

GSA TODAY

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1996 ANNUAL MEETING

Technical Program
Schedule *Page 13*

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GSA Members, Fellows, and Other Colleagues:

All GSA members—every one of us—should contribute to the Second Century Fund, GSA's first major continuing fund drive. Here's why.

We live in a time of staggering challenges—the end of the Cold War; the apparent end of the “social contract” between society as a whole and science; widespread misunderstanding of science, particularly geology; the electronic and information revolution. The U.S. Bureau of Mines no longer exists; the USGS was saved but has been downsized and combined with the National Biological Service (NBS). The Geological Survey of Canada has also experienced major reorganization and downsizing. Some universities and colleges have acted to abolish their geology departments.

Geology is crucially important to society because:

- It provides an attractive pathway into science knowledge essential for children and adults; nearly everyone is interested in some aspect of geology, whether it be landscape, earthquakes, floods, volcanic eruptions, impacts, dinosaurs, or just rocks, dirt, and fossils.
- Every citizen needs some basic understanding of Earth, which geology can provide, in order to make intelligent decisions on environment or resource issues or mundane decisions such as where to buy a home.
- Some knowledge of geology enriches anyone's appreciation of the changing world around us. It's “good for the soul.”

While most of us will agree on geology's importance, we seem to have a difficult time getting our message across to the public at large. How can we do it better?

GSA's Council, officers, and science editors are working with headquarters staff to respond to these issues. They are trying not only to

enhance the science framework of the Society—our traditional role—but also to provide programs that increase public awareness and

understanding of geology. These actions include:

- **New efforts to enhance GSA's publications.** The *Geology* editors are communicating with science journalists who effectively translate technical subjects for newspaper and magazine readers. The *Bulletin* editors are actively seeking papers on a wide range of subjects; manuscript submissions are up 20%. Numbers of subscriptions and citations for both *Geology* and *Bulletin* are substantially higher than for competing journals. *Environmental and Engineering Geoscience*, a joint GSA–Association of Engineering Geologists quarterly, and *Hydrogeology Journal* are offering some GSA members the applied journal they requested. In response to member feedback, *GSA Today* is broadening its spectrum of topics. The Maps and Charts and Books editors have new ideas for future directions of those series.

- **Science Awareness through Geoscience Education (SAGE) program.** SAGE has dynamic initiatives underway in several areas:

The Earth-Space Center, integrating cutting-edge research, computer technology, and innovative teaching practices into new models for K–16 teaching; Geoscience Education Through Intelligent Tutors (GET-IT) program, an interactive computer-based geoscience curriculum for the middle schools, and the Earth and Space Science Technological Education Project (ESSTEP), an NSF-funded professional development program for teachers of grades 8–14; Partners for Education Program (PEP), which fosters K–12 partnerships between educators and geoscientists and collaborations with other scientific societies, government agencies, and businesses. Its projects include producing exciting high-quality educational programs at GSA annual and section meetings; cooperative efforts with other groups to develop and support geoscience programs aimed at underrepresented minorities; and collaboration with the National Park Service and other societies to enhance public understanding of the geology of national parks and monuments; development, with support of the Department of Energy, of workshop modules to help aid understanding of standards-based education and how it can be used to improve K–12 teaching and learning; and participation in an NSF-funded initiative in Colorado to develop a community-involvement program about standards-based education.

- **Institute for Environmental Education (IEE)**, which sponsors environmental forums at GSA annual and section meetings, media workshops for geoscientists, and the Roy Shlemon Applied Geology Mentor Program; guides the GSA Congressional Science Fellow program; promotes the Geology and Environment Public Outreach Program (GEPOP) of 300 geoscientists volunteering to serve in environmental problem-solving; and facilitates gatherings of diverse groups to address environmental issues, such as

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Eldridge Moores,
President, GSA

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SECOND CENTURY FUND

EARTH ♦ EDUCATION ♦ ENVIRONMENT



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STAFF: Prepared from contributions from the GSA staff and membership.
Executive Director: Donald M. Davidson, Jr.
Science Editor: Suzanne M. Kay
Department of Geological Sciences, Cornell University, Ithaca, NY 14853
Forum Editor: Bruce F. Molnia
U.S. Geological Survey, MS 917, National Center, Reston, VA 22092
Managing Editor: Faith Rogers
Production & Marketing Manager: James R. Clark
Production Editor and Coordinator: Joan E. Manly
Graphics Production: Joan E. Manly, Adam S. McNally

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Classifieds and display: contact Ann Crawford (303) 447-2020; fax 303-447-1133

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the meetings this summer between interested parties about issues that might be addressed by the just-merged NBS-USGS.

- **Restructuring of GSA annual meetings.** An Annual Meeting Committee will soon be at work determining how to enhance the quality of science at the annual meeting.
- **Internationalization.** We live in an increasingly global community, and geology has become increasingly global in scope. GSA is now seeking a volunteer International Secretary to facilitate the Society's outreach beyond North America.
- **Planning.** GSA has re-instituted a long-range planning process.

Where Does the Money Come From?

All this activity costs more money—50% more—than GSA receives in regular income such as membership dues, subscriptions, meeting fees, etc. For example, IEE and SAGE were started using seed money from the endowment. In addition, GSA publications have been subsidized for decades from endowment income. Unlike some other societies, GSA views its publications as a service to members and the science in general, rather than as "cash cows." Thus, Council recently acted to increase GSA's nonmember subscription rates modestly so that publications will be self-supporting. Even so, GSA's nonmember rates will be much less than those of most of its competition (\$300/year vs. \$1,000 to \$3,000/year for other society journals and for-profit publications). This makes them affordable to more libraries and other institutions.

While GSA has enjoyed the luxury of having endowment income to support activities, these funds can only be stretched so far. Despite excellent investment results in recent years, in view of long-term inflation and the need to preserve and enhance the real value of our endowment, Council has prudently adopted a policy that limits the use of endowment income for programs and operations to not more than 5% of the total portfolio value. Thus, although initially supported from endowment income, IEE and SAGE are making great efforts and good progress to become self-supporting.

Also, while Executive Director Don Davidson has achieved impressive cost savings at headquarters, it has become crystal clear that GSA needs more income to support these important efforts.

Here's Where You Come In

The Second Century Fund campaign was begun in 1992 with a goal of \$10 million. So far we have reached half that amount. We need to complete the Second Century Fund campaign so as to increase endowment to the point where income from it will allow for continued funding of SAGE, IEE, and other important GSA activities without an undue increase in membership or subscription rates.

Participation of the membership at large in this fund-raising effort is crucial at this stage, and GSA needs your help. The GSA Foundation must be able to demonstrate large-scale support from the membership in the form of individual contributions to attract further contributions from major donors and funding agencies. Officers, Councilors and headquarters employees have contributed to this "money-begets-money" effort. You have received or soon will get a Second Century Fund solicitation from your section. I urge you to make a commitment to the campaign at this time.

The Foundation suggests a member pledge of \$250, in five yearly \$50 increments. Significant contribution support at the \$250 level from individual members would assure a successful campaign. However, we urgently need your participation, at whatever level you can afford. Unrestricted or undesignated contributions will be added to the endowment; 20% of your contribution will go to your section's endowment at the Foundation.

Remember, every contribution, whatever size, makes a difference. We need your help, and we need it now.

Please join me in pitching in to assure support for GSA's vitally important programs. Thanks for your help. If you have any comments or suggestions, please let me know:

Eldridge Moores
Telephone: (916) 752-0352
Fax 916-752-0951
E-mail: moores@geology.ucdavis.edu ■

Imaging Laurentide Ice Sheet Drainage into the Deep Sea: Impact on Sediments and Bottom Water

Reinhard Hesse*, Ingo Klaucke, Department of Earth and Planetary Sciences, McGill University, Montreal, Quebec H3A 2A7, Canada

William B. F. Ryan, Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY 10964-8000

Margo B. Edwards, Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI 96822

David J. W. Piper, Geological Survey of Canada—Atlantic, Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2, Canada
NAMOC Study Group†

ABSTRACT

State-of-the-art sidescan-sonar imagery provides a bird's-eye view of the giant submarine drainage system of the Northwest Atlantic Mid-Ocean Channel (NAMOC) in the Labrador Sea and reveals the far-reaching effects of drainage of the Pleistocene Laurentide Ice Sheet into the deep sea. Two large-scale depositional systems resulting from this drainage, one mud dominated and the other sand dominated, are juxtaposed. The mud-dominated system is associated with the meandering NAMOC, whereas the sand-dominated one forms a giant submarine braid plain, which overlaps the eastern NAMOC levee. This dichotomy is the result of grain-size separation on an enormous scale, induced by ice-margin sifting off the Hudson Strait outlet. At the upslope end of the mud system, fine, suspended sediment was dispersed by buoyantly rising meltwater plumes and entrained by the south-flowing Labrador Current. Deposition from the turbid surface plumes blanketed the continental slope south of the strait, whose high relief was subsequently created by retrograde canyon erosion. Remobilization of this fine-grained slope sediment created the mud-rich NAMOC. In contrast, bedload-rich meltwater discharges generated sandy turbidity currents on the low-relief slope off the Hudson Strait, which basinward formed the braid plain. Periodic surging of the Hudson Strait ice stream, possibly related to subglacial-lake outburst flooding that triggered extraordinary large, bedload-rich meltwater discharges, released unusual quantities of icebergs that left their trace in Heinrich layers rich in ice-rafted debris and marked times of short-term climate cooling. The injection of large volumes of fresh or brackish water into the ocean bottom circulation may be a side effect of Heinrich events in the deep sea.

INTRODUCTION

Pleistocene continental ice caps shaped the surface of Earth more profoundly than any other geologic phenomenon of comparable duration. Their geomorphic effects on land are best known from their smaller cousins, the Alpine mountain glaciers, but these give no idea of the extent to which large, land-based ice sheets have shaped the ocean floors adjacent to ice margins. The far-reaching marine influence of ice sheets, which we have documented in sidescan sonar imagery, is little known. Our understanding of the role of continental ice sheets in Pleistocene paleoclimate change has recently changed dramatically with recognition that ice sheets may control short-term climate variations through direct ocean-atmosphere feedback (Broecker, 1994), rather than merely record orbitally forced climate change. The role of ice sheets in short-term climate

change through the thermohaline circulation may be coupled with a similarly pronounced impact on deep-sea sedimentation for the Pleistocene Laurentide Ice Sheet and neighboring Labrador Sea.

HUDSON STRAIT AND THE NAMOC SUBMARINE DRAINAGE SYSTEM

The Hudson Strait played a unique role during the late Pleistocene as a single major ice-sheet outlet. Through this outlet, the subglacial drainage system of the Hudson Bay area, a 3–4 x 10⁶ km² area (Fisher et al., 1985; Hughes, 1987) composing the northeastern sector of the Laurentide Ice Sheet, was connected with the basin-wide submarine drainage system of the Northwest Atlantic Mid-Ocean Channel (NAMOC) on the Labrador Slope and basin floor (Hesse et al., 1987; Hesse and Rakofsky, 1992). The NAMOC extends nearly 4000 km from 61°N off the Hudson Strait to 37°N in the North American Basin (Chough and Hesse, 1976). Combined with the >2000-km-long subglacial part on land, this is one of the world's longest interconnected Pleistocene land-sea drainage systems. Through its channels, glacially derived sediments were transported as far as the Sohm Abyssal Plain in

the western Atlantic, some 5000 to 6000 km from their source.

Drainage of the ice sheet involved repeated collapse of the ice dome over Hudson Bay, releasing vast numbers of icebergs from the Hudson Strait ice stream in short time spans. The repeat interval was on the order of 10⁴ yr. These dramatic ice-rafting events, named Heinrich events (Broecker et al., 1992), occurred throughout the North Atlantic and flooded the ocean north of 40°N with icebergs. Heinrich events were associated with short-term climate change (Bond et al., 1993) because they caused suppression of the conveyor-belt circulation. The freshwater lid from the melting icebergs prevented deep-water formation in the Norwegian Sea, which stopped the Gulf Stream from penetrating northward, thus triggering short-term Northern Hemisphere cooling (Broecker, 1994; Paillard and Labeyrie, 1994).

SEA-FLOOR MORPHOLOGY AND CHANNEL GEOMETRY

Establishing seascape morphology with high precision by sonar imaging is a fundamental first step in interpreting sea-floor evolutionary processes (e.g., Macdonald et al., 1993). To do this, state-of-the-art sidescan-sonar imagery and swath bathymetry were acquired using the HAWAII MR-1 (Hawaii Institute of Geophysics Acoustic Wide-Angle Imaging Instrument Mapping Researcher 1) system, the successor of SeaMARC II (Rognstad, 1992), on *Hudson* cruise 93-025. The system is towed 70–80 m below the water surface at 8–9 kn with the sidescan sonar operating at frequencies of 11 and 12 kHz, respectively on the port and starboard sides. Simultaneous deployment of 3.5 kHz and airgun vertical seismic systems makes this the most efficient remote-sensing package for deep-sea floor surveys. Approximately 7000 km of real-time data covering 140 000 km² of seafloor were obtained and used to construct up to six-track-wide mosaics of parts of the NAMOC (each track being 20 km wide).

The resulting 2500-km-long and up to 120-km-wide corridor of sidescan imagery along the course of NAMOC (Figs. 1 and 2) provides a bird's-eye view of the ocean floor diagonally across the Labrador Sea.

*Also at: Institut für Allgemeine und Angewandte Geologie, Ludwig Maximilians Universität, Munich, Germany.

†Saeed Khodabakhsh, Larry A. Mayer, and shipboard participants J.-F. Boily, B. Chapman, R. B. Davis, J. R. Erickson, D. J. Johnson, C. Keeley, B. Konyukhov, C. Olson Major, K. Parlee, A. Peslier, S. Renaud, S. Ryan, K. L. Sender, R. Sparkes, K. Wagner, and J. S. Won.

Ice Sheet Drainage continued from p. 3

Four distinct morphologic regions can be recognized.

Region 1: Continental slope in <3000 m water depth (west of 57°N, sea-floor gradient >1:500). A dendritic pattern of closely spaced tributary canyons with increasingly complex upslope branching (Fig. 2) shows steep canyon walls with spectacular relief of up to 700 m (Fig. 3A) alternating with low-relief sectors. Canyons in the low-relief regions are <120 m deep and have broad floors flanked by broad ridges or levees. Low-relief sectors occur in front of glacial outlets, seaward of the shelf break (Hesse and Klaucke, 1995), whereas high-relief sectors typically lie south of these outlets.

