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Middle East Tectonics: Applications of Geographic Information Systems (GIS)

*Dogan Seber, Marisa Vallvé,
Eric Sandvol, David Steer,
Muawia Barazangi*
Institute for the Study of the Continents,
Cornell University, Snee Hall,
Ithaca, NY 14853-1504,
E-mail: seber@geology.cornell.edu

ABSTRACT

The Middle East region incorporates all known types of major plate boundaries in its territory as well as significant active intraplate deformation. Until recently, understanding the tectonics in this complex region has been hindered by a relative lack of data and the complexity of the geologic and tectonic problems. Even with the increase in the amount of data in the past decade or so, the complexities of the region require a multidisciplinary approach to understand the geology and tectonics. In order to handle large, multidisciplinary data sets with varying quality and resolution, we have adopted a Geographic Information System (GIS) approach for construction of a multipurpose database to look at these problems in a comprehensive and unconventional way. Here, we present new compilation maps of surficial tectonic features and depth to the Moho for the Middle East, and describe a cross-section tool to work with data in a GIS format. These maps are available at our web site at <http://atlas.geo.cornell.edu>.

INTRODUCTION

At present, the earth sciences are undergoing a revolution. Evidence comes from collection to analysis of data, interpretation, and publication. Classical approaches are being increasingly supplemented by digital techniques, i.e., analog maps by digital counterparts, air photos by high-resolution satellite imagery, hand-collection of field data by GPS receivers and laptop computers, simple modeling by computer using sophisticated software, and electronic publication of results. This development is an inevitable outcome of modern technology. However, this technological revolution is not without problems. Already, somewhat chaoti-

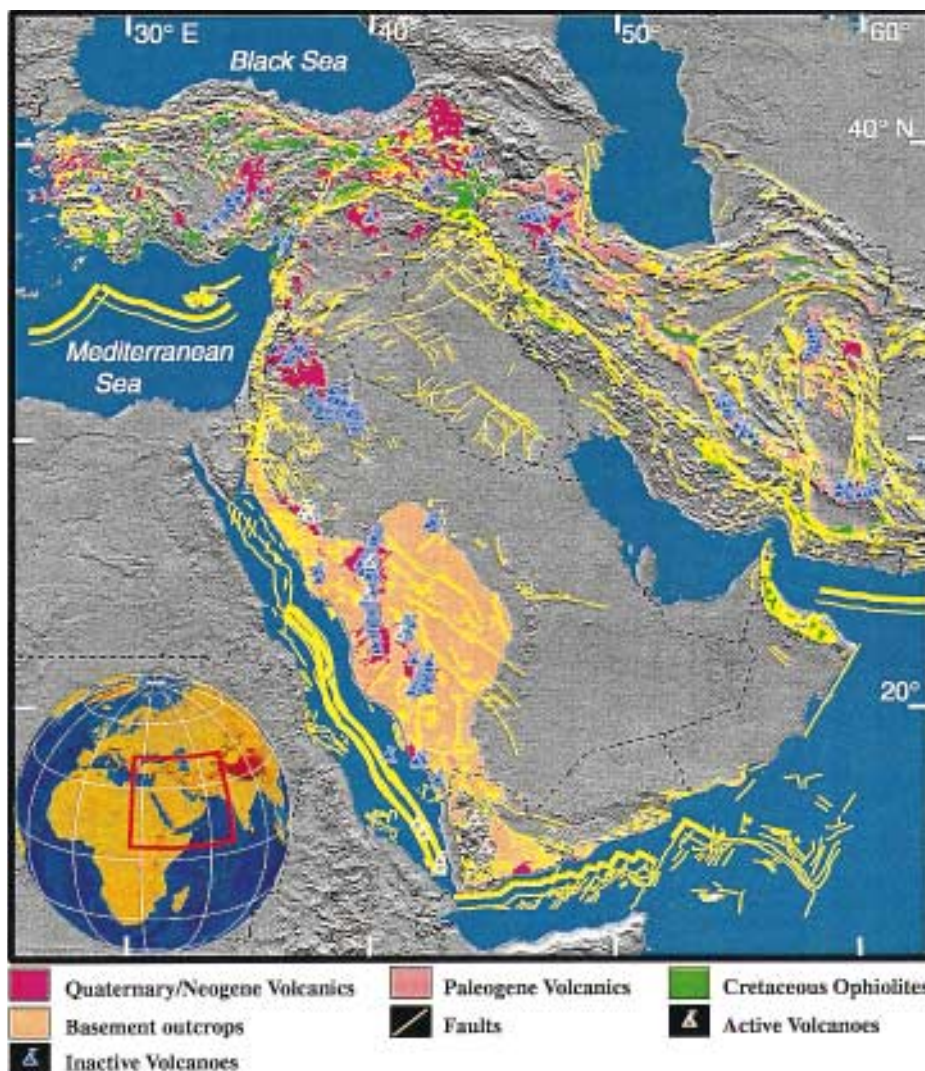


Figure 1. New map of the Middle East region showing locations of oceanic trenches, rift zones and major faults (thick yellow lines; see names in Figure 2), secondary faults, ophiolites, regions of basement outcrop, and principal areas of volcanism. This map is compiled from GIS data set that includes tectonic and geologic maps of various scales from the different countries in the region. See Figure 2 for tectonic interpretation. The gray background image is the shaded topographic relief map, illuminated from the north (shown in more detail in Figure 3). A clear correlation between topographic features and faults suggests that most of the faults shown on the map are still active.

cally organized databases are appearing in the digital world owing to problems like data accessibility and formats. Geographic Information Systems (GIS) provide a means to eliminate these problems and to keep data in an organized and centralized system (see also Walker et al., 1996). Struc-

tured properly, well-engineered databases are easy to use, update, modify, manage, distribute, and exchange.

One of the common misconceptions about GIS database development is that it

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In Memoriam

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is primarily a mapping tool. Although the output is commonly in map form, the main use of GIS is to analyze, search, manipulate, and select databases for a specific purpose. The use of GIS systems opens new avenues for comprehensive studies and solving complex problems related to integrated and dynamic earth systems. Earth sciences, by their very nature, are among the most suitable disciplines for GIS applications.

BUILDING A COMPREHENSIVE DATABASE FOR THE MIDDLE EAST

In this paper, we apply GIS technology to regional-scale tectonic problems of the Middle East. To do this, we are developing a comprehensive database at a resolution of 1:1,000,000 scale which can be used as both a scientific and educational tool. Developing such a database system for multiple users is most advantageous, if easy-to-use tools for accessing and manipulating data sets are built into the system so that scientists can use

the database in innovative ways to make research advances. The principal reasons for constructing this database in the Middle East are to help in the monitoring and verification of the recently signed global Comprehensive Test Ban Treaty (CTBT) (see Barazangi et al., 1996) and to study the complex tectonic and geologic problems of the region. This database will also have an impact in natural hazard evaluation, particularly in understanding the earthquake occurrences in the region and seismic risk assessment. The data set can also be used in classrooms as an educational tool.

GIS Data and an Improved Middle East Tectonic Map

A tectonic map made from our GIS data set showing the major plate boundaries and surface features of the Middle East is shown in Figure 1. The background for the map is a high-resolution (~90 m) digital topographic map of the Middle East obtained from the Defense Mapping Agency (DMA). Information on the map includes locations of trenches, rifts, secondary faults, volcanic rock and ophiolite distributions, basement outcrops, and basins. The features have been compiled from regional tectonic and geologic maps among which the most important are the Geological Survey of Iran *Seismotectonic Map of the Middle East*, the Syrian Arab Republic Ministry of Petroleum and Mineral Resources *Geologic Map of Syria*, and the General Directorate of Mineral Research and Exploration of Turkey *Active Fault Map of Turkey*. In the GIS database, geologic features on the maps have all been assigned attributes defining their properties.

Using the Middle East GIS data system, one can display any set of data needed for a particular study. For example, faults longer or shorter than any given length can be selected, or active faults and volcanoes can be displayed. High-resolution satellite imagery and field geology data can be incorporated in the database system for special studies such as the effects of erosion on topography. Among important problems for study in the Middle East are reasons for volcanic activity in both tectonically active and platformlike environments, for the complex patterns of seismicity, and for variations in crustal structure.

The map shown in Figure 2 has been modified from previous versions through the use of our GIS database. Particularly important in this modification was the use of the high-resolution (~90 m) digital topographic map shown in the background of Figure 1 and in Figure 3. Digital Elevation Models (DEMs) like this provide highly accurate elevation information that can be used as a guide in defining boundaries of tectonic units, especially those related to young (i.e., Quaternary) defor-

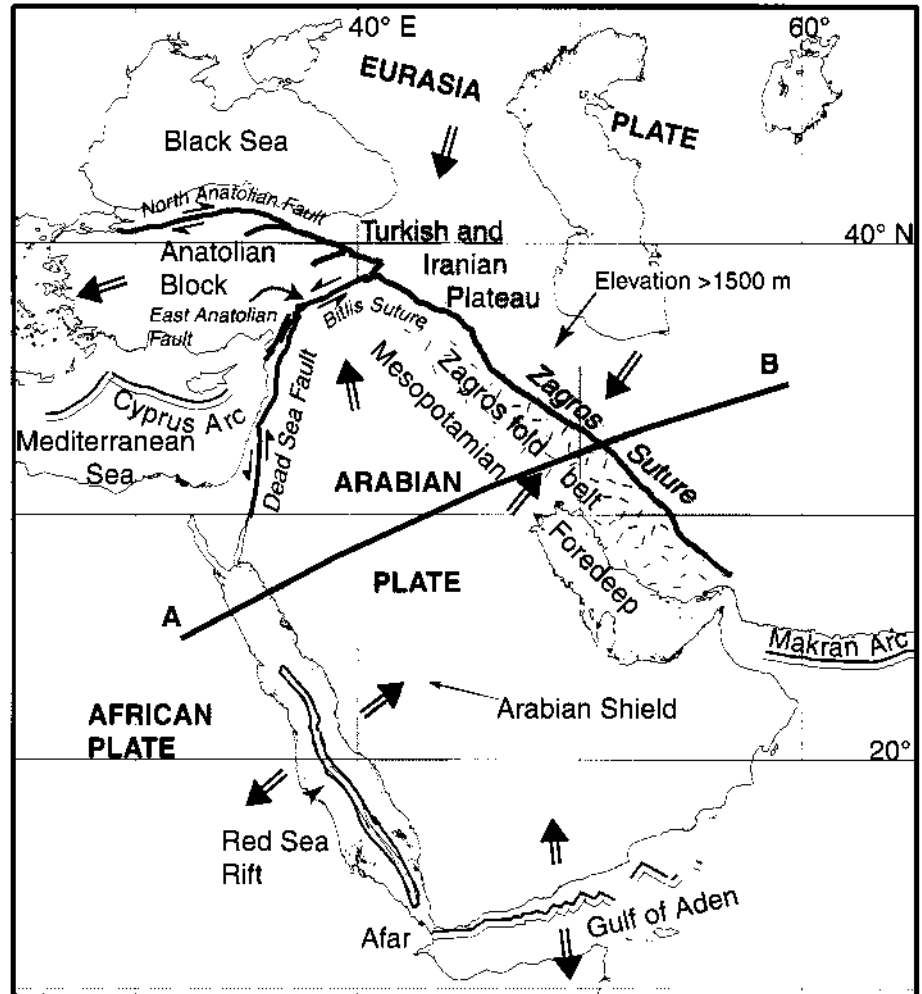


Figure 2. Simplified tectonic map of the Middle East showing types of plate boundaries surrounding the Arabian plate, features within the Arabian plate, and location of profile A-B in Figure 5. Modifications from previous regional tectonic maps include the boundaries of the Turkish and Iranian plateau and the exact locations of the North and East Anatolian faults. See discussion in the text.

mation. Using the DEM with our database, we have found first-order correlations between topography, faults, and seismicity that indicate that most of the major faults in Figure 1 are still active and that the topography is in large part shaped by active tectonic processes. Taking advantage of this correlation, we have refined the positions of the North and East Anatolian faults and defined a new boundary for the Turkish-Iranian plateau.

Figures 1 and 2 can be used as a guide for a tutorial on the major tectonic features of the Middle East. As shown, the region incorporates all known types of major plate boundaries around the borders of the Arabian plate (e.g., Dewey and Şengör, 1979). To the south along the Red Sea and the Gulf of Aden, new oceans are opening (see Cochran, 1983; Le Pichon and Francheteau, 1978). To the north and east, continental collision is occurring along the Bitlis suture zone in southern Turkey (Şengör and Kidd, 1979; Şengör et al., 1985) and the Zagros suture zone in western Iran (Snyder and Barazangi, 1986;

Ni and Barazangi, 1986). The current counterclockwise rotation and northward motion of the Arabian plate relative to Eurasia are accommodated along these collision zones. Well-developed arc volcanoes and a foreland basin along the entire Zagros mountain system indicate Neogene subduction in this region. Although a similar volcanic arc and foreland basin are not easily identified along the Bitlis suture, a Neogene subduction zone is also inferred in this region, especially in southeast Turkey. To the northwest, the Dead Sea fault system manifests itself as a left-lateral strike-slip plate boundary that extends approximately 900 km along the boundary between the Arabian and African-Levantine plates (Garfunkel, 1981; Girdler, 1990; Chaimov et al., 1990). Other major strike-slip zones are the right-lateral North Anatolian fault in northern Turkey and the left-lateral East Anatolian fault in eastern Turkey, which form respectively the northern and eastern boundaries of the

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Anatolian block. These faults developed to accommodate escape of the Anatolian block toward the west in response to the collision of Arabia and Asia (Şengör et al., 1985).

A consequence of the collision between the Arabian and Eurasian plates was the development of the high Turkish and Iranian plateau in eastern Turkey and northwestern Iran. This plateau covers a wide region behind the main Zagros and Bitlis suture zones. By following the 1500 m elevation contour on the high-resolution topographic image, we have been able to map the boundary of this plateau. This contour represents the maximum elevation or base level of the plateau that defines a continuous elevated surface over the entire region. Although the mechanism that holds up this high plateau is not well understood, extensive volcanism and strong seismic shear wave attenuation in the mantle lithosphere beneath the plateau (e.g., Kadinsky-Cade et al., 1981) suggest that a thermal component is required. Further work is needed to fully understand the crustal and upper mantle structures of this region.

The western part of the Arabian platform, east of the Red Sea, has a large region called the Arabian shield where Precambrian crystalline rocks are exposed (Fig. 2). Unlike other shields, which by definition are regions of long-term tectonic stability, the Arabian shield has been subjected to recent tectonic activity. In particular, the continuing rifting process that formed the Red Sea has affected the region. The presence of Cenozoic volcanic activity within the Arabian shield area shows a real departure from a typical shield environment (e.g., Camp and Roobol, 1992). The very low seismic crustal Q values of the Arabian shield (Seber and Mitchell, 1992), which are atypical of shield regions, reflect this tectonic and magmatic activity.

New Moho Map and Crustal Cross Section of the Middle East

One of the least known geological features in the Middle East region is the thickness of the continental crust—that is, the depth to the crust-mantle boundary or Moho. To constrain Moho depth in this region, we have digitized more than 50 interpreted crustal-scale refraction and gravity profiles (Fig. 4) from the published literature. All boundaries have been assigned specific attribute names like “basement” and “Moho.” To this database, we have added Moho depth estimates obtained using a single-station technique (Sandvol et al., 1996). Moho depth values from surface-wave tomographic studies (Ghalib, 1992) and interpretations of Bouguer gravity data in Iran (Dehghani, 1981) were also incorporated. The Moho

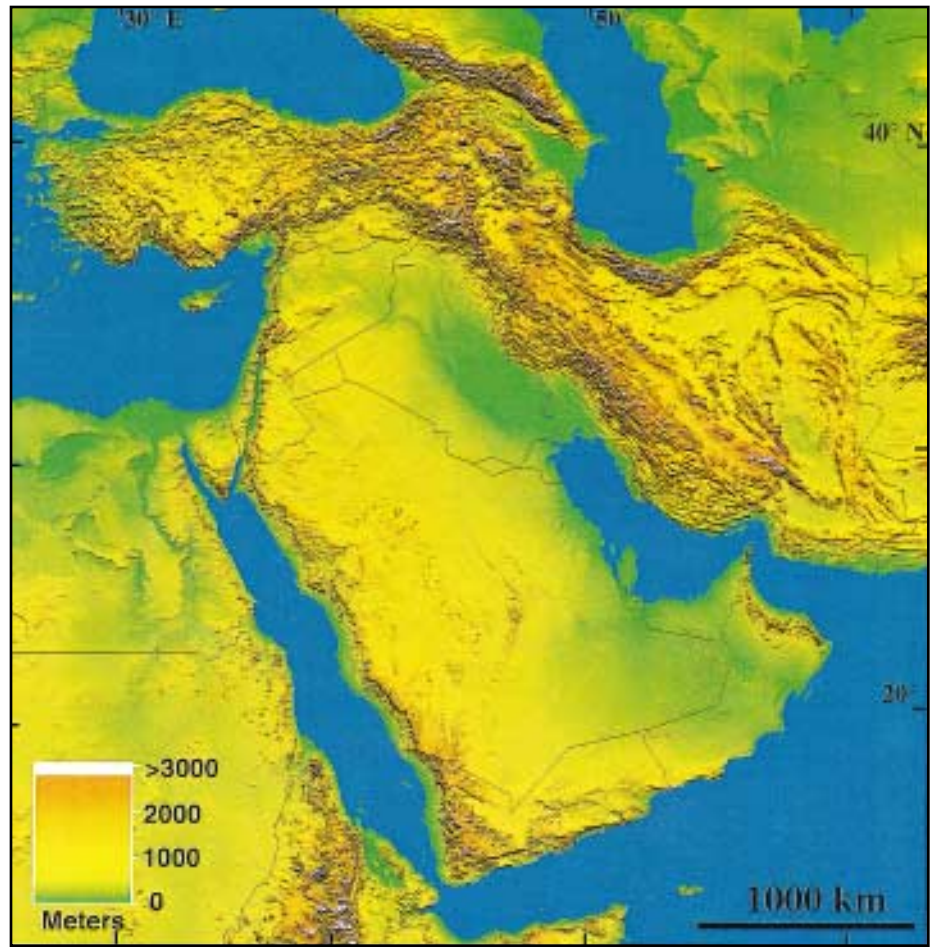


Figure 3. Shaded topographic relief map for the Middle East created from Defense Mapping Agency data and the 1 km global elevation model from the U.S. Geological Survey. Elevations range from sea level to over 6000 m in some localized peaks. See Figure 2 for names of tectonic units and Figure 4 for geographic names.

map in Figure 4 was made by selecting and gridding all of the Moho depth values in the database. In regions where data were limited, Moho depth was determined by interpolating from the nearest data points.

Examination of the map in Figure 4 points to several first-order crustal characteristics in the Arabian plate region. First, the thickest crust occurs beneath the Zagros Mountains in Iran where continental collision is taking place. Second, the thinnest crust occurs beneath the southern Red Sea where new oceanic crust is forming. Third, the crustal thickness beneath the Arabian shield appears to be mostly around 40–45 km. This result is constrained by a single profile, and should be taken cautiously. However, seismological data recently collected by Scripps Institution of Oceanography and Saudi scientists will soon allow us to provide additional constraints in Moho depth in this region. Fourth, the crust is very thin (~8 km) beneath the Afar triangle of Africa, just west of the southern Red Sea. This region is thought to be underlain by either an oceanic crust or stretched conti-

mental crust heavily injected by magmatic rocks (e.g., Mohr, 1989).

A tool called Profile Maker that we have developed for use with gridded databases is useful in detailed studies of crustal variations. This tool extracts and draws two-dimensional crustal scale cross sections between any two points within the area of data coverage. Any combination of topographic, basement depth, crustal thickness, seismic velocity, gravity, and any other available data can be incorporated. These profiles can be used for multiple research purposes such as seismic waveform or gravity modeling, or for teaching.

A cross section made with this tool which incorporates topography, depth to crystalline basement, and total crustal thickness (Fig. 5) illustrates the thin crust in the Red Sea and the thick crust beneath the Zagros Mountains in comparison with the rest of the Arabian platform. The Mesopotamian foredeep is identifiable by the thickening of sedimentary rock toward the Zagros collision zone.

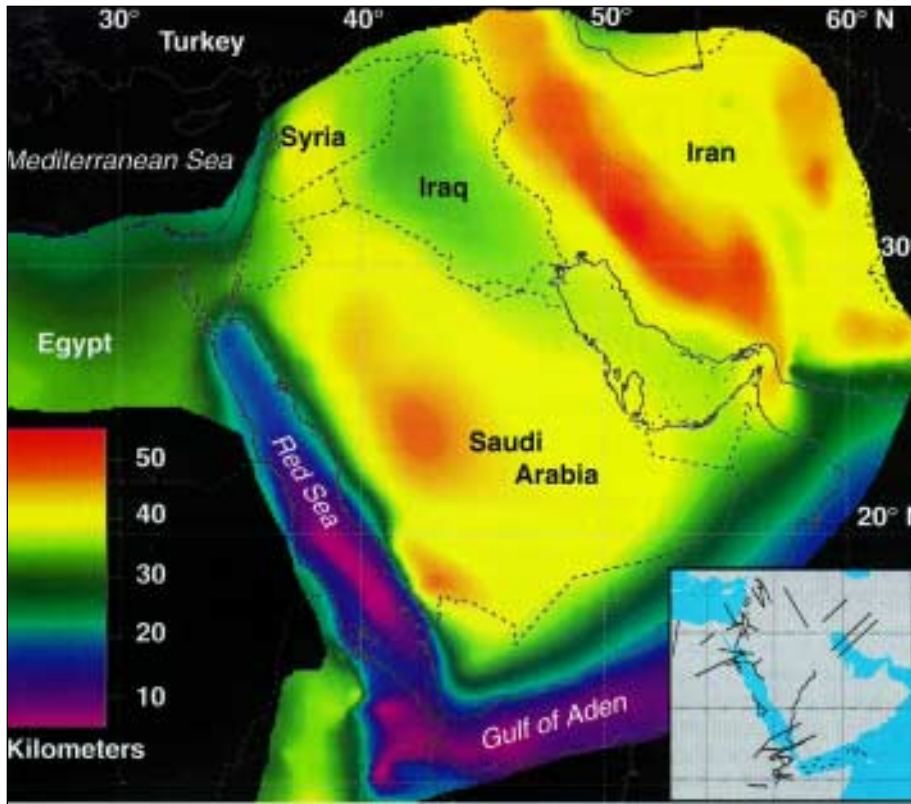


Figure 4. New compilation map for depth to the Moho in the Middle East made by merging more than 50 crustal scale profiles with other geophysical information (see text). The deepest Moho occurs beneath western Iran, whereas the shallowest Moho is under the southern part of the Red Sea. Moho depths are near 40 km in most of the Arabian plate. The inset map shows locations of published profiles used in the compilation.

CONCLUSIONS

As we progress into the digital technology age, efficient ways of capturing, storing, organizing, manipulating, and updating data sets are needed so that we are not overwhelmed by the amount, diversity, and heterogeneity of the data. Clearly, GIS provides a convenient plat-

form for data collection, organization, and research with multidisciplinary data sets. As more groups adopt GIS applications, the earth sciences community will be in a position to prepare a unified global database for more efficient, productive, and rewarding research. Such a database platform will significantly affect the way we conduct research, teach, and educate

future generations of earth scientists. This study shows that there are significant scientific returns for the effort required in putting together a GIS database. With our GIS database we are developing a better understanding of the tectonics and crustal structure of the Middle East. More information on our Middle East GIS database, as well as access to the databases and profile tool discussed in this article, can be found on the Internet at <http://atlas.geo.cornell.edu>.

