals represent man and his environment from ocean depths to outer space. The murals were designed to commemorate the achievements in oceanographic sciences and space sciences of Dr. Maurice Ewing and his associates.

Publication design and coordination by Patricia E. Ganey-Curry and Judith A. Haller. Photo editorial assistance by Denise S. Kakas.

This publication was printed with private funds.



U T I G

Institute for Geophysics
The University of Texas at Austin
8701 North Mopac Blvd.
Austin, Texas 78759-8345

(512) 471-6156