Region 2: Continental rise between 3000 and 3400 m water

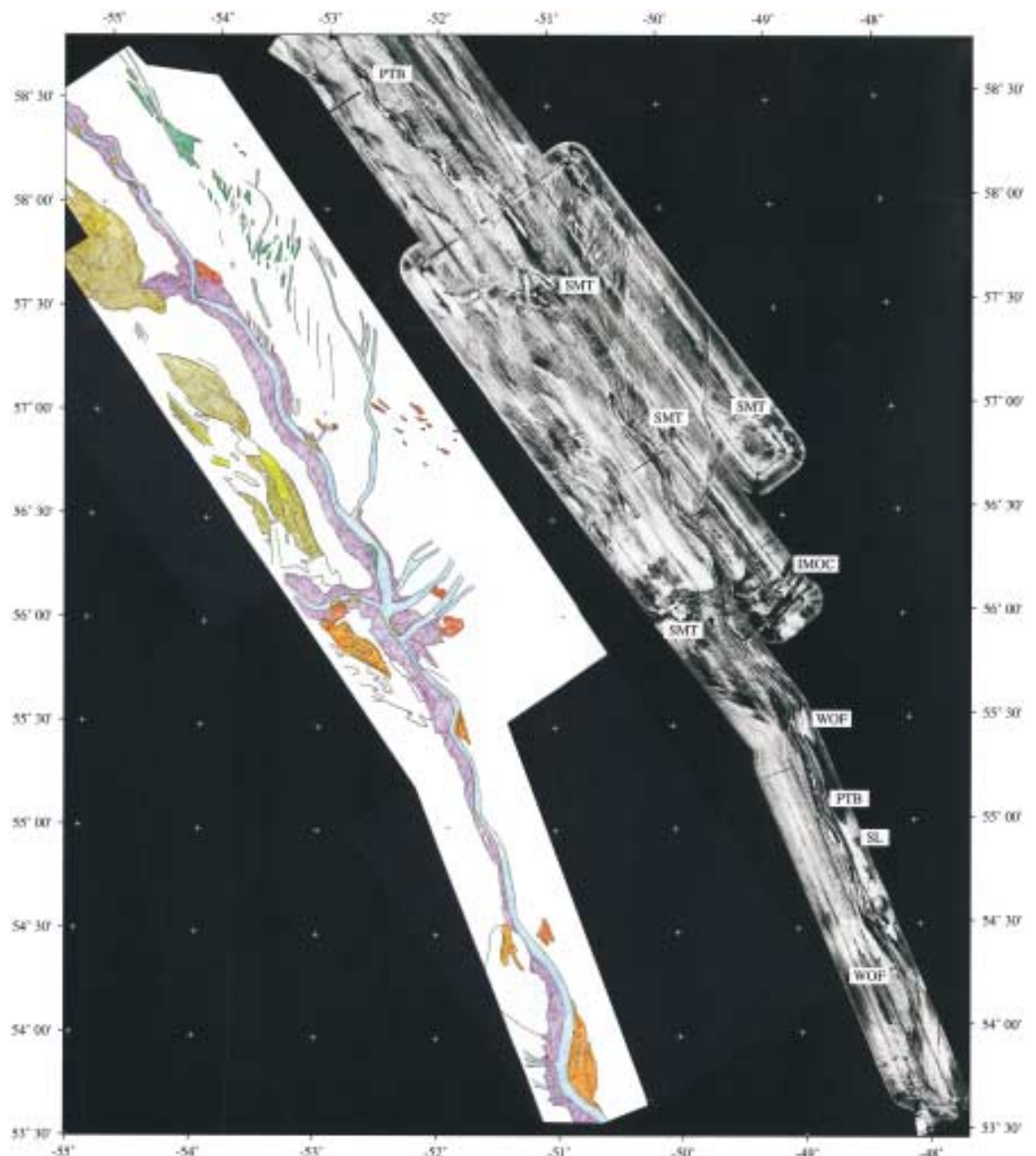
depth. Canyons (called channels on the rise and basinward) are dramatically fewer in number and have less relief than on the slope (Fig. 3B), and the NAMOC appears as a discernible trunk channel of the drainage system. No upslope canyon can be singled out as the main NAMOC feeder. On the sidescan mosaic in Figure 2, the most prominent aspect between about 57° and 54°30'W is the dichotomy between the high-backscatter-energy (light areas) muddy levees of the NAMOC, and the low-backscatter (dark areas) sand and gravel-rich plains to the northeast. Lithologies were established by piston coring (Fig. 4).

Region 3: Labrador Basin floor south of 59°45'N and below 3400 m water depth to confluence with H tributary and Imarssuak Mid-Ocean Channel at 56°N (average sea-floor

gradient 1:1000 or less). The channel floor appears as a meandering 2- to 3-km-wide band of low-backscatter energy with low sinuosity (meander radius ranges from 17 to 55 km, averages 25 km). Tributaries run parallel to the NAMOC for several hundred kilometers (Hesse, 1989) but eventually join the main channel (confluence with tributary E/F at about 57°40'N; Fig. 1). Bright areas in the channel are interpreted as slumps or point bars. The point bars are concentrated on, but not restricted to, inner meander bends on the right channel wall. We imaged washover fans, hanging submarine valleys, and chute pools in this region for the first time in the deep sea (Klaucke and Hesse, 1996).

The most surprising morphologic feature of the entire mosaic is the curved alternating high- and low-backscatter-energy streaks on the sand and gravel

Figure 1. Mosaic of HAWAII MR-1 sidescan sonar images (6 ship tracks, each 20 km wide) in the central Labrador Sea (for location see inset in Fig. 2, southern part of red corridor) showing submarine braid plain with curved ridges and sand and gravel bars (bright) immediately east of the meandering NAMOC with its muddy levees. The imagery is displayed in normal polarity—i.e., low-backscatter reflectivity appears dark and high-backscatter reflectivity bright.



ture of the streaky pattern toward the main channel where the east NAMOC levee is absent (between 57° and 56°30'N) shows that the levee was eroded by currents flowing from the braid plain into the channel, not vice versa.

The occurrence of the submarine braid plain distal to the upslope non-braided sand-and-gravel plain (region 2) is contrary to expectation and could be an artifact of sidescan penetration through mud cover. Piston cores from the braid plain show a 1–1.5-m-thick Holocene mud blanket above massive sand layers up to several meters thick. The sidescan signal could have penetrated the thinner “mud screen” in region 3, but not the thicker mud cover near the ice outlet in region 2.

Region 4: NAMOC segment between 56°N and 44°30'N below 3800 m water depth (average sea-floor gradient: 1:2000). In this region (not shown in Fig. 1), NAMOC meander radii increase from 50 km north of 54°S, to >50 km farther south. Some channel reaches are straight (in the sense of Clark et al., 1992), whereas in others, seamounts and basement structures cause sharp, generally north-northwest–south-southeast to west-east deflections as the channel enters and leaves fracture zones.

INTERPRETATION: EFFECTS OF SEDIMENT INPUT AND TRANSPORT MECHANISMS ON SEA-FLOOR MORPHOLOGY

The profound changes and juxtaposition of sea-floor morphologies described above can be attributed to sediment delivery and transport mechanisms during glacial episodes. The transfer of the glacially derived sediment to the marine environment requires two major steps: (1) delivery to the ice margin and upper slope by primary transport mechanisms, and (2) slope erosion and redeposition by secondary transport mechanisms. The upper-slope dichotomy of low- vs. high-relief sectors (Fig. 3A), which is projected basinward by the submarine braid-plain vs. leveed-channel dichotomy (Figs. 3B, 5) is the result of a giant grain-size fractionation process at the ice margin. When detritus carried by the glacier and its rivers reaches the sea, the suspended load is separated from the bedload by processes appropriately named ice-margin sifting.

Low-Relief Morphology: Transport by Debris Flows and “Primary” Turbidity Currents

The vast volumes of coarse material melted from the huge Hudson Strait glacier tongue led to the production of giant debris flows that had a smoothing effect on the relief. Periodic meltwater discharge peaks caused heavy sand-laden freshwater flows to break the seawater

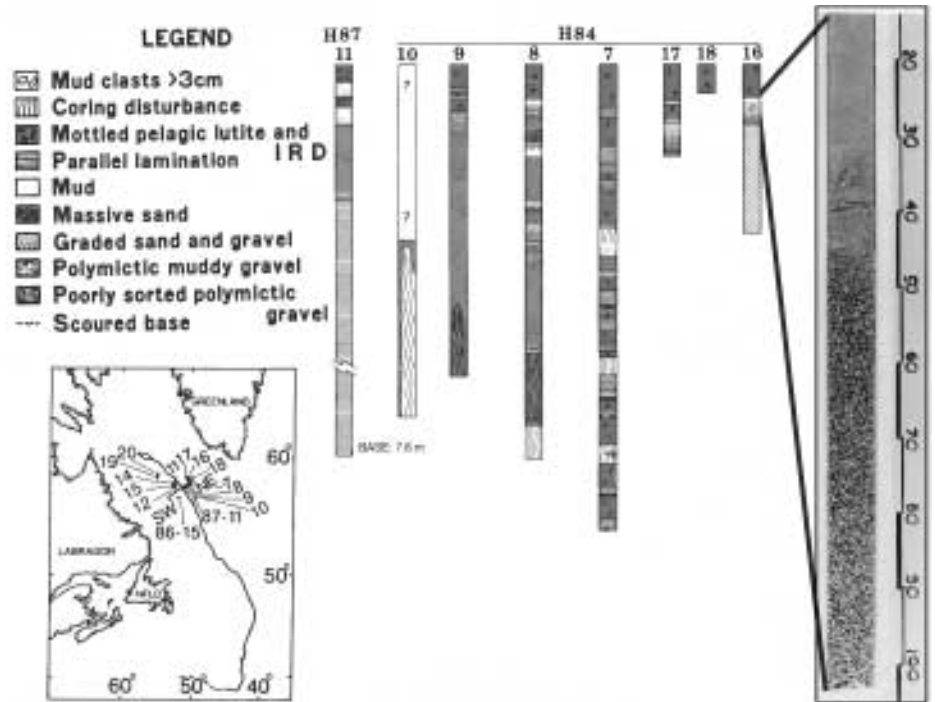


Figure 4. Piston cores from the submarine braid plain showing massive or graded sand and gravel layers up to several meters thick overlain by a 1-m-thick Holocene pelagic lutite layer. IRD is ice-rafted debris.

density barrier and form density underflows (Mulder and Syvitski, 1995). These turbidity currents carried sandy sediment well beyond the upper or mid-slope (as far as region 3 and probably beyond) and fed the sand and gravel plains east of the NAMOC. The plains adjacent to the NAMOC are best explained as forming by deposition of sand-rich sheet flows originating in Hudson Strait and circumventing the NAMOC and its tributaries, rather than by flooding from the trunk channel. Some of the flows were apparently of unusually large volume (see below). These currents overflowed the low-relief slope in front of the strait and cut shallow channels into the substrate of the debris-flow deposits on the upper slope (Fig. 3A).

High-Relief Morphology: Turbid-Plume Deposition, Slope Erosion and Redeposition

The normal mode of turbidity-current generation in an ice-marginal environment is secondary transport due to remobilization of glacial-front upper-slope sediment, not meltwater flooding. To a large extent, the upper-slope region south of the Hudson Strait outlet received sediment as a mud blanket deposited by particle-by-particle settling. Meltwater entering the sea, even when heavily loaded with suspended sediment, rose buoyantly to the surface, forming turbid surface plumes—a well-known phenomenon in modern tide-water glaciers (Syvitski et al., 1987; Pfirman and Solheim, 1989; Lemmen, 1990). Meltwater plumes jetting out from under

or above the Labrador Sea ice were entrained by the south-flowing Labrador Current. Typical turbid-plume deposits (Fig. 6) have been identified in piston cores from within 20 km of the assumed ice-margin position. The remainder of the slope is predominantly underlain by fine-grained sediments with equal parts of hemipelagic sediments and muddy spillover turbidites. Subordinate constituents are from ice rafting (Fig. 6, B, and D), including distinct Heinrich layers (Wang and Hesse, 1996), and moving bottom layers of suspended sediment called nepheloid-layer deposits (Fig. 6).

The modern high relief of the slope has been generated by retrograde syn- or postdepositional erosion involving headward and sideward gullying in the canyons producing the present-day dendritic, high-relief canyon pattern. Remobilization of sediment by slumping, debris flow, and turbidity current formation has been the main sediment source for the NAMOC, whose muddy levees in regions 2 and 3 formed by spillover from the fine-grained tops of turbidity currents (same spillover turbidites as in Fig. 6D, but without ice-rafted debris).

Channelized Turbidity Currents

The change from the depositional-erosional topography of the slope to a mostly depositional topography on the rise is marked by the appearance of channels with true depositional levees built by overbank deposition from turbidity currents. Levee development peaked along the upper NAMOC in regions 2 and 3

(upstream from the entrance of sandy flows from the braid plain) where levees reach a maximum height of 80 m above the adjacent basin plains, and widths up to 40 km to the west and 20 km to the east of the NAMOC (Fig. 3C). Down-channel decreases of levee relief from 80 to 30–10 m and channel depth from 200 to 140–75 m imply that flow parameters decreased down-flow. The difference in levee height between the west and east levees also decreases from a maximum of 90 m to 30 m in the proximal to the distal channel reaches, signaling the decreasing effect of Coriolis force with latitude together with decreasing flow velocities and densities in the distal channel.

Quantification of flow parameters by using imaged channel geometry (width, meander radii) and a digital terrain model generated from the bathymetric data (channel depth, levee asymmetry) provide information on flow-velocity variation, both longitudinally along the flow path and vertically within the flows (Klaucke, 1995). Equilibrium-flow conditions have been established only for the first 350 km of region 3. Low flow velocities of 0.8 m/s that decrease to 0.05 m/s, calculated for region 3 bankfull flows, are flow-top velocities (Klaucke, 1995). Gravel-sized channel-fill sediments in the NAMOC along regions 2 and 3 (Chough et al., 1987) give maximum calculated bottom velocities of 6.5 to 8 m/s (for the lower 50 to 80 m of up to 200-m-thick flows). These higher bottom velocities apparently shaped the overall channel geometry, including the low-sinuosity meander pattern.

RELATION BETWEEN BRAID-PLAIN DEVELOPMENT, HEINRICH EVENTS, AND SHORT-TERM CLIMATE CHANGE

The development of the submarine braid plain in the Labrador Basin adjacent to the NAMOC (Fig. 5) sheds light on a possible relation between the injection of sand-laden meltwater by turbidity currents and Heinrich ice-raftering events. Some of the turbidity currents that deposited sand on the braid plain must have been unusually large. After having traveled more than 1000 km from the Hudson Strait outlet, some of them were still powerful enough to erode the east NAMOC levee between 57° and 56°30'N. There, they entered the main channel and traveled down channel an unknown distance, probably to the channel terminus on the Sohm Abyssal Plain. These flows deposited sandy overbank sediment all along the east levee of the distal channel (Klaucke, 1995). The only suitable reservoirs of appropriate size that could have released such very large volumes of sediment and water are subglacial lakes in Hudson Strait and its drainage area. The former existence of these lakes is indicated by large depressions (e.g., in the floor of the strait). If the

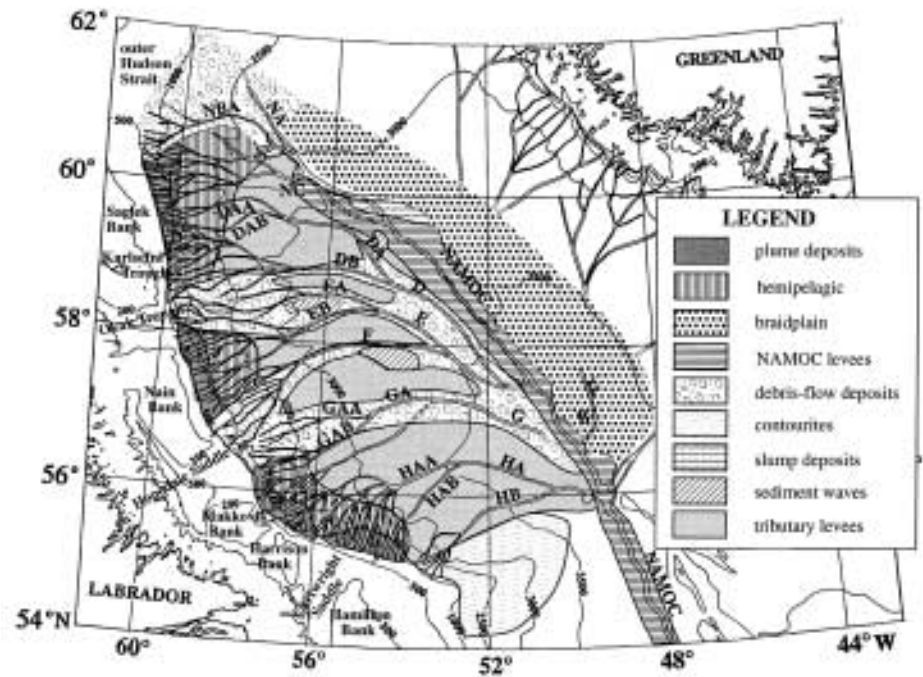


Figure 5. Facies distribution map, Labrador slope and basin, based on seismic profiles and ground-truthing piston cores.