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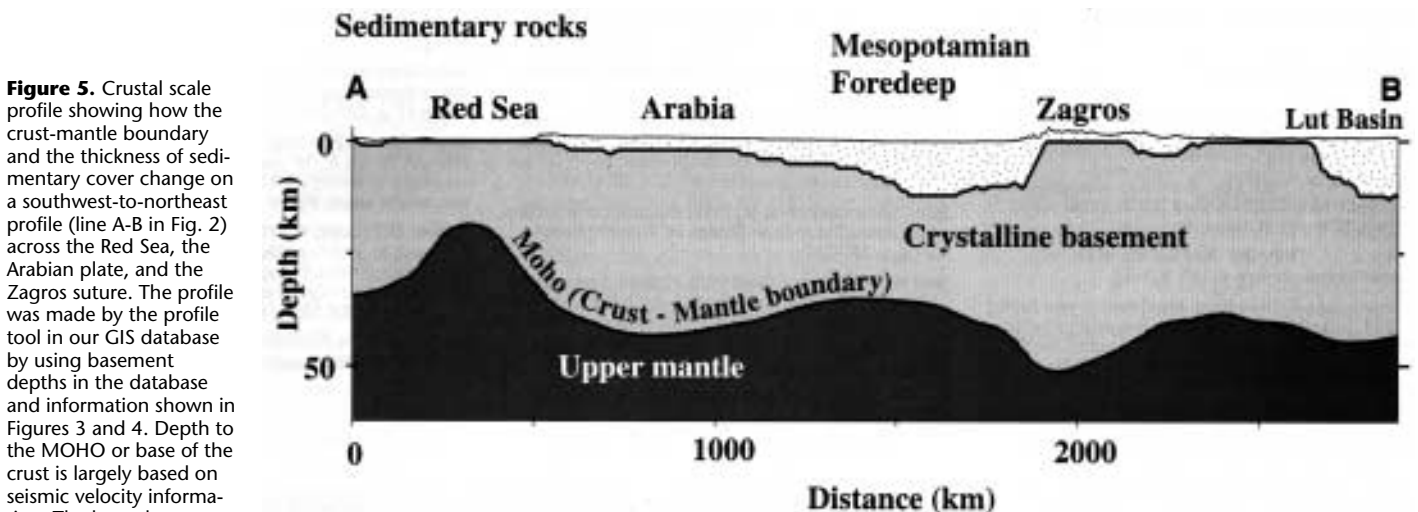


Figure 5. Crustal scale profile showing how the crust-mantle boundary and the thickness of sedimentary cover change on a southwest-to-northeast profile (line A-B in Fig. 2) across the Red Sea, the Arabian plate, and the Zagros suture. The profile was made by the profile tool in our GIS database by using basement depths in the database and information shown in Figures 3 and 4. Depth to the MOHO or base of the crust is largely based on seismic velocity information. The boundary

between sedimentary cover and crystalline basement is set where seismic P-wave velocities reach 6 km/s when based on seismic data. Note the effects of rifting and thinning of the crust in the Red Sea, and the thickening of foredeep sediments and crust beneath the Zagros collision zone.

WASHINGTON REPORT

Bruce F. Molnia

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WIPPIng the Problem of Nuclear Waste

"Scientific analyses indicate that the WIPP repository has the ability to isolate transuranic waste for more than 10,000 years, provided it remains undisturbed by human activity."

— Charles Fairhurst,
Professor of Mining Engineering and Rock Mechanics
University of Minnesota

A newly released National Research Council (NRC) report indicates that human exposure to radiation from nuclear waste that would be stored in an already constructed, underground disposal site in southeastern New Mexico is "likely to be low," not exceeding U.S. and international radiation protection standards. The report, "The Waste Isolation Pilot Plant: A Potential Solution for the Disposal of Transuranic Waste," was prepared by a 13-member committee that included Stanford University geochemist Konrad B. Krauskopf and U.S. Geological Survey hydrologist Leonard F. Konikow. The committee's report is one of a series prepared by the NRC since 1978 in response to a request from the U.S. Department of Energy (DOE), for an independent review of scientific and technical issues related to designing, constructing, and operating a

pilot plant for isolating radioactive wastes from the biosphere. The NRC is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering. It is a private, nonprofit institution that provides science and technology advice under a congressional charter.

The Waste Isolation Pilot Plant (WIPP) is a network of underground excavations, chambers, and tunnels cut in a layer of "geologically stable," Permian age Salado Formation salt, 2,160 ft (658 m) below the desert surface, 25 mi (40 km) east of Carlsbad, New Mexico. The WIPP is designed to be a permanent repository for a category of intermediate-level, defense-related, radioactive waste known as transuranic (TRU), waste containing radionuclides with atomic numbers greater than uranium (atomic number 92),

which results chiefly from the production of nuclear weapons from plutonium and enriched uranium.

The WIPP is the first geological repository in the nation for which an application to begin permanent geologic isolation of TRU waste has been submitted for a regulatory decision. If approved, the WIPP site will be the deepest intermediate waste repository in the world. (An intermediate-level waste repository in Olkiluoto, Finland, is about 400 ft (125 m) below the surface.)

The WIPP is designed to store 175,580 cubic meters of TRU waste. It is anticipated that 137,000 cubic meters of TRU waste with an activity of 7,900,000 Ci will eventually be stored at the facility. The TRU waste consists of contaminated materials from laboratory and production operations, including discarded protective clothing, laboratory reagents and test equipment, solidified sludge, and machine components. This waste has been stored for as much as 50 years in 55-gallon steel drums and wooden boxes at locations around the country. Additional TRU waste will result from the future clean-up of U.S. weapons sites (see January 1997 Washington Report).

The objective of the U.S. nuclear waste disposal program is to place waste in a location where "harmful quantities cannot return to the biosphere by any foreseeable process." According to the report, unless the site is breached by humans sometime in the future, there is no credible, probable mechanism for release of radioactive material into the surrounding environment. Committee chair Charles Fairhurst stated, "There are ways to engineer the facility—should studies now in

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Washington Report *continued from p. 6*

progress indicate that they are worthwhile—that could be used to reduce the chances of radioactive releases resulting from human intrusion.”

The report states, “Speculative scenarios of human intrusion should not be used as the sole or primary basis for judging the acceptability of the site. The consequences of future drilling or activities at the site should be examined in order to assess ways to reduce its vulnerability, but predictions of what human activities and technologies will be thousands of years from now are highly conjectural and lack scientific foundation.” The report includes discussion on the natural setting and geological resources of the WIPP area, risk assessment, brine inflow to excavations in the Salado Formation, creep behavior of WIPP salt, actinide source terms, regional hydrology, and other related topics.

If approved, the federally operated facility would be the nation's first permanent disposal site for TRU waste. DOE has been investigating the suitability of the WIPP as a TRU waste repository since the 1970s and has asked the U.S. Environmental Protection Agency for certification to open and operate the site. In order to get this certification, DOE first must demonstrate that the WIPP facility will comply

with federal regulations intended to protect human health and the environment.

The NRC committee believes that DOE should be able to do this if some combination of the following were to occur:

- The projected risk of radiation releases caused by future drilling would be much lower if EPA were to reevaluate its assumption that the frequency of drilling for gas and oil in this area during the past century will continue unchanged for the next 10,000 years. Although drilling for natural gas and oil now occurs in the area surrounding the site, reserves of these resources will be nearly exhausted in less than 100 years. According to the committee, “While it is possible that drilling could occur for other resources which currently are uneconomical to recover or whose uses are not yet evident, the assumption that the drilling rate will stay the same is arbitrary, highly subjective, and scientifically untestable.”
- Laboratory and on-site research programs, both in progress and planned, could show that the potential is minimal for some radioactive elements to dissolve in salty ground water and migrate from the facility before they decay to low radiation levels that would not pose increased risk to humans.

- The consequences of drilling or other human intrusion at the WIPP site could be substantially reduced if DOE plans called for placing the waste in individually sealed rooms to prevent gas and fluid flow within the facility and/or for sealing the repository with a mixture of crushed salt and minerals having chemical characteristics that “trap” certain radioactive isotopes.

Construction of the WIPP facility began in 1979 and proceeded through the 1980s. This site was selected after a previous candidate site, an abandoned salt mine near Lyons, Kansas was abandoned in the early 1970s. The decision to develop a waste disposal facility in salt arose following a 1957 NRC committee assessment of high-level radioactive waste disposal. The results were reported in “The Disposal of Radioactive Waste in Land.”

Copies of “Waste Isolation Pilot Plant: A Potential Solution for the Disposal of Transuranic Waste” are available from the National Academy Press, (202) 334-3313 or 1-800-624-6242. The cost of the report is \$35 (prepaid), plus shipping charges of \$4.00 for the first copy and \$0.50 for each additional copy. ■

Summer Opportunities for Undergraduate Geoscience Majors:

National Park Service Internships Sponsored by GSA's Institute for Environmental Education

GSA Undergraduate Student Associates: Would you like to spend this summer conducting geological research at Denali National Park, Alaska, or the Badlands National Park, South Dakota?

GSA's Institute for Environmental Education is sponsoring two National Park Service undergraduate internships for the summer of 1997. Interns will work with park scientists on paleontological research, development of interpretive programs, and other high-priority projects.

Each internship carries with it a stipend of \$2,500, to cover transportation, food, and incidental expenses. Accommodations in the park will be provided free of charge.

Internships will be awarded on a competitive basis to two junior or senior undergraduates majoring in geosciences. Applicants must be GSA Student Associates. (If you aren't and you want to apply for the internship, you may join GSA at the same time as you submit your application for the intern program.) Additional qualifications are listed in the individual internship descriptions, below.

Applications for an IEE-National Park Service Internship should include the following information:

- One-page letter explaining your interest in and qualifications for the internship. The letter should also include: (1) dates that you are available for the internship; (2) internship(s) that you are applying for (Denali, Badlands, or both); (3) your phone number; (4) your GSA membership number or completed application for GSA Student Associate.
- A copy of your academic transcript (unofficial is okay).
- Your resume.
- One letter of reference from a faculty member in your geoscience department. (This letter may be included with your application package in a separate, sealed envelope, with the signature of the reference across the seal, or it can be mailed separately.)

Send applications to:

Institute for Environmental Education, NPS Internship, Geological Society of America, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301

All application materials must be received at GSA headquarters by **March 17, 1997**.

The two successful applicants will be notified no later than **April 15, 1997**.

For more information, call 303-447-2020 ext. 194, or E-mail iee@geosociety.org

Internship:

Denali National Park, Alaska

More than 150 paleontological sites (mostly marine invertebrates) have been identified within the park and are reported in various maps, publications, student theses, inventory data forms, and other documents. Some of these records duplicate and/or overlap each other; a systematic database to sort these conditions does not exist. Also, the park has fewer than 5% of the primary reference samples of some major fossil localities.

Position Description: A volunteer is needed to cross-correlate these records to produce a paleontology database for Denali National Park. This project requires data input (GIS attributable or Dbase-like)

of species, age(s), lithologies, units, localities, and other pertinent information. Site localities would be precisely located on hard-copy maps with the intent of transferring the data to a GIS or similar spatial mapping system. As time and scheduling permit, the intern will target areas for a park reference sample collection, and will collect samples.

Qualifications: Undergraduate junior or senior geoscience major with course work in introductory geology, historical geology, and invertebrate paleontology. It is preferable, but not necessary, that the individual have completed additional courses in stratigraphy, sedimentology, structure, and/or field methods.

Dates: Begin mid-May to early June, until early to mid-September 1997.

Internship: Badlands National Park

Carved by erosion, this scenic landscape contains a wide variety of animal fossils dating from 26 to 37 Ma.

Position Description: The intern will spend 50% of the time providing public education on park geological and paleontological resources, including presenting geology walks and giving paleontology talks and writing text for exhibits, way-sides, and site bulletins on topics relating to geology. About 25% of the time will be spent at the Pig Wallow site, an active paleontology site in the park, serving as site interpreter to the public and working at the site as a researcher. The other 25% of the time will be spent working with the Chief of Resource Education, developing text for a publication on park geology and paleontology. The only existing publication was written in 1927 and is badly out of date.

Qualifications: Undergraduate junior or senior geoscience major with course work in introductory geology and invertebrate paleontology. It is preferable, but not necessary, that the individual have completed additional courses in historical geology, stratigraphy, sedimentology, structure, and/or field methods. Student must be capable of translating technical geologic data into information that is easily understood by the average park visitor.

A personal car is advisable for this internship, but is not required.

Dates: Begin May 25 through August 16, 1997. ■

Upcoming IEE-Sponsored Events

GSA Southeastern Section Meeting • Auburn, Alabama, March 27–28, 1997

Roy Shlemon Mentors in Applied Geology Program

A half-day workshop for senior undergraduate and graduate geoscience students on professional and scientific opportunities in applied geoscience will be presented by Ryan D. Turner. The workshop will include discussions of the mentor's expertise (environmental hydrogeology), experiences in making the transition from academia to the "real world," and "lab-style" exercises on practical problems, involving actual field cases, marketing, dealing with government regulations, contracts, lawsuits, expert witness testimony, and other issues.

Symposia and Theme Sessions

- Groundwater Geochemistry, Microbiology, and Bioremediation.
- Solid Earth Science: The Foundation of Ecosystem Management and Defendable Environmental Regulations (cosponsored with GSA's Geology and Public Policy Committee).
- GIS Applications in Geology.

For more information on these programs, see the Final Announcement for the GSA Southeastern Section meeting in the January 1997 issue of *GSA Today*.



About People

GSA Fellow **James E. Brooks**, Southern Methodist University, has been named vice chairman of the Institute for the Study of Earth and Man at SMU. Replacing Brooks as president of ISEM will be Richard J. Kruienza.

U.S. Geological Survey Water Resources Division employees recently given the Meritorious Service Award, for significant contributions to the earth sciences and to management and administration of USGS scientific programs, include GSA members **Kenneth J. Hollett**, Reston, Virginia; and **Eric T. Sundquist**, Woods Hole, Massachusetts.

Fellow **John Vecchioli**, U.S. Geological Survey, Tallahassee, Florida, has received the U.S. Department of the Interior Distinguished Service Award, for outstanding contributions to the USGS ground-water hydrology programs.

CALL FOR NOMINATIONS REMINDERS

PENROSE AND DAY MEDALS, AND HONORARY FELLOWSHIP

Nominations for 1997 Penrose and Day Medals and for Honorary Fellowship in the Society are due by **FEBRUARY 3, 1997**.

YOUNG SCIENTIST AWARD (DONATH MEDAL)

The Young Scientist Award was established in 1988 to be awarded to a young scientist (35 or younger during the year in which the award is to be presented) for outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the earth sciences. The award, consisting of a gold medal called the Donath Medal and a cash prize of \$15,000, was endowed by Dr. and Mrs. Fred A. Donath.

For the year 1997, only those candidates born on or after January 1, 1962, are eligible for consideration. In choosing candidates for the Young Scientist Award, scientific achievement and age will be the sole criteria. Nominations for the 1997 award must include

- biographical information,
- a summary of the candidate's scientific contributions to geology (200 words or less),
- a selected bibliography (no more than 10 titles),
- supporting letters from five scientists in addition to the person making the nomination.

Deadline for nominations for 1997 is **FEBRUARY 3, 1997**.

OFFICERS AND COUNCILORS

The GSA Committee on Nominations requests your help in compiling a list of GSA members qualified for service as officers and councilors of the Society. The committee requests that each nomination be accompanied by basic data and a description of the qualifications of the individual for the position recommended (vice-president, treasurer, councilor).

Deadline for nominations for 1998 is **FEBRUARY 18, 1997**.

DISTINGUISHED SERVICE AWARD

The GSA Distinguished Service Award was established by Council in 1988 to recognize individuals for their exceptional service to the Society. GSA Members, Fellows, Associates, or, in excep-

tional circumstances, GSA employees may be nominated for consideration. Any GSA member or employee may make a nomination for the award. Awardees will be selected by the Executive Committee, and all selections must be ratified by the Council. Awards may be made annually, or less frequently, at the discretion of Council. This award will be presented during the annual meeting of the Society. Deadline for nominations for 1997 is **MARCH 3, 1997**.

JOHN C. FRYE ENVIRONMENTAL GEOLOGY AWARD

In cooperation with the Association of American State Geologists (AASG), GSA makes an annual award for the best paper on environmental geology published either by GSA or by one of the state geological surveys. The award is a \$1000 cash prize from the endowment income of the GSA Foundation's John C. Frye Memorial Fund. The 1997 award will be presented at the autumn AASG meeting to be held during the GSA Annual Meeting in Salt Lake City.

Nominations can be made by anyone, based on the following criteria: (1) paper must be selected from GSA or state geological survey publications, (2) paper must be selected from those published during the preceding three full calendar years, (3) nomination must include a paragraph stating the pertinence of the paper.

Nominated papers must establish an environmental problem or need, provide substantive information on the basic geology or geologic process pertinent to the problem, relate the geology to the problem or need, suggest solutions or provide appropriate land-use recommendations based on the geology, present the information in a manner that is understandable and directly usable by geologists, and address the environmental need or resolve the problem. It is preferred that the paper be directly applicable by informed laypersons (e.g., planners, engineers). Deadline for nominations for 1997 is **MARCH 31, 1997**.

NATIONAL AWARDS

The deadline is **April 30, 1997**, for submitting nominations for these four awards: William T. Pecora Award, National Medal of Science, Vannevar Bush Award, Alan T. Waterman Award.

From the Ground Up

FEBRUARY. A hapless month . . . too long past the last celebration to maintain the glow of holiday cheer; too far from the next celebration to anticipate the glow of springtime cheer. Mercifully, a short month.

The name is thought to be from the Latin *februare* meaning "to purify," and may derive from the ancient Feast of Purification observed on February 15. The idea of cleansing and renewal can put a different light on these days. So let us contemplate the concept of educational renewal.

In its recent report "Years of Promise," the Carnegie Corporation of New York found that by the time they reach age 18, young Americans typically have watched 15,000 hours of TV. That's more hours than they have spent in school! Not surprisingly, the report calls for radical improvement in this ratio.

While calling as well for improvement in educational systems, the report also states, "Schools may have the primary responsibility for children's formal education, but their educational success is influenced by far more than what happens to them in school." Beyond the immediate influences of family, neighborhood, and religious experience, ". . . the broader

array of institutions that bear on children's lives—the media, employers in all sectors, higher education, and government—have shared responsibility to contribute to children's learning and healthy development."

This brings us to the SAGE initiatives, clearly honoring GSA's share of the responsibility to contribute to children's learning. Particularly enlightened in the SAGE agenda is the recognition that learning takes place both inside *and* outside the classroom and that learning can be enhanced by participation of adults in educational activities.

The Earth and Space Science Technological Education Project (ESSTEP) is a collaboration with Cypress Community College and the Space Science Institute. Beginning this summer, it will provide teachers of grades 8 to 14

- opportunities to become familiar with the content and application of technologies employed by earth and space scientists, and
- materials, training, and follow-up support enabling them to make classroom instruction in these sciences more relevant and engaging for their students.

The Colorado Rock Park is a pilot project to create the nation's first outdoor exhibit presenting a state's geology and establishing a model adaptable to any

state. Comprising a representative sample of real rocks and fossils in an accessible area of one to two acres, the Rock Park demonstrates

- the effects of landscape and geology on cultural development, and
- the relation between nature and the daily lives of visitors to the park.

These are but two of the undertakings by which GSA translates gift dollars into constructive contributions to education about earth sciences. For helping us do our share, GSA is truly grateful to all the donors who support the SAGE programs.

This month's bumper sticker:
If you think education is expensive, try ignorance.

Can You Help?

GSA headquarters is down to one copy of *The Life and Letters of R. A. F. Penrose, Jr.*, the biography by Helen R. Fairbanks and Charles P. Berkey published in 1952. We get periodic requests for access to information in the book or inquiries about purchase, so we would like to have more than one copy of the book on hand. If you know of one or more copies that we might acquire, please call Donna Russell at (303) 447-2020, ext.154, or E-mail her at drussell@geosociety.org. ■

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Digging Up the Past

Most memorable early geologic experience: My first field season as a graduate student at Rice in 1966 mapping in the Mojave with Clark Burchfiel and Greg Davis. What a fantastic introduction to field geology!

—John F. Sutter



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FIVE YEARS OF SAGE: Where We've Been and Where We're Going

In the spring of 1990, the GSA Council approved the Science Awareness through Geoscience Education (SAGE) program. This followed two years of hard work by a committee consisting of Bill Greenwood, Pete Palmer, Clement Shearer, Dave Stephenson, Steve Stow, and Wes Ward, and the support of many GSA members. The idea of developing outreach programs in the areas of K–12 geoscience education and environmental policy had originated in the late 1980s as GSA approached its centennial celebration. GSA was, then, and still is, widely recognized as one of the premier geoscience societies in the world, with excellent scientific meetings, publications, research grants, and awards. However, like many scientific organizations, GSA realized that a rapidly changing, technological world would require a more scientifically literate populace, and that to survive and prosper in that rapidly changing world would require GSA to become a more responsive and outward-looking professional society. With the support of many GSA members, that goal has become a reality.

the past five years was the creation and publication of the National Science Education Standards (NSES) by the National Research Council. With release of the NSES in December 1995, the earth sciences were given the opportunity to become a legitimate and integral part of the K–12 science curriculum.

The strong emphasis on earth science in the NSES document was not just a matter of serendipity. In 1993 and 1994, earth science education had gained visibility and support when the American Association for the Advancement of Science (AAAS) published "Benchmarks for Science Literacy," a product of Project 2061, and the National Geographic Society published "Geography for Life: The National Geography Standards." Both of these publications contain strong earth science strands.

A second significant event occurred in February 1993 at a meeting in Racine, Wisconsin. At this meeting, scientists, educators, and members of diverse organizations came together to create the Coalition for Earth Science Education (CESE), a major step forward in how the geoscience

Where was the SAGE program during this time? During 1991–1994, we were working hard to build bridges, develop partnerships, and overcome old suspicions within the earth science education community. Our belief then and now is that improving earth science education is an enormous, complex, and long-term task that cannot possibly be done by one, two, or even 10 or 20 organizations working independently. By working collaboratively, we all gain. We reduce the duplication of earth science programs and materials, we build on and support each other's efforts, and we gain the ability to focus our individual and collective resources and energies, rather than each organization feeling compelled to do everything by itself.

During 1995 and 1996, we continued to work with other organizations to promote earth science education and the National Science Education and Geography Standards. With funding from the Department of Energy, we developed standards-based earthquake, geography, and mathematics workshops for elementary and middle school educators and a companion plate tectonics workshop for secondary educators. In addition to our emphasis on promoting the standards, we also worked to strengthen our Partners for Excellence Program, now the Partners for Education Program, and to develop new earth science education initiatives involving the use of computer-based technologies.

As we begin 1997, it is interesting to look at the current status of SAGE programs. We now have more than 1300 active partners in the Partners for Education Program, and nearly 200 new E-mail partners. After careful study and discussions with members, educators, scientists, business people, and the public, we have also chosen to focus our K–16 education efforts and resources on integrating earth science concepts and cutting-edge earth systems research, with effective use of computer-based technologies and high-quality teaching and assessment. In support of this goal, we currently have two major earth science-technology education projects underway. In collaboration with Cambrian Systems, Inc., we are working on the Geoscience Education Through Intelligent Tutors (GET-IT) project to develop interactive multimedia modules for middle-school classrooms. In collabo-

SAGE continued on p. 13

Probably the most significant event to occur in earth science education during the past five years was the creation and publication of the National Science Education Standards (NSES) by the National Research Council. With release of the NSES in December 1995, the earth sciences were given the opportunity to become a legitimate and integral part of the K–12 science curriculum.

In the fall of 1991, shortly after my arrival at GSA, the Partners for Excellence Program (as it was then called) had 69 members and I had just written my first SAGE Remarks article, "Building a Better Yellow Brick Road." In that article I provided a perspective on the current state of geoscience education and a rationale to encourage GSA members to take a more active role in K–12 education via PEP and other activities. With all of the changes in science education that have occurred since 1991, it is worth taking another hike along that road to see where we have been and where we are going.

Probably the most significant event to occur in earth science education during

community communicates about and works on education projects and activities. By changing from a solid earth (geology) perspective to an earth systems perspective, the geoscience community was able to develop new collaborations with organizations involved in atmospheric science, astronomy, space science, environmental science, agronomy, oceanography, and hydrology education. Working together, this much larger and more diverse group had a stronger impact on the development of the NSES document than any one organization. Without CESE, it is also likely that many of our organizational voices and concerns would have been ignored or lightly dismissed.