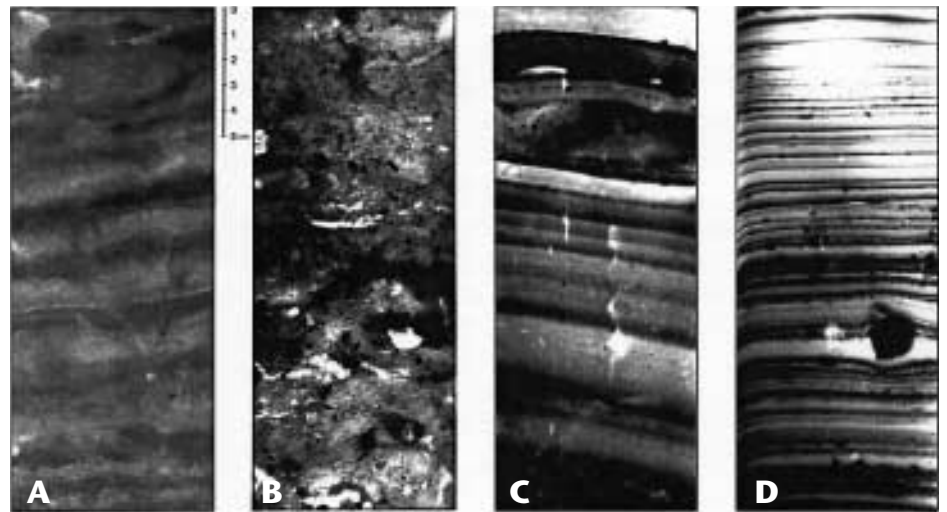


Figure 6. X-radiographs of glaciomarine depositional facies from the Labrador slope and basin. A: Turbid surface-plume deposits; B: hemipelagic sediment with ice-rafted debris; C: nepheloid-layer deposits; D: overbank levee spillover turbidites alternating with laminae of ice-rafted debris.

lakes were dammed by end moraines, or by the ice itself, surging of the Hudson Strait ice stream during Heinrich events could have cut the barriers, causing the catastrophic emptying of the lakes. Alternatively, rising lake levels may have lifted the ice dams and been the cause that triggered ice surging and Heinrich events. The ensuing subglacial lake outburst flooding events would have cut the gorges and canyons now subaerially exposed as spillways on Meta Incognita Peninsula on the north coast of the strait (Johnson and Lauritzen, 1995). Large volumes of fresh or brackish water entrained in the resulting turbidity currents could have been

injected into the deep-ocean circulation. This may have affected deep-water density and, accordingly, the deep conveyor-belt circulation in the Atlantic, at least temporarily. This possibility has not been considered previously in the climate-feedback scenarios, which have recently incorporated Heinrich events as short-term climate pacemakers.

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Ice Sheet Drainage continued on p. 8

WASHINGTON REPORT

Bruce F. Molnia

Washington Report provides the GSA membership with a window on the activities of the federal agencies, Congress and the legislative process, and international interactions that could impact the geoscience community. In future issues, Washington Report will present summaries of agency and interagency programs, track legislation, and present insights into Washington, D.C., geopolitics as they pertain to the geosciences.

Pristine No More

Several recent reports have provided a variety of information indicating that human and natural changes are having a significant impact on many of the northern and Arctic marginal seas. These areas include the Bering Sea, Kara Sea, Barents Sea, Laptev Sea, Sea of Okhotsk, and Sea of Japan. The human activities include dumping radioactive waste, overfishing, release of metals and other contaminants to the environment, and a variety of other actions. Radioactive waste has also been dumped in the northernmost northwest Pacific Ocean.

Three reports—two released in the past few months and one released last year—clearly document what is known about the extent of change to these northern areas. Two reports were released by the U.S. Interagency Arctic Research Policy Committee (IARPC). They are “Workshop on Arctic Contamination” and “Proceedings of the Japan—Russia—United States Study Group on Dumped Nuclear Waste in the Sea of Japan, Sea of Okhotsk, and the North Pacific Ocean.” The third report, “The Bering Sea Ecosystem,” released in May 1996, was prepared by the Polar Research Board (PRB) of the National Research Council and published by the National Academy Press.

The IARPC, a federal committee with a membership composed of the 14 agencies active in the Arctic, coordinates Federal Arctic basic and applied research, monitoring efforts, and other informa-

tion-gathering activities. In 1992, after learning that several million curies of radioactive waste had been dumped by the former Soviet Union into the Arctic's marginal seas, the IARPC convened an international workshop to identify the breadth and sources of existing data and information about Arctic contamination, to identify major data gaps, and to determine whether specific Arctic contaminants present a risk to the environment, ecosystems, or human health in Alaska, the Arctic, and the global environment. The focus of the workshop was not only radioactive contamination, but also other contaminants that exist in and affect the Arctic.

The result is a 311-page proceedings volume, which contains about 60 presentations, including 12 papers and 10 abstracts by Russian experts. The workshop identified that a broad variety of contaminants are found in the Arctic, even though they are not used in that area. For instance, natural transportation processes concentrate compounds like DDT in the coastal Arctic even though they are not being used within a several thousand mile radius. The proceedings volume, was released in May 1995, as the volume 8, spring issue of *Arctic Research of the United States*.

The second report, “Proceedings of the Japan—Russia—United States Study Group on Dumped Nuclear Waste in the Sea of Japan, Sea of Okhotsk, and the North Pacific Ocean,” expanded the geographic area of concern to the marginal seas of the Russian Far East. As the title

implies, only nuclear contamination was considered. This workshop documented that much less radioactive waste had been dumped into the far eastern marginal seas than into the Arctic marginal seas. One reason for this was that most of the high-level solid waste in the Russian Far East, generally reactors and spent fuel rods of mothballed nuclear submarines, were still in temporary storage at naval sites along the coastline. Even more problematic was the fact that a suitable reprocessing capability and the means to transport these highly radioactive materials do not exist. The proceedings of this workshop were released in May 1996, as the volume 9, fall/winter issue of *Arctic Research of the United States*.

In June 1996, a follow-on workshop, cosponsored by the U.S. Geological Survey, was held in Niigata, Japan. Its purpose was to continue the multinational international dialogue on how to reduce the volume of radioactive waste stored in the Russian Far East. The proceedings of this workshop will be published early in 1997 in *Arctic Research of the United States*.

The third report, “The Bering Sea Ecosystem,” 309 pages long, concluded that during the past 50 years, natural changes in the ocean environment have combined with the effects of human harvesting of whales, the taking of other marine mammals, such as seals, and overfishing “to cause a cascading and possibly irreversible sequence of changes in the Bering Sea ecosystem.” These activities appear to have reduced the amount of high-quality food available to young marine mammals and birds. Nine recommendations are presented, including some possible changes to the management of the Bering Sea fishery.

Both IARPC proceedings are available at no cost from the Office of Polar Programs at the National Science Foundation; the PRB report may be purchased from the National Academy Press. For additional information, contact your Washington Report editor (bmolnia@usgs.gov). ■

Ice Sheet Drainage continued from p. 7

Kirk Maasch, substantial editorial assistance by Suzanne Kay, the cooperation of Captain Lewis, and the officers and crew of CSS *Hudson*, and major funding from the Canadian Natural Science and Engineering Research Council and the U.S. National Science Foundation.

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Ice Sheet Drainage continued on p. 9

Penrose Conference Scheduled

Faults and Subsurface Fluid Flow: Fundamentals and Applications to Hydrogeology and Petroleum Geology

September 10–15, 1997

A Geological Society of America Penrose Conference, "Faults and Subsurface Fluid Flow: Fundamentals and Applications to Hydrogeology and Petroleum Geology," will be held September 10–15, 1997, in Albuquerque and Taos, New Mexico. The conference will be a synopsis of state-of-the-art field, laboratory, and computer modeling studies of the role of faults as barriers to and conduits for single- and multiphase fluid flow. Topics to be addressed will include deformation of rocks and sediments in fault zones; the influence of deformation on fluid flow and transport phenomena; diagenetic alterations and their feedback into hydrologic and structural processes; and geological and geophysical imaging of fault properties. We will emphasize both fundamental research and application to problems such as ground-water supply, ground-water contamination, petroleum migration, and petroleum production.

Participants will be picked up at the Albuquerque airport and spend the evening of September 10 in Albuquerque, and assemble the next morning for a field trip to examine the relation between faults and ground-water flow in the Albuquerque basin. Planned stops will highlight the structure and stratigraphy of the Cenozoic basin-fill aquifer system; deformational features, paleoflow indicators, and zones of cementation along faults cutting unconsolidated basin-fill sediments; and the hydrogeology of basin-bounding faults. We will then travel to Taos, for three days of oral presentations, poster sessions, and discussions concerning current and future research on the interrelation of

faults and subsurface fluid flow. Participants will be returned to the Albuquerque airport before noon on September 15.

The conference will be limited to 70 participants, who will be selected to represent a broad range of disciplines and geographic areas of expertise. We encourage interested graduate students to apply, and we will be able to offer some partial student subsidies. The registration fee, which will cover lodging, meals (except for first night's dinner), ground transportation during the conference, field trip, and all other costs except personal incidental expenses, is expected to be approximately \$600 to \$700. Participants will be responsible for transportation to and from the conference.

Co-conveners are: **William C. Haneberg**, New Mexico Bureau of Mines & Mineral Resources, 2808 Central Avenue SE, Albuquerque, NM 87106, (505) 262-2774,

fax 505-255-5253, E-mail: haneberg@nmt.edu; **J. Casey Moore**, Earth Sciences Board, University of California, Santa Cruz, CA 95064, (408) 459-2574, E-mail: casey@rupture.ucsc.edu; **Laurel B. Goodwin**, Department of Earth and Environmental Science, New Mexico Tech, Socorro, NM 87801, (505) 835-5178, E-mail: lgoodwin@nmt.edu; **Peter S. Mozley**, Department of Earth and Environmental Science, New Mexico Tech, Socorro, NM 87801, (505) 835-5311, E-mail: mozley@nmt.edu.

Application deadline is March 1, 1997. Invitations will be mailed to participants by April 1, 1997. We will have a limited number of invited oral presentations, so that a significant part of the meeting can be devoted to poster presentations and informal discussions.

Potential participants should send a letter of application to William Haneberg (address above), including a brief statement of interest, the relevance of the applicant's recent work to the themes of the meeting, and the subject of any proposed poster presentation. Although E-mail inquiries to any or all of the conveners are welcome, potential participants should submit two paper copies of their application. E-mail letters of application will not be considered. ■

About People

GSA Fellow **Wallace S. Broecker**, Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York, has been awarded the National Medal of Science for his pioneering contributions in understanding chemical changes in the ocean and atmosphere.

Fellow **Farouk El-Baz**, Boston University, Boston, Massachusetts, is the 1996 recipient of the AAPG Michel T. Halbouty Human Needs Award, for his contributions in remote sensing to the search for natural resources in arid lands.

Joining the Colorado School of Mines (Golden, Colorado) faculty are GSA Members **Murray W. Hitzman** (Charles Franklin Fogarty Distinguished Chair in Economic Geology) and **Neil F. Hurley** (Charles Boettcher Distinguished Chair in Petroleum Geology).

Fellow **John G. Vedder**, Portola Valley, California, is the fourth recipient of the Dibblee Medal, presented by the Thomas Wilson Dibblee, Jr., Geological Foundation, in recognition of extraordinary accomplishment in geologic mapping.

Ice Sheet Drainage *continued from p. 8*

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Manuscript received August 1, 1995; revisions received October 31, 1995, January 18, 1996, June 11, 1996; accepted June 18, 1996. ■

Barbara L. Mieras,
Partners for Education
Program Manager



For All GSA Members

Here are three good reasons to look for the PEP materials in your 1996 membership renewal packet:

1. The Partners for Education Program (PEP) needs feedback on GSA members' involvement in K-12 geoscience education; *whether or not* you're a PEP member, please take a few minutes to fill out the K-12 Geoscience Survey enclosed with your membership materials and return it to us in the postage-paid envelope.

2. If you aren't already a PEP member, please consider joining us to lend some support to K-12 geoscience education—it's free, and it's a priceless contribution!

3. New and continuing PEP members: Would you be willing to help as an E-mail partner or PEP expert? You can join these efforts by returning the appropriate information on the card enclosed with your membership materials or by contacting us at bmieras@geosociety.org or bklocek@geosociety.org. Thank you.

Make your travel plans for the GSA 1996 Annual Meeting in Denver. We are looking forward to a dynamic exchange of ideas and information—geoscience education is one of four disciplinary categories that received more than 200 abstracts. We also have a host of favorite special events returning this year, including the Earth Science Social Hour, the Rock Raffle (with PEP coupons, of course), and the Share-A-Thon. Please let us know if you have an enticing rock, mineral, or fossil sample to donate to the Rock Raffle. In addition to the technical sessions and informal gatherings dealing with geoscience education throughout the meeting, education events will be in full swing during the weekend preceding the meeting, with workshops, field trips, and other gatherings that PEP educators and scientists will find especially inviting. Please spread the word to your partners and other K-12 educators. Educators can get more information by calling the GSA Education Department at 800-824-7243 or (303) 447-2020, ext. 162.

If you don't receive your PEP logo sticker for your registration badge before the meeting opens, please pick one up at the PEP booth at the entrance to the Exhibit Hall so everyone will know that you are a member of the PEP team. New PEP members can also register at the booth, and we will have some outstanding low-cost resources available for use in the classroom. Hope to see you in Denver! ■



The Future Has Arrived: Environmental Geoscience at the GSA Annual Meeting

Daniel Sarewitz, IEE Director

The growing importance of geoscientists and geoscience information for environmental problem-solving is reflected in the technical sessions that will be held at the GSA Annual Meeting in Denver next month. By my count, there will be eight symposia and 17 theme sessions that are directly related to environmental issues. *This represents fully a quarter of all proposed technical sessions.* While many of these 25 events focus on purely technical questions, quite a few are concerned with the application of geoscience information to political decision-making, socioeconomic concerns, and education. The high proportion of sessions devoted to environmental issues is a powerful indicator of the future direction of the geosciences.

One of the kick-off events of the GSA annual meeting is the IEE Annual Environmental Forum. This year's forum is entitled "Prospects for the Future: Gold and Water in the Earth System." Gold and water are the two most valuable natural resources in the West, and the impact of hard-rock mining on water quality has proven to be one of the most controversial and intractable environmental issues facing the region. The IEE forum will explore the history, politics, economics, and science of this difficult problem.

This year's forum speakers are involved on a daily basis with mining and environmental quality issues. Through their collective experience, the forum will explore the political and economic context within which earth science information is used—and sometimes abused—while illustrating the value of good communication among earth scientists, policy makers, the private sector, and the public at large.

The Annual Environmental Forum will include panel discussions and time for significant audience participation. The forum will be held from 1:30 to 5:30 p.m. on Sunday, October 27, in room A207-209 of the Colorado Convention Center, and is open to the public.

IEE Fifth Annual Environmental Forum: Speakers

Dave Shaver, Chief, Geologic Resources Division, National Park Service. "The New World Mine—The Interface of Science and Policy Outside Yellowstone National Park."

James Otto, Associate Director, Institute for Global Resources Policy, Colorado School of Mines. "Effective Environmental Mining Legislation: An International Perspective."

David Holm, Director, Colorado Water Quality Control Division. "The Watershed-Based Approach for Addressing Water Quality Impacts from Mining Activities."

Geoffrey Plumlee, U.S. Geological Survey. "The Environmental Benefits of Effective Communication Between Earth Scientists and Mining Regulators."

Ann Maest, Hagler Bailly Consulting. "Divining the Past: The Limitations of Current Methods for Determining Baseline Water Quality at Mine Sites."

Maxine Stewart-Green, President, Colorado State Land Board. "Regulatory Accommodation for Environmentally Sound Mining—A Vision for the Future."

Scott Smith, Director, Environmental, Health and Safety Policy, Coors Brewing Company. "Abandoned Mines: Pariahs or Prizes? Banes or Blessings?"

Carol Russell, Community Involvement Team Leader, Environmental Protection Agency. "Smoothing Troubled Waters—A Scientific, Systematic View of Mining Communities and Their Environment."

Robert Moran, Woodward Clyde Consultants, will be the moderator.

Other symposia and theme sessions sponsored or cosponsored by IEE at the 1996 GSA Annual Meeting:

Symposia

- Dinosaurs, Asteroids, Spotted Owls, and Humanity: An Evolving View of Ecosystems and the Role of Science in Their Management. (Monday p.m.)
- Geoscience Information for Tomorrow's Markets: What Is Wrong with the Present Products? (Cosponsored by the GSA International Division and the Commission on the Management and Application of Geoscience Information; Wednesday p.m.)
- Earth Science—Environmental Justice Summit. (Cosponsored by the GSA Committee on Geology and Public Policy, GSA Committee on Minorities and Women in the Geosciences, Association for Women Geoscientists,

IEE continued on p. 11

Robert L. Fuchs

The Book Nook—for Retirement and Estate Planning

The Foundation has a library of booklets and pamphlets on retirement and estate planning. The reading is easy, so if you are thinking of your future retirement, arranging your estate, worrying about taxes, or just wondering if you ought to be doing these things, this information may be just what you need to start or modify a plan for you and your family.

Some of the titles include *Ideas for Retirement*, *Trusts for Tomorrow*, *Rewards of Financial Planning*, *Trusts for Family and Society*, *Golden Opportunities*, and *Planning for Real Estate Owners*. Send for a complete list from which to choose, or better yet, just check this month's Foundation coupon and we'll send you the entire collection (free of charge, of course).

Two other items that you may find helpful in regard to this year's finances are the 1996 Personal Planning Guide and Federal Tax Guide. Again, we'll be happy to send these on request. ■

News of the Second Century Fund Membership Campaign

• *Reminder: GeoHostel Drawing*—A drawing for a GeoHostel will be held at the GSA Annual Meeting in Denver (October 27–31). The second and third prizes will be announced later. Eligible participants are all those who have pledged at least \$50 a year for five years, or made a one-time contribution of at least \$250, to the membership campaign. Make sure to get your qualifying Second Century Fund pledge in soon!

• *North-Central Section Names SCF Coordinators*—Lee J. Suttner, chair of the North-Central Section Second Century Fund membership campaign, has organized a team of SCF coordinators to facilitate fund-raising campaigns in each of their respective geographic areas. We thank these individuals (listed here) for helping the Foundation with this important task.

Richard Anderson
Wayne I. Anderson
Kennard B. Bork
Richard A. Davis
Richard D. Harvey
Vance T. Holliday
Peter J. Hudleston
James Knox
David L. Meyer

Arthur Mirsky
John C. Palmquist
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Charles H. Summerson
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John E. Utgaard ■



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Merwin Bernstein
James A. Dutcher
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Paul R. Shaffer

IEE continued from p. 10

and National Association for Black Geologists and Geophysicists; Tuesday a.m.)

Theme Sessions

- Neogene and Quaternary Geology of the Yucca Mountain Region, Nevada, and Its Relevance to Long-Term Nuclear Waste Isolation. (Monday p.m.; Tuesday a.m.)
- Environmental Geology: The Voice of Reason. (Cosponsored by the National Association of Geoscience Teachers.) (Tuesday p.m.)

- Global Impacts of Mining and Urbanization on Fluvial and Coastal Systems. (Monday a.m.)
- Clean-up at Rocky Flats, a Former Nuclear Weapons Plant: Application of Science to Site Remediation Plans. (Tuesday p.m.)
- Rates of Geologic Processes in the Holocene. (Wednesday a.m. and p.m.)
- Linking Natural and Social Systems in Geoscience Education: Pedagogy, Content, and Context. (Cosponsored by the National Association of Geoscience Teachers.) (Wednesday p.m.)
- The Impact of Geologic Heterogeneities on Characterization, Transport, and

Remediation of Non-Aqueous-phase Liquids at Hazardous Waste Sites. (Wednesday p.m.)

- Integrated Site Characterization for Waste Disposal. (Thursday p.m.)

These and other environmental geoscience sessions at the GSA annual meeting demonstrate the growing demand for high-quality geoscientific knowledge in the environmental arena, the importance of interdisciplinary approaches to environmental problem-solving, and the urgent need to understand and communicate the value of geoscience within a broad societal context. ■

Annual Meeting Sponsors

The following companies have generously donated funds or services to support the Denver Annual Meeting. GSA appreciates this support and thanks these companies.

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NOTICE OF COUNCIL MEETING

Meetings of the GSA Council are open to Fellows, Members, and Associates of the Society, who may attend as observers, except during executive sessions. Only councilors, officers, and section representatives may speak to agenda items, except by invitation of the chair. Because of space and seating limitations, notification of attendance must be received by the Executive Director prior to the meeting. The next meeting of the Council will be Tuesday afternoon, October 29, 1996, at the Annual Meeting in Denver.

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We have extended our bookstore hours* through Thursday (9:00 a.m. to 3:00 p.m.) — a full day after all other exhibits close. All show discounts and specials will be in effect through close on Thursday.

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*GSA service booths, Membership, Foundation, SAGE and PEP will also be open Thursday.

Annual Meeting Co-Sponsors



Colorado Scientific Society

The Colorado Scientific Society was founded in Denver, Colorado, on December 8, 1882, six years after Colorado became a state. Founder S. F. Emmons of the U.S. Geological Survey, who later was also a founder and president (1903) of the Geological Society of America, and 11 colleagues were interested in an exchange of observations and ideas on topics in earth science. The membership has grown from these original 12 to about 375. Current members include representatives from many earth-science organizations including federal and state government agencies, colleges, universities, and private industry. The objectives of the Society are to promote knowledge, the understanding of science, and the application of science to human needs.



*Current President:
Rich Madole, USGS,
Denver, Colorado*



Rocky Mountain Association of Geologists

The Rocky Mountain Association of Geologists is a nonprofit organization whose purposes are to promote interest in geology and allied sciences and their practical application, to foster scientific research, and to encourage fellowship and cooperation among its members.

The Rocky Mountain Association of Geologists is one of the largest associations of geologists in the United States. RMAG is composed of earth scientists from industry, government, and academia encompassing a wide spectrum of backgrounds. All share a common interest in the geology of the Rocky Mountain area. Founded in 1922, RMAG is one of the most active AAPG affiliates in the country.



*Current President:
Edward D. Dolly,
Anschutz Exploration Corporation*



Society for Sedimentary Geology (SEPM)-Rocky Mountain Section

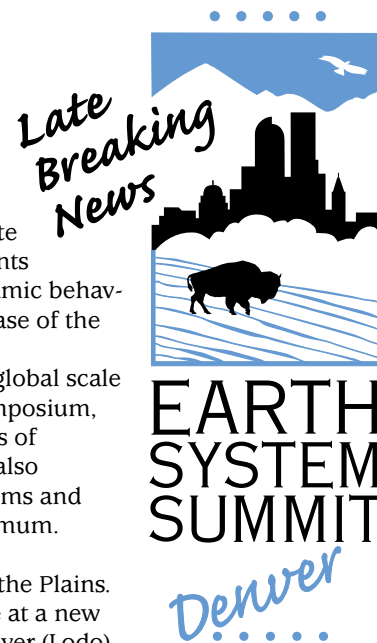
The Rocky Mountain Section (RMS) was organized in the early 1970s to promote all aspects of sedimentary geology in the Rocky Mountain region. The RMS holds luncheon meetings in Denver, on the fourth Tuesday of the month from September to May. The group publishes books about the sedimentary geology of the Rocky Mountain region and conducts field trips and short courses in conjunction with regional and national AAPG and SEPM meetings. Its most recent publication, "Paleozoic Systems of the Rocky Mountain Region," will be available at the GSA Annual Meeting. Its fall 1996 field trip will examine Paleozoic and Mesozoic depositional systems in southern Wyoming and northern Utah.



*Current President:
John W. Robinson,
Snyder Oil Corporation*

1996 GSA Annual Meeting

Denver, Colorado • October 28-31
Colorado Convention Center • Marriott City Center—Headquarters Hotel



The theme for the 1996 Denver meeting is Earth System Summit. The Earth is a complete system whose processes are complexly interrelated at a variety of scales. We are all inhabitants of this amazing system, and our actions can significantly impact, or be impacted by, its dynamic behavior. The gathering of scientists and engineers for the GSA Annual Meeting in Denver, at the base of the Rocky Mountains, will be an intellectual summit, focusing on the Earth System.

Read through the extensive list of symposia and theme sessions. Topics range from the global scale to focus on the southern Rocky Mountains; something to interest everyone. Our keynote symposium, convened by E-an Zen and Karen Prestegard, considers Linkages Among Dynamic Processes of Oceans, Continents, and Atmosphere on a global scale. The Annual Meeting Committee has also recruited symposia on the geologic development of the southern Rocky Mountains, ecosystems and the role of science in their management, and Earth system processes at the last glacial maximum. We invite you all to come, listen, and participate.

Every geologist knows Denver, founded on mining and still known as the Queen City of the Plains. Colorado is booming, and Denver, its capital, is more than keeping pace. The meeting will be at a new convention center in a revitalized, completely rejuvenated downtown. Lower downtown Denver (Lodo) is an exciting dining and entertainment area, with restaurants, brew pubs, and clubs. It's only a few miles west to the foot of the Rockies. There will be opportunities to get out and to enjoy the scenery. Come to Denver this autumn to stimulate your mind, to see your colleagues, and to enjoy Colorado.

—1996 General Co-Chairs: Gregory S. Holden and Kenneth E. Kolm



1996 Annual Meeting Committee: (From left to right) Front Row: Lisa Finiol, Ken Kolm, Chuck Pillmore, Kata McCarville. Middle Row: Kris Zumalt, Greg Holden, Doug Peters. Back Row: John Warme, John Humphrey, Ren Thompson. Not pictured: Dwaine Edington, Jeanne Fuchs, Linda Martin.

REGISTRATION AND HOUSING INFORMATION

June issue of *GSA Today*

PREREGISTRATION DEADLINE

September 20

HOUSING DEADLINE

September 30

FOR INFORMATION

1-800-472-1988, ext. 133; fax 1-303-447-0648

E-mail: meetings@geosociety.org

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Overview of the 1996 GSA Annual Meeting Program

There will be 202 technical sessions presented during the course of the meeting. Of these, symposia (invited papers) and theme sessions (volunteered papers submitted to a specific topic) are referred to by a number that precedes the title. All other sessions are referred to by disciplines, such as Geochemistry I, II. Sessions are oral unless poster is indicated.

Symposia

- S1. GSA Keynote Symposium: Linkages Among Dynamic Processes of Oceans, Continents, and Atmosphere. 1996 GSA Annual Meeting Committee. Oct. 28, a.m.
- S2. Tectonic Development of the Southern Rocky Mountains. 1996 GSA Annual Meeting Committee. Oct. 30, a.m.
- S3. Dinosaurs, Asteroids, Spotted Owls, and Humanity: An Evolving View of Ecosystems and the Role of Science in Their Management. 1996 GSA Annual Meeting Committee and IEE. Oct. 28, p.m.

- S4. Earth System Processes at the Last Glacial Maximum. 1996 GSA Annual Meeting Committee. Oct. 30, a.m.
- S5. Dimensional Scaling and the Stratigraphic Record of Episodic and Periodic Forcing. Sedimentary Geology Division. Oct. 29, p.m.
- S6. Interdisciplinary Strategies for Teaching about the Earth as a System. Geoscience Education Division. Oct. 28, p.m.
- S7. Coalbed Methane—From Micropore to Pipeline. Coal Geology Division. Oct. 28, a.m.
- S8. The Geoarchaeology of Caves and Cave Sediments. Archaeological Geology Division. Oct. 29, p.m.
- S9. Annual Environmental Forum: Prospects for the Future: Gold and Water in the Earth System. IEE. Oct. 27, p.m.
- S10. Earth Systems Education: K-16. NESTA. Oct. 28, a.m.
- S11. Recent Advances in Plate Tectonics—What Students Should Know. NAGT. Oct. 29, p.m.

KEY TO ORGANIZATIONS SPONSORING SESSIONS

CF	Cushman Foundation
GIS	Geoscience Information Society
GS	Geochemical Society
IEE	Institute for Environmental Education
MSA	Mineralogical Society of America
NABGG	National Association for Black Geologists and Geophysicists
NAGT	National Association of Geoscience Teachers
NESTA	National Earth Science Teachers Association
PS	Paleontological Society
SEG	Society of Economic Geologists
SGE	Sigma Gamma Epsilon

- S12. Geochemical Constraints on Seawater Composition and the Coupled Ocean-Atmosphere System: The Precambrian Revisited. GS. Oct. 29, p.m.
- S13. Organic Geochemistry—Linking the Biosphere and Geosphere. GS—Organic Geochemistry Division. Oct. 27, a.m./p.m.
- S14. Engineering Geology Applications of Geologic Maps. Engineering Geology Division. Oct. 30 a.m.
- S15. Farvolden Hydrogeology Symposium. Hydrogeology Division. Oct. 29, a.m.
- S16. Perspectives on Soil-Based Information for Investigating Earth Surface Processes. Quaternary Geology and Geomorphology Division. Oct. 29, a.m.
- S17. Planets as Complex Systems. Planetary Geology Division. Oct. 29, a.m.
- S18. Expanding Boundaries: Geoscience Information for Earth System Science. GIS. Oct. 29, a.m.
- S19. Seismic Investigations Along the Western Margin and Cordillera of North America: Tectonic Implications. Geophysics Division. Oct. 29, p.m.
- S20. Active Tectonics of Intracontinental Mountain Belts with Implications for Ancient Systems. Structural Geology and Tectonics Division. Oct. 28, p.m.
- S21. SGE Student Research. Oct. 29, p.m. (POSTERS).
- S22. Alteration Geochemistry: Genetic and Exploration Perspectives. SEG. Oct. 27 a.m./p.m.
- S23. Geoscience Information for Tomorrow's Markets: What Is Wrong with the Present Products. IEE, GSA International Division, and IUGS Commission on the Management and Application of Geoscience Information (COGEOINFO). Oct. 30, p.m.
- S24. Tectonic Evolution of the Urals and Surrounding Basins. International Division. Oct. 29, a.m.
- S25. Earth Science—Environmental Justice Summit. GSA Committee on Public Policy, IEE, GSA Committee on Minorities and Women in the Geosciences, NABGG. Oct. 29, a.m.
- S26. Environmental Mineralogy: Science and Politics. MSA, Clay Minerals Society. Oct. 30, p.m.

- S27. The Role of Preferential Flow in the Unsaturated Zone. Hydrogeology Division. Oct. 31, a.m.
- S28. Biology of the Foraminifera: Applications in Paleocceanography, Paleobiology, and the Environmental Sciences. CF. Oct. 28, a.m.
- S29. Evolutionary Paleocology. PS. Oct. 29, a.m.
- S30. Impact of the Western Surveys. History of Geology Division. Oct. 29, p.m.
- S31. Applications of Reactive Transport Modeling to Natural Systems. MSA. Oct. 28, a.m.

Theme Sessions

- T1. The U.S. Atlantic Passive Margin: Tectonics, Eustasy, and Sedimentation—A Memorial to James Patrick Owens. Sedimentary Geology Division. Oct. 28, a.m. (ORAL)/p.m. (POSTERS).
- T2. History of the Equatorial Atlantic. Oct. 28, p.m. (POSTERS).
- T3. High-Resolution Glacial Records from Marine and Lacustrine Basins. Quaternary Geology and Geomorphology Division. Oct. 31, p.m.
- T4. Application of Soil-Based Information for Understanding Earth Surface Processes. Quaternary Geology and Geomorphology Division. Oct. 29, p.m.
- T5. Cretaceous of the Western Interior Seaway, North America. Oct. 28, a.m./p.m.
- T6. The Rockies Across the Southern Border. Oct. 29, a.m.
- T7. Paleozoic and Mesozoic Tectonic History of Central Asia. Oct. 28, a.m.
- T10. Appalachian and Cordilleran Melanges: Comparisons and Contrasts. Northeastern, Southeastern, Cordilleran Sections of GSA. Oct. 31, p.m.
- T11. Laramide Sedimentation and Tectonics in the Rocky Mountains. Oct. 30, p.m.
- T12. History of Recurrent Basement Faulting in Cratonic North America and Its Orogenic Margins. Oct. 31, a.m. (ORAL)/p.m. (POSTERS).
- T13. Geologic and Hydrologic Studies of Fluid Flow in Faults. Oct. 29, p.m.
- T14. Evolution of the Neogene Strain Field in the Southeastern Great Basin: Roles of Faults, Folds, and Magmatism. Oct. 31, a.m. (ORAL)/p.m. (POSTERS).
- T15. Neogene and Quaternary Geology of the Yucca Mountain Region, Nevada, and Its Relevance to Long-term Nuclear Waste Isolation. IEE. Oct. 28, p.m./Oct. 29, a.m.
- T16. Seismic Investigations Along the Western Margin and Cordillera of North America: Data and Earth Models. Geophysics Division. Oct. 29, a.m. (POSTERS)
- T17. Cenozoic Uplift of the Western United States. Geophysics Division. Oct. 31, p.m.
- T18. Precambrian Lithosphere I: Proterozoic Tectonics—Modification of Archean Cratons and Additions of Juvenile Crust. Oct. 30, a.m. (ORAL)/Oct. 31, p.m. (POSTERS).
- T19. Precambrian Lithosphere II: Mid-Proterozoic Magmatism and Tectonics of Western North America. Oct. 30, p.m.
- T20. Precambrian Lithosphere III: Middle Crustal Processes. Oct. 31, a.m.
- T21. Volcanism, Tectonism, and Sedimentation in the Rio Grande Rift and Its Margins in New Mexico and Colorado. Oct. 30, p.m. (POSTERS)/Oct. 31, p.m. (ORAL).
- T22. Magma Generation and Evolution at Convergent Margins. Oct. 30, p.m.
- T23. High and Ultrahigh Strain Rate Processes in the Earth and Planetary Sciences. Oct. 30, p.m.
- T24. Mapping Other Worlds. Planetary Geology Division. Oct. 28, p.m. (POSTERS).
- T25. Jupiter: Solar System Exploration Continues. Planetary Geology Division. Oct. 28, a.m.
- T26. Application of Reactive Transport Modeling to Natural Systems. MSA. Oct. 28, p.m.
- T27. Mineralogy of Planetary Surfaces Using In-Situ Analysis and Remote Sensing. MSA and Planetary Division. Oct. 30, a.m. (ORAL)/p.m. (POSTERS).
- T28. Environmental Mineralogy. MSA and Clay Minerals Society. Oct. 31, a.m./p.m.
- T29. Hydrogeology of Confining Units I: Sampling, Analysis, and Interpretation. Hydrogeology Division and Society for Sedimentary Geology. Oct. 27, p.m.
- T30. Hydrogeology of Confining Units II: Physical and Biogeochemical Processes. Hydrogeology Division and Society for Sedimentary Geology. Oct. 28, a.m.
- T31. Field-Scale Investigations of Biodegradation. Hydrogeology Division. Oct. 28, p.m.
- T32. Scale Effects of Fluid Flow and Fractures. Oct. 28, a.m./p.m.
- T33. Geofluids: The Role of Fluids in Crustal Processes. Oct. 30, a.m. (ORAL)/p.m. (POSTERS).
- T34. Applications of Isotopes for Understanding Hydrologic Systems. Hydrogeology Division. Oct. 28, p.m./Oct. 29, a.m.
- T35. High Plains Hydrogeology. Hydrogeology Division. Oct. 28, a.m.
- T36. Physical and Chemical Heterogeneity: Impact on Reactive Transport. Hydrogeology Division. Oct. 30, a.m.
- T37. Innovations and Applications of Inverse Ground-water Models. Hydrogeology Division. Oct. 30, p.m.
- T38. Evaporite Karst: Origins, Processes, Landforms, Examples, and Impacts. Hydrogeology Division and Engineering Geology Division. Oct. 30, p.m.
- T39. The Death Valley Hydrogeologic System. Oct. 31, a.m.
- T40. Physical and Chemical Heterogeneity: Impact on Samples and Measurements at Wells. Hydrogeology Division. Oct. 31, a.m.
- T41. Diagenetic Processes at Waste-Disposal Sites. Hydrogeology Division. Oct. 29, p.m.
- T42. Global Impacts of Mining and Urbanization on Fluvial and Coastal Systems. Oct. 28, a.m./Oct. 29, a.m.
- T43. Environmental Geology: The Voice of Reason. IEE. Oct. 29, p.m.
- T44. Clean-up at Rocky Flats, a Former Nuclear Weapons Plant: Application of Science to Site Remediation Plans. IEE. Oct. 29, a.m.
- T45. Integrated Site Characterization for Waste Disposal. IEE. Oct. 31, p.m.
- T46. Interpretation of Continental Sedimentation Patterns Using Surface and Subsurface Data. Oct. 31, p.m.
- T47. The Impact of Geologic Heterogeneities on Characterization, Transport, and Remediation of Non-Aqueous Phase Liquids (NAPLs) at Hazardous Waste Sites. Oct. 30, p.m.
- T48. Rates of Geologic Processes in the Holocene. IEE. Oct. 30, p.m.
- T51. Mechanics of the Riverbed: Hydrology, Sedimentology, and Geomorphic Consequences. (Combined with T49 and T50.) Oct. 29, p.m.
- T52. Geographic Information Systems and Integrated Digital Databases: Tools for Geoscience Analysis. (Combined with T53.) Oct. 29, p.m. (POSTERS)/Oct. 31, a.m./p.m. (ORAL).