The Earth and Space Science Technological Education Project (ESSTEP)

Do YOU teach in grades 8–14, and are you interested in:

- Learning about and using the latest technologies employed by earth and space scientists?
- Knowing how Geographic Information Systems, GPS, the Internet, image processing, and multimedia can make your teaching more relevant and engaging for students?
- Being provided the support and resources to construct a powerful learning environment at your home institution?
- Helping students to be thoughtful problem solvers using technical and scientific skills for 21st century careers?

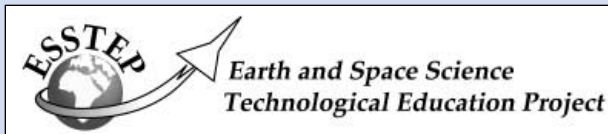
Then join us for an exciting new national program that will begin in the summer of 1997 (July 7–19 or August 4–16 in Boulder, Colorado)

Interested faculty must apply as a team (2–4 persons/team) from institutions in the same community; 40 spaces are available in 1997.

For application materials please contact:

Edward Geary, Geological Society of America,
P.O. Box 9140, Boulder, CO 80301.
(303) 447-2020 ext. 162, fax: 303-447-1133,
E-mail: egeary@geosociety.org

Applications for 1997 summer workshops are due on March 15, 1997.



CALL FOR NOMINATIONS

To reward and encourage **teaching excellence** in beginning professors of earth science at the college level, the Geological Society of America announces:

THE SIXTH ANNUAL

Biggs Award

For Excellence In Earth Science Teaching For Beginning Professors

ELIGIBILITY: All earth science instructors and faculty at 2- and 4-year colleges who have been teaching full time for 10 years or less. (Part-time teaching is not counted in the 10 years.)

AWARD AMOUNT: An award of \$500 is made possible as a result of support from the Donald and Carolyn Biggs Fund.

NOMINATION PROCEDURE: For nomination forms write to Edward E. Geary, Coordinator for Educational Programs, Geological Society of America, P.O. Box 9140, Boulder, CO 80301.

DEADLINE: Nominations and support materials for the 1997 Biggs Earth Science Teaching Award must be received by **April 30, 1997.**

SAGE continued from p. 12

ration with the Space Science Institute and Cypress Community College, we are working on the Earth and Space Science Technological Education Project (ESSTEP) to assist faculty from community colleges, four-year institutions, and secondary schools in using computers more effectively in their classrooms. Both GET-IT and ESSTEP are funded in part by grants from the National Science Foundation. We are also working with the Space Science Institute, U.S. West Advanced Technologies, CU Boulder, Ball Aerospace, the University Corporation for Atmospheric Research, and several other organizations to create the Center for Advanced Technological Education (CATE) in earth, space, and environmental science. The goal of CATE is to create a dynamic, visionary model for science education in the 21st century.

Equally important to the GSA Council and the GSA Executive and Budget committees, the current SAGE program is cost effective. While the GSA contribution to SAGE has remained relatively constant over time, the SAGE program has quadrupled in size. This is primarily due to pro-

ject revenues from government grants and contributions to SAGE from foundations, corporations, and GSA members.

Another interesting way to examine the growth of educational programs at GSA is to look at abstract submittals for annual meetings during the past decade. Between 1985 and 1988, the average number of education abstracts at the GSA annual meeting was 22. Between 1989 and 1993 the average number of education abstracts increased to 60; in 1994 and 1995 this number increased to 98 and 111 abstracts, respectively; and in 1996 there were 192 education abstracts. These data suggest that SAGE has struck a responsive chord among a rapidly growing number of GSA members.

As we look to the future, we will continue to strengthen and improve our current K–16 education programs and to be responsive to member needs. However, the road ahead is also taking us into the unexplored region of informal (public) education. Our newest SAGE initiatives emphasize the integration of earth science, education, technology, and community. By the year 2000, our goal is to develop a set of high-quality informal earth science education programs that complement our

formal K–16 education initiatives. To achieve this goal, we have several community-based earth science education initiatives currently under development. Among these are: (1) We Are All Related, (2) the Colorado Rock Park Project, (3) the GeoArt Project, and (4) Family Involvement in Relevant Science and Technology (FIRST). In each of these initiatives, there is a strong emphasis on working with diverse cultural, ethnic, and differently abled populations as well as the general public. Look for more information on these programs to appear in *GSA Today* in the months ahead.

I conclude with heartfelt thanks to Barb Mieras, Vicki Harsh, Beth Ann Brown, Liz Knapp, Robyn Wright Dunbar (now back at Rice University), and Van Schoales, my dedicated colleagues at GSA who make our educational programs work, and to all of you who have supported SAGE and PEP during the past five years. Without your ideas, encouragement, and support, none of these efforts would have been possible. We look forward to the next five years of SAGE with great excitement, and we hope you will join us and guide us as we continue our journey. ■

Tennessee Walkers

Rogue's gallery from a field trip to the western Highland Rim of Tennessee, sponsored by the Tennessee Academy of Science and the Tennessee Division of Geology, April 30, 1960.

Participants, left to right:

Front row: Mel Marcher, U.S. Geological Survey, Nashville; Elliot Cushing, U.S. Geological Survey, Memphis; Dick Stearns, Vanderbilt University; Bill Hardeman, Tennessee Division of Geology; Willard Jewell, Vanderbilt University; Preston McGrain, Kentucky Geological Survey.

Second row: [unidentified]; Bob Floyd, Ned Luther, both Tennessee Division of Geology; [unidentified]; Bo Daniels, Geological Survey of Alabama.

Third row: Bill Lambert, U.S. Geological Survey, Paducah, Kentucky; Bob Barnes, Jack Colvin, both Tennessee Division of Geology; Dick Lounsbury, U.S. Geological Survey, Nashville; Bob Hatcher, Vanderbilt University; Bob Miller, Tennessee Division of Geology.

Back row: John Coombs, Evansville, Indiana; Bill Rose, Kentucky Geological Survey; Bob Hershey, Tennessee Division of Geology; Ollie Smith, U.S. Geological Survey, Nashville; Nat Dortch, Paducah (Kentucky) Junior College.

Photo submitted by Bill Rose, Westford, Massachusetts, and Bob Hatcher, Knoxville, Tennessee.



Scholarship and Fellowship Opportunities

Association for Women Geoscientists Chrysalis Scholarship

The Association for Women Geoscientists will award at least two Chrysalis Scholarships on March 31, 1997. The \$750 awards will be given to geoscience master's or Ph.D. candidates to cover expenses associated with finishing their theses. The Chrysalis Scholarship is for women who have returned to school after an interruption in their education of one year or longer. The support can be used for anything necessary to assist the candidate in completing her thesis, such as typing, drafting expenses, field work, or child care.

Applications should be made by *February 28, 1997*. The applicant should write a letter stating her background, her career goals and objectives, her involvement in both the geosciences and her community, and how she will use the money, and should explain the length and nature of the interruption to her education.

The applicant should also submit two letters of reference. The reference letters should include a statement of the applicant's prospects for future contributions to both the geosciences and her community. Her thesis advisor should also include when the candidate will finish

her degree and what requirements are still to be completed.

For information on obtaining an application or for additional information, please contact: Chrysalis Scholarship, Association for Women Geoscientists, G&H Production Company, LLC, 518 17th Street, Suite 930, Denver, CO 80202, (303) 534-0708, fax 303-623-6724.

University of Wyoming Bernard L. Majewski Research Fellowship

The University of Wyoming invites applications from interested scholars for the Bernard L. Majewski Fellowship. The fellowship is named in honor of the late petroleum industry pioneer, Bernard L. Majewski, and provides a stipend of \$2500 in support of research conducted in the archival collections at the American Heritage Center on the campus of the University of Wyoming. Acceptable areas of research include history, oral history, and historical archaeology pertaining to economic and petroleum geology, or environment and natural resources, or business or economic history pertaining to economic and petroleum geology. The deadline for applications for the 1997 fellowship is March 1, 1997. Research

should be conducted by the Fellow within one year of appointment. For application information or a comprehensive listing of available research collections, contact: Bradford R. Burton, International Archive of Economic Geology, American Heritage Center, P.O. Box 3924, University of Wyoming, Laramie, WY 82071, (307) 766-6506, fax 307-766-5511, bburton@uwyo.edu, Web page: <http://www.uwyo.edu/ahc/iaeg/majewan.htm>.

Shamsher Prakash Research Awards

The Shamsher Prakash Foundation, established in 1989, offers an annual award of \$1001 for a young engineer or scientist for excellence in geotechnical and/or geotechnical earthquake engineering. Applicants must be no older than 40 years as of May 31, 1997.

Nomination-application forms for the 1997 Shamsher Prakash Research Award are available from Sally Prakash, Honorary Secretary, Shamsher Prakash Foundation, "Anand Kutir," 1111 Duane Ave., Rolla, MO 65401, fax 573-364-5572 (*51), prakash@novell.civil.umar.edu.

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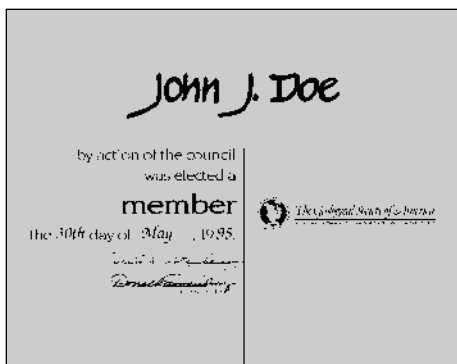
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ODP FROM MOUNTAINS TO MONSOONS

The interactive, educational CD-ROM, "ODP: From Mountains to Monsoons," is now available in both Macintosh and PC formats. This program uses results from Ocean Drilling Program cruises in the Indian Ocean to study the theory that the uplift of the Himalayan Mountains resulted in the intensification of the Southeast Asian monsoon. The "cruise participant" works with scientists from a variety of shipboard laboratories and combines data to put the pieces of the scientific puzzle together. An accompanying teachers manual is also available upon request.

A free copy is available to educators. Please contact:
Joint Oceanographic Institutions
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Washington, DC 20036-2102
fax: (202) 232-8203
e-mail: joi@brook.edu

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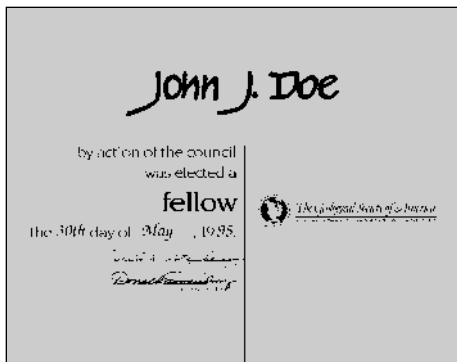
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Please send order form and remittance to:
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P.O. Box 9140, Boulder, CO 80301 U.S.A.

2/97

Call for Nominations

WANTED: Mentors in Applied Geology

The Geological Society of America's Institute for Environmental Education is now soliciting nominations for the Roy J. Shlemon Mentor Program in Applied Geology. Funded by an endowment from Roy J. Shlemon, the Applied Geology Mentor Program bridges the gap between the applied and academic geology communities. The mentors are experienced geologists currently practicing in various fields of applied geology. Each mentor presents a one-day workshop for graduate and senior undergraduate geology students focusing on professional opportunities and challenges in the applied geosciences. Workshops may include lectures and/or field and laboratory exercises, depending on the technical specialty of the mentor, as well as discussion of "practical problems" in applied geology such as running a business, marketing, hiring and firing, and legal and regulatory challenges.

Mentors receive an honorarium of up to \$1,000 for conducting the workshop, in partial recognition of their outstanding contribution to the applied geosciences. Up to six Shlemon Mentor workshops will be held each year, in conjunction with the six GSA section meetings.

The 1996 Roy Shlemon Applied Geology Mentors were
James E. Slosson, Van Nuys, California—
Rocky Mountain Section
William R. Cotton, Los Gatos, California—
Cordilleran Section
Michael Hart, San Diego, California—
Cordilleran Section
Dean Lewis, Ames, Iowa—
North-Central Section

Criteria for Nomination

Mentors should be highly regarded practitioners in the applied geosciences. Preference will be given to nominees who emphasize one of the following specialties: Quaternary geology, geomorphology, environmental geology, engineering geology, geoarchaeology, and hydrogeology. Nominees should have at least 15 years of experience outside of academia and government and should be working actively in an applied field. Nominees should also be active in the geological community, preferably with a record of presented or published papers.

Nominations should be in the form of a brief (one-half page) narrative summarizing the qualities and experiences of the nominee. This narrative may be supported

PUBLICATIONS NEWS FROM THE GSA BOOKSTORE

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PHANEROZOIC FAUNAL & FLORAL REALMS OF THE EARTH: THE INTERCALARY RELATIONS OF THE MALVINOKAFFRIC AND GONDWANA FAUNAL REALMS WITH THE TETHYAN FAUNAL REALM
by A. A. Meyerhoff, A. J. Boucot, D. Meyerhoff-Hull, J. M. Dickens, 1996
MWR189, 78 p., hardbound, indexed, ISBN 0-8137-1189-4, \$40.00; Member price \$32.00

PALYNOLOGICAL CORRELATION OF MAJOR PENNSYLVANIAN (MIDDLE AND UPPER CARBONIFEROUS) CHRONOSTRATIGRAPHIC BOUNDARIES IN THE ILLINOIS AND OTHER COAL BASINS
by R. A. Peppers, 1996
MWR188, 118 p., hardbound, 1 pocket insert, ISBN 0-8137-1188-6, \$55.00; Member price \$44.00

THE LATE QUATERNARY CONSTRUCTION OF CAPE COD, MASSACHUSETTS: A RECONSIDERATION OF THE W. M. DAVIS MODEL
edited by E. Uchupi and G. S. Giese, D. G. Aubrey, D.-J. Kim, 1996
Data from geologic and geophysical studies of Cape Cod and southeast coastal Massachusetts were used to reconstruct the geologic history of the region and to compare this construction with that proposed by W. M. Davis in 1986. This work also suggests that historical changes in Cape Cod are not limited to natural processes as Davis suggested, but that past and present human activities, such as construction of harbors and the Cape Cod Canal, dredging of channels and mooring areas, revegetation, mining, timber harvesting, clearing of land for agriculture and unrestricted grazing, played a significant role in creating the present morphology of Cape Cod.
SPE309, 76 p., ISBN 0-8137-2309-4, \$30.00, Member price \$24.00

ORDOVICIAN K-BENTONITES OF EASTERN NORTH AMERICA
edited by D. R. Kolata, W. D. Huff, S. M. Bergström, 1996
The Ordovician stratigraphic succession of eastern North America contains at least 60 altered volcanic ash beds, K-bentonites, one or more of which are distributed over an area of 1.5 million square km. Most Ordovician K-bentonites are not widely distributed, but a few can be correlated for hundreds or thousands of kilometers by chemical fingerprinting techniques, tracing on wireline logs, and matching of detailed outcrop descriptions. K-bentonites are a potential source of diverse geologic information. Because the beds were deposited in a geologic instant over large areas, they constitute nearly isochronous rock units useful in precise correlations applicable to biogeographic, paleogeographic, paleoecologic, tectonomagmatic, geochronologic, and sedimentologic investigations on both local and regional scales. The volume presents the most comprehensive set of data currently available on the occurrence and characteristics of Ordovician K-bentonites in eastern North America. The authors (1) summarize the mineralogies and

chemical compositions that help distinguish individual beds and provide information regarding the tectonomagmatic setting of the source volcanoes; (2) document the geographic and stratigraphic distribution of the 60 or more Ordovician K-bentonites in eastern North America; (3) determine the relative positions of K-bentonites within an established biostratigraphic framework; and (4) determine which beds or bed complexes have potential event-stratigraphic significance.
SPE313, 90 p., 8 plates on 2 sheets, ISBN 0-8137-2313-2, \$46.00; Member price \$36.80

SUBSURFACE GEOLOGIC INVESTIGATIONS OF NEW YORK FINGER LAKES: IMPLICATIONS FOR LATE QUATERNARY DEGLACIATION AND ENVIRONMENTAL CHANGE
edited by H. T. Mullins, N. Eyles, 1996
Focuses on the subsurface Quaternary geology of the Finger Lakes of New York State. Includes high-resolution seismic reflecting surveys of the lakes correlated with a 120-m-long drill core, including downhole geophysics. Results of these subsurface investigations have implications for the origin and evolution of the world-renowned lakes, stability of the Laurentide ice sheet during the last deglaciation, and regional climate change over the past 14,000 years. Of interest to Quaternary geologists, geomorphologists, glaciologists, paleolimnologists, paleoclimatologists.
SPE311, 96 p., ISBN 0-8137-2311-6, \$35.00, Member price \$28.00

THE THIRD HUTTON SYMPOSIUM ON THE ORIGIN OF GRANITES AND RELATED ROCKS
M. Brown, P. A. Candela, D. L. Peck, W. E. Stephens, R. J. Walker, E-an Zen, 1996
The invited papers in this volume, from the Third Hutton Symposium on the Origin of Granites and Related Rocks, summarize the latest ideas concerning crustal anatexis, melt segregation, magma transfer, and granite emplacement into lower-grade upper-crustal rocks.
SPE315, 225 p., indexed, ISBN 0-8137-2315-9, \$78.00, Member price \$62.40

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The Geological Society of America

by additional professional and biographical material. We request that nominators include their phone number and/or E-mail address.

Mentors will be selected by GSA section meeting committees from the pool of nominees.

Please send nominations to:
Roy Shlemon Applied Geology Mentor Program
Institute for Environmental Education
Geological Society of America
P.O. Box 9140
Boulder, CO 80301



Check out our CATALOG on the Web!

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GSA Initiates Abstract Fee for 1997 Annual Meeting

Donald M. Davidson, Jr., Executive Director

Costs for implementing an electronic abstract submission system, as well as increasing costs for producing the printed *Abstracts with Programs* books, have led to establishment of a \$15 abstract fee for the GSA Annual Meeting, beginning with the 1997 meeting (Salt Lake City, Utah).

Background

Owing to considerable demand by the membership and encouragement from the GSA Council in 1994-1995, GSA embarked upon construction of an electronic abstract-submission system. This system was brought on line early in 1996, tested, and put into place for the Denver meeting. The system proved to be quite a success—44% (1,257) of the abstracts submitted were sent electronically (*GSA Today*, v. 6, no. 10, p. 14-15).

The total abstracts submitted (2,870) for the 1996 GSA Annual Meeting represent not only a record number, but a doubling in a decade. The price of the *Abstracts with Programs* volume was \$15 in 1986 and \$24 in 1996—a 60% price increase for a 100% volume increase. Additionally, GSA spent \$30,000 constructing the electronic-submission system, including design of the electronic form; generation of the program, documentation, and instruction; testing of the design and implementation of the Web product; design and implementation of the 1996 Annual Meeting program on the basis of the electronic input; and components of the GSA Web server access and overhead. These costs did not include

printing costs and were, of course, not covered by the \$2 price increase in *Abstracts with Programs* from 1995 to 1996. Current calculations project annual costs for the electronic abstract system, including conversion and delivery to an electronic end product, to be on the order of \$5,000 annually.

To summarize, in the past few years costs for producing GSA annual meeting *Abstracts with Programs* have been \$125,000-\$150,000, whereas income ranged from \$80,000 to \$90,000—a 25% to almost 50% shortfall. Historically, this shortfall has been absorbed or “made up” either by other revenue sources from the annual meeting or by investment income (a subsidy). However, the GSA annual meeting has not generated the income necessary to subsidize the *Abstracts with Programs*—or any other subsidized costs—in five of the past 10 years. Annual meeting costs have escalated in several areas, and revenues have not kept pace, which obviously impacts our base meeting charges (the subject of a future article). Additionally, demands on investment income by new initiatives have stretched those funds to their limit.

Why a Fee?

GSA is making every attempt to address the concerns of its members and to provide improvements through technological application, but we must do so in a cost-effective manner. Thus, we are budgeting our abstract fee to address the costs of receiving, handling, printing, and dis-

tributing both electronic and paper abstracts for the GSA annual meeting. The fee is *not* designed to cover general annual meeting expenses.

There will be no fee for Section meeting abstracts.

Because these costs have developed in response to user demand for an electronic-submission system, I feel it only fair that those who submit abstracts for the GSA annual meeting should bear this modest expense. Some may claim that students will be at a disadvantage because of this fee, but the cost is less than the average cost of a music CD, and I suspect that most students submitting abstracts have several such CDs. I also believe that members, libraries, and other buyers of the hard-copy product should not have to pay for the electronic product through significantly increased volume prices.

Finally, please note that these increases will generate only about half of the \$80,000 annual shortfall for *Abstracts with Programs*; thus, GSA will continue to underwrite at least 25% of the costs of this publication, even as we endeavor to reduce costs further. Note also that GSA absorbed \$30,000 of start-up costs for the electronic-submission system.

Questions or Comments?

If you have questions about the reasons for implementation of an abstract fee by GSA, please feel free to contact me at (303) 447-2020 or davidson@geosociety.org. ■

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Here's your **LAST CHANCE** to obtain many of these older GSA books and maps. We **MUST** clear our inventory during this sale. Most older copies remaining on March 1, 1997, will be recycled.

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Final Announcement

NORTH-CENTRAL SECTION, GSA 31st Annual Meeting

Madison, Wisconsin

May 1-2, 1997



The Wisconsin Geological and Natural History Survey of the University of Wisconsin—Extension and the Department of Geology and Geophysics, University of Wisconsin—Madison will jointly host the 31st Annual Meeting of the North-Central Section of the Geological Society of America. The meeting will be held at the Madison Concourse Hotel and Governor's Club in downtown Madison, Wisconsin. Societies meeting in conjunction with the GSA North-Central Section include the Great Lakes Section of SEPM, North-Central Section of the Paleontological Society, Central Section of the National Association of Geoscience Teachers, and Association for Women Geoscientists. Meeting sponsorship by the Wisconsin Geological and Natural History Survey is, in part, a celebration of the state survey's centennial. Join us and share in the experience of May in Madtown!

SETTING

Madison is located in south-central Wisconsin in the Four Lakes area formed following the retreat of the glaciers of the Wisconsin Glaciation some 13,000 years ago. Madison is the capital of Wisconsin and has a population of about 200,000. Locally referred to as "Madtown" or "Mad City," Madison is recognized for its educational institutions, its many fine restaurants and cultural opportunities, the beauty and diversity of its natural setting, and the numerous landmarks of historical and cultural interest. Visit the Web site for Madison (<http://www.ci.madison.wi.us/>) and learn more about one of the most popular locales in the upper Midwest.

REGISTRATION

Registration is required for all who participate in any event at the meeting, including technical sessions, symposia, workshops, field trips, exhibits, and planned social events.

Preregistration Deadline: March 28, 1997

Advance registration is encouraged to aid the local committees in making final plans for the meeting. A preregistration discount is available to those who register using the form provided in this announcement. Advance registration is required for field trips and any workshops. **Return the completed registration form with full payment by check or credit card to the Geological Society of America North-Central Meeting, P.O. Box 9140, Boulder, CO 80301-9140.** Full payment MUST accompany registration. Please register one professional, one student, or one K-12 educator per form; however, guests registering for the meeting may register on the same form. Your confirmation letter from GSA will be your receipt. Preregistration forms

received after March 28, 1997, will be charged at the on-site rate.

Early registration is strongly recommended for all field trips, workshops, and special activities because of limits on the number of participants.

Registration badges must be worn for access to ALL activities. Guest registration is required to attend guest activities; however, all guest activities are additional opportunities for all registrants to experience more of the Madison area. Guest rates are available for persons accompanying a professional, student, or K-12 professional registered for the meeting. Current student ID is required to obtain student rates. Students not having a current student ID when they arrive to pick up registration materials will be required to pay the full professional registration fee.