- T54. Improving Geoscience Courses Through the Use of the Internet and the World Wide Web. NAGT. Oct. 30, a.m./p.m.
- T55. Roles of Multiple Intelligences and Creativity in Teaching, Learning, and Doing Geoscience. (Combined with T56.) Oct. 28, p.m.
- T57. National Parks as Classrooms for Geoscience Education. NAGT. Oct. 28, a.m./p.m.
- T58. The Role of Geology Field Camp in the Geology Curriculum: An Appraisal. Oct. 29, a.m./p.m.
- T59. Geology Field Camp Exercises in the Rocky Mountains. Oct. 30, a.m. (POSTERS)
- T60. Linking Natural and Social Systems in Geoscience Education: Pedagogy, Content, and Context. NAGT and IEE. Oct. 30, a.m. (ORAL)/p.m. (POSTERS).
- T61. Organics-Ore Interactions in the Field and Laboratory. SEG and IGCP, Project #357. Oct. 28, a.m.
- T62. The Magmatic-Hydrothermal-Epithermal Transition and Associated Alteration and Mineralization. SEG. Oct. 30, a.m./p.m.
- T63. Quantifying the Environmental Impacts of Mining. SEG. Oct. 31, a.m./p.m.

The missing theme numbers received too few abstracts. The minimum number to be submitted was 16. In general, the abstracts submitted to these themes have been combined with other themes as noted or absorbed into discipline sessions.

Session Program Calendar

Titles and Authors Database:
<http://www.geosociety.org>

SUNDAY, OCTOBER 27, AM

- Session 1, 8:00 AM, CCC:A101-103
Organic Geochemistry Division of the GS Symposium (S13): Organic Geochemistry—Linking the Biosphere and Geosphere—Part I
- Session 2, 8:00 AM, CCC:A105-107
SEG Symposium (S22): Alteration Geochemistry: Genetic and Exploration Perspectives—Part I

SUNDAY, OCTOBER 27, PM

- Session 3, 1:30 PM, CCC:A207-209
IEE Symposium (S9): IEE Annual Environmental Forum: Prospects for the Future: Gold and Water in the Earth System
- Session 4, 1:30 PM, CCC:A101-103
Organic Geochemistry Division of the GS Symposium (S13): Organic Geochemistry—Linking the Biosphere and Geosphere—Part II
- Session 5, 1:30 PM, CCC:A105-107
SEG Symposium (S22): Alteration Geochemistry: Genetic and Exploration Perspectives—Part II
- Session 6, 1:30 PM, CCC:A102-104-106
T29. Hydrogeology Division and Society for Sedimentary Geology: Hydrogeology of Confining Units I: Sampling, Analysis, and Interpretation

MONDAY, OCTOBER 28, AM

- Session 7, 8:00 AM, CCC:Ballroom 2&3
1996 GSA Annual Meeting Committee (S1): GSA Keynote Symposium: Linkages Among Dynamic Processes of Oceans, Continents, and Atmosphere

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GSA TECHNICAL SESSIONS ON THE WEB

The titles and authors database is available on the Web. You can download sessions, events, exhibits, field trips, and courses together with a basic search and sorting software that will create your personal daily calendar. Internet: <http://www.geosociety.org>.

- Session 8, 8:00 AM, CCC:C109
Aqueous Geochemistry I—Organic and Biogeochemistry
- Session 9, 8:00 AM, CCC:Posters Hall B1
Aqueous Geochemistry Posters
- Session 10, 8:00 AM, CCC:Posters Hall B1
Carbonate Sediments and Diagenesis Posters
- Session 11, 8:00 AM, CCC:C209
CF Symposium (S28): Biology of the Foraminiferida: Applications in Paleocyanography, Paleobiology, and the Environmental Sciences
- Session 12, 8:00 AM, CCC:A111
Coal Geology Division Symposium (S7): Coalbed Methane—From Micropore to Pipeline
- Session 13, 8:00 AM, CCC:Posters Hall B1
Experimental Petrology (Posters)
- Session 14, 8:00 AM, CCC:A108
Marine Geology
- Session 15, 8:00 AM, CCC:Posters Hall B1
Metamorphic Petrology Posters
- Session 16, 8:00 AM, CCC:Posters Hall B1
Mineralogy/Crystallography Posters
- Session 17, 8:00 AM, CCC:A101-103
MSA Symposium (S31): Applications of Reactive Transport Modeling to Natural Systems
- Session 18, 8:00 AM, CCC:C101-103
NESTA Symposium (S10): Earth Systems Education: K–16
- Session 19, 8:00 AM, CCC:A202-204
Paleontology/Paleobotany I—Turning Points in Life History
- Session 20, 8:00 AM, CCC:Posters Hall B1
Quaternary Geology Posters I—Glacial and Neotectonics
- Session 21, 8:00 AM, CCC:C201-205
Tectonics I—Southern Hemisphere and Precambrian Tectonics
- Session 22, 8:00 AM, CCC:A102-104-106
T01. Sedimentary Geology Division: The U.S. Atlantic Passive Margin: Tectonics, Eustasy, and Sedimentation—A Memorial to James Patrick Owens—Part I
- Session 23, 8:00 AM, CCC:A205
T05. Cretaceous of the Western Interior Seaway, North America—Part I.
- Session 24, 8:00 AM, CCC:A105-107
T07. Paleozoic and Mesozoic Tectonic History of Central Asia
- Session 25, 8:00 AM, CCC:C108-110-112
T25. Planetary Geology Division: Jupiter: Solar System Exploration Continues
- Session 26, 8:00 AM, CCC:A201
T30. Hydrogeology Division and Society for Sedimentary Geology: Hydrogeology of Confining Units II: Physical and Biogeochemical Processes
- Session 27, 10:00 AM, CCC:A108
T32. Scale Effects of Fluid Flow and Fractures—Part I

- Session 28, 8:00 AM, CCC:C207
T35. Hydrogeology Division: High Plains Hydrogeology
- Session 29, 8:00 AM, CCC:C102-104-106
T42. Global Impacts of Mining and Urbanization on Fluvial and Coastal Systems—Part I
- Session 30, 8:00 AM, CCC:C105-107
T57. NAGT: National Parks as Classrooms for Geoscience Education—Part I
- Session 31, 8:00 AM, CCC:A207-209
T61. SEG and IGCP, Project #357: Organics-Ore Interactions in the Field and Laboratory

MONDAY, OCTOBER 28, PM

- Session 32, 1:30 PM, CCC:C108-110-112
1996 GSA Annual Meeting Committee and IEE Symposium (S3): Dinosaurs, Asteroids, Spotted Owls, and Humanity: An Evolving View of Ecosystems and the Role of Science in Their Management
- Session 33, 1:30 PM, CCC:Posters Hall B1
Archaeological Geology Posters

MEDIA WORKSHOP TO ILLUSTRATE EFFECTIVE COMMUNICATION

The need for geoscientists to communicate effectively with decision-makers and the public has never been greater. Because the news media are the most important vehicle for reaching a broad, nontechnical audience, GSA is offering a hands-on workshop that can teach you how to get your message heard. If you have limited experience dealing with the media, if you've had negative experiences in past media interviews, or even if you're comfortable speaking to reporters but would like some additional pointers, this workshop will help prepare you for future encounters with the press, radio, and television.

The GSA Media Workshop will be held on *Sunday, October 27*, from 8:30 a.m. to noon. This event is offered as a public service at no cost to attendees of the GSA 1996 Annual Meeting in Denver. Workshop attendance is limited, however, so if you would like to participate, please contact: Sandra Rush, GSA Public Information Consultant, Geological Society of America, P.O. Box 9140, Boulder, CO 80301, (303) 494-1576, E-mail: rushsvcs@aol.com.

Session 34, 1:30 PM, CCC:C109
Clastic Sediments I—Sedimentary Petrology

Session 35, 1:30 PM, CCC:A102-104-106
Economic Geology I—Magmatic and Epithermal Deposits

Session 36, 1:30 PM, CCC:Posters Hall B1
Environmental Geology Posters

Session 37, 1:30 PM, CCC:C101-103
Geoscience Education Division Symposium (S6): Interdisciplinary Strategies for Teaching about the Earth as a System

Session 38, 1:30 PM, CCC:A202-204
Mineralogy/Crystallography

Session 39, 1:30 PM, CCC:C207
Paleontology/Paleobotany II—Terrestrial Ecosystems and Quantitative Methods

Session 40, 1:30 PM, CCC:A105-107
Planetary Geology

Session 41, 1:30 PM, CCC:A207-209
Quaternary Geology/Geomorphology I—Process Geomorphology

Session 42, 1:30 PM, CCC:C201-205
Structural Geology and Tectonics Symposium (S20): Active Tectonics of Intracontinental Mountain Belts with Implications for Ancient Systems

Session 43, 1:30 PM, CCC:C102-104-106
Tectonics II—Cordilleran Tectonics 1

Session 44, 1:30 PM, CCC:Posters Hall B1
T01. Sedimentary Geology Division: The U.S. Atlantic Passive Margin: Tectonics, Eustasy, and Sedimentation—A Memorial to James Patrick Owens—Part II (Posters)

Session 45, 1:30 PM, CCC:Posters Hall B1
T02. History of the Equatorial Atlantic (Posters)

Session 46, 1:30 PM, CCC:A205
T05. Cretaceous of the Western Interior Seaway, North America—Part II

Session 47, 3:30 PM, CCC:A105-107
T15. IEE: Neogene and Quaternary Geology of the Yucca Mountain Region, Nevada, and its Relevance to Long-Term Nuclear Waste Isolation—Part I

Session 48, 1:30 PM, CCC:Posters Hall B1
T24. Planetary Geology Division: Mapping Other Worlds. (Posters)

Session 49, 1:30 PM, CCC:A101-103
T26. MSA: Application of Reactive Transport Modeling to Natural Systems

Session 50, 1:30 PM, CCC:A201
T31. Hydrogeology Division: Field-Scale Investigations of Biodegradation

Session 51, 1:30 PM, CCC:A111
T32. Scale Effects of Fluid Flow and Fractures—Part II

Session 52, 1:30 PM, CCC:C209
T34. Hydrogeology Division: Applications of Isotopes for Understanding Hydrologic Systems—Part I

Session 53, 1:30 PM, CCC:A108
T55. Creative Links between Geoscience and Learners

Session 54, 1:30 PM, CCC:C105-107
T57. NAGT: National Parks as Classrooms for Geoscience Education—Part II

TUESDAY, OCTOBER 29, AM

Session 55, 8:00 AM, CCC::A201
Aqueous Geochemistry II—Experimental and Theoretical Geochemistry

Session 56, 10:00 AM, CCC:A108
Archaeological Geology

Session 57, 8:00 AM, CCC:Posters Hall B1
Coal Geology Posters

Session 58, 8:00 AM, CCC:Posters Hall B1
Economic Geology Posters

Session 59, 8:00 AM, CCC:C109
Engineering Geology

Session 60, 8:00 AM, CCC:C209
Experimental Petrology

Session 61, 8:00 AM, CCC:A105-107
Geochemistry I—High Temperature and Hydrothermal Geochemistry

Session 62, 8:00 AM, CCC:C105-107
Geology Education I

Session 63, 8:00 AM, CCC:A202-204
GIS Symposium (S18): Expanding Boundaries: Geoscience Information for Earth System Science

Session 64, 8:00 AM, CCC:A205
GSA Committee on Public Policy, IEE, GSA Committee on Minorities and Women in the Geosciences, NABGG Symposium (S25): Earth Science—Environmental Justice Summit

Session 65, 8:00 AM, CCC:A108
History of Geology

Session 66, 8:00 AM, CCC:C102-104-106
Hydrogeology Division Symposium (S15): Farvolden Hydrogeology Symposium

Session 67, 8:00 AM, CCC:C101-103
International Division Symposium (S24): Tectonic Evolution of the Urals and Surrounding Basins

Session 68, 8:00 AM, CCC:Posters Hall B1
Micropaleontology Posters

Session 69, 8:00 AM, CCC:Ballroom 2&3
Planetary Geology Division Symposium (S17): Planets as Complex Systems

Session 70, 8:00 AM, CCC:C201-205
PS Symposium (S29): Evolutionary Paleocology

Session 71, 8:00 AM, CCC:A102-104-106
Quaternary Geology and Geomorphology Division Symposium (S16): Perspectives on Soil-Based Information for Investigating Earth Surface Processes

Session 72, 8:00 AM, CCC:Posters Hall B1
Stratigraphy Posters—Impact Megabeds

Session 73, 8:00 AM, CCC:C108-110-112
Structural Geology I—Faulting

Session 74, 10:00 AM, CCC:C109
T06. The Rockies Across the Southern Border

Session 75, 8:00 AM, CCC:A207-209
T15. IEE: Neogene and Quaternary Geology of the Yucca Mountain Region, Nevada, and its Relevance to Long-Term Nuclear Waste Isolation—Part II

Session 76, 8:00 AM, CCC:Posters Hall B1
T16. Geophysics Division: Seismic Investigations Along the Western Margin and Cordillera of North America: Data and Earth Models. (Posters)

Session 77, 8:00 AM, CCC:C207
T34. Hydrogeology Division: Applications of Isotopes for Understanding Hydrologic Systems—Part II

Session 77.5, 10:00 AM, CCC:A111
T42. Global Impacts of Mining and Urbanization on Fluvial and Coastal Systems—Part II

Session 78, 8:00 AM, CCC:A111
T44. IEE: Clean-up at Rocky Flats, a Former Nuclear Weapons Plant: Application of Science to Site Remediation Plans

Session 79, 8:00 AM, CCC:A101-103
T58. The Role of Geology Field Camp in the Geology Curriculum: An Appraisal—Part I

TUESDAY, OCTOBER 29, PM

Session 80, 1:30 PM, CCC:A105-107
Archaeological Geology Division Symposium (S8): The Geoarchaeology of Caves and Cave Sediments

Session 81, 3:30 PM, CCC:A108
Coal Geology

Session 82, 1:30 PM, CCC:C102-104-106
Economic Geology II

Session 83, 1:30 PM, CCC:Posters Hall B1
Geochemistry Posters

Session 84, 1:30 PM, CCC:C101-103
Geophysics Division Symposium (S19): Seismic Investigations Along the Western Margin and Cordillera of North America: Tectonic Implications

Session 85, 1:30 PM, CCC:Posters Hall B1
Geoscience Information Posters

Session 86, 1:30 PM, CCC:A201
GS Symposium (S12): Geochemical Constraints on Seawater Composition and the Coupled Ocean-Atmosphere System: The Precambrian Revisited

Session 87, 1:30 PM, CCC:C105-107
History of Geology Division Symposium (S30): Impact of the Western Surveys

Session 88, 1:30 PM, CCC:Posters Hall B1
History of Geology Posters

Session 89, 1:30 PM, CCC:Ballroom 2 & 3
NAGT Symposium (S11): Recent Advances in Plate Tectonics—What Students Should Know

Session 90, 1:30 PM, CCC:A111
Paleoceanography/Paleoclimatology I—Cenozoic to Paleozoic Climates and Oceans

Session 91, 1:30 PM, CCC:Posters Hall B1
Planetary Geology Posters

Session 92, 1:30 PM, CCC:C109
Precambrian Geology

Session 93, 1:30 PM, CCC:A207-209
Quaternary Geology/Geomorphology II—Late Quaternary Climates: Western U.S. and Eastern Pacific Oceans

DESIGNING GEOLOGY CLASSES ON THE XEROX LIVEBOARD

*Sunday, October 27, 8:30 to 11:30 a.m.; Colorado Convention Center, A204.
 Sponsored by Xerox Corporation.*

This workshop will demonstrate how to use the world's easiest authoring system to design introductory geology courses using graphics, video, sound, and text on a Xerox LiveBoard. This 67"-screen-computer uses infrared pen and shared surface technology for interactive on-site and remote presentation. Learn how to make dinosaurs roar, plates move before your eyes, and field camps come alive while you are still writing on the electronic chalkboard.

Limit: 45. No fee. For information: Hilde Schwartz or Joyce R. Blueford, Math/ Science Nucleus, 4009 Pestana Place, Fremont, CA 94538-6301, (510) 490-6284.

1996 Technical Program Summary BY SCIENTIFIC DISCIPLINE

KEY: I, II, III, ... X = Discipline session number in a series; P = Poster; S = Symposium; T = Theme Session (listed under disciplines having the majority of the abstracts).

DISCIPLINE	SUN, OCT. 27 8:00 a.m.–12:00 N 1:30–5:30 p.m.		MON, OCT. 28 8:00 a.m.–12:00 N 1:30–5:30 p.m.		TUES, OCT. 29 8:00 a.m.–12:00 N 1:30–5:30 p.m.		WED, OCT. 30 8:00 a.m.–12:00 N 1:30–5:30 p.m.		THURS, OCT. 31 8:00 a.m.–12:00 N 1:30–5:30 p.m.	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
	ANNUAL MEETING-VARIOUS			S1				S2, S4		
ARCHAEOLOGY				P	I	S8				
COAL			S7		P	I				
COMPUTERS						TP52			T52	T52
ECONOMIC	S22	S22	T61	I	P	II	T62	T62	T63	T63,III
EDUCATION			S10, T57	S6, T55, T57	T58, I	S11, SP21, T58	T54, TP59, T60	T54, TP60, P	II	III
ENGINEERING					I		S14	T38	P	
ENVIRONMENTAL			T42	P	T42, T44	T43		T47	I	T45, T46
GEOCHEMISTRY, AQUEOUS			I, P		II	S12	T33	TP33		III
GEOCHEMISTRY, OTHER	S13	S13			I	P		II		
GEOPHYSICS/ TECTONOPHYSICS				T15	T15, TP16	S19	I		P	T17
GEOSCIENCE INFORMATION					S18	P	I			
HISTORY					I	S30, P				
HYDROGEOLOGY		T29	T30, T32, T35	T31, T32, T34	S15, T34	T41	T36, I	T37, P	S27, T40	II
MARINE			I						P	
MICROPALAEONTOLOGY			S28		P					I
MINERALOGY/ CRYSTALLOGRAPHY			S31, P	T26, I			T27	S26, TP27	T28	T28
PALEOCEANOGRAPHY/ PALEOCLIMATOLOGY				TP2		I		II	P	
PALEONTOLOGY/ PALEOBOTANY			I	II	S29		III, P	IV	V	VI
PETROLEUM									I	P
PETROLOGY, EXPERIMENTAL			P		I					
PETROLOGY, IGNEOUS							I	T22	II	P
PETROLOGY, METAMORPHIC			P					I	II	
PLANETARY/REMOTE SENSING			T25	TP24, I	S17	P	T27	T23,TP27		
PRECAMBRIAN						I	T18	T19	T20	P
PUBLIC POLICY		S9		S3	S25			S23		
QUATERNARY/ GEOMORPHOLOGY			P	I	S16	T4, T51, II	III, P	T48	T39, IV	T3, V
SEDIMENTS, CARBONATE			P				I	II		
SEDIMENTS, CLASTIC			T1	TP1, I		S5	P		II	III
STRATIGRAPHY			T5	T5	P		I	II		T46
STRUCTURE				S20	I	T13, II, P			T14, III	TP14
TECTONICS			T7, I	II	S24, T6	III	IV	T11, V	T12, P	T10, TP12, VI
VOLCANOLOGY								TP21		T21, P

POSSIBLE BIOGENIC ACTIVITY IN MARTIAN METEORITE ALH84001

Sponsored by the GSA Planetary Geology Division. Tuesday, October 29, 5:45 to 7:30 p.m., Colorado Convention Center, Ballroom 2-3

This session represents the first opportunity for the geoscience community to obtain first-hand information about what could be a fundamentally important discovery. The session will involve presentations by one of the authors of the *Science* paper (August 16) and an expert on the Martian meteorites, Harry McSween of the University of Tennessee, followed by a question-and-answer period. The momentous but controversial nature of the topic should lead to a stimulating discussion.

Session 94, 1:30 PM, CCC:Posters Hall B1

Remote Sensing Posters

Session 95, 1:30 PM, CCC:C201-205

Sedimentary Geology Division Symposium (S5): Dimensional Scaling and the Stratigraphic Record of Episodic and Periodic Forcing

Session 96, 1:30 PM, CCC:Posters Hall B1

SGE Symposium (S21): Student Research. (Posters)

Session 97, 1:30 PM, CCC:C108-110-112

Structural Geology II—Fault-fold Relations

Session 98, 1:30 PM, CCC:Posters Hall B1

Structural Geology Posters

Session 99, 1:30 PM, CCC:A202-204

Tectonics III—Ultrahigh P Metamorphism, Forearc Tectonics, Oceanic Tectonics, Foreland Basins

Session 100, 1:30 PM, CCC:A102-104-106

T04. Quaternary Geology and Geomorphology Division: Application of Soil-Based Information for Understanding Earth Surface Processes

Session 101, 1:30 PM, CCC:A205

T13. Geologic and Hydrologic Studies of Fluid Flow in Faults

Session 102, 1:30 PM, CCC:A108

T41. Hydrogeology Division: Diagenetic Processes at Waste-Disposal Sites

Session 103, 1:30 PM, CCC:C209

T43. IEE: Environmental Geology: The Voice of Reason

Session 104, 1:30 PM, CCC:C207

T51. Mechanics of the Riverbed: Hydrology, Sedimentology, and Geomorphic Consequences

Session 105, 1:30 PM, CCC:Posters Hall B1

T52. Geographic Information Systems and Integrated Digital Databases: Tools for Geoscience Analysis—Part I (Posters)

Session 106, 1:30 PM, CCC:A101-103

T58. The Role of Geology Field Camp in the Geology Curriculum: An Appraisal—Part II.

WEDNESDAY, OCTOBER 30, AM

Session 107, 8:00 AM, CCC:Ballroom 2&3

1996 GSA Annual Meeting Committee Symposium (S2): Tectonic Development of the Southern Rocky Mountains.

Session 108, 8:00 AM, CCC:C108-110-112

1996 GSA Annual Meeting Committee Symposium (S4): Earth System Processes at the Last Glacial Maximum.

Session 109, 8:00 AM, CCC:A205

Carbonate Sedimentology I—Modern Carbonate Processes, Nannobacteria, Glauconite, Cyclostratigraphy, Chemostratigraphy, and Breccias.

Session 110, 8:00 AM, CCC:Posters Hall B1

Clastic Sedimentology Posters—Sedimentary Processes and Petrology

Session 111, 8:00 AM, CCC:C101-103

Engineering Geology Division of GSA Symposium (S14): Engineering Geology Applications of Geologic Maps.

Session 112, 10:00 AM, CCC:C109

Geophysics

Session 113, 8:00 AM, CCC:C109

Geoscience Information

Session 114, 8:00 AM, CCC:A102-104-106

Hydrogeology I—Physical and Chemical

Session 115, 8:00 AM, CCC:C209

Igneous Petrology I

Session 116, 8:00 AM, CCC:A108

Paleontology/Paleobotany III—Mineralization and Phylogeny—Building Life

Session 117, 8:00 AM, CCC:Posters Hall B1

Paleontology/Paleobotany Posters

Session 118, 8:00 AM, CCC:C102-104-106

Quaternary Geology/Glomorphology III—Tectonic Geomorphology and Hillslope Processes

Session 119, 8:00 AM, CCC:Posters Hall B1

Quaternary Geology/Glomorphology Posters II

Session 120, 8:00 AM, CCC:A105-107

Stratigraphy I

Session 121, 8:00 AM, CCC:A101-103

Tectonics IV—Cordilleran Tectonics 2

Session 122, 8:00 AM, CCC:A111

T18. Precambrian Lithosphere I: Proterozoic Tectonics—Modification of Archean Cratons and Additions of Juvenile Crust

Session 123, 8:00 AM, CCC:C201-205

T27. MSA and Planetary Division: Mineralogy of Planetary Surfaces Using In-Situ Analysis and Remote Sensing—Part I

Session 124, 8:00 AM, CCC:C207

T33. Geofluids: The Role of Fluids in Crustal Processes—Part I

Session 125, 8:00 AM, CCC:A201

T36. Hydrogeology Division: Physical and Chemical Heterogeneity: Impact on Reactive Transport

Session 126, 8:00 AM, CCC:C105-107

T54. NAGT: Improving Geoscience Courses Through the Use of the Internet and the World Wide Web—Part I

Session 127, 8:00 AM, CCC:Posters Hall B1

T59. Geology Field Camp Exercises in the Rocky Mountains. (Posters)

Session 128, 8:00 AM, CCC:A202-204

T60. NAGT and IEE: Linking Natural and Social Systems in Geoscience Education: Pedagogy, Content, and Context—Part I

Session 129, 8:00 AM, CCC:A207-209

T62. SEG: The Magmatic-Hydrothermal-Epithermal Transition and Associated Alteration and Mineralization—Part I

WEDNESDAY, OCTOBER 30, PM

Session 130, 1:30 PM, CCC:A205

Carbonate Sedimentology II—Ancient Carbonate Processes, Dolomites, Cements, and Diagenetic Models

Session 131, 1:30 PM, CCC:C209

Geochemistry II—Low Temperature Geochemistry

Session 132, 1:30 PM, CCC:Posters Hall B1

Geology Education Posters

Session 133, 1:30 PM, CCC:Posters Hall B1

Hydrogeology Posters

Session 134, 1:30 PM, CCC:C101-103

IEE, GSA International Division, and IUGS Commission on the Management and Application of Geoscience Information (COGEOINFO) Symposium (S23): Geoscience Information for Tomorrow's Markets: What is Wrong with the Present Products?

Session 135, 1:30 PM, CCC:A108

Metamorphic Petrology I

Session 136, 1:30 PM, CCC:A102-104-106

MSA, Clay Mineral Society (S26): Environmental Mineralogy: Science and Politics

Session 137, 1:30 PM, CCC:C207

Paleoceanography/Paleoclimatology II—Quaternary Climates and Oceans

Session 138, 1:30 PM, CCC:C201-205

Paleontology/Paleobotany IV—Taphonomy, Vertebrates, and Biogeography

Session 139, 1:30 PM, CCC:A105-107

Stratigraphy II

Session 140, 1:30 PM, CCC:C102-104-106

Tectonics V—Asian Tectonics

Session 141, 1:30 PM, CCC:Ballroom 2&3

T11. Laramide Sedimentation and Tectonics in the Rocky Mountains

Session 142, 1:30 PM, CCC:A111

T19. Precambrian Lithosphere II: Mid-Proterozoic Magmatism and Tectonics of Western North America

Session 143, 1:30 PM, CCC:Posters Hall B1

T21. Volcanism, Tectonism, and Sedimentation in the Rio Grande Rift and its Margins in New Mexico and Colorado—Part I (Posters)

Session 144, 1:30 PM, CCC:A201

T22. Magma Generation and Evolution at Convergent Margins

Session 145, 1:30 PM, CCC:A101-103

T23. High and Ultrahigh Strain Rate Processes in the Earth and Planetary Sciences

Session 146, 1:30 PM, CCC:Posters Hall B1

T27. MSA and Planetary Division: Mineralogy of Planetary Surfaces Using In-Situ Analysis and Remote Sensing—Part II (Posters)

Session 147, 1:30 PM, CCC:Posters Hall B1

T33. Geofluids: The Role of Fluids in Crustal Processes—Part II (Posters)

Session 148, 1:30 PM, CCC:C109

T37. Hydrogeology Division: Innovations and Applications of Inverse Ground-water Models

Session 149, 1:30 PM, CCC:A202-204

T38. Hydrogeology Division and Engineering Geology Division: Evaporite Karst: Origins, Processes, Landforms, Examples, and Impacts

Session 150, 3:30 PM, CCC:C109

T47. IEE: The Impact of Geologic Heterogeneities on Characterization, Transport, and Remediation of Non-Aqueous Phase Liquids (NAPL's) at Hazardous Waste Sites

Session 151, 1:30 PM, CCC:C108-110-112

T48. IEE: Rates of Geologic Processes in the Holocene

Session 152, 1:30 PM, CCC:C105-107

T54. NAGT: Improving Geoscience Courses Through the Use of the Internet and the World Wide Web—Part II

FOURTH ANNUAL PRESIDENT'S STUDENT FORUM

Wednesday, October 30, 4:00 to 5:30 p.m.; Colorado Convention Center, Room A206. Sponsored by GSA Council.

Outgoing GSA President Eldridge M. Moores and incoming GSA President George A. Thompson invite all students to an informal meeting to discuss such topics as: What are your perceptions of GSA? How does GSA meet your needs? What does GSA do well? How could GSA improve? Please come and help us explore how to make GSA better. Complimentary beverages will be available.