Access. The GSA North-Central Section is committed to making every event at the 1997 North-Central Section Meeting accessible to all people interested in attending. The Madison Concourse Hotel complies with all ADA requirements. If you have special requirements of any kind, please indicate this on the registration form or call Thomas J. Evans at (608) 263-4125. We will be happy to make whatever arrangements we can to enable

full participation in the meeting. If possible, please let us know by March 28, 1997, so that we have time to make any necessary arrangements.

Cancellations, Changes, and Refunds. All requests for registration additions, changes, and cancellations must be made in writing and received by April 4, 1997. Faxes (303-447-1133 or 303-447-0648) will be accepted. Advance registrations will be refunded for all such cancellations. **NO REFUNDS WILL BE MADE ON CANCELLATION NOTICES RECEIVED AFTER APRIL 4, 1997.** Refunds paid by credit card will be credited according to the card number on the preregistration form. NO refunds will be given for on-site registration and ticket sales.

ON-SITE REGISTRATION SCHEDULE

Registration will be held in the common area on the second floor of the Madison Concourse Hotel and Governor's Club. Registration hours are:
Wed., April 30 4:30 p.m. to 8:00 p.m.
Thurs., May 1 7:30 a.m. to 4:30 p.m.
Fri., May 2 7:30 a.m. to 12:00 noon

STUDENT PAPER AWARDS AND TRAVEL ASSISTANCE GRANTS

The North-Central Section of GSA will award \$100 for each paper (up to a total of eight papers) judged to be best and whose principal author and presenter is a graduate or undergraduate student. Abstracts of papers submitted for consideration for these awards should be so indicated on the abstract form.

Grants for travel assistance of up to \$200 (exclusive of field trip fees) may be made to student members and associates. The assistance will be offered on a first-come, first-served basis, with priority given to students presenting oral or poster papers, if funds are limited. To be eligible for travel assistance grants, students must be currently enrolled in an academic department and certify their student membership in GSA. Applications for travel assistance grants may be obtained by writing to Thomas J. Evans, General Chair for GSA North-Central Section,

REGISTRATION FEES

	Advance*		On-Site	
	Full Meeting	One Day	Full Meeting	One Day
Professional Member	\$60	\$35	\$70	\$45
Professional Nonmember	\$65	\$40	\$75	\$50
Student Member	\$20	\$15	\$25	\$20
Student Nonmember	\$25	\$20	\$30	\$25
K-12 Professional	\$25		\$30	
Guest or Spouse	\$30		\$40	
*By March 28, 1997				

Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 263-4125, tevans@facstaff.wisc.edu. Applications for travel assistance must be received no later than **March 22, 1997**.

TECHNICAL PROGRAM

Questions regarding the technical program should be addressed to Bruce A. Brown, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 263-3201, fax 608-262-8086, babrown1@facstaff.wisc.edu. (Note: UW is University of Wisconsin.) Technical sessions will begin at 8:00 a.m. on Thursday, May 1, 1997, and will conclude at 5:00 p.m. on Friday, May 2, 1997.

SYMPOSIA AND THEME SESSIONS

- 1. Temporal Trends in Ethology, Ecology, and Taphonomy** (sponsored by Paleontological Society North-Central Section). Joanne Kluessendorf, Dept. of Geology, University of Illinois, 1301 W. Green St., Urbana, IL 61801, (217) 367-5916, fax 217-244-4996.
- 2. History of Wisconsin Geologists.** Allan F. Schneider, UW—Parkside, 900 Wood Rd., Box 2000, Kenosha, WI 53141-2000, (414) 595-2326, fax 414-595-2056, schneide@cs.uwp.edu.
- 3. Paleoglaciology** (sponsored by Midwest Glaciology Meeting). David Mickelson, Dept. of Geology and Geophysics, UW—Madison, Lewis G. Weeks Hall, Room 256B, Madison, WI 53706, (608) 262-7863, fax 608-262-0693, mickelson@geology.wisc.edu; John Attig, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 262-6131, fax 608-262-8086, jwattig@facstaff.wisc.edu.
- 4. Importance of Field Trips in Undergraduate Education** (sponsored by the National Association of Geoscience Teachers Central Section). David Malone, Dept. of Geography-Geology, Illinois State University, Campus Box 4400, Normal, IL 67190-4400, (309) 438-2692, fax 309-438-5310, dhmalone@rs6000.cmp.ilsta.edu.
- 5. Basement Structural Influences on Phanerozoic Sedimentation in the Mid-Continent Area** (sponsored by SEPM Great Lakes Section). Robert E. Sloan, Dept. of Geology and Geophysics, University of Minnesota, 108 Pillsbury Hall, 310 Pillsbury Dr., Minneapolis, MN 55455-0219, (612) 624-5543, bsloan@maroon.tc.umn.edu.
- 6. Gilbert O. Raasch Symposium: Paleozoic Geology and Paleontology of the Central United States.** Donald G. Mikulic, Illinois State Geological Survey, 615 E Peabody Dr., Champaign, IL 61820, (217) 244-2518, fax 217-244-7004.

- 7. Special Poster Session on Undergraduate Research.** The fifth annual undergraduate research poster session will be sponsored by the Council on Undergraduate Research. These papers are to be written and presented by undergraduate students on their research. Co-authored papers for which the student is senior author will also be considered. The session will form a separate poster session or be part of another poster session, depending on the response. Undergraduate students who have been involved in research are strongly urged to submit abstracts on their research projects, activities, techniques, and/or preliminary results. Additional information can be obtained from Karen G. Havholm, Dept. of Geology, UW—Eau Claire, Eau Claire, WI 54701, (715) 836-2945, fax 715-836-2380, havholkg@uwec.edu; Robert D. Shuster, Dept. Geography/Geology, University of Nebraska at Omaha, Omaha, NE 68182, (402) 554-2457, fax 402-554-3518, bshuste@cwis.unomaha.edu.
- 8. New Ideas for Field Trips in the Upper Midwest** (special poster session sponsored by NAGT Central Section). David Malone, Dept. of Geography-Geology, Illinois State University, Campus Box 4400, Normal, IL 67190-4400, (309) 438-2692, fax 309-438-5310, dhmalone@rs6000.cmp.ilsta.edu.
- 9. K-16 Teachers: Collaborative Educators for Earth Science Literacy.** Reports of collaborative projects between K-12 and college teachers are especially encouraged, including field programs, hands-on projects, and in-service programs. K-12 teachers are particularly invited to participate. C. Patrick Ervin, Dept. of Geology, Northern Illinois University, DeKalb, IL 60115-1943, (815) 753-1942, fax 815-753-1945, ervin@geol.niu.edu; William F. Kean, Jr., Dept. of Geosciences, UW—Milwaukee, Milwaukee, WI 53201, (414) 229-5231, wkean@csd4.uwm.edu.
- 10. Recent Studies in Precambrian Geology of the Mid-Continent Region.** L. G. Medaris, Jr., Dept. of Geology and Geophysics, UW—Madison, Lewis G. Weeks Hall, 1215 W. Dayton St., Madison, WI 53706, medaris@geology.wisc.edu; Bruce A. Brown, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 262-1705, babrown1@facstaff.wisc.edu; Frank R. Luther, Dept. of Geology, UW—Whitewater, Whitewater, WI 53190-1790, (414) 472-5257.
- 11. Hydrogeology of Non-Point-Source Pollution.** George Kraft, Central Wisconsin Groundwater Center, UW—Stevens Point, Stevens Point, WI 54431, (715) 346-2984, fax 715-346-2965, gkraft@uwspmail.uwsp.edu; Ken Bradbury, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison,

- WI 53705-5100, (608) 263-7921, fax 608-262-8086, krbradbu@facstaff.wisc.edu.
- 12. Hydrogeologic Studies in Fractured Media.** Ken Bradbury, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 263-7921, fax 608-262-8086, krbradbu@facstaff.wisc.edu; Maureen Muldoon, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 262-1580, fax 608-262-8086, muldoon@mac.wisc.edu.
 - 13. Ore Deposits in the Mid-Continent Region and Elsewhere.** Richard Hagni, Dept. of Geology and Geophysics, University of Missouri—Rolla, Rolla, MO 65409, (573) 341-4616, fax 573-341-6935, rhagni@umr.edu; Phil Brown, Dept. of Geology and Geophysics, UW—Madison, Madison, WI 53706, (608) 262-5954, pbrown@geology.wisc.edu.
 - 14. Undergraduate Research Results.** Robert W. Baker and Sam Huffman (samuel.huffman@uwrf.edu), Dept. of Plant and Earth Science, UW—River Falls, River Falls, WI 54022, (715) 425-3345, fax 715-425-3785.

PROJECTION EQUIPMENT

Two standard 35 mm carousel projectors for 2" x 2" slides and two viewing screens will be provided in each meeting room. An overhead projector for transparencies will be available for each room as well. A speaker ready room equipped with projectors will be available for review of slides and overheads and for speaker preparation. Each carousel to be used in an oral presentation should be identified with the speaker's name, session number, and speaker number and must be ready for use at the beginning of the particular technical session.

POSTER SESSIONS

Students and professionals are encouraged to take advantage of this effective means of presentation. Each poster booth will contain two areas, 4 feet by 4 feet each, arranged at table height. Poster sessions will include all topics listed on the GSA abstract form. The four poster sessions, on Thursday and Friday, May 1 and 2, will be located in the Madison Ballroom on the second floor of the Madison Concourse Hotel and Governor's Club. They will be in the same area as exhibits and will be available for viewing for four hours.

Undergraduate students are especially encouraged to submit posters for symposium 7, Special Poster Session on Undergraduate Research. The fifth annual undergraduate research poster session will be sponsored by the Council on Undergraduate Research. These papers are to be writ-

North-Central continued on p. 21

PREREGISTRATION FORM

GSA North-Central Section

Madison, Wisconsin, May 1-2, 1997

Please print clearly • THIS AREA IS FOR YOUR BADGE

Name as it should appear on your badge (last name first) _____

 Employer/University Affiliation _____

 City _____ State or Country _____

Mailing Address (use two lines if necessary) _____

 City _____ State _____
 ZIP Code _____ Country (if other than USA) _____
 Circle member affiliation (to qualify for registration member discount):
 (A) GSA (B) AWG (C) NAGT (D) PS (E) SEPM

GUEST INFORMATION • Please print clearly • This area is for badge

Name as it should appear on your guest's badge (last name first) _____

 City _____ State or Country _____

Please inform us by March 28, 1997 of any special considerations that you or your guest require.
 I will need special considerations.

() _____ Business Phone _____
 () _____ fax _____
 () _____ Home Phone _____

Preregistration Deadline: March 28
Cancellation Deadline: April 4

MAIL TO:
GSA NORTH-CENTRAL SECTION MEETING
P.O. BOX 9140, BOULDER, CO 80301

Remit in U.S. funds payable to:
1997 GSA North-Central Section Meeting
*(All preregistrations must be prepaid.
 Purchase Orders not accepted.)*

Payment by (check one): Check MasterCard
 American Express VISA MasterCard

Card Number _____ Expires _____
 Signature _____

REGISTRATION FEES

	Full Meeting	One Day	Qty.	Amount
Professional Member*	(01) \$60 <input type="checkbox"/>	(02) \$35 <input type="checkbox"/>	1	\$ _____
Professional Nonmember	(03) \$65 <input type="checkbox"/>	(04) \$40 <input type="checkbox"/>	1	\$ _____
Student Member*	(05) \$20 <input type="checkbox"/>	(06) \$15 <input type="checkbox"/>	1	\$ _____
Student Nonmember	(07) \$25 <input type="checkbox"/>	(08) \$20 <input type="checkbox"/>	1	\$ _____
K-12 Professional	(42) \$25 <input type="checkbox"/>	NA	1	\$ _____
Guest or Spouse	(09) \$30 <input type="checkbox"/>	NA	1	\$ _____

*Member fee applies to any current Professional OR Student Member of GSA or Associated Societies listed at left. Discount does not apply to guest registrants.

ALTERNATIVE OPPORTUNITIES FOR REGISTRANTS AND GUESTS

1. Univ. of Wisconsin Geology Museum	May 1	(20)	FREE	1	_____
2. Hike on the Ice Age Trail	May 1	(21)	FREE	1	_____
3. Tour of Univ. of Wisconsin Arboretum	May 2	(22)	FREE	1	_____
4. Wisconsin State Capitol Building	May 2	(23)	FREE	1	_____

SPECIAL EVENTS

1. GSA N-C Section Management Board Breakfast	May 1	(60)	FREE	1	_____
2. Paleontological Society-SEPM Luncheon	May 1	(61)	\$ 10	1	\$ _____
3. Annual Banquet	May 1	(62)	\$ 22	1	\$ _____
Circle entree choice:		(63)	\$ 22	1	\$ _____
Chicken Breast Marsala	May 2	(64)	\$ 10	1	\$ _____
Vegetarian Stuffed Puff Pastry	May 2	(65)	FREE	1	_____
4. AWG Breakfast	May 2	(66)	\$ 10	1	\$ _____
5. GSA N-C Campus Reps Breakfast	May 2	(60)	FREE	1	_____
6. NAGT Luncheon	May 2	(150)	\$ 5	1	\$ _____

WORKSHOP

1. Ordovician and Silurian Rocks	May 2	(150)	\$ 5	1	\$ _____
2. Roy Shlemon Mentors Program	May 2	(151)	FREE	1	_____

FIELD TRIPS

1. Silurian Dolomite Aquifer of Door Peninsula	April 29-30	(101)	\$140	1	\$ _____
2. Geologic Traverse of East-Central Wisconsin	April 29-30	(102)	\$ 95	1	\$ _____
3. Field Guide to Baraboo District	April 30	(103)	\$ 45	1	\$ _____
4. Green Bay Lobe during Wisc. Glaciation	April 30	(104)	\$ 45	1	\$ _____
5. Precambrian Waterloo Quartzite	April 30	(105)	\$ 20	1	\$ _____
6. Pleist. Geomorph. & Stratig., Door Peninsula	May 2-4	(106)	\$170	1	\$ _____
7. Late Cambrian Shelf Sedimentation	May 2-4	(107)	\$240	1	\$ _____
8. Mining History and Geology of SW Wisconsin	May 3	(108)	\$ 40	1	\$ _____
9. Glacial Geomorphology of Green Bay Lobe	May 3	(109)	\$ 45	1	\$ _____
10. Sequence Stratigraphy of Silurian Strata	May 3	(110)	\$ 45	1	\$ _____
11. Sedimentol. of Middle Ordovician, E. Wisconsin	May 3-4	(111)	\$130	1	\$ _____

TOTAL FEES REMITTED \$ _____

ten and presented by undergraduate students on their research. Co-authored papers for which the student is senior author will also be considered. The session will form a separate poster session or be part of another poster session, depending on the response. Undergraduate students who have been involved in research are strongly urged to submit abstracts on their research projects, activities, techniques, and/or preliminary results for this session. Additional information can be obtained from Karen G. Havholm, Dept. of Geology, UW—Eau Claire, Eau Claire, WI 54701, (715) 836-2945, fax 715-836-2380, havholkg@uwec.edu; Robert D. Shuster, Dept. of Geography and Geology, University of Nebraska at Omaha, Omaha, NE 68182, (402) 554-2457, fax 402-554-3518, bshuste@cwis.unomaha.edu.

WORKSHOPS

- 1. Ordovician and Silurian Rocks of Eastern Wisconsin.** A workshop to study recently drilled cores of the Ordovician and Silurian rocks of eastern Wisconsin will be presented by Mark Harris of University of Wisconsin—Milwaukee and J. A. Simo of University of Wisconsin—Madison. Participants will receive a guide with an introduction to the geologic setting and core descriptions. *This workshop will be of particular interest to those participating in field trips 1, 10, and 11.* Friday, May 2. Cost: \$5. See *Abstracts with Programs* volume for location.
- 2. Roy Shleman Mentors in Applied Geology Program: Workshop for Students** (sponsored by the Institute for Environmental Education). Designed for upper-level undergraduate and graduate students, this workshop is presented by practicing professional geologist(s) in the private sector in order to provide student geologists with information on geologic principles applied to environmental problems confronting today's society. There is no charge to students for this workshop; however, preregistration is required as space may be limited. Use the registration form included in this announcement. See *Abstracts with Programs* volume for location and time. Friday, May 2.

FIELD TRIPS

The field trip coordinator for the 1997 GSA North-Central Section meeting is Michael G. Mudrey, Jr., Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 263-5495, fax 608-262-8086, mgmudrey@facstaff.wisc.edu. All inquiries regarding field trip arrangements should be directed to Mudrey. All trips begin and end at the Concourse Hotel and Governor's Club in Madison, Wisconsin.

Premeeting

1. The Silurian Dolomite Aquifer of the Door Peninsula: Facies, Sequence Stratigraphy, and Hydrogeology.

Mark T. Harris, Dept. of Geosciences, UW—Milwaukee, P.O. Box 413, Milwaukee, WI 53201, (414) 229-5777, fax 414-229-5452, mtharris@csd.uwm.edu; Maureen Muldoon, Wisconsin Geological and Natural History Survey; Ronald D. Stieglitz, UW—Green Bay.

Five depositional sequences in Lower Silurian dolomite provide a regional framework for an aquifer matrix porosity-conductivity model that clarifies aquifer conditions of fracture-dominated groundwater flow patterns in the Door Peninsula, Wisconsin.

Two days, departing 8:00 a.m. on Tuesday, April 29, 1997, and returning in time for meeting registration on April 30. Cost: \$140.

2. Geologic Traverse of East-Central Wisconsin.

Steven I. Dutch, Natural and Applied Sciences, University of Wisconsin—Green Bay, Green Bay, WI 54311-7001, (414) 465-2370, fax 414-465-2376, dutchs@uwgb.edu; Joseph M. Moran and Ronald D. Stieglitz, University of Wisconsin—Green Bay.

A geologic overview of Silurian, Ordovician, Cambrian, and Precambrian units west and south of Green Bay in eastern Wisconsin will be presented.

Two days, departing 5:00 p.m. on Tuesday, April 29, 1997, and returning in time for meeting registration on April 30. Cost: \$95.

3. Field Guide for Field Trip Leaders to the Baraboo District, Wisconsin.

David H. Malone, Dept. of Geography-Geology, Illinois State University, Campus Box 4400, Normal, IL 61790-4400, (309) 438-2692, fax 309-438-5310, dhmalon@rs6000.cmp.ilstu.edu; Nicholas Van Wyck, Tucson, Arizona; Robert Nelson, Illinois State University.

Classical and seldom-visited localities in the Baraboo-Devils Lake area will be examined as opportunities for instruction. The outcrops can be used to review early studies of structural geology, deformational history, and sedimentology in light of modern methods.

One day, departing 8:00 a.m. on Wednesday, April 30, 1997, and returning in time for meeting registration. Cost: \$45.

4. Conditions Around the Margin of the Green Bay Lobe During the Height of the Wisconsin Glaciation.

Lee Clayton, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608)-263-6839, fax 608-262-0693, lclayton@facstaff.wisc.edu; John W. Attig, Wisconsin Geological and Natural History Survey; David M. Mickelson, UW—Madison.

Processes operating near the margin of the Green Bay Lobe during the height

of the Wisconsin glaciation will be examined in the area northwest of Madison.

One day, departing 8:00 a.m. on Wednesday, April 30, 1997, and returning in time for meeting registration. Cost: \$45.

5. The Precambrian Waterloo Quartzite, Dodge and Jefferson Counties, Wisconsin—Petrology, Structure, and Industrial Use.

Frank R. Luther, Dept. of Geology, UW—Whitewater, 800 West Main Street, Whitewater, Wisconsin 53190, (414) 593-2660.

Participants will see small-scale sedimentary structures, structural geology elements, dikes, and metamorphic minerals in the Waterloo Quartzite.

One-half day, departing 1:00 p.m. on Wednesday, April 30, 1997, and returning in time for meeting registration. Cost: \$20.

Postmeeting

6. Pleistocene Geomorphology and Stratigraphy of the Door Peninsula, Wisconsin.

Allan F. Schneider, Dept. of Geology, UW—Parkside, Box 2000, Wood Road, Kenosha, WI 53141-2000, (414) 595-2439, schneide@cs.uwp.edu; Barry Miller, Kent State University; Eric Dott, Minnesota Pollution Control Agency.

Modern and ancient shorelines, bedrock control of geomorphic features, and glacial history, including stratigraphy of the Two Creeks sites, postglacial geology, and karst will be illustrated.

Three days, departing 5:00 p.m. (after technical sessions) Friday, May 2, 1997, and returning by 5:00 p.m., Sunday, May 4. Cost: \$170.

7. Late Cambrian Shelf Sedimentation, Upper Mississippi Valley, Wisconsin and Minnesota.

J. Brian Mahoney, Dept. of Geology, UW—Eau Claire, Eau Claire, WI 54701-4004, (715) 836-4952, fax 715-836-2380, mahonej@uwec.edu; Karen G. Havholm, UW—Eau Claire; Anthony C. Runkel, Minnesota Geological Survey; Robert L. Hooper, UW—Eau Claire.

Refined biostratigraphic framework, recognition of sequence boundaries, and facies relations among Upper Cambrian-Lower Ordovician strata shed new light on the depositional history in western Wisconsin and eastern Minnesota on the eastern edge of the Hollandale embayment.

Three days, departing 5:00 p.m. (after technical sessions) on Friday, May 2, 1997, and returning by 5:00 p.m., Sunday, May 4. Cost: \$240.

8. 300 Years of Mining History and Geology in the Upper Mississippi Valley Zinc-Lead District, Southwestern Wisconsin.

M. G. Mudrey, Jr., Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 263-5495, fax 608-262-8086, mgmudrey@facstaff.wisc.edu.

Geology, ore deposits, and cultural and technological history of the type–Upper Mississippi Valley zinc-lead deposits from pre-1690 to modern are presented in outcrop and visits to underground and surface museums.

One day, departing 8:00 a.m., Saturday, May 3, 1997, and returning by 5:00 p.m. Cost: \$40.

9. Glacial Geomorphology and Glaciology of the Green Bay Lobe During the Last Deglaciation, Southeastern Wisconsin. Patrick M. Colgan, Dept. of Geology, Northeastern University, 14 Holmes Hall, Boston, MA 02115, pcolgan@lynx.dac.neu.edu; David M. Mickelson, UW—Madison; Lee Clayton and John Attig, Wisconsin Geological and Natural History Survey.

Glacier dynamics and bed conditions of the Green Bay lobe are reconstructed through mapping of landforms and sediment in southeastern Wisconsin.

One day, departing 8:00 a.m. on Saturday, May 3, 1997, and returning 5:00 p.m. Cost: \$45.

10. Sequence Stratigraphy and Depositional Environments of Silurian Strata of Southeastern Wisconsin. Joanne Kluessendorf, Dept. of Geology, University of Illinois, 1301 West Green Street, Urbana, IL 61801; Donald G. Mikulic, Illinois State Geological Survey.

Regional stratigraphic relationships and new work on conodont biostratigraphy will be emphasized on visits to classic localities, including Silurian reefs and the Waukesha soft-bodied fossil locality.

One day, departing 8:00 a.m. on Saturday, May 3, 1997, and returning by 5:00 p.m. Cost: \$45.

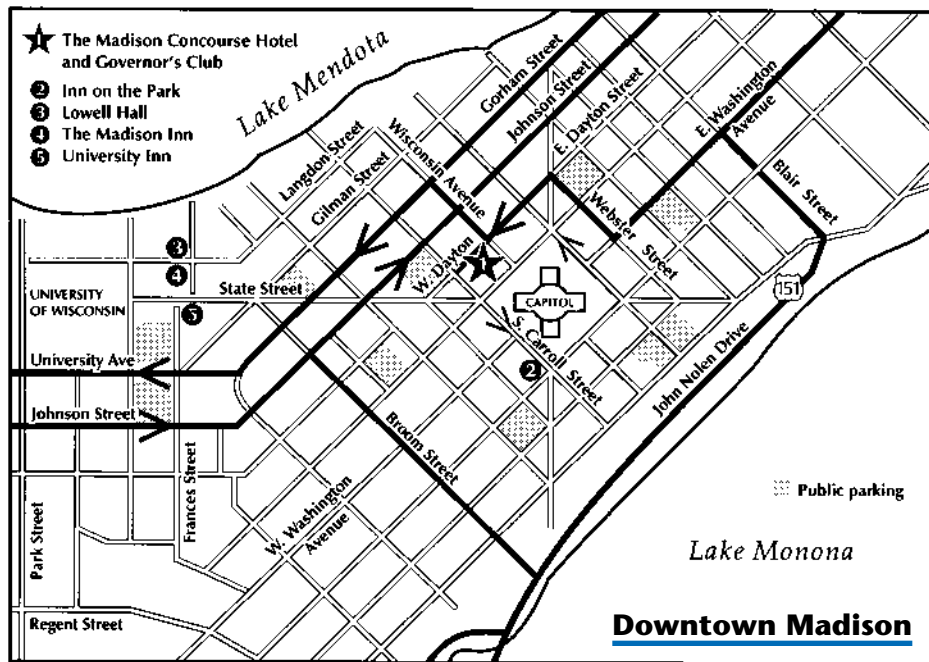
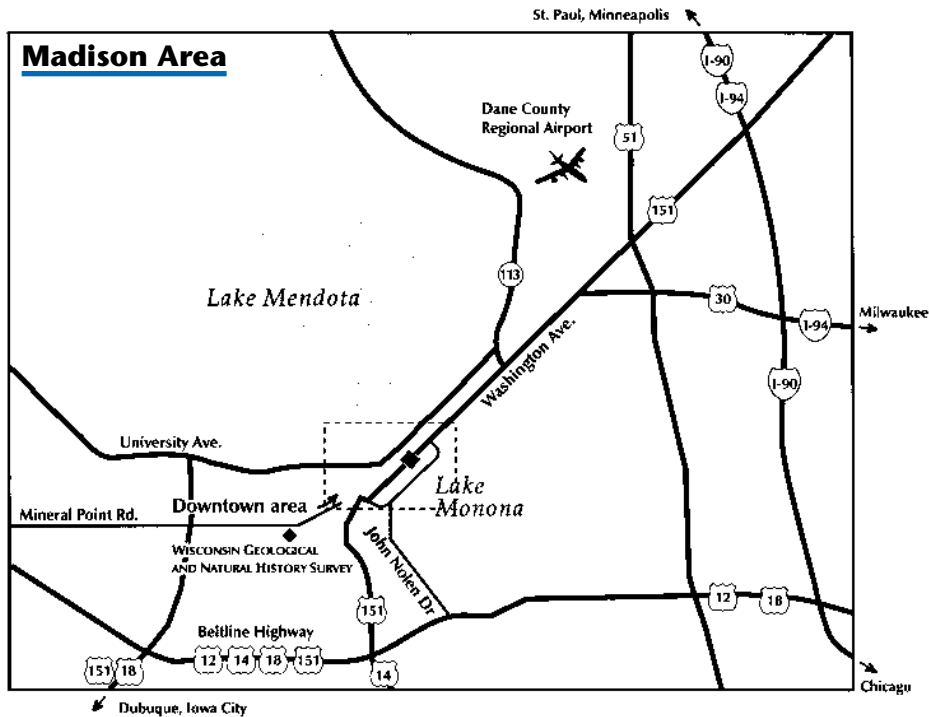
11. Sedimentology, Sequence Stratigraphy, and Paleooceanography of the Middle Ordovician of Eastern Wisconsin. J. A. Simo, Dept. of Geology and Geophysics, UW—Madison, 1215 W. Dayton St., Madison, WI 53705-1692, (608) 262-5987, fax 608-262-0693, simo@geology.wisc.edu; Luke Choi, Phil Freiberg, Charlie W. Byers, Robert H. Dott, and Beverly Saylor, UW—Madison.

Sequence stratigraphy, unconformities, depositional environments, and hardground interpretation of late Early to Middle Ordovician carbonates are used to emphasize the evolution from a shallow, warm tropical sea to deeper, temperate ocean.

Two days, departing 8:00 a.m. on Saturday, May 3, 1997, and returning by 5:00 p.m. Sunday, May 4. Cost: \$130.

SPECIAL ACTIVITIES AND EVENTS

All special events and business meetings will be held in the Madison Concourse Hotel and Governor's Club. A **Welcoming Reception** will be held on



Wednesday evening, April 30, 1997. Special music entertainment for the reception will be provided by the Checkered Past jazz band featuring M. E. (Buzz) Ostrom, former Wisconsin State Geologist. The **Annual Banquet** will be held on Thursday evening, May 1, preceded by a social hour beginning at 6:00 p.m. The banquet will be followed by a short business meeting. Please register for the Annual Banquet (cost is \$22) on the registration form included in this announcement, and indicate your choice of a main entree. A **special address** by Robert H. Dott, Jr. will follow the dinner and brief business meeting.

The **GSA North-Central Section Management Board** will hold its business meeting with breakfast on Thursday, May 1, 1997, beginning at 7:00 a.m. The location will be announced in the *Abstracts with Programs* volume. The **North-Central GSA Campus Representatives** breakfast and meeting will be held Friday, May 2, 1997, at 7:00 a.m. A breakfast meeting for the **Association for Women Geoscientists** will be held on Friday, May 2; cost is \$10 per person, and preregistration is required. See *Abstracts with Programs* for details on meeting time and location. Luncheon meetings for the **North-Central Section of the**

Paleontological Society (in conjunction with the Great Lakes Section of SEPM) on Thursday, May 1, and the **Central Section of the National Association of Geoscience Teachers** on Friday, May 2, begin at 12 noon in the Concourse Hotel. Cost for either is \$10 per person; preregistration is required. See *Abstracts with Programs* for room location.

ALTERNATIVE OPPORTUNITIES FOR REGISTRANTS AND GUESTS

The local committee has planned four opportunities for registrants and guests at the meeting to enjoy just a few of the many interesting features of the Madison area. Please preregister for these events.

1. **University of Wisconsin—Madison Geology Museum.**

Well known in the upper Midwest for the quality of its fossil collections, mineral specimens, and state-of-the-art interpretative geological displays, the museum features a six-foot rotating globe, a black-light mineral and rock exhibit, meteorites, and the skeletons of dinosaurs and a Wisconsin mastodon. Tour participants will gather in the lobby of the Madison Concourse Hotel no later than 8:30 a.m. on Thursday, May 1. The tour will last for approximately two hours and, weather permitting, will be followed by a brief visit to Allen Gardens along Observatory Drive on the University of Wisconsin—Madison campus. Participants will return to the Madison Concourse Hotel and Governor's Club in time to join others for lunch at a Madison restaurant of their choice.

2. **Hike on the Ice Age Trail.** A representative of the Ice Age Trail Foundation will lead a short hike along the National Ice Age Trail segment in the Dane County area near Madison. Participants will meet in the lobby of the Madison Concourse Hotel at 1:00 p.m. on Thursday, May 1, for transportation to the trailhead and will return to the hotel by 4:30 p.m., in time to enjoy the Annual Banquet and other activities of the meeting. In case of inclement weather, a slide presentation featuring the Ice Age Trail will be presented in the Madison Concourse Hotel at a location specified in the *Abstracts with Programs* volume.

3. **Tour of the University of Wisconsin—Madison Arboretum.** A unique feature of the local area is the university's arboretum, located in the midst of the urban landscape of Madison; it features prairies, forests, and wetland environments typical of the south-central Wisconsin region. Flowering trees, shrubs, and scenic hiking trails are all a part of one of Madison's special natural locales. Participants on the tour will meet in the lobby of the Madison Concourse Hotel no later than 9:00 a.m. on Friday, May 2. If the weather is inclement, an indoor program on the arboretum grounds will be substi-

tuted. Tour participants will be returned to the meeting hotel by noon.

4. **Wisconsin State Capitol Building and State Historical Museum.** Within easy walking distance of the Madison Concourse Hotel and Governor's Club, the Wisconsin State Capitol Building features an interesting mix of dramatic dimension stones from all over the world, in addition to a large array of striking architectural features. Participants will meet at 1:30 p.m. on Friday, May 2, to walk together to the capitol. Following the 50-minute guided tour, participants will visit the State Historical Museum located across the street from the capitol building for a self-guided tour beginning at 3:15 p.m. Participants will be able to return to the Madison Concourse Hotel by 4:30 p.m.

ACCOMMODATIONS

Several hundred rooms have been reserved at the Madison Concourse Hotel and Governor's Club, the meeting center and location of all major meeting events, as well as in other nearby hotel facilities. **Meeting registrants and guests are responsible for making their own lodging arrangements.** Reservations should be made **no later than April 1, 1997**, to guarantee the special room rates that have been negotiated for this meeting. Be sure to indicate that you are participating in the North-Central Section of the Geological Society of America meeting to receive the special room rate. Meeting registrants are encouraged to take advantage of the world-class facilities of the Madison Concourse Hotel and Governor's Club by registering to stay at the meeting center. The rate for the Madison Concourse Hotel is a room rate for as many as four persons per room, each of which has two double beds.

1. **Madison Concourse Hotel and Governor's Club.** One West Dayton Street, Madison, WI 53703, (608) 257-6000; \$79/room.

2. **Inn on the Park.** 22 S. Carroll Street, Madison, WI 53703, (608) 257-8811; \$79/room.

3. **Lowell Hall** (residential facility operated by the University of Wisconsin—Extension Conference Center). 610 Langdon Street, Madison, WI 53703, (608) 256-2514; \$46–\$52 (1 or 2 persons).

4. **The Madison Inn.** 601 Langdon Street, Madison, WI 53703, (608) 257-4391; \$52/1 person; \$60/2 persons.

5. **University Inn.** 441 N. Frances Street, Madison, WI 53703, (608) 257-4881; \$72/room.

MEALS

Madison is recognized for its many fine restaurants, brew pubs, and diverse ethnic eating facilities. In addition to The Bistro, located in the Madison Concourse

Hotel and Governor's Club, many excellent eating establishments are within easy walking distance of the meeting facilities. A selected list of restaurants with additional information on price ranges, available ethnic cuisines, and addresses will be included in the registration materials available upon registration at the meeting on the second floor of the Madison Concourse Hotel.

TRANSPORTATION

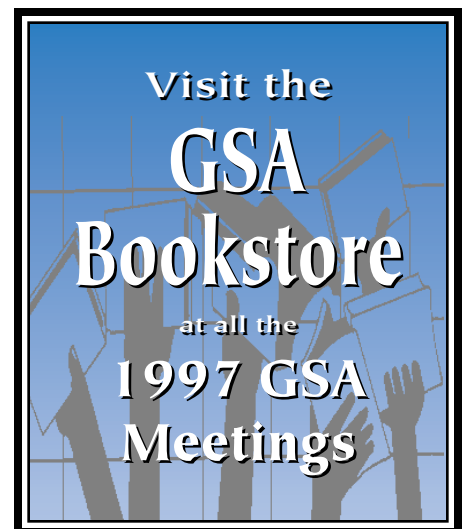
The Madison Concourse Hotel and Governor's Club is located in downtown Madison. Madison is reached by major highways including I-90, I-94, and I-39, U.S. Hwy. 151, and U.S. Hwy. 51. Madison is served by several major airlines via the Dane County Regional Airport and is a major hub for Greyhound Bus and Badger Bus service.

Parking at the Madison Concourse Hotel and Governor's Club will be free to registrants who are also staying in the meeting hotel.

For meeting registrants staying at other hotels or local accommodations, parking at the Concourse will be at a rate of \$3 per day. Downtown Madison is also served by several other parking facilities located close to the Madison Concourse Hotel.

EXHIBITS

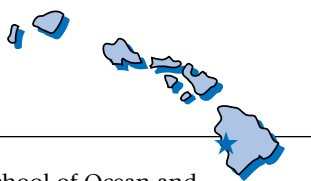
Exhibits of educational and commercial organizations will be on display in the Madison Ballroom on the second floor of the Madison Concourse Hotel and Governor's Club close to the symposia, technical sessions, and displays, and in the same room as the poster sessions. Exhibit space must be reserved by *February 28, 1997*. For further information, contact Fred Madison, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705, (608) 262-1705, fax 608-262-8086. ■



Final Announcement

CORDILLERAN SECTION, GSA 93rd Annual Meeting

Kailua-Kona, Hawaii
May 21–23, 1997



The Department of Geology and Geophysics of the School of Ocean and Earth Science and Technology, University of Hawaii, will host the 1997 meeting of the Cordilleran Section of the Geological Society of America. Meetings will be held at the Convention Center of the Kona Surf Resort and Country Club, on the west coast of Hawaii about 10 km south of Kailua-Kona.

SETTING

Kailua is a coastal town in the North Kona District of the island of Hawaii ("Big Island") in the State of Hawaii. It lies on the west side of Hawaii, and of Hualalai, a dormant volcano that last erupted in 1800–1801. For May in Kona expect a mid-afternoon high of about 28°C, and a dawn low of about 18°C. A late-afternoon sea breeze commonly brings clouds and showers, but heavy rain is unusual—the highest monthly total recorded for any May is 12 cm. The sea-surface temperature will be about 24°C.

Air access to Kona is through the Keahole Airport, about 11 km north of Kona. The airport has daily direct flights to and from San Francisco, Los Angeles, and Tokyo. There are about two flights per hour to and from Honolulu on interisland

airlines, and Honolulu has numerous daily direct or connecting flights to West Coast and inland cities. Keahole (Kailua-Kona) also has numerous flights to other airports within Hawaii. Some airlines allow a "common fare" between a U.S. West Coast or inland airport, through Honolulu, and on to an airport on one of the outer islands (e.g., Los Angeles–Honolulu–Kona) for the cost of the fare to Honolulu alone. Some other airlines charge each section separately (e.g., Los Angeles–Honolulu, plus Honolulu–Kona). Ask your travel agent.

The meeting site is relatively isolated. Air transport and hotel accommodations will be adequate for the meeting if attendees plan their travel, registration, housing, and field-trip choices in accord with the normal deadlines. When the Cordilleran Section decided on a Hawaii venue five years ago it was not known that observance of Memorial Day would be moved to May 26, from its traditional May 30 date; because of this holiday alteration, the most convenient flights may fill quickly.

REGISTRATION

Preregistration Deadline: April 18, 1997

Name badges and tickets to special functions will be mailed to those who take advantage of lower registration costs by preregistering before the *April 18, 1997*, deadline. Save yourself time and money—preregister today!

Advance registration is encouraged for many of the field trips because of participation limits. Use the preregistration form provided in this announcement. All registrations received after April 18 will be held for on-site processing and charged the on-site rates.

Badges must be worn for access to all activities, 5:00 p.m. Tuesday through 5:00 p.m. Friday.

Registration discounts are given to members of GSA and the Associated Societies listed on the registration form. Please indicate your affiliation(s) to register using the member rates. Speakers not affiliated

with member societies may receive the discount by checking the speaker box.

Full payment must accompany registration. Unpaid purchase orders are not accepted as valid registration. Charge cards are accepted as indicated on the pre-registration form. Please recheck the card number given, as errors will delay your registration. The confirmation card will be your receipt. No other receipt will be given.

Register one professional or student per form. Copy the form for your records.

Guest registration is required for those attending meeting activities, including technical sessions. Guest registrants must be accompanied to activities, except for Field Trip 8, by either a registered professional or a registered student. A guest is defined as a nongeologist spouse or friend of a professional or student registrant.

Students and K–12 professionals must show a current ID on site in order to obtain these rates. Students or educators not having a current ID when registering on site will be required to pay the professional fee.

On-site registration will be available on the lobby floor of the Kona Surf hotel from 3:00 p.m. to 7:00 p.m. on Tuesday, 7:30 a.m. to 4:00 p.m. on Wednesday and Thursday, and 7:30 a.m. to 12 noon on Friday.

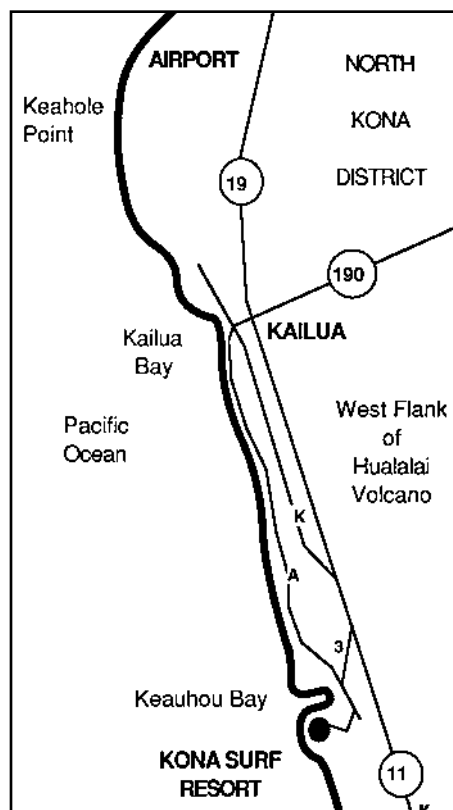
The *Abstracts with Programs* book may be purchased with your GSA membership renewal, or on site in the registration area.

Cancellations, Changes, and Refunds

All requests for registration additions, changes, and cancellations must be made in writing and received by April 25, 1997. GSA will refund or credit preregistration fees for cancellations received in writing by that date. No refunds or credits will be made on cancellation notices received after April 25. Refunds will be processed after the meeting. There will be no refunds for on-site registration and ticket sales.

Accessibility for Registrants with Special Needs

GSA and Kona Surf are committed to making every event at the 1997 Cordilleran



PREREGISTRATION FEES		
by April 18	Full Meeting	One Day
Professional		
Member	\$80	\$40
Nonmember	\$90	\$45
Student		
Member	\$30	\$15
Nonmember	\$40	\$20
K–12 Professional	\$15	\$ 5
Guest or Spouse	\$10	NA

Section meeting accessible to all people interested in attending. All areas of the hotel and its Convention Center are wheelchair-accessible except the salt-water pool. Equipment for the hearing-impaired is available. If you have a special requirement, we ask you to indicate it on the registration form. If you have questions, contact Ralph Moberly, ralph@soest.hawaii.edu. If possible, please let us know by March 21, 1997.

HOUSING

Preregistration Deadline: March 21, 1997

Housing registration by mail will be handled by the Kona Surf, which has reserved for GSA a block of rooms in its hotel, and reserved overflow into the nearest adjacent hotel. Together the two will accommodate the average number of Cordilleran Section attendees of the past 15 years. Room rates, including upgrades, reduced rates for students sharing rooms, and accommodation for children are on the Housing Form in this announcement.

FIELD TRIPS AND WORKSHOPS

For details about specific trips, please contact the field trip leaders listed below. General questions should be addressed to Field Trips Chair Floyd W. McCoy, Jr., Natural Sciences, Windward Community College, 45-720 Kealahala Rd., Kaneohe, HI 96744, fmccoy@hawaii.edu; or co-chair Patty Lee, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Rd., Honolulu, HI 96822, plee@soest.hawaii.edu.

Participants will be accepted on a first-come, first-served basis. Be aware of cancellation penalties imposed by airlines; you may need to plan alternatives in advance, in case the trip for which you register is already filled or is canceled. Note that some trips do not include all airfares to or from the Honolulu or Kona airports, because some attendees may wish to arrive in Hawaii early or leave late, or that they are already covered in whatever air package you receive from your travel agent. Also, some trips may not cover all meals, as some participants may want to take advantage of the variety of offerings in cuisine or in cost.

Interisland airline personnel have informed us that scheduled departures and arrivals may change once or even twice by the time of the meeting, usually by just a few minutes. Trip leaders will notify registered participants of any changes that may affect their connecting flights.

A field guide is included for all trips except the GMT workshop, for which a set of workshop notes will be provided.

The cost listed is for professionals, students, guests, and spouses. The cost in

HOUSING FORM — Kona Surf Resort

Cordilleran Section, Geological Society of America May 21–23, 1997

Accommodations for single or double occupancy, per room, per night. Rates are available from Sunday, May 18 through Sunday, May 25, and are noncommissionable.

- Standard Room \$95 Ocean View Room \$105
Each additional adult at \$15 each (4 max.): Third person Fourth person
Children under age 18 are free when sharing room with parent and using beds already in room; rollaway bed is an additional \$20 per night; no charge for cribs.

Student Quads (for 4-student occupancy) one-fourth of \$115 A/V*

**Check here if you have applied for and will receive aid from the Local Committee to assist with A/V. Send this registration form but do not send prepayment to the hotel. If roommates are known, list them here (maximum 4); otherwise, roommates will be assigned.*

Reservations must be made by **March 21, 1997**.

Rooms will be assigned in order of receipt of deposit. Standard rooms will be upgraded to garden view, and ocean view rooms will be upgraded to ocean front, through their availability. If no room remains available at the rate requested, reservation will be made at the other rate. Later registrants may be accommodated in an adjacent hotel for comparable quality and rates. Rates have additional 10.17% state and hotel taxes (subject to change). By union regulations, a \$4.17 baggage-handling fee will be imposed for guests using a prearranged ground handler (e.g., bus, but not rental cars or taxis).

Date of Arrival _____ Approximate Time _____ Number of Nights _____

- Smoking Nonsmoking Either
 I have special needs (with respect to the ADA) (contact hotel with requirement)
 I qualify for a government rate (contact hotel for rate)
 I am interested in a lanai suite (contact hotel for rate)

Check-in is 3:00 p.m. (early check-ins accepted subject to room availability).
Check-out is 12:00 noon.

This reservation form, along with a one-night deposit by U.S. check or money order or a major credit card must be received no later than 60 days prior to guest's arrival. Note that the credit-card number for a one-night deposit will be charged 30 days prior to arrival. Balance is to be paid upon checkout.

Name _____

Address _____

City _____ State/Prov _____ ZIP _____

Representing _____ Telephone _____ O H

My deposit is by

Check Money order Credit card: AMEX MC VISA Other _____

Card number: _____ Expires _____

Signature _____

Send to: Kona Surf Resort, 78-128 Ehukai Street, Kona, HI 96740
(808) 323-3411 (800) 367-8011 fax 808-322-3245

parentheses for trips 1, 7, 8, 9, and 10 is for K-12 professionals.

Premeeting

1. Volcanoes and the Sea: Geologic Processes on Maui and Hawaii.

May 18–20. This general trip will be repeated in reverse order after the meeting. Patty Lee, Dept. of Geology and Geophysics, University of Hawaii,

2525 Correa Road, Honolulu, HI 96822, plee@soest.hawaii.edu; Pow-foong Fan, University of Hawaii; Nancy Baker, Haleakala National Park; Glenn Shepherd, consultant, Maui; Janet Babb, consultant, Hawaii; Alex Malahoff, University of Hawaii. Cost: \$425 (\$385 for K-12 teachers) includes airfare, Honolulu to Maui

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and Maui to Hilo; ground transportation on Maui and Hawaii; two box lunches and one box dinner; two nights at hotels on Hawaii. Does not include one lunch and one dinner. Limit: 21. First day: Fly to Maui; features of Haleakala Volcano (last erupted two centuries ago) and vicinity. While at summit (3000 m) the group can be divided, if necessary, into those undertaking more strenuous and less strenuous activities. Fly to Hilo. Second morning in Puna Rift area. Late afternoon and evening viewing on flank and coast in area of active flows. Third morning in and near Kilauea Caldera, Hawaii Volcanoes National Park; afternoon on flanks of Kilauea, Mauna Loa, and Hualalai. Assemble at 6:45 a.m. Sunday, May 18, at Aloha Airlines check-in counter, Honolulu Airport. Arrive Kona Surf hotel at 6:00 p.m. Tuesday, May 20.

2. Weathering and Soil Formation on Hawaii Island. May 20. Oliver A. Chadwick, Dept. of Geography, University of California, Santa Barbara, CA 93106, oac@geog.ucsb.edu; Robert Gavenda, USDA Soil Conservation Service, Kealahou, rgavenda@hi.nrcs.usda.gov; Carolyn G. Olson, USDA Soil Conservation Service, Lincoln, Nebraska, agro202@unlvm.unl.edu. Cost: \$70, includes van transportation, lunch. Limit: 25. Pedology and tropical microclimates. Processes that contribute to soil morphology and mineralogy, as demonstrated in outcrops ranging from a few hundred to 400,000 yr old and in a rainfall gradient of from 200 to 3000 mm/yr. Consideration of geochemistry, eolian and Be contributions, and isotopic composition of soil water and soil minerals. Leave 8:00 a.m. Tuesday, May 20 from Kona Surf main entrance, and return at 5:30 p.m.