Session 153, 1:30 PM, CCC:Posters Hall B1
T60. NAGT and IEE: Linking Natural and Social Systems in Geoscience Education: Pedagogy, Content, and Context—Part II (Posters)

Session 154, 1:30 PM, CCC:A207-209
T62. SEG: The Magmatic-Hydrothermal-Epithermal Transition and Associated Alteration and Mineralization—Part II

THURSDAY, OCTOBER 31, AM

Session 155, 8:00 AM, CCC:A202-204
Clastic Sedimentology II—Marine and Coastal Processes

Session 156, 8:00 AM, CCC:Posters Hall B1
Engineering Geology Posters

Session 157, 8:00 AM, CCC:C108-110-112
Environmental Geology

Session 158, 8:00 AM, CCC:A201
Geology Education II

Session 159, 8:00 AM, CCC:Posters Hall B1
Geophysics/Tectonophysics Posters

Session 160, 8:00 AM, CCC:A102-104-106
Hydrogeology Division Symposium (S27): The Role of Preferential Flow in the Unsaturated Zone

Session 161, 8:00 AM, CCC:C105-107
Igneous Petrology II

Session 162, 8:00 AM, CCC:Posters Hall B1
Marine Geology Posters

Session 163, 8:00 AM, CCC:C101-103
Metamorphic Petrology II

Session 164, 8:00 AM, CCC:Posters Hall B1
Paleoceanography/Paleoclimatology Posters

Session 165, 8:00 AM, CCC:C209
Paleontology/Paleobotany V—Problematica and Miscellaneous Mollusks

Session 166, 8:00 AM, CCC:A108
Petroleum Geology

Session 167, 8:00 AM, CCC:C102-104-106
Quaternary Geology/Geomorphology IV—Quaternary Glacial Events

Session 168, 8:00 AM, CCC:C109
Structural Geology III—Pluton Emplacement and Regional Structures

Session 169, 8:00 AM, CCC:Posters Hall B1
Tectonics Posters

Session 170, 8:00 AM, CCC:C201-205
T12. History of Recurrent Basement Faulting in Cratonic North America and its Orogenic Margins—Part I

Session 171, 8:00 AM, CCC:A205
T14. Evolution of the Neogene Strain Field in the Southeastern Great Basin: Roles of Faults, Folds, and Magmatism—Part I

Session 172, 8:00 AM, CCC:A111
T20. Precambrian Lithosphere III: Middle Crustal Processes

Session 173, 8:00 AM, CCC:A207-209
T28. MSA and Clay Mineral Society: Environmental Mineralogy—Part I

Session 174, 8:00 AM, CCC:A101-103
T39. The Death Valley Hydrogeologic System

Session 175, 8:00 AM, CCC:C207
T40. Hydrogeology Division: Physical and Chemical Heterogeneity: Impact on Samples and Measurements at Wells

Session 176, 8:00 AM, CCC:A105-107
T52. Geographic Information Systems and Integrated Digital Databases: Tools for Geoscience Analysis—Part II

Session 177, 8:00 AM, CCC:Ballroom 2&3
T63. SEG: Quantifying the Environmental Impacts of Mining—Part I

HOT TOPICS AT NOON

POPULAR SCIENTIFIC DEBATES FOR EVERYONE

ORGANIZED BY JOHN WARME

Monday, October 28 through Thursday, October 31, 12:15 to 1:15 p.m., Colorado Convention Center, A207-209.

Join your colleagues in spirited lunch-time debates. Keeping with the theme, hot and mild red and green chili along with beer and soft drinks will be available for purchase outside the debate room. Bring your lunch.

MONDAY

Chicxulub: How Did It Do It?—The K-T Boundary, Mass Extinction, and the Post-Chicxulub Era.

Moderator: Philippe Claeys, Museum für Naturkunde, Berlin, Germany.

Invited speakers include: Joanne Bourgeois, University of Washington; Gregory Retallack, University of Oregon, Eugene.

It is now difficult to argue against a large-sized impact at the K-T boundary, but we still need to document and clarify more fully the mechanisms leading to the extinction of organisms across the boundary. How can this be accomplished with testable results?

TUESDAY

Bald Uprights from the Pleistocene: Paleoclimate Influence on Human Evolution.

Moderator: Craig Feibel, Rutgers University.

Invited speakers include: Peter deMenocal, Lamont-Doherty Earth Observatory, Columbia University; Rick Potts, Smithsonian Institution; Steven Stanley, Johns Hopkins University; Elisabeth Vrba, Yale University.

Climatic shifts in Pliocene-Pleistocene time dramatically changed the face of the planet at the same time that critical evolutionary steps were being taken in Africa. How were global climatic trends felt in Africa, and what were the ecological and habitat changes that fostered this unusual lineage? To what extent can we tie the critical stages of early human evolution to major events in climatic, tectonic, and biotic change?



WEDNESDAY

Life's New Twist: The Precambrian-Cambrian Explosion of Life.

Moderator: Jere Lipps, Museum of Paleontology, University of California, Berkeley.

Invited speakers include: Stefan Bengtson, Swedish Museum of Natural History, Stockholm; Sandy Carlson, University of California, Davis; Charles Marshall, University of California, Los Angeles; Douglas Erwin, National Museum of Natural History, Smithsonian Institution.

The Precambrian-Cambrian explosion of life has not been satisfactorily explained or interpreted. Many hypotheses have been suggested, though none is generally accepted. The discussion will focus on this important and controversial event in biotic history.

THURSDAY

Fossil Collecting Laws.

Moderator: Richard Stucky, Denver Museum of Natural History.

In recent years, legislation has been proposed to regulate and/or deregulate fossil collecting from public lands. Some paleontologists believe that there should be no regulations, whereas others believe that all fossil vertebrates and scientifically important specimens should be placed into public repositories. This discussion will examine the basic principles underlying the protection of fossils from public lands. A vertebrate paleontologist, invertebrate paleontologist, and paleobotanist will provide background on the kinds of regulations or lack thereof which would best promote their science. Information will also be provided on the recently proposed legislation in the House of Representatives and how well it meets the needs of paleontologists.

THURSDAY, OCTOBER 31, PM

- Session 178, 1:30 PM, CCC:C109
Aqueous Geochemistry III—Geochemistry of Surface and Groundwaters
- Session 179, 1:30 PM, CCC:C207
Clastic Sedimentology III—Continental Sedimentary Deposits
- Session 180, 1:30 PM, CCC:C108-110-112
Economic Geology III—Archaean Deposits and Geochronology
- Session 181, 1:30 PM, CCC:A201
Geology Education III
- Session 182, 1:30 PM, CCC:A202-204
Hydrogeology II
- Session 183, 1:30 PM, CCC:Posters Hall B1
Igneous Petrology Posters
- Session 184, 1:30 PM, CCC:C105-107
Micropaleontology
- Session 185, 1:30 PM, CCC:C209
Paleontology/Paleobotany VI—Paleo Cubed
- Session 186, 1:30 PM, CCC:Posters Hall B1
Petroleum Geology Posters
- Session 187, 1:30 PM, CCC:Posters Hall B1
Precambrian Geology Posters
- Session 188, 1:30 PM, CCC:Posters Hall B1
Precambrian Lithosphere I, II, III Posters
- Session 189, 1:30 PM, CCC:C102-104-106
Quaternary Geology/Geomorphology V—Quaternary Paleoclimate
- Session 190, 1:30 PM, CCC:C201-205
Tectonics VI—Appalachian-Caledonian-Variscan Tectonics
- Session 191, 1:30 PM, CCC:Posters Hall B1
Volcanology Posters
- Session 192, 1:30 PM, CCC:C101-103
T03. Quaternary Geology and Geomorphology Division: High-Resolution Glacial Records from Marine and Lacustrine Basins
- Session 193, 1:30 PM, CCC:A108
T10. Northeastern, Southeastern, Cordilleran Sections of GSA: Appalachian and Cordilleran Melanges: Comparisons and Contrasts
- Session 194, 1:30 PM, CCC:Posters Hall B1
T12. History of Recurrent Basement Faulting in Cratonic North America and its Orogenic Margins—Part II (Posters)
- Session 195, 1:30 PM, CCC:Posters Hall B1
T14. Evolution of the Neogene Strain Field in the Southeastern Great Basin: Roles of Faults, Folds, and Magmatism—Part II (Posters)
- Session 196, 1:30 PM, CCC:A205
T17. Geophysics Division: Cenozoic Uplift of the Western United States
- Session 197, 1:30 PM, CCC:A102-104-106
T21. Volcanism, Tectonism, and Sedimentation in the Rio Grande Rift and its Margins in New Mexico and Colorado—Part II
- Session 198, 1:30 PM, CCC:A207-209
T28. MSA and Clay Mineral Society: Environmental Mineralogy—Part II
- Session 199, 1:30 PM, CCC:A111
T45. IEE: Integrated Site Characterization for Waste Disposal
- Session 200, 1:30 PM, CCC:A101-103
T46. Interpretation of Continental Sedimentation Patterns Using Surface and Subsurface Data
- Session 201, 1:30 PM, CCC:A105-107
T52. Geographic Information Systems and Integrated Digital Databases: Tools for Geoscience Analysis—Part III
- Session 202, 1:30 PM, CCC:Ballroom 2&3
T63. SEG: Quantifying the Environmental Impacts of Mining—Part II

GRADUATE SCHOOL INFORMATION FORUM

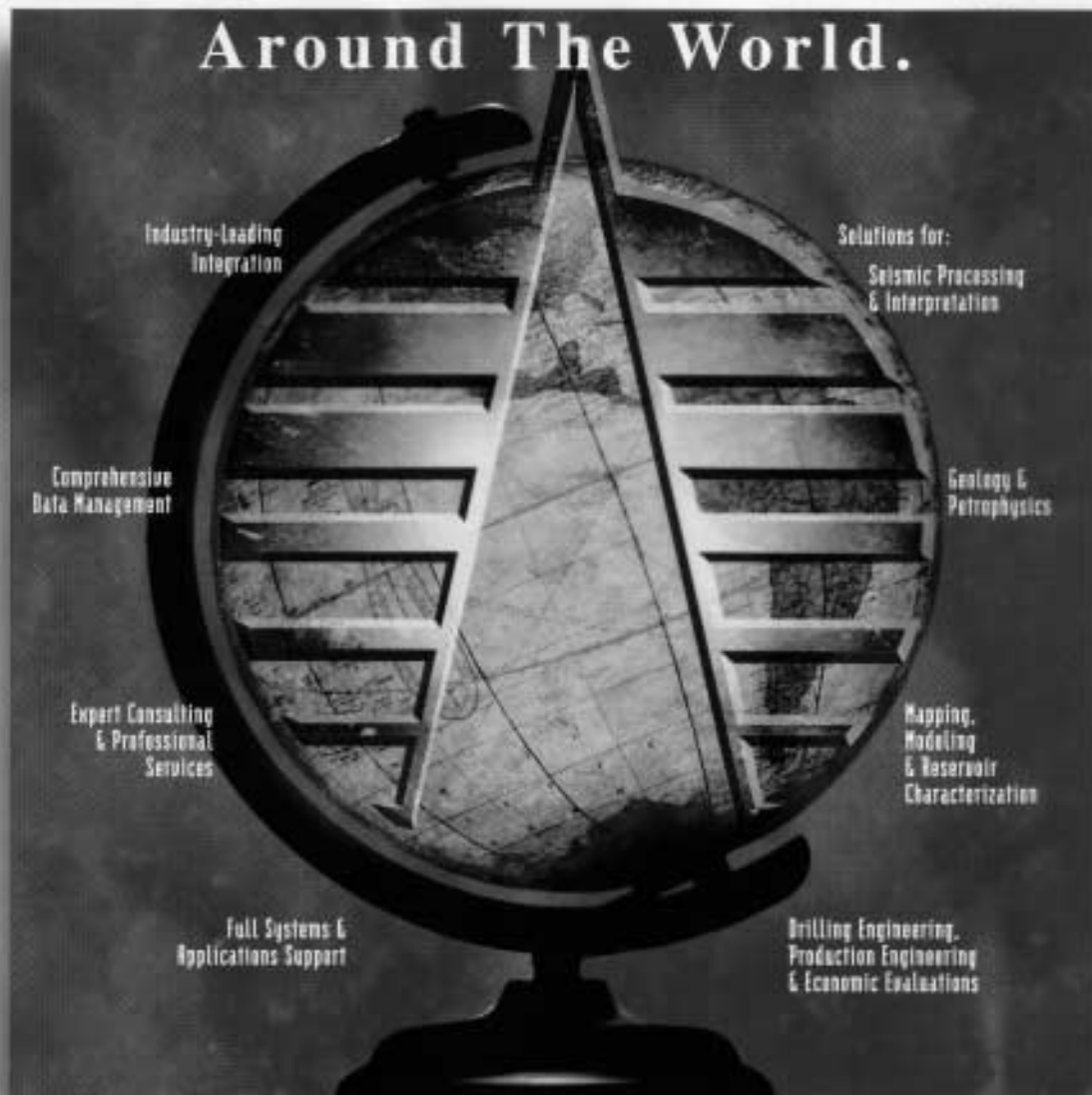
Colorado Convention Center, Hall A

Shortcut your search for the right graduate school by coming to the GSA Annual Meeting in Denver. Meet with representatives from universities across the nation without spending travel time and money to go to each school for interviews. The schools participating (at press time) are listed below.

Individual appointments are not necessary, although students are welcome to contact the schools in advance to schedule a meeting time. If you would like to receive a complete list of schools, with the contact person and telephone number, contact Matt Ball, GSA Meetings Department, E-mail: mball@geosociety.org.

PARTICIPATING SCHOOLS	Monday Oct. 28	Tuesday Oct. 29	Wednesday Oct. 30
Clemson University		•	•
CUNY Graduate School and University Center		•	
Duke University		•	
Florida International University		•	
Indiana University	•	•	
Iowa State University of Science and Technology	•	•	
Montana Tech of the University of Montana		•	
New Mexico Institute of Mining and Technology		•	
New Mexico State University		•	
Pennsylvania State University		•	
Rice University	•		
Southern Illinois University at Carbondale	•		
State University of New York at Binghamton	•		
Texas Tech University	•	•	
Universidad de Sonora		•	
University of Alabama		•	
University of Alaska		•	•
University of California, Riverside	•	•	
University of Colorado	•	•	
University of Delaware		•	
University of Kansas	•		
University of Kentucky			•
University of Maryland at College Park	•	•	
University of Massachusetts	•		
University of Missouri, Columbia		•	
University of Nebraska, Lincoln	•	•	•
University of Nevada, Reno		•	
University of North Carolina, Chapel Hill	•		
University of North Dakota	•		
University of Notre Dame	•	•	•
University of Tennessee	•	•	
University of Texas at Arlington	•	•	
University of Texas at Dallas	•	•	
University of Utah		•	
Utah State University		•	
Vanderbilt University		•	
Virginia Polytechnic Institute and State University	•	•	
West Virginia University	•		
Yale University	•	•	•

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NORTHEASTERN SECTION, GSA 32nd Annual Meeting

**King of Prussia, Pennsylvania
March 17-19, 1997**

The hosts for the 1997 meeting of the Geological Society of America Northeastern Section are geologists from Bryn Mawr College, the Delaware Geological Survey, LaSalle University, Montgomery County Community College, Pennsylvania State University—Ogontz, Temple University, the University of Delaware, Villanova University, West Chester University, Emrich & Associates, ERM Group, and the Pennsylvania Department of Environmental Protection. Meeting in conjunction with the GSA Northeastern Section will be the Eastern Section of SEPM, Northeastern Section of the Paleontological Society, Eastern and New England Sections of the National Association of Geoscience Teachers, and Association of Women Geoscientists.

The meeting will be at the Valley Forge Sheraton Hotel, King of Prussia, Pennsylvania, near Valley Forge National Park.

CALL FOR PAPERS

Papers are invited from students and professionals for presentation in oral and poster general sessions and theme (volunteered) sessions. Presentations that may fit into one of the symposia (mostly invited papers) are also solicited. If you wish to present a paper at a symposium, contact the convener of the symposium and/or indicate on the submitted abstract that the abstract be considered for a particular symposium.

Oral general technical and theme sessions will include 15 minutes for presentation and 5 minutes for discussion. Two 35 mm carousel projectors and two screens will be provided for each oral session. All slides must fit into a standard carousel tray. An overhead projector will be available for each oral session.

Poster sessions will allow at least three hours of display time; authors must be present for two hours.

ABSTRACTS

Abstracts must be submitted camera-ready on the official 1997 GSA section meeting abstract form in accordance with instructions on that form (e.g., about 250 words). Abstract forms are available from: Abstracts Coordinator, Geological Society of America, P.O. Box 9140, Boulder, CO 80301, (303) 447-2020, ext. 161, or E-mail: ncarlson@geosociety.org.

Send one original and five copies of abstracts to be considered to: Allan M. Thompson, Technical Program Co-chairman, Dept. of Geology, University of Delaware, Newark, DE, 19716-2544, (302) 831-2585, E-mail: thompson@udel.edu. Authors of invited (symposium) papers, and those who think their paper might be suitable for inclusion in a symposium or theme session should send an extra copy of the abstract to the appropriate (first

listed) contact person for that particular symposium.

Abstracts will be reviewed for content, originality, and format. Only one volunteered paper may be presented by an individual; however, a person may also be a coauthor on papers presented by others. Additional papers may be presented by individuals invited for symposia.

**ABSTRACTS ARE DUE BY
November 12, 1996.**

SYMPOSIA

The following symposia are planned for the 1997 meeting. Symposia will include invited papers and selected volunteered papers. Prospective authors are encouraged to contact the conveners directly. General information regarding symposia may be obtained by contacting Richard N. Benson, Technical Program Co-chairman, Delaware Geological Survey, University of Delaware, Newark, DE 19716-7501, (302) 831-8259, rnbenson@udel.edu.