3. Petrology and Volcanology of Maui. May 18–20. *For the physically fit.* John Sinton, Dept. of Geology and Geophysics and HCV, University of Hawaii, Honolulu, HI 96822, sinton@soest.hawaii.edu; Scott Rowland, University of Hawaii, scott@kahana.pgd.hawaii.edu. Cost: \$150, includes airfare Honolulu-Maui-Kona, two nights hotel on Maui, 2 lunches, ground transportation; does not include breakfasts or dinners, or hotels or transportation before or after trip. Limit: 20. First day: Fly to Maui, van trip around West Maui Volcano, with short walking trips to view caldera region, rift zones, and lava flows, including shield stage basaltic lavas and postshield differentiated alkalic flows and domes. Second day: Van trip to Haleakala summit, followed by 18 km hike through Haleakala Crater. Walking trip descends from 3050 m to the crater floor at about 2070 m, crosses the crater and exits along a trail that ascends to 2750 m. Spectacular cinder cones, spatter vents, lava flows, dikes, and

a lava tube. Third day: Semilithified dune deposits and a Hawaiian heiau (religious site); fly to Kona. Assemble at Aloha Airlines check-in counter in Honolulu at 7:15 a.m. on Sunday, May 18; arrival in Kona on Tuesday, May 20 at 2 p.m.

4. Field Workshop: Active and Young Basalt Lava Flows. Cosponsored by Center for the Study of Active Volcanoes, and Hawaii Volcano Observatory–U.S. Geological Survey, May 15–20. *For the physically fit.* Stephen Self, Dept. of Geology and Geophysics and CSAV, University of Hawaii, Honolulu, HI 96822, self@soest.hawaii.edu; Carl Thornber, Hawaii Volcano Observatory, cthornber@hvo.wr.usgs.gov; Katherine Cashman, University of Oregon, cashman@uoregon.uoregon.edu. Cost: \$255, includes van transportation starting and ending at the Kona Surf hotel, four nights lodging at Kilauea Military Camp, and six lunches. Does not include breakfasts, dinners, and lodging at Kona Surf during the field trip on May 19, or lodging there before or after the trip. Limit: 30. First day: Travel to town of Kalapana; measurement and dynamics of pahoehoe sheet flows; lava-flow inflation process. Second day: Summit of the active flow field; different forms and surface textures of pahoehoe. Third day: Features in vent regions of summit and rift-zone eruptions; overview of monitoring techniques at U.S. Geological Survey Hawaii Volcano Observatory. Fourth day: Revisit active flows of second day; note and discuss changes in 48 hours; demonstration of monitoring techniques, including drilling, geophysics, and IR imaging. Fifth day: Travel from Kilauea to Kailua via Saddle Road. Lava tubes; flows of the 19th century; discussion of pahoehoe vs. aa. Night at Kona Surf hotel. Sixth day: Vents, channels, and xenolith beds of Hualalai Volcano. Leave Thursday, May 15, 8:00 a.m., from main entrance of Kona Surf hotel; end at Kona Surf at 5:00 p.m. Tuesday, May 20.

5. Field Workshop: Volcanic-gas Sampling at Kilauea Fumaroles (cosponsored by IAVCEI Gas Geochemistry Working Group, Center for the Study of Active Volcanoes, and Hawaii Volcano Observatory–U.S. Geological Survey), May 16–20. Jeff Sutton, Hawaii Volcano Observatory, P.O. Box 51, Hawaii National Park, Volcano, HI 96718, jsutton@hvo.wr.usgs.gov; Donald Thomas, Hawaii Institute of Geophysics and Planetology and CSAV, University of Hawaii, dthomas@soest.hawaii.edu. Cost: \$400, includes lodging, bus transport from Hilo to Kilauea and return, van transport at summit, and helicopter transport. Does not include meals or Hilo-Kailua transportation, by air or rental car. Limit: 20. Friday: Bus from Hilo to Kilauea Military Camp. Saturday: Briefing with Hawaii Volcano Observatory on status and scheduling; tour of thermal areas at Kilauea sum-

mit; discussion of sampling and analytical protocols. Sunday, Monday, and Tuesday: Prepare for helicopter transport into Halemaumau Crater to sample high-temperature fumaroles; sampling; independent sampling of other Kilauea summit fumaroles. Leave for Hilo and Kailua. Have your own sampling equipment and field gear, including gas mask. Leave Friday, May 16, 4:00 p.m. from curbside, Hilo International Airport. Arrive 3:00 p.m. Tuesday, May 20, at Hilo International Airport.

6. GMT Map-making Workshop (Oahu). May 20. Paul Wessel, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, wessel@soest.hawaii.edu. Cost: \$25, includes time on Sun Ultra UNIX workstations. Does not include any transport, lodging, or meals before or after the workshop, nor lunch. Limit: 15. Introduction to Generic Mapping Tools (GMT), used worldwide by more than 5,000 scientists. Basic skills, processing data, preparation of various map products ranging from simple contour maps to 3-D illuminated perspective views. No prior exposure to UNIX or GMT is required. Assemble main (west) entrance to POST Building, 1680 East-West Road, University of Hawaii, Honolulu, at 7:30 a.m. Tuesday, May 20; ends at same place at 5:00 p.m.

7. Inquiry-based Field Trips for Introductory Geology Instructors: Example: Evidence for Global Change at Kaena Point, Oahu. May 20. Martha Sykes, Hawaii Institute of Geophysics and Planetology, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, mlsykes@soest.hawaii.edu. Cost: \$55 (\$45 for K–12 teachers), includes van transportation, lunch, snack, and materials for field notes. Does not include hotel and breakfast before trip, or air fare to Kailua-Kona. Limit: 21. Travel to vicinity of northwest point of island, and traverse along an elevated late Quaternary coral reef. Leave Tuesday, May 20, 7:15 a.m. from main entrance, Outrigger Hotel, Waikiki, Honolulu, and arrive at Honolulu International Airport by 2:00 p.m. for your own flight to Kailua-Kona.

During Meeting
8. Natural History of the Kona Coast: Geology, Marine Biology, Botany, and Applied Science, May 22 (half day, morning or afternoon). Sara Peck, Sea Grant, c/o Natural Energy Laboratory of Hawaii, 73-4460 Queen Kaahumanu Highway, Kailua-Kona, HI 96740, peck@hawaii.edu; Charles Helsley, Sea Grant, University of Hawaii, chuck@soest.hawaii.edu. Cost: \$30 (\$24 for K–12 teachers), includes van transportation, refreshments. Does not include rental of snorkel gear, which might be between \$4 and \$9, depending on what is rented. Limit: 25 each, morning and afternoon. Start with a

visit to Hawaii Natural Energy Laboratory for observation of aquiculture pilot and production facilities, and ocean thermal-energy conversion equipment; HNELA uses cold, pathogen-free seawater pumped from depth (<http://bigisland.com/nelha>). Lava features and plants described along the coast, then snorkeling in Keauhou Bay, for an introduction to reef ecology in a protected bay. Leave Thursday, May 22, from front entrance of Kona Surf, either at 8:00 a.m., returning at 11:55, or at 12:00 noon, returning at 4:00 p.m..

Postmeeting

9. Volcanoes and the Sea: Geologic Processes on Hawaii and Maui.

May 24–26. Reverse order of premeeting Trip 1. Pow-foong Fan, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, pffan@soest.hawaii.edu; Alex Malahoff, University of Hawaii; Nancy Baker, Haleakala National Park; Janet Babb, consultant; Glenn Shepherd, consultant. Cost: \$425 (\$385 for K–12 teachers), includes airfare from Hilo to Maui and from Maui to Honolulu; van transportation on Hawaii and Maui; two box lunches and one box dinner; two nights at hotels on Hawaii. Does not include one lunch and one dinner. Limit: 21. First day: Flanks of Hualalai, Mauna Loa, and Kilauea; late afternoon and evening viewing on flank and coast in area of active flows. Second day: Features in and near Kilauea Caldera, Hawaii Volcanoes National Park, and in Puna Rift area. Third day: Fly to Maui; features of Haleakala Volcano (last erupted two centuries ago) and vicinity. At summit (3000 m), group can be divided, if necessary, into those undertaking more strenuous and less strenuous activities. Fly to Honolulu. Leave Saturday, May 24 at 7:45 a.m. from main entrance of Kona Surf hotel; arrive at Honolulu Airport at 6:00 p.m. Monday, May 26.

10. Geology and Ground-water Resources of Kauai.

May 24–26. Floyd W. McCoy, Jr., Natural Sciences, Windward Community College, 45-720 Kealahala Road, Kaneohe, HI 96744, fmccoy@hawaii.edu; Doak C. Cox, Institute of Water Resources, University of Hawaii; Steve Gingerich, U.S. Geological Survey, Honolulu. Cost: \$425 (\$375 for K–12 teachers) includes transport from Lihue Airport to Kauai Sands hotel, van transportation, two nights lodging (double occupancy), and three box lunches. Does not include Friday night lodging in Kona or Kauai, air transportation to or from Kauai, or breakfasts and dinners. Limit: 30. Volcanic, geomorphic, and sedimentary development of a mid-plate island, with a focus on new information on ground-water occurrences. Shield-building lavas; caldera structure and lavas; paleosols and unconformities; collapse of edifice; later volcanism and sedimentary

rocks. First (half) day: Lihue Basin and eastern Kauai. Second day: Northern areas. Third day: Southern, western, and higher areas. Leave Saturday, May 24, 12:00 noon, from main entrance of Kona Surf hotel; end at Lihue Airport 5:00 p.m. Monday, May 26.

11. **Summit and Northeast Rift Zone, Mauna Loa.** May 23–26. *For the physically fit.* John P. Lockwood, c/o U.S. Geological Survey–Hawaii Volcano Observatory, P.O. Box 51, Hawaii National Park, HI 96718, geohaz@aloha.net; Frank Trusdell, Hawaii Volcano Observatory, trusdell@liko.wr.usgs.gov. Cost: \$120 includes transportation to Pohakuloa State Cabins and one night's lodging, and to 3500 m level; three camp dinners, and breakfast liquids. Does not include camp breakfasts or lunches. Limit: 25. An arduous trip at high elevations for experienced backpackers. First evening: Drive (with stops en route), to cabins at 2000 m level to help altitude adjustment. First full day: Drive to NOAA's Mauna Loa Observatory at 3500 m. Climb up to and across Mokuaweoweo Caldera. Overnight at summit (4050 m; chilly). Second day: Commence 17 km hike along 1984 and older lavas; near-vent structures and flow structures of the eight historic eruptions along the Northeast Rift Zone; overnight at 3000 m. Third day: Puu Ulaula area and source vents of flows into or near Hilo. Hike down southeast slope of Mauna Loa to be met by vans and your stored luggage; on to Hilo. Leave Friday, May 23 at 5:00 p.m. from main entrance of Kona Surf hotel; arrive at Hilo Airport (or Hilo hotels) at 5:00 p.m. Monday, May 26.

12. **Hydrogeology of Oahu.** May 23–24. Frank Peterson, Dept. of Geology and Geophysics, University of Hawaii, Honolulu, HI 96822, peterston@soest.hawaii.edu; Chester Lao, Honolulu Board of Water Supply. Limit: 26. Problems of ground-water supply and contamination. General orientation of Oahu ground-water occurrence and development, Waihee tunnel from which dike-contained ground water is developed; Hawawa underground pumping station from which large volume of basal ground water is developed; Del Monte Pineapple Superfund ground-water contamination site. Cost: \$156, includes transfer from hotel to Kona airport, airfare from Kona to Honolulu, transfer from Honolulu airport to hotel, one night lodging double occupancy, field-trip bus, box lunch, and airport or hotel drop-off. Does not include dinner May 23 or breakfast May 24. Leave Friday, May 23 from main entrance of Kona Surf hotel, for Honolulu and trip; arrive Honolulu Airport at 4:00 p.m. Saturday, May 24 (or a hotel drop-off can be arranged).

13. **Phreatomagmatic Volcanism and Geology of Southeast Oahu.** May 23–25. Steve Self, Dept. of Geology and Geophysics and HCV, University of

Hawaii, Honolulu, HI 96822, self@soest.hawaii.edu; Ralph Moberly, University of Hawaii, ralph@soest.hawaii.edu; Charles Fletcher, University of Hawaii, fletcher@soest.hawaii.edu. Limit: 20. Pyroclastic deposits of the Koko line of vents of the Honolulu Volcanic Group (late Quaternary); volcanic processes evidenced in the outcrops of the Hanauma Bay tuff rings and Koko Crater; lavas, tuffs, and diagenetic features of other Honolulu vents at Ulupau Head, Diamond Head, and elsewhere; caldera and rift-zone structure and lithologies of the underlying Koolau Volcano (a basalt shield formed about 2.3 Ma); and evidence of present and past coastal processes at several sites in southeastern Oahu. Cost: \$185, includes Friday and Saturday nights in hotel in Honolulu (contact S. Self if you need to stay overnight Sunday at hotel at same rate), van transportation Saturday and Sunday, and lunches. Does not include air transportation from Kona to Honolulu, nor any breakfasts and dinners. Leave 8:00 a.m. Saturday, May 24 from main entrance of Hawaiian Monarch Hotel, Waikiki, Honolulu; end at Honolulu Airport at 5:00 p.m. Sunday, May 25.

14. Giant-Wave Deposits on Lanai and Molokai.

May 24–25. James G. Moore, U.S. Geological Survey, MS 910, 345 Middlefield Rd., Menlo Park, CA 94025, jmoore@mojave.wr.usgs.gov; Wilfred B. Bryan, wbryansail@aol.com; George Moore, moore@ava.bcc.orst.edu; Andy Moore, moorea@u.washington.edu. Cost: \$390, includes air, connecting, and van transportation, Saturday lodging, and lunches; does not include breakfasts or Saturday dinner. Limit: 36. Basalt and carbonate conglomerates on Molokai and Lanai believed to be deposits left by giant waves generated when a major submarine landslide occurred on the flank of a volcano about 105,000 yr ago; soil-stripping and bedforms of deposited debris that bear on the size, nature, and timing of the waves. Leave 8:00 a.m. Saturday, May 24, from main entrance of Kona Surf hotel; end at Honolulu Airport at 6:00 p.m. Sunday, May 25.

TECHNICAL PROGRAM

Contact the individual organizers of symposia and theme sessions for specific information. The number and scope of the sessions may be adjusted, depending on the contribution of abstracts. The abstract deadline was January 24, 1997.

SYMPOSIA

1. **Hawaiian Islands as a Natural Laboratory for Soil-Weathering and Ecosystem Studies.** Oliver A. Chadwick, Dept. of Geography, University of California, Santa Barbara, CA 93106, oac@geog.

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ucsb.edu; Robert Gavenda, USDA Soil Conservation Service, Kealahou, Hawaii, rgavenda@hi.nrcs.usda.gov; Carolyn G. Olson, USDA Soil Conservation Service, Lincoln, Nebraska, agro202@unlvm.unl.edu.

2. Formation of Authigenic Marine Minerals; FROMAGE Symposium

(Friends of Marine Authigenesis; SEPM Research Group on Marine Authigenesis). Craig R. Glenn, Dept. of Geology and Geophysics, University of Hawaii, Honolulu, HI 96822, glenn@mano.soest.hawaii.edu; William C. Burnett, Florida State University, wburnett@mail.fsu.edu.

3. Sediment, Pollutants, and Chemical Fluxes in Terrestrial, Estuarine, and Coastal Waters.

Frank Peterson, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, peterson@soest.hawaii.edu; Eric DeCarlo, University of Hawaii, edecarlo@soest.hawaii.edu; Khalil Spencer, University of Hawaii, khal@soest.hawaii.edu.

4. Landslides and Tsunamis, Hawaii and Elsewhere.

Barbara Keating, Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI 96822, keating@soest.hawaii.edu; James G. Moore, U.S. Geological Survey, Menlo Park, California, jmoore@mojave.wr.usgs.gov; Wilfred B. Bryan, Woods Hole Oceanographic Institution.

5. Volcanic-gas Geochemistry: Present Status; Future Methods.

Donald Thomas, Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI 96822, dthomas@soest.hawaii.edu; Jeff Sutton, Hawaii Volcano Observatory, jsutton@tako.wr.usgs.gov.

THEME SESSIONS

Applied Paleontology: (a) Biotic Reactions to Global Warmth as Preserved in the Fossil Record, and (b) Other Aspects of Applied Paleontology. Cosponsored by

West Coast Section of the Paleontological Society. Johanna Resig, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, jresig@soest.hawaii.edu; Paula Noble, California State University, Sacramento, noblepj@csus.edu.

Comparative Volcanology, Submarine and Subaerial.

Alex Malahoff, Dept. of Oceanography, University of Hawaii, 1000 Pope Road, Honolulu, HI 96822, malahoff@soest.hawaii.edu.

Fabric and Microfabric of Sediment and Rock.

Jane Tribble, Dept. of Oceanography, University of Hawaii, 1000 Pope Road, Honolulu, HI 96822, jtribble@soest.hawaii.edu; Roy Wilkens, Hawaii Institute of Geophysics and Planetology, wilkens@soest.hawaii.edu.

Geologic Hazards, Circum-Pacific and Intra-Pacific.

Steve Self, Dept. of Geology and Geophysics, University of Hawaii, Honolulu, HI 96822, self@soest.hawaii.edu; Barbara Keating, Hawaii Institute of Geophysics and Planetology, keating@soest.hawaii.edu.

Geoscience Education and Workshop.

Martha Sykes, Hawaii Institute of Geophysics and Planetology, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, mlsykes@soest.hawaii.edu.

Island and Coastal Aquifers: Hydrogeology, Geochemistry, Utilization.

Charles D. Hunt, Jr., U.S. Geological Survey, 677 Ala Moana Blvd., Suite 415, Honolulu, HI 96813, cdhunt@usgs.gov.

Monitoring Active Tectonics and Active Volcanism: GPS; Volcanic and Underwater Observatories.

Michael Bevis, Hawaii Institute of Geophysics and Planetology, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, bevis@soest.hawaii.edu; Paul Okubo, Hawaiian Volcano Observatory, pokubo@liko.wr.usgs.gov; Fred Duennebie, University of Hawaii, fred@soest.hawaii.edu.

Pacific Shorelines. Charles Fletcher, Dept. of Geology and Geophysics, University of Hawaii, Honolulu, HI 96822, fletcher@soest.hawaii.edu.

Remote Sensing of Circum- and Intra-Pacific Geology from Airborne and Space-based Platforms.

Luke Flynn, Hawaii Institute of Geophysics and Planetology, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, flynn@waterloo.pgd.hawaii.edu.

Structure and Morphology of the Pacific Seafloor. Charles Helsley, Sea Grant, University of Hawaii, 1000 Pope Road, Honolulu, HI 96822.

Subduction and Collision on Pacific Convergent Margins.

Jill Karsten, Dept. of Geology and Geophysics, University of Hawaii, Honolulu, HI 96822, karsten@soest.hawaii.edu; Gregory Moore, University of Hawaii, moore@soest.hawaii.edu.

GSA BOOKSTORE

GSA publications will be exhibited and for sale in the Convention Center's Milo Room, where the poster sessions will be held.

EARTH SCIENCE EDUCATION PROGRAM

Field trip 6 is designed for instructors of introductory earth-science courses in secondary school and college. Science teachers (K-12) and instructors of freshman- and sophomore-level earth-science education should consider going on one or more of field trips 1 or 8 and field trip 9. The third (optional additional) day of trip 9 and field trip 7 during the meeting will have a broader scope than geology alone. The Local Committee will arrange the program so there is no conflict of trip 7 with the educational theme sessions and workshop, and minimal conflict with the poster and oral sessions that should be of interest to earth-science educators. Further information: Ruth Fletcher, NAGT-GSA, Chair, Science Department, Punahou School, Honolulu, HI 96822, ruthf@punahou.edu.

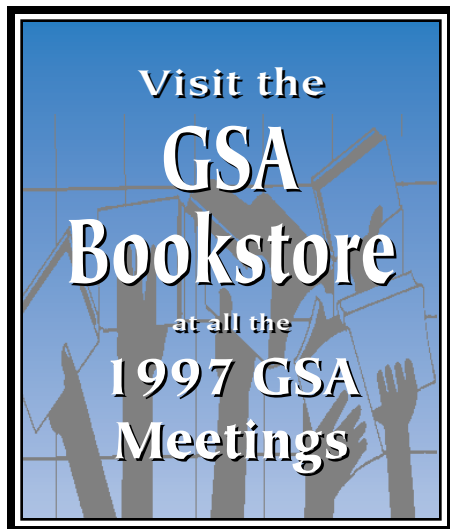
STUDENT SUPPORT

The GSA Cordilleran Section has funds available for partial support of GSA Student Associates of the section who are presenting papers at the meeting. Apply to Cordilleran Section Secretary Bruce A. Blackerby, Dept. of Geology, California State University, Fresno, CA 93740. Further information: bruceb@csufresno.edu, or (209) 278-2955. Applications should include certification that the student is presenting a paper and is a GSA Student Associate of the Cordilleran Section. All letters must be received by *February 15, 1997*.

The Local Committee has funds available for partial support of students who will assist with the audio-visual equipment at the meeting. Apply to Student Coordinator Steve Martel, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822. Further information: martel@soest.hawaii.edu, or (808) 956-7797. Applications should state the student's interest in attending the meeting, including whether or not the student is presenting a paper. All letters must be received by *February 15, 1997*.

DETAILED INFORMATION

Meeting information will be updated during the spring months at http://www.soest.hawaii.edu/GG/GSA_meet.html. If you have general questions and suggestions or need to know who to contact specifically, contact the local chair, Ralph Moberly, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, ralph@soest.hawaii.edu.



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GSA Cordilleran Section **Kailua-Kona, Hawaii, May 21-23, 1997**

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Preregistration Deadline: APRIL 18
Cancellation Deadline: APRIL 25

MAIL TO:
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*Member fee applies to any current Professional OR Student Member of GSA or Associated Societies listed at left. Discount does not apply to guest registrants.

SPECIAL EVENTS

1. FROMAGE Luncheon	May 21	(60) \$ 20	—	\$ _____
2. Kona Surf Banquet	May 21	(61) \$ 45	—	\$ _____
3. Paleontological Society Luncheon	May 22	(62) \$ 20	—	\$ _____
4. Cordilleran Section Business Luncheon	May 23	(63) \$ 20	—	\$ _____

WORKSHOP

1. Roy Shlemon Mentors Program	May 23	(150) FREE	1	\$ _____
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FIELD TRIPS

1. Volcanoes and the Sea	May 18-20	Professional K-12	(101) \$425	1	\$ _____
			(102) \$385	1	\$ _____
2. Weathering and Soil Formation on Hawaii	May 20	(103) \$ 70	1	\$ _____	
3. Petrology and Volcanology of Maui	May 18-20	(104) \$150	1	\$ _____	
4. Field Workshop: Basalt Lava Flows	May 15-20	(105) \$255	1	\$ _____	
5. Field Workshop: Volcanic-gas Sampling	May 16-20	(106) \$400	1	\$ _____	
6. GMT Map-Making Workshop (Oahu)	May 20	(107) \$ 25	1	\$ _____	
7. Inquiry-based Field Trips for Geology Instructors	May 20	Professional	(108) \$ 55	1	\$ _____
		K-12	(109) \$ 45	1	\$ _____
8. Natural History of Kona Coast	May 22	Morning—Professional	(110) \$ 30	1	\$ _____
		K-12	(111) \$ 24	1	\$ _____
		Afternoon—Professional	(112) \$ 30	1	\$ _____
		K-12	(113) \$ 24	1	\$ _____
9. Volcanoes and the Sea	May 24-26	Professional	(114) \$425	1	\$ _____
		K-12	(115) \$385	1	\$ _____
10. Geology and Ground-water Resources, Kauai	May 24-26	Professional	(116) \$425	1	\$ _____
		K-12	(117) \$375	1	\$ _____
11. Summit and Northeast Rift Zone, Mauna Loa	May 23-26	(118) \$120	1	\$ _____	
12. Hydrogeology of Oahu	May 23-24	(119) \$156	1	\$ _____	
13. Phreatomagmatic Volcanism	May 23-25	(120) \$185	1	\$ _____	
14. Giant-Wave Deposits on Lanai and Molokai	May 24-25	(121) \$390	1	\$ _____	

TOTAL FEES \$ _____



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Visit the GSA Web Site at <http://www.geosociety.org>. From our home page you can link to many information resources. Here are some highlights:

View the **Meetings** page for information on the 1997 annual meeting. Complete information on the 1997 GeoVentures is also online.

On our **Membership** page you'll learn about the GSA Employment Service, find out how to become a GSA Campus Representative, or learn how to get forms to join GSA as a professional or as a student. You'll also find information here on how to nominate a GSA member to Fellowship standing.

Under the **Publications** heading, you'll find many links, including one to the GSA Bookstore on the Web. Here's a fast, new way to shop! Search the descriptive copy and tables of contents on all GSA books, maps, transects, memorials, and other products in print or in production. You can read or print product descriptions, tables of contents, pricing, and other data. You can build and place a credit-card order safely via our secure Web server. The best part is that more than 200 titles are now on sale (until March 1997). Information for Contributors to journal articles, article offprint information, how to request copyright permissions, and more are also available.

The GSA Data Repository (DRP) is here, too. You'll find all DRP entries since 1992, in Adobe Acrobat format for easy download via your browser. These Data Repository entries supplement some articles in GSA's journals. This is a new, faster way to obtain these data. Every month, you'll also find tables of contents and abstracts of journal articles for *GSA Bulletin* and *Geology*, plus information for authors on preparation of articles for submission to GSA.

In the **Education** section, read about GSA's educational programs, including PEP (Partners for Education Program), and the Earth and Space Science Technological Education Project (ESSTEP). Application materials for 1997 ESSTEP summer workshops are now available. Find out about GSA's environment and public policy activities in the **Institute for Environmental Education** section, including updates on the GSA Congressional Science Fellowship program, the Roy J. Shlemon Applied Geology Mentor Program, and the U.S. Geological Survey-National Biological Service scientific opportunities workshop.

Under **Foundation** you will find information on the Foundation and the current annual giving campaign, a list of trustees and officers, and several ways to make a planned gift.

See the **Administration** section for information on GSA Medals and Awards, and other general information about GSA. You can also link to the pages for GSA Sections and Divisions for specific information on each of these.

CALENDAR

Only new or changed information is published in *GSA Today*. A complete listing can be found in the **Calendar** section on the Internet: <http://www.geosociety.org>.

1997 Penrose Conferences

April

April 24–30, **Paleocene-Eocene Boundary Events in Time and Space**, Albuquerque, New Mexico. Information: Spencer Lucas, New Mexico Museum of Natural History, 1801 Mountain Road NW, Albuquerque, NM 87104, (505) 841-2873, fax 505-841-2866, E-mail: lucas@darwin.nmmnh-abq.mus.nm.us.

September

September 10–15, **Faults and Subsurface Fluid Flow: Fundamentals and Applications to Hydrogeology and Petroleum Geology**, Albuquerque and Taos, New Mexico. Information: William C. Haneberg, New Mexico Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, 2808 Central Ave. SE, Albuquerque, NM 87106, (505) 262-2774, fax 505-255-5253, E-mail: haneberg@nmt.edu. For more information, see <http://www.nmt.edu/~haneberg/Fluids.html>.

September 23–28, **Tectonics of Continental Interiors**, Cedar City, Utah. Information: Michael Hamburger, Department of Geological Sciences, Indiana University, Bloomington, IN 47405, (812) 855-2934, fax 812-855-7899, E-mail: hamburg@indiana.edu.

1997 Meetings

March

March 5–7, **Recent Advances in Soft Soil Engineering**, Kuching, Sarawak, Malaysia. Information: Saptuyah Mahmud, Faculty of Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia.

May

May 14–16, **AAPG Pacific Section**, Bakersfield, California. Information: Bob Timmer, Mobil, (805) 665-4042, fax 805-665-3539, or Pacific Section Convention, P.O. Box 1072, Bakersfield, CA 93302.

May 18–22, **AAAS Southwestern and Rocky Mountain Division Annual Meeting**, College Station, Texas. Information: Donald J. Nash, Dept. of Biology, Colorado State University, Fort Collins, CO 80523, (970) 491-5481, fax 970-491-0649, dnash@lamar.colostate.edu.

September

September 9–14, **International Symposium on Mining History**, Fairbanks, Alaska. Information: William R. Wood, P.O. Box 74086, Fairbanks, AK 99707, (907) 456-1984, fax 907-452-8878.

September 22–27, **International Association for Mathematical Geology 4th Annual Meeting**, Barcelona, Spain. Information: Vera Pawlowsky, Universitat Politècnica de Catalunya, Dept. de Matemàtica, Aplicada III, E-8034 Barcelona, Spain, 34-3-401-6909, fax 34-3-401-6504, iamg97@ma3.upc.es.

October

October 19–23, **American Water Resources Association Annual Conference and Symposium**, Long Beach, California. Information: American Water Resources Association, 950 Herndon Pkwy., Ste. 300, Herndon, VA 20170-5531, (703) 904-1225, fax 703-904-1228, awrahq@aol.com, Web: <http://www.awra.org/~awra>.

November

November 2–5, **28th Underwater Mining Institute**, Seattle, Washington. Information: Karynne Chong Morgan, Underwater Mining Institute, c/o Marine Minerals Technology Center, 811 Olomehani St., Honolulu, HI 96813-5513, (808) 522-5611, fax 808-522-5618; 70673.534@compuserve.com.

November 16–19, **International Conference on Advances in Ground-Water Hydrology**, Tampa, Florida. Information: AIH, 2499 Rice St., Ste. 135, St. Paul, MN 55113, (612) 484-8169, fax 612-484-8357, AIHydro@aol.com.

Send notices of meetings of general interest, in format above, to Editor, *GSA Today*, P.O. Box 9140, Boulder, CO 80301, E-mail: editing@geosociety.org.

GSA SECTION MEETINGS—1997

NORTHEASTERN SECTION,

March 17–19, Sheraton Valley Forge Hotel, King of Prussia, Pennsylvania. Information: William A. Crawford, Department of Geology, Bryn Mawr College, Bryn Mawr, PA 19010-2899, (610) 526-5112, fax 610-526-5086, wrcrawfor@brynmawr.edu. *Preregistration Deadline: February 14, 1997.*

SOUTH-CENTRAL and ROCKY MOUNTAIN SECTIONS,

March 20–21, University of Texas, El Paso, Texas. Information: Elizabeth Y. Anthony, Department of Geological Sciences, University of Texas, El Paso, TX 79968-0555, (915) 747-5483, anthony@geo.utep.edu. *Preregistration Deadline: February 7, 1997.*

SOUTHEASTERN SECTION,

March 27–28, Auburn University, Auburn, Alabama. Information: Mark G. Steltenpohl, Department of Geology, Auburn University, Auburn, AL 36849-5305, (334) 844-4893, steltmg@mail.auburn.edu. *Preregistration Deadline: February 21, 1997.*

NORTH-CENTRAL SECTION,

May 1–2, The Concourse Hotel, Madison, Wisconsin. Information: Thomas J. Evans, Wisconsin Geol. & Nat. History Survey, 3817 Mineral Point Rd., Madison, WI 53705, (608) 263-4125, tevans@facstaff.wisc.edu. *Preregistration Deadline: March 28, 1997.*

CORDILLERAN SECTION,

May 21–23, Kona Surf Resort and Convention Center, Kailua-Kona, Hawaii. Information: Ralph Moberly, Department of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, (808) 956-8765, ralph@soest.hawaii.edu. *Preregistration Deadline: April 18, 1997.*

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FOUR ASSISTANT PROFESSOR POSITIONS

The University of Calgary Departments of Geology and Geophysics, Geography and Archaeology invite applications for four tenure-track or contingent term/specific term four-year appointments in the Earth Science Program at the Assistant Professor rank, to begin July 1, 1997. A PhD is required for these positions.

- **Applied Hydrology** - Preference will be given to candidates with expertise in ground water-surface water interactions, geotechnical applications and/or water quality studies. The ideal candidate will have a strong geological and quantitative background.
- **Applied Geophysics** - Preference will be given to candidates with expertise related to methods of investigation of the shallow subsurface including ground penetrating radar, electrical and electromagnetic methods, magnetic methods and shallow seismic. The ideal candidate will have a strong background in rock and soil properties.
- **Geoarchaeology** - Preference will be given to candidates with expertise in Geoarchaeology, human geography and earth science interface and interaction. The ideal candidate will have a strong background in paleoenvironmental reconstruction.
- **Geographical Methods/Remote Sensing** - Preference will be given to candidates with expertise in earth system science and modelling, geographic information systems and remote sensing applications. The ideal candidate will have a strong background in spatial modelling and systems.

The duties include teaching at the undergraduate and graduate levels, supervision of graduate students, independent research and service to the University.

In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. The University of Calgary is committed to Employment Equity.

The closing date for applications is March 1, 1997. Applicants should send a letter of application, and a curriculum vitae with the names and addresses of three references to one of the following:

Dr. Ian Hutcheon, *Head*
Department of Geology & Geophysics

Dr. S. E. Franklin, *Head*
Department of Geography

Dr. Scott Raymond, *Head*
Department of Archaeology

The University of Calgary
2500 University Drive N.W. Calgary, Alberta, Canada T2N 1N4



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*Members of IAH receive *Hydrogeology Journal* as part of their IAH dues and should not order from GSA. Members of AEG receive *Environmental & Engineering Geoscience* as part of their AEG dues and should not order from GSA.

*Environmental & Engineering Geoscience**



A joint, quarterly publication of the Association of Engineering Geologists (AEG) and the Geological Society of

America (GSA). Includes refereed articles on applied topics in the environmental and hydrological geosciences, and special features like the *Geology of Cities* series; technical notes on current topics; a comment and reply forum; memorials to geologists of note; book reviews; and biographies on well-known geologists in the applied fields. Features new theory, applications, and case histories illustrating the dynamics of the fast-growing, environmental and applied disciplines. Co-edited by AEG and GSA.

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GSA ANNUAL MEETINGS

1997

Salt Lake City, Utah
 October 20–23
 Salt Palace
 Convention Center
 Little America Hotel

General Chair:
M. Lee Allison,
Utah Geological Survey

Technical Program Chairs:
John Bartley,
Erich Petersen,
University of Utah
 Proposal Deadline was January 2.

Field Trip Chairs:
Bart Kowallis,
Brigham Young University
Paul Link, Idaho State University
 No more field trips will be accepted.



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Meetings

1998

Toronto, Ontario, Canada, October 26–29
 Metro Toronto Convention Centre
 Sheraton Toronto Centre Hotel and Towers

General Chair: *Jeffrey J. Fawcett, University of Toronto*

Technical Program Chairs:
Denis M. Shaw, McMaster University
Andrew Miall, University of Toronto

Call for Field Trip Proposals:
We are interested in proposals for single-day and multi-day field trips beginning or ending in Toronto, and dealing with all aspects of the geosciences. Please contact the Field Trip Chairs listed below.

Pierre Robin
 University of Toronto
 Dept. of Geology
 22 Russell Street
 Toronto, ON M5S 3B1, Canada
 (416) 978-3022
 fax 416-978-3938

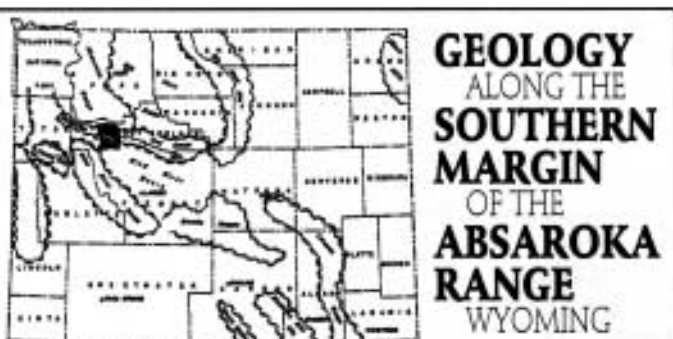
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FUTURE MEETINGS

1999 — Denver, Colorado October 25–28
 2000 — Reno, Nevada November 13–16
 2001 — Boston, Massachusetts November 5–8
 2002 — Denver, Colorado October 28–31



by John David Love
 originally published 1939

This volume, out of print for more than 50 years, still presents some of the best descriptive information on the Absaroka Range. In answer to the many requests, the original author has produced this excellent facsimile volume, complete with the colored plate, and GSA has obtained a limited supply. Describes the geology of an area of about 430 sq. miles in northwestern Wyoming and includes the southern margin of the Absaroka Range, the western end of the Owl Creek Mountains, and the northwestern part of the Wind River Basin.

SPE020, 134 p., paperback, 1 large color plate, indexed, ISBN 0-8137-2020-6, \$25.00; Member price \$20.00

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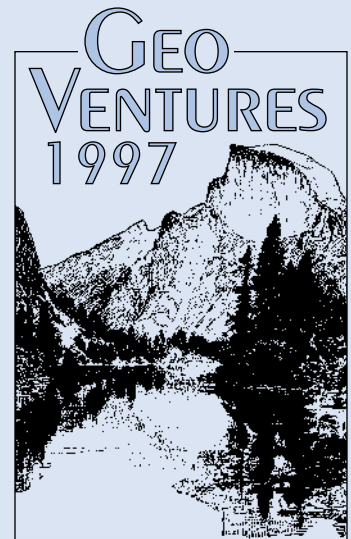
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The Geological Society of America

See the December or January issues for details.
 Also visit GSA's web site: <http://www.geosociety.org>.

GEOVENTURES are a special benefit created for members, but are open also to guests and friends. GeoVentures is the overall name for adult educational and adventure experiences of two kinds: GeoTrips or GeoHostels. Both are known for expert scientific leadership. Fees for both are low to moderate (relative to the length of time and destination) and include lodging and meals as designated. The venues, however, are quite different.



Field Trips with a Difference ... for GSA Members and Friends

GeoHostel

Richard B. Waitt,
 U.S. Geological Survey, Vancouver
 Patrick Pringle,
 Washington Dept. of Natural Resources.

This GeoHostel will focus on field trips to Mount St. Helens, especially to explore processes and effects of the cataclysmic eruption of May 18, 1980. Among these are: decapitation of the former summit; world's largest historic landslide; a tsunami wave as high as 800' on Spirit Lake; the gigantic pyroclastic surge (so-called "lateral blast") that in four minutes mowed down 235 mi² of mature forest; great muddy floods (lahars). Everyone should see this area of devastation before it becomes obscured by trees. Two days will be devoted to the east and southeast sides of Mount St. Helens, and two days to the south and west sides, including two stunning new visitor facilities in the heart of the devastated area, and one day at spectacular Mount Rainier (northeast, east, and south flanks) in Mount Rainier National Park. With the remaining snow still visible on the higher mountain peaks, June will be stunning for photography.

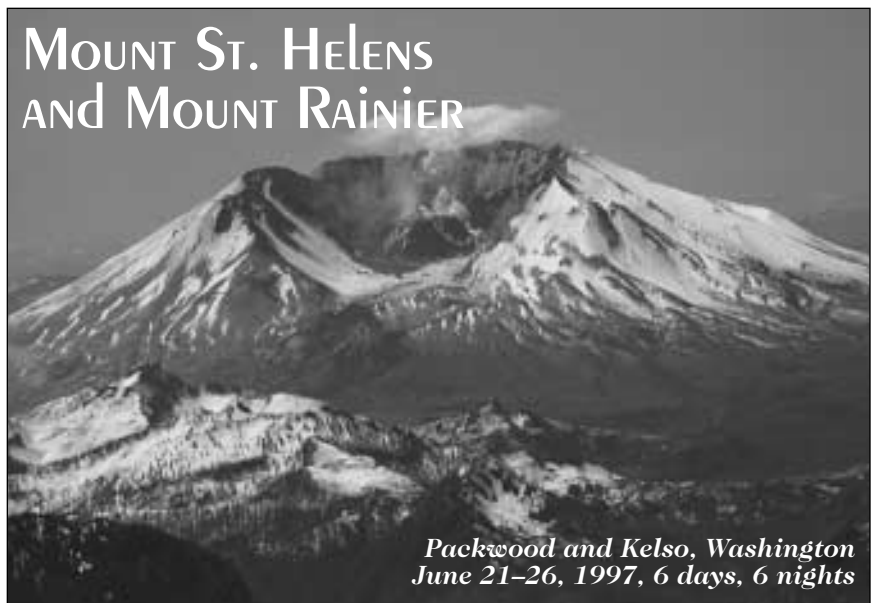


Photo by Richard Waitt

MOUNT ST. HELENS AND MOUNT RAINIER

*Packwood and Kelso, Washington
 June 21-26, 1997, 6 days, 6 nights*

Lodging, Meals, and Ground Transportation

The group will be lodged on Saturday, Sunday, and Monday at the Inn of Packwood, Packwood, Washington, and on Tuesday, Wednesday and Thursday nights at the Red Lion Inn in Kelso, Washington. All lodging is planned as double occupancy. Meals will include plenty of hors d'oeuvres at the Welcoming Reception and Orientation on Saturday evening, daily breakfasts, sack lunches, and a hearty farewell dinner on Thursday evening. Field trip transportation will be provided in air-conditioned, 15-passenger vans.

1997 GeoVentures Fee Schedule

	Italy	Canyonlands	Mount St. Helens	Yellowstone-Beartooth	Sky Islands, SE Arizona
Dates	May 9-21	May 30-June 7	June 21-26	July 19-24	August 2-7
No. of Days	14	10	6	6	6
Member Fee	\$2375	\$1445	\$650	\$690	\$540
Nonmember Fee	\$2475	\$1545	\$700	\$740	\$590
Deposit	\$250	\$200	\$100	\$100	\$100
Balance Due	February 28	March 28	April 28	May 28	June 28
100% Deposit refund date (less processing fee)	February 28 (\$50)	March 28 (\$50)	April 28 (\$20)	May 28 (\$20)	June 28 (\$20)

GeoHostel

Tim Lawton and Nancy McMillan,
New Mexico State University

Above the grasslands of southeastern Arizona, isolated ranges, the "Sky Islands," rise to heights of eight and nine thousand feet. August is a perfect time to travel there. The geology and natural history of these mountains bear stronger affinities with the Sierra Madre of Mexico than with the Rocky Mountain cordillera, making the region unique in the United States. The monsoon of late July and August brings cooling—and sometimes drenching—afternoon rains and an array of Madrean wildflowers to the higher elevations. The geology of the Chiricahua, Mule, and Huachuca Mountains records Paleozoic marine deposition, Jurassic-Cretaceous crustal extension and basin formation, latest Cretaceous mountain building and basin inversion of the Laramide orogeny, and catastrophic volcanism in the Tertiary. This GeoHostel, which includes a program of ambitious hikes, will explore the geology and the natural and human history built on it by means of a series of field trips and half-day hikes to several ranges and mining centers. Located within 50 miles of the Mexican border, the area is a world-renowned mecca for bird-watchers.

Lodging, Meals, and Ground Transportation

The group will be lodged at Cochise College in dormitory style, single occupancy (doubles for couples) type rooms. Meals will include plenty of hors d'oeuvres at the Welcoming Reception and Orientation on Saturday evening, daily breakfasts and sack lunches, and a hearty farewell dinner on Thursday evening. Field trip transportation will be provided in air-conditioned, 15-passenger vans.

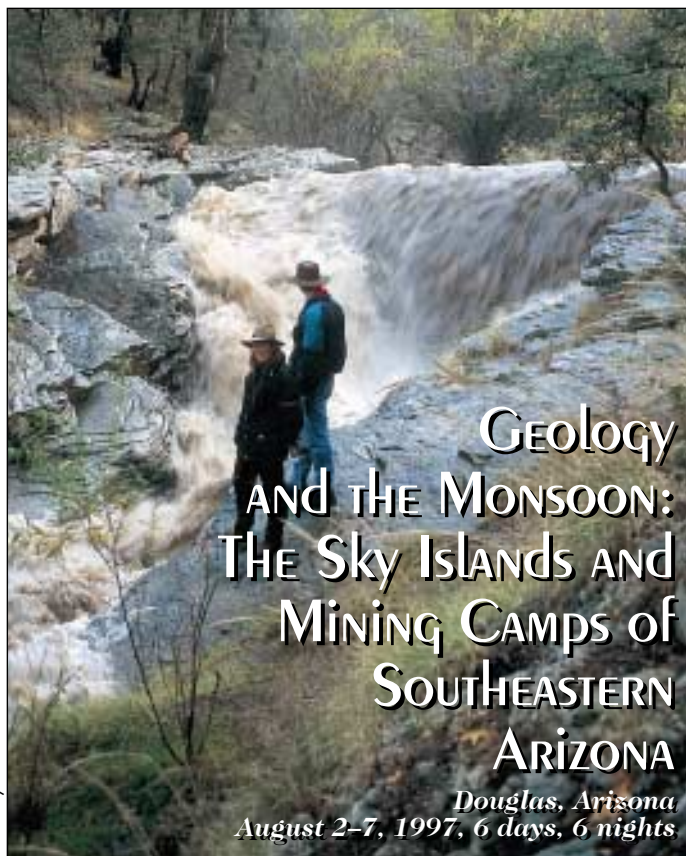


Photo by Tim Lawton

Full Information

appears in the December 1996 and January 1997 issues of GSA Today and on GSA's Web Page,
<http://www.geosociety.org/meetings>

*Space will go quickly, so get in touch with us if you are interested.
Detailed information on itineraries, registration fees, and travel arrangements will be sent on request.*

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Check for updates: <http://www.geosociety.org>

	DEPOSIT PER PERSON	NO. OF PERSONS	TOTAL PAID DEPOSIT
GT971—Italy	\$250	—	\$ _____
GT972—Canyonlands	\$200	—	\$ _____
GH971—Mount St. Helens	\$100	—	\$ _____
GH972—Yellowstone (Sold Out)	\$100	—	\$ _____
GH973—Sky Islands	\$100	—	\$ _____
TOTAL DEPOSIT			\$ _____

I've enclosed no deposit, but I'm interested. Please send information.

VISA MasterCard American Express

Credit Card # _____ Exp. Date _____

Signature _____

YOU CAN REGISTER ON THE WEB OR MAIL OR FAX REGISTRATION FORM AND CHECK OR CREDIT CARD INFORMATION TO:

1997 GSA GeoVentures, GSA Meetings Department,
P.O. Box 9140, Boulder, CO 80301.
fax 303-447-0648

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GEOTrip

Haraldur Sigurdsson, Graduate School of Oceanography, University of Rhode Island
Mauro Rossi, University of Pisa, Pisa, Italy

This unique trip has been requested dozens of times; at last it's here, with extraordinary leaders. After air travel to Rome connecting to Naples, on May 8, the trip begins with exploration of Vesuvius volcano. Visits to the archaeological sites of Pompeii and Herculaneum, destroyed by the famous A.D. 79 eruption follow, and then the group takes a ferry to the island volcano of Stromboli, continuously active for over 2500 years. Ferry trips to the adjacent volcanic islands of Lipari and Vulcano follow. The group continues to Sicily and ascends to Mount Etna, Europe's largest active volcano. The home-ward journey begins on May 21.

The trip fee does not include airfare, but it does include just about everything else—all lodging, meals, ground transportation (including ferries), and fees. Accommodations are double occupancy in "Superior Tourist" class hotels and one night aboard a ferry (May 13). Every day includes full breakfasts, box lunches, and full dinners. Meals include dinner on the arrival night (May 9) and continue through the departure breakfast (May 21). Transport is by deluxe air-conditioned motorcoach for eight days (Naples, Lipari, and Sicily); none is required in Vulcano and Stromboli. Also included are field guides and maps, wine with dinner, gratuities, taxes, and all fees.

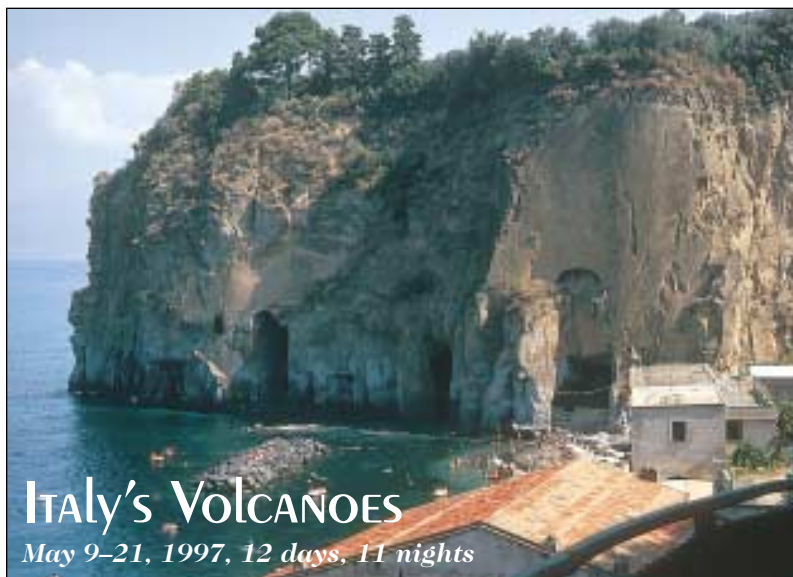


Photo by Haraldur Sigurdsson

Italy's Volcanoes

May 9-21, 1997, 12 days, 11 nights

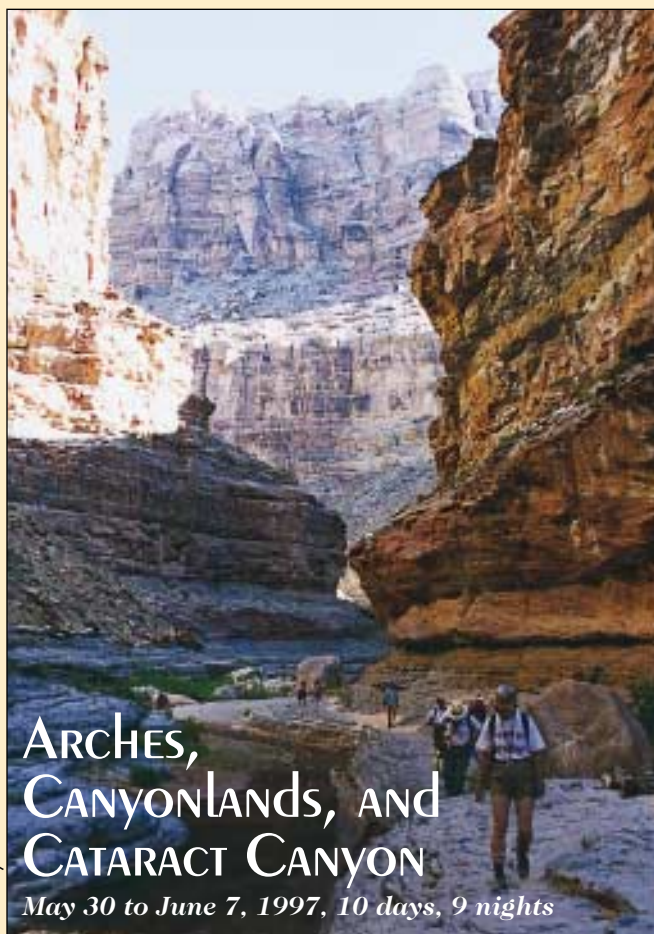


Photo by Ken Kolm

ARCHES, CANYONLANDS, AND CATARACT CANYON

May 30 to June 7, 1997, 10 days, 9 nights

GEOTrip

Jack Campbell, Fort Lewis College

This trip is an exceptional educational opportunity for the physically active person.

We will be hiking the rim area of the Canyonlands, including trips to the LaSal Mountains and Arches National Park (Fiery Furnace). We'll hike from the rim at the Upheaval Dome site to the river to meet the rafts. Each day after that we'll hike from our campsite to a remarkable new area. At last the boatmen will guide our rafts through wet and wild Cataract Canyon, a major whitewater experience. On the last day, we'll hike out of the Dark Canyon back to the rim, where we will be picked up for the return flight to Moab. This sunset overflight is unforgettable.

For post-trip adventure, Moab is within driving distance of Bryce, Zion, and Grand Canyon and an array of other features such as Capitol Reef and the newly designated Grand Staircase-Escalante National Monument.

The fee includes many items that are not part of a standard river trip through Cataract Canyon. It covers ALL meals for the four days we are in and around Moab, except for breakfast on the departure day; comfortable van transportation; double-occupancy lodging in comfortable, modern Moab Valley Inn; the 5-day river trip; complete duffle package of tents, sleeping bags, and pads when camping; geological reading materials and guidebook; the companionship of an expert scientific leader; and finally a spectacular evening overflight of Canyonlands as we return from Hite Marina at the head of Lake Powell to Moab for a final farewell dinner at Mi Vida, the former home of a wealthy uranium miner.

CLASSIFIED ADVERTISING

Published on the 1st of the month of issue. Ads (or cancellations) must reach the GSA Advertising office one month prior. Contact Advertising Department (303) 447-2020, 1-800-472-1988, fax 303-447-1133, or E-mail: acrawfor@geosociety.org. Please include complete address, phone number, and E-mail address with all correspondence.

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Positions Open

PETROLEUM RESEARCH POSITION THE UNIVERSITY OF ALABAMA

The Department of Geology at the University of Alabama invites applications for a 1-year petroleum research position to begin March 1, 1997. The successful candidate must have a B.S. degree (M.S. preferred) in geology or allied field and experience in the petroleum industry with background in computer application to solving geologic problems. Experience with geographic information systems and standard geologic software is expected. Duties will include providing technical and computer assistance to oil and gas producers and assisting with the characterization of petroleum reservoirs and fields.

Applicants should send a resume, university transcript (unofficial), and names, addresses, and phone numbers of three references to Chair, Search Committee, Department of Geology, University of Alabama, Box 870338, Tuscaloosa, Alabama 35487-0338. Review of applications will begin February 1, 1997, but applications will be accepted until the position is filled.

The University of Alabama is an equal opportunity, affirmative action employer which encourages applications from underrepresented groups.

FACULTY POSITION / PALEONTOLOGY

The Department of Geological Sciences, Mackay School of Mines, University of Nevada, Reno invites outstanding science teachers to apply for a position as Assistant Professor of Geology (tenure-track) in paleontology. Areas of expertise may include, but are not limited to, invertebrate/vertebrate paleontology (micro or macropaleontology), or paleobiology. We are particularly interested in applicants who work in the areas of biostratigraphy, paleo-biostratigraphy, paleoecology, or paleoclimatology. A Ph.D. in Geological Sciences or equivalent field of study is required.

Mackay School of Mines has an established tradition of field-oriented teaching that takes advantage of the superb geology of the Great Basin. Paleontology is an essential part of our geoscience curriculum. We seek Ph.D.-level applicants who will enthusiastically participate in teaching introductory lecture and laboratory courses in earth sciences. Undergraduate teaching responsibilities also will include an invertebrate paleontology/biostratigraphy course that is a major requirement for our undergraduate program. We offer B.S., M.S., and Ph.D. degrees in geological engineering. We expect the new faculty member to teach and develop graduate-level seminars and direct graduate student research in area of specialty.

The successful applicant will have the opportunity to integrate teaching and research into our varied programs of geologic studies that include tectonics, structural geology, stratigraphy, sedimentology, seismology, geophysics, neotectonics, geological engineering, economic geology, geochemistry, and Quaternary climate studies. Preference will be given to candidates with experience in field applications and quantitative methods. Applicants should demonstrate the potential for developing sponsored research and have publication records appropriate to their experience.

A curriculum vitae, a list of publications, a description of teaching and research interests, and a list of three references (including phone, fax numbers, and e-mail addresses) should be sent to: Search Committee Chair, Department of Geological Sciences / 172, University of Nevada, Reno, NV 89557. For full consideration, application materials should be received by March 1, 1997. The University of Nevada is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

ECONOMIC GEOLOGIST / PETROLOGIST SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY

The Department of Geology and Geological Engineering is seeking to fill a 1-year, term contract position at the Assistant or Associate Professor level in economic geology/hard-rock petrology. Depending on the availability of funding, the position may continue for more than 1 year. The successful candidate will be required to teach undergraduate and graduate classes in economic geology, mineralogy, and petrology, and is expected to have an established research program or be able and willing to develop funded research program in support of the M.S. and Ph.D. degree programs. Ph.D. is required, and it is preferable that the candidate has experience in mineral exploration and/or mine geology. Salary will be commensurate with qualifications and experience.

Send vitae, letter of application, and three letters of reference to: Dr. Colin J. Paterson, Chairman, Dept. of Geology and Geol. Eng., SDSM&T, 501 E. St. Joseph St., Rapid City, SD 55701. Applications will be reviewed beginning March 15, 1997, and will continue until a suitable candidate is hired. Address inquiries to paterson@silver.sdsmt.edu, phone (605) 394-2461, fax 605-394-6703. Information on the university and department, located in the beautiful Black Hills, is at the following Web address: <http://www.sdsmt.edu/campus/mineral/geology/geolhp.htm>. SDSM&T is an AA/EEO/ADA employer and provider.

DEPARTMENT OF PHYSICAL SCIENCES KUTZTOWN UNIVERSITY HARD-ROCK GEOLOGIST (TENURE-TRACK)

Applications are invited for a full-time, tenure-track faculty position at the Assistant Professor level in Hard-Rock Geology beginning August, 1997. A Ph.D. in Hard-Rock Geology is required along with a commitment to course development, excellence in undergraduate teaching and research. Primary responsibilities include: on a two-year cycle, Mineralogy, Optical Mineralogy, Igneous and Metamorphic Petrology, and Structural Geology; and on a regular basis, Physical Geology and supervision of undergraduate research. The teaching load consists of twenty-four contact hours per academic year. Submit a letter of application, curriculum vitae, undergraduate and graduate transcripts, a brief statement of teaching philosophy, student/faculty research plans, and three current letters of recommendation to: Chairperson of Geology Search Committee, Department of Physical Sciences, P.O. Box 730, Kutztown University, Kutztown, PA 19530 by February 28, 1997. Kutztown University is an AA/EEO employer. Also on World Wide Web at http://www.kutztown.edu/faculty/simpson/geo_home.html

ECONOMIC / EXPLORATION GEOLOGIST AND GEOLOGICAL ENGINEER

The Department of Geology and Geological Engineering at the University of Idaho is soliciting applications for two tenure-track faculty positions, one for an Economic/Exploration Geologist and the other for a Geological Engineer. The Economic/Exploration Geologist position is open at the Assistant Professor level, rank commensurate with experience. The Geological Engineering position is open for an Assistant Professor, either at the entry or experienced level. The Ph.D. is required at the time of appointment,

and the successful candidate for each position must have commitment both to undergraduate and graduate education and to the development of an externally funded research program. The successful candidates also will be expected to establish strong industrial connections within the state and region.

The University of Idaho, located in Moscow, is Idaho's primary institution for graduate education and research. The Department of Geology and Geological Engineering is part of the College of Mines and Earth Resources and has close working relations with the Idaho Geological Survey. The 16-member Geology and Geological Engineering faculty has a strong commitment to undergraduate education and is particularly interested in candidates who will contribute to existing strengths in the program of integrated laboratory and field-oriented research and education. The department occupies adjacent buildings of the College of Mines and Earth Resources and has state-of-the-art laboratories and offices in the newly completed McClure building. Interested applicants are referred to the department web site for additional information (<http://www.mines.uidaho.edu/geology>).

Applications, with a curriculum vitae, statement of research interests and teaching philosophy, and the names, addresses, telephone numbers, and e-mail address of at least five references should be sent to Professor John S. Oldow, Department of Geology and Geological Engineering, University of Idaho, Moscow, Idaho, 83844-3022. Salary will be competitive and commensurate with experience. Search and selection procedures will be closed when a sufficient number of qualified candidates have been identified, but not earlier than 1 March, 1997.

To enrich education through diversity, the University of Idaho is an equal opportunity/affirmative action employer.

UNIVERSITY OF NEW HAMPSHIRE SEDIMENTARY GEOLOGIST

The Earth Sciences Department invites applications for a tenure-track position in sedimentary geology/stratigraphy at the assistant professor level, starting September 1997, or as soon as possible thereafter. The successful candidate will be expected to teach courses in earth history (introductory level) and sedimentary geology/stratigraphy (intermediate level) as part of the undergraduate core curriculum in geology, graduate course(s) in his/her specialty, and to develop a strong research program involving graduate and undergraduate students. We seek candidates with interests in the broad areas of sedimentology and earth history, such as paleoecology, biostratigraphy, basin analysis, and/or the sedimentary record of recent or ancient global or environmental change, to carry out research complementary to current departmental and college research efforts. A strong commitment to undergraduate teaching and familiarity with field methods are essential. UNH offers the B.Sc. in Geology and Hydrology; B.A. in Earth Sciences; M.Sc. in Geology, Hydrology, Oceanography, and Geochemistry; and the Ph.D. in Earth Sciences. The Department has 13 academic and 10 research faculty, and has strong ties to the Institute for the Study of Earth, Oceans, and Space. Starting salary will be commensurate with experience and qualifications. Candidates should have completed the Ph.D. Post-doctoral and/or teaching experience is desirable.

Application review starts March 1, 1997. Please send complete CV (non-citizens should include current visa status), statement of research and teaching interests, and names and addresses of three references to Search Committee, Department of Earth Sciences, University of New Hampshire, 56 College Road, Durham, NH 03824. Hiring is contingent upon eligibility to work in the U.S. UNH is an AA/EEO Employer.

ENVIRONMENTAL GEOLOGIST

Boise State University seeks applications for a tenure-track position at the assistant professor level beginning August 1997. Individuals with research and teaching interests in hydrogeology/hydrology, applied geomorphology or low-temperature geochemistry are particularly encouraged to apply. A Ph.D. is required at the time of appointment. The successful applicant will be expected to: 1) teach introductory hydrogeology and additional graduate and undergraduate courses in the candidate's field of expertise, 2) take a lead role in expanding the department's GIS research and teaching capabilities, 3) supervise MS-thesis and undergraduate research, and 4) establish a strong, externally funded research program.

Please submit a vitae, list of publications, statement of research and teaching interests and objectives, and the names, phone numbers and e-mail addresses of three references to: Search Committee, Department of Geosciences, Boise State University, Boise, ID 83725. BSU is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply. Details about our department can be found on the World Wide Web at: <http://earth.idbsu.edu>.

DIRECTOR OF EDUCATION PALEONTOLOGICAL RESEARCH INSTITUTION

The Paleontological Research Institution invites applications for a full-time Director of Education. Responsibilities include oversight of the Institution's rapidly growing educational programs in public outreach and teacher education in paleontology and earth science, as well as interaction with other staff in the Education Department engaged in educational product development and distance learning via the World Wide Web. Strong ability to seek and obtain outside funding is a must. Strong interest in primary and/or secondary education, teaching experience, and a postgraduate degree in paleontology or a related field required; Ph.D. and primary/secondary teaching experience preferred. Experience in geology/paleontology of New York State a plus. The Institution is looking for a dynamic, articulate individual to spearhead its lead program area during a period of exciting growth. The Paleontological Research Institution, founded in 1932, is a private educational organization housing one of the largest invertebrate fossil collections in the U.S. Deadline for applications: March 1, 1997. Start date June 1 or as soon as possible thereafter. Send letter of application, resume, and names and addresses of three references to: Director, Paleontological Research Institution, 1259 Trumansburg Road, Ithaca, NY 14850. e-mail: wadal@cornell.edu.

GEOLOGY-OCEANOGRAPHY INSTRUCTOR

MiraCosta Community College District, located in North San Diego (CA) County, is recruiting for a full-time, tenure-track Geology-Oceanography Instructor, beginning August 1997 (subject to available funding). A Master's degree or the equivalent is required. To request an application form and job announcement: leave your name, address, and title of the position on the Job Line Tape (619) 757-2121, ext. 6868; or reply by e-mail on the Internet to jobs@miracosta.cc.ca.us (Website: <http://www.miracosta.cc.ca.us>). The closing date is March 7, 1997.

MiraCosta College is an equal employment opportunity and affirmative action employer and seeks to enhance its staff diversity by specifically inviting and encouraging qualified minorities and women to apply. MiraCosta College, Attn: Human Resources, One Barnard Drive, Ocean-side, CA 92056.

Services & Supplies

LEATHER FIELD CASES. Free brochure, SHERER CUSTOM SADDLES, INC., P.O. Box 385, Dept. GN, Franktown, CO 80116.

Opportunities for Students

Graduate Opportunities in Geochemistry at the University of New Orleans. The Department of Geology and Geophysics invites applicants for graduate research assistantships in petrology and geochemistry. Research projects include: volcanologic, petrologic, and geochemical studies in the Central American Arc; geochemistry and metamorphism of ultramafics; and crustal evolution. For further information regarding this program please contact Dr. Kathleen Johnson at (504) 280-6792 or e-mail: kjohnson@geology.uno.edu. For general information on other graduate programs contact the Graduate Coordinator, Department of Geology and Geophysics, University of New Orleans, New Orleans, LA 70148. Completed applications must be received by March 1, 1997.

Traveling Fellowship: Interdisciplinary Research Training Group (RTG) in ecology, geology, archeology, geography, and soils. Graduate students are invited to Minnesota

for up to 3 months to enhance training in "Paleorecords of Global Change." Stipend (provided for citizens, nationals or permanent residents of the U.S.), travel and living allowance, and tuition. Application deadline April 1 (for travel July 1 - December 31) and October 1 (for travel January 1 - June 30). For application contact RTG, University of Minnesota, Ecology, Evolution and Behavior, 1987 Upper Buford Circle, St. Paul, MN 55108. Phone 612/624-4238; fax 612/624-6777; e-mail: eastwold@ecology.umn.edu. An Equal Opportunity Educator and Employer.

JOI/USSAC Ocean Drilling Fellowships. JOI/U.S. Science Advisory Committee is seeking doctoral candidates who are enrolled at U.S. institutions to conduct research compatible with that of the Ocean Drilling Program. April 15, 1997 is the next fellowship application deadline for both shipboard and shorebased research proposals. Shipboard research is related to future ODP legs on which students wish to sail as scientists. Shorebased research may be directed towards broader themes or the objectives of a specific DSDP or ODP leg, past, present, or future.

Shipboard proposals submitted for the upcoming April 15 deadline should be based on the following ODP legs: Leg 176 Hole 735B, Leg 177 Southern Ocean Paleocceanography, Leg 178 Antarctic Peninsula, Leg 179 NERO/Hammer Drilling, Leg 180 Woodlark Basin, Leg 181 SW Pacific Gateways, and Leg 182 Great Australian Bight. Staffing for these legs will begin during the next few months. Fellowship candidates wishing to participate as shipboard scientists must also apply to the ODP Manager of Science Services in College Station, TX. A shipboard scientist application form and leg descriptions are included in the JOI/USSAC Ocean Drilling Fellowship application packet.

Both one-year and two-year fellowships are available. The award is \$22,000 per year to be used for stipend, tuition, benefits, research costs and incidental travel, if any. Applicants are encouraged to propose innovative and

imaginative projects. For more information and to receive an application packet contact: Andrea Johnson, JOI/USSAC Ocean Drilling Fellowship Program, Joint Oceanographic Institutions, Inc. 1755 Massachusetts Ave., NW, Suite 800, Washington, DC 20036-2102 (Telephone: 202-232-3900, ext. 213; Internet: ajohnson@brook.edu).

Graduate Assistantships/Coastal Processes, Texas Christian University. The Geology Department has assistantships available for M.S. research in most fields of geology. A new area of expertise includes coastal and estuarine dynamics, with emphasis on modeling nearshore profile and shoreline variability, analyzing the impact of tidal inlets on adjacent beaches, and quantifying estuarine circulation and sediment transport patterns. Study areas include the Outer Banks of North Carolina, Kennebec River Estuary in Maine, and Long Island Sound. In addition to full laboratory and analytical facilities, the department houses the Center for Remote Sensing and has an extensive computer network. Financial aid includes two-year stipend, full tuition waiver, and research funds. Contact Michael Fenster, Department of Geology, TCU, Fort Worth, TX 76129 (817) 921-7506, m.fenster@tcu.edu, <http://geowww.geo.tcu.edu/>

Information Needed

Geology student doing thesis work at ISIRI in ISO 14000 Environmental Management Systems Standards seeks contacts, information, and papers relating to Application of Palynology in Environmental Targets, especially related to industrial environmental problems. E-mail user274@khayam.ut.ac.ir (J.Asadi) or send materials to Asadi, c/o J. Clark, P.O. Box 9140, Boulder, CO 80301 USA for forwarding.

ASSISTANT PROFESSOR

The University of Calgary

The Department of Geography invites applications for a tenure-track position in field-oriented Process Geomorphology at the Assistant Professor rank, to begin July 1, 1997. A PhD is required for this position. Preference will be given to candidates with additional expertise in core geographic methodologies (GIS, remote sensing, modelling) and landscape dynamics, with research in alpine or northern environments. The duties include undergraduate teaching, graduate teaching and supervision, research and university service. The department currently has a faculty of 15 members, and offers undergraduate major and honours programs, and a graduate program leading to the MA, MSc, and PhD degrees.

In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. The University of Calgary is committed to Employment Equity.

The closing date for applications is March 1, 1997. Applicants should send a letter of application, three letters of reference, and a curriculum vitae, directly to:

Dr. S. E. Franklin, Head
Department of Geography
The University of Calgary
2500 University Drive N.W.
Calgary, Alberta T2N 1N4



THE UNIVERSITY OF CALGARY

www.ucalgary.ca

**Council on Undergraduate Research
Geology Division
Welcomed to GSA as
Associated Society**



Associated Society status was accorded the Geology Division of the Council on Undergraduate Research (CUR) in October 1996 by the GSA Council. CUR is a nonprofit, professional organization for the advancement of scientific research primarily at undergraduate collegiate institutions. It consists of seven disciplinary divisions; the Geology Division is a member of the American Geological Institute.

The Geology Division supports CUR goals through sponsorship of poster sessions at GSA section meetings, workshops at the GSA Annual Meeting, travel grants for students to professional meetings, and sponsorship of various publications and research directories.

Officers for 1997 are:
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Secretary Karen H. Fryer,
Past Chair Donald L. Woodrow, and National Executive Officer John G. Stevens.

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ORDOVICIAN K-BENTONITES OF EASTERN NORTH AMERICA

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The Ordovician stratigraphic succession of eastern North America contains at least 60 altered volcanic ash beds, K-bentonites, one or more of which are distributed over an area of 1.5 million km². Most Ordovician K-bentonites are not widely distributed, but a few can be correlated for hundreds or thousands of kilometers by chemical fingerprinting techniques, tracing on wireline logs, and matching of detailed outcrop descriptions. K-bentonites are a potential source of diverse geologic information. Because the beds were deposited in a geologic instant over large areas, they constitute nearly isochronous rock units useful in precise correlations applicable to biogeographic, paleogeographic, paleoecologic, tectonomagmatic, geochronologic, and sedimentologic investigations in both local and regional scales. The volume presents the most comprehensive set of data currently available on the occurrence and characteristics of Ordovician K-bentonites in eastern North America. The authors (1) summarize the mineralogies and chemical compositions that help distinguish individual beds and provide information regarding the tectonomagmatic setting of the source volcanoes; (2) document the geographic and stratigraphic distribution of the 60 or more Ordovician K-bentonites in eastern North America; (3) determine the relative positions of K-bentonites within an established biostratigraphic framework; and (4) determine which beds or bed complexes have potential event-stratigraphic significance.

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