- 1. Finding the Adirondacks' Place in the Grenville.** James Alcock, College of Earth and Mineral Sciences, Penn State University, Ogontz Campus, 1600 Woodland Road, Abington, PA 19001, (215) 881-7356, jea4@psuvm.psu.edu.; Peter Muller, Dept. of Earth Sciences, Ravine Parkway, SUNY, College at Oneonta, Oneonta, NY 13820, (607) 436-3707, Mullerpd@oneonta.edu.
- 2. Tectonic Connections Between the Northern and Southern Appalachians.** Alec Gates, Dept. of Geological Sciences, Rutgers University, Newark, NJ 07102, (201) 648-5034, gates@andromeda.rutgers.edu.; David Valentino, Dept. of Physical Sciences, Concord College, Athens, WV 24712, (304) 384-5238, VALENTID@math.concord.wvnet.edu.
- 3. Flood Basalts and Margin Magmas of the Atlantic Rift.** Greg McHone,

Graduate Liberal Studies Program, Wesleyan University, Middletown, CT 06459, (860) 685-3339, jmchone@wesleyan.edu.; Dick Benson, Delaware Geological Survey, University of Delaware, Newark, DE 19716, (302) 831-8259, rnbenson@udel.edu.

4. Biogenic Influences on Sedimentation. (Sponsored by SEPM) Kathy Browne, Dept. of Geological and Marine Sciences, Rider University, 2083 Lawrenceville Road, Lawrenceville, NJ 08648, (609) 895-5408, browne@enigma.rider.edu.; Bob Demicco, Dept. of Geological Sciences, SUNY at Binghamton, Binghamton, NY 13902, (607) 777-2604, demicco@binguns.cc.binghamton.edu.

5. Freshwater Ecosystems of the Catskill Delta: Stratigraphic, Sedimentological, and Paleontological Approaches. (Sponsored by SEPM) Neil Shubin, Dept. of Geology, University of Pennsylvania, Philadelphia, PA 19104, (215) 898-5724.

6. Paleontology in Science Education. (Sponsored by the Northeastern Section of the Paleontological Society) Jeff Over, Dept. of Geological Sciences, SUNY, College at Geneseo, 1 College Circle, Geneseo, NY 14454, (716) 245-5294 or 5291, over@uno.cc.geneseo.edu.; Steve Good, Dept. of Geology, SUNY, College at Cortland, Cortland, NY 13045, (607) 753-5697, goods@snycorva.cortland.edu.

7. Biotic Response to Global Change (Fossils as Clues to Global Change: Geochemical and Faunal Assemblage Indicators). (Sponsored by the Northeastern Section of the Paleontological Society) Jeff Over, Dept. of Geological Sciences, SUNY, College at Geneseo, 1 College Circle, Geneseo, NY 14454, (716) 245-5294 or 5291, over@uno.geneseo.edu.

8. Cyclic Hierarchies: Fabric of the Stratigraphic Record or Figments of Stratigraphic Imagination? Peter Goodwin, Dept. of Geology, Temple University, Philadelphia, PA 19122, (215) 204-8229; Edwin Anderson, Dept. of Geology, Temple University, Philadelphia, PA 19122, (215) 204-8249.

9. The Influence of Sir Charles Lyell's Mid-19th Century Visits to North America. Tom Pickett, 11236 Black Walnut Point, Indianapolis, IN 46236, (317) 823-2933, INME100@INDYCMS.IUPUI.EDU; Don Hoskins, Bureau of Topographic and Geologic Survey, P.O. Box 8453, Harrisburg, PA 17105, (717) 787-2169, hoskins.donald@A1.pader.gov.

10. Superfund Successes. Grover Emrich, Emrich and Associates, 1488 Hancock Lane, Wayne, PA 19087-1119, (610) 296-5068, emrich@aol.com; Charles Bandoian, ERM Group, 855 Springdale Drive, Exton, PA 19341, (610) 524-3510.

11. Well-Head Protection. Charles Bandoian, ERM Group, 855 Springdale Drive, Exton, PA 19341, (610) 524-3510; Grover Emrich, Emrich and Associates,

1488 Hancock Lane, Wayne, PA 19087, (610) 296-5068, emrich@aol.com.

THEME SESSIONS

The 1997 GSA Northeastern Section meeting committee invites papers related to the following broad themes of current interest. These sessions are similar to symposia in their focus on specific topics, but each is an open forum where the papers are volunteered. Prospective authors are encouraged to contact the appropriate session conveners directly. The following theme sessions have been proposed and will be held under these titles if enough relevant papers are submitted. If insufficient papers are received, submitted papers will be considered for regular technical oral or poster sessions.

- 1. Frontiers of Mineralogy.** Darby Dyar, Dept. of Geology and Astronomy, West Chester University, West Chester, PA 19383, (610) 436-2727, ddyar@wcupa.edu.
- 2. Economic Mineral Deposits of Northeastern North America.** Bill Kelly, New York State Geological Survey, 3140 Cultural Education Center, Albany, NY 12230, (518) 474-7559, wkelly@museum.nysed.gov; Bob Altamura, Dept. of Geology and Planetary Science, University of Pittsburgh, Johnstown, PA 15904.
- 3. Current Research in Sand Resources of the Inner Continental Shelf.** (Sponsored by SEPM) Jane Uptegrove, New Jersey Geological Survey, CN 427, Trenton, NJ 08625, (609) 292-2576, janeu@njgs.dep.state.nj.us; Bob Conkwright, Maryland Geological Survey, 2300 St. Paul St., Baltimore, MD 21218, (410) 554-5500, tbird@mgs.dnr.md.gov.
- 4. Nearshore Processes and the Development of the Coastal Stratigraphic Record.** Sue Halsey, Division of Science and Research, Dept. of Environmental Protection and Energy, State of New Jersey, Trenton, NJ 08625, (609) 292-0950, shalsey@dep.state.nj.us; Nicholas Coch, Queens College (CUNY), Dept. of Geology, Flushing, NY 11367-0904, (718) 997-3326; Dan Belknap, Dept. of Geological Sciences, University of Maine at Orono, Boardman Hall 5711, Orono, ME, (207) 581-2159, belknap@maine.maine.edu.
- 5. Geological Applications of GIS.** Mary Jo Hall, Dept. of Geological and Marine Sciences, Rider University, Lawrenceville, NJ 08648, (609) 895-5416, HALL@enigma.rider.edu; Randy Kerhin, Maryland Geological Survey, 2300 St. Paul St., Baltimore, MD 21218, (410) 554-5544, rkerhin@mgs.dnr.md.gov.
- 6. Undergraduate Research.** POSTER SESSION (Sponsored by the Geology Division, Council on Undergraduate Research) Students must be listed as the authors and must have been the major preparer of the poster. Topics may vary over a broad spectrum (e.g., see GSA abstract form),

but must be the result of the student's own participation in undergraduate research programs. Larry Malinconico, Dept. of Geology, Lafayette College, Easton, PA 18042, (610) 250-5193, malincol@lafayette.edu.

- Environmental Geology. POSTER SESSIONS.** Grover Emrich, Emrich and Associates, 1488 Hancock Lane, Wayne, PA 19087, (610) 296-5068, emrich@aol.com; Charles Bandoian, ERM Group, 855 Springdale Drive, Exton, PA 19341, (610) 524-3510; Ben Greeley, Pennsylvania Department of Environmental Protection, Bureau of Water Supply & Community Health, 555 North Lane, Suite 6010, Conshohocken, PA 19428, (610) 832-6055, GREELEY.BENJAMIN@a1.pader.gov.
- 7. Superfund Cleanup**
- 8. Philadelphia Naval Base Redevelopment**
- 9. Redevelopment of Past Industrial Sites: Pennsylvania Act II (Brownfields)**
- 10. Coal Mine Reclamation**
- 11. Surface Water Hydrology: 1996 Northeast Pennsylvania Floods**

K-12 TEACHER EVENT

An all-day workshop will be held on Sunday, March 16. The following topics will be covered: Paleobiology and the Origin of Coal; Dinosaurs, the Historic Marsh-Cope Debates on the Warm-bloodedness of Dinosaurs; Local Five County Geology (Pennsylvania and New Jersey); Geology of the State of Pennsylvania; Environmental Problems of the Tristate Area. For more details contact: Gene C. Ulmer, Dept. of Geology, Temple University, Philadelphia, PA 19122, (215) 204-7171.

STUDENT AWARDS AND TRAVEL ASSISTANCE

Awards will be given for the best oral paper and best poster session presented by students. Although the faculty mentor may appear as the junior author, a major part of the paper or poster session must represent work by the student author. NOTE: *Papers submitted for this award should be so designated at the bottom of the abstract form.*

The Northeastern Section of GSA will award travel grants to students who give papers (oral or poster) of which he or she is the presenter and author or coauthor at the meeting. In addition, the Northeastern Section will award student research grants to undergraduate students in 1997. Applications for travel assistance and guidelines for student research grants may be obtained from Kenneth N. Weaver, Secretary-Treasurer, Northeastern Section, GSA, c/o Maryland Geological Survey, 2300 St. Paul Street, Baltimore, MD 21821-5210, (410) 554-5532, fax 410-554-5502.

SHORT COURSES

Two short courses will be offered on Sunday, March 16. Preregistration is required for both. For details, contact Gene C. Ulmer, Dept. of Geology, Temple University, Philadelphia, PA 19122, (215) 204-7171.

- 1. Aminostratigraphy.** Applications of amino acid racemization geochemistry to the geochronology and stratigraphy of Quaternary deposits. John F. Wehmiller, Dept. of Geology, University of Delaware, Newark, DE 19716, (302) 831-2926, jwehm@udel.edu.
- 2. Geoscience Courseware Workshop.** Addresses the needs of educators who wish to use the latest technology in their courses, but are limited by tight budgets or by lack of technical know-how. Declan DePaor, Earth'nWare, Inc., 148 Cadish Ave., Hull, MA 02045-1643, (617) 925-0264, earthnmail@aol.com.

Additional workshops may include: Groundwater Hydrocarbon Remediation Workshop and Milankovitch Cyclicity: A Drill Core Workshop.

EXHIBITS

Exhibit space will be available in the hall that serves as a passageway to the poster sessions at the Valley Forge Sheraton. Booths will be available for exhibitors during the entire meeting, 8:00 a.m., Monday, March 17, to noon, Wednesday, March 19. Reduced rates are available for educational or nonprofit groups. A limited number of table exhibits will be available at a reduced cost. For further information and space reservation, contact C. Gil Wiswall, Exhibits Coordinator, Dept. of Geology and Astronomy, West Chester University, West Chester, PA 19383, (610) 436-2570, gwiswall@wcupa.edu.

SPECIAL EVENTS

Breakfast and luncheon meetings will include Paleontological Society, Northeastern Section; National Association of Geoscience Teachers, Eastern and New England Sections; SEPM, Eastern Section; Association for Women Geoscientists; and GSA Northeastern Section Management Board.

The welcoming reception will be Sunday, March 16. The GSA Northeastern Section Reception and Banquet will be Monday, March 17.

HOUSING

A large block of rooms has been reserved for meeting participants at the Valley Forge Sheraton, the convention site. It has easy access by road and ample free open-air parking. For conference planning and to ensure guaranteed room rates,

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Preliminary Announcement and Call for Papers

SOUTH-CENTRAL and ROCKY MOUNTAIN SECTIONS, GSA Joint Annual Meeting

El Paso, Texas
March 20–21, 1997

The Departments of Geological Sciences of the University of Texas at El Paso and New Mexico State University invite you to the annual meeting of the South-Central and Rocky Mountain Sections of the Geological Society of America. The meeting will be held Thursday, March 20, and Friday, March 21, on the University of Texas at El Paso campus during spring break. All field trips are scheduled for the weekend after the meeting.

LOCATION

El Paso, Texas, is located at the junction of Texas, New Mexico, and Mexico. Its sister city, across the Rio Grande, is Ciudad Juarez. It is easily reached via U.S. Interstate Highways 10 and 25 and has inexpensive air connections via America West, American, Continental, Frontier, Southwest, and Aeromexico.

The name El Paso has rich historical significance. It is a shortened version of El Paso del Rio del Norte, the name given to the pristine river valley by conquistador Don Juan de Onate more than four centuries ago. Through this pass, today marked as a historic monument, Spanish explorers found their way into what is now America, claiming it for the Spanish Crown. Visitors enjoy this city—its historic mission trail, beautiful mountain vistas and desert sunsets, Mexican cuisine, and colorful history—which offers the lure of the Old West and three distinct cultures in two nations.

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it is important that you reserve your room before February 14, 1997.

CHILD CARE

Child care arrangements will be coordinated by Mary Louise Hill, Dept. of Geology, Temple University, Philadelphia, PA 19122, (215) 204-8226; E-mail: melhill@astro.ocis.temple.edu.

REGISTRATION

To obtain low registration fees and to assist the local committee planning, please preregister. Special low fees will be available for students and K–12 schoolteachers. One-day registration fees will also be available. Registration will be handled by GSA

CALL FOR PAPERS

Papers are invited for presentation in oral sessions, symposia, and poster sessions. Oral presentations will be 17 minutes, with 3 minutes for questions. Poster sessions will be set up for four hours, and authors will be available for two hours.

Volunteered abstracts not included in symposia will be scheduled for regular technical sessions. Anyone wishing to organize a symposium should contact Elizabeth Anthony, Dept. of Geological Sciences, University of Texas, El Paso, TX 79968-0555, (915)747-5483, fax: 915-747-5073, E-mail: anthony@geo.utep.edu.

SYMPOSIA

1. **Pander Society Conodont Symposium**, Dave Lemone, UT El Paso, and James Barrick, Texas Tech University.
2. **Precambrian Geology of the Western United States**. Karl Karlstrom, University of New Mexico; Calvin Barnes,

headquarters. Registration forms will appear in the December 1996 issue of *GSA Today*.

Preregistration deadline:
FEBRUARY 14, 1997

DETAILED INFORMATION

Complete information on registration, accommodations, and activities will appear in the December 1996 issue of *GSA Today* and as part of the *Abstracts with Programs* for 1997 mailed in late February 1997. For additional information or suggestions, contact the general chairman, William A. Crawford, Dept. of Geology, Bryn Mawr College, Bryn Mawr, PA 19010-2899, (610) 526-5112, fax 610-526-5086, preferably E-mail: wcrawfor@brynmawr.edu. ■

Texas Tech University; and Kate Miller, UT El Paso.

3. **Mesozoic Redbeds of Mexico**. Claudio Bartolini, UT El Paso, Jaime Rueda Gaxiola, Universidad Nacional Autónoma de México; Mario Aranda, PEMEX; and Wolfgang Stinnesbeck, Universidad Autónoma de Nuevo Leon.
4. **Rio Grande Rift: Its Geology and Geophysics**. G. Randy Keller, Libby Anthony, and Wendi Williams, UT El Paso.
5. **Environmental Geology and Hydrogeology of Intermontane Basins**. Greg Ohlmacher and John Walton, UT El Paso, and Mike Whitworth, New Mexico Tech.
6. **Mesozoic Geologic History of the Southern United States and Mexico**. Tim Lawton, Kate Giles, and Nancy McMillan, New Mexico State University.
7. **Recent Advances in the Economic Geology of Mexico and Adjacent Areas**. Ken Clark, UT El Paso.
8. **Using Multimedia in the Classroom**. Vicki Harder, UT El Paso.
9. **Geology and Public Policy: The Political Education of a Scientist**. Joe Yelderman, Baylor University.
10. **New Refinements of the Geochronology of Events in the Western U.S. and Mexico**. Bill McIntosh and Matt Heitzler, New Mexico Tech.
11. **Undergraduate Student Research**. Betsy Julian, UT El Paso, and Diane Smith, Trinity University. Sponsored by the Geology Division of the Council on Undergraduate Research.

South-Central–Rocky Mountain
continued on p. 25

Mentor Program

Graduate students and undergraduate seniors: The Roy J. Shlemon Mentors Program in Applied Geology is coming to all of your 1997 section meetings. This program can help you learn about professional opportunities in the applied geosciences, as explained by leading private-sector practitioners in fields such as Quaternary geology, geomorphology, environmental geology, engineering geology, and hydrogeology. For more information, contact your section committee chair, section secretary, or GSA's Institute for Environmental Education.

South-Central-Rocky Mountain

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FIELD TRIPS

The field trips are organized by New Mexico State University. If you have questions concerning the trips, please contact Nancy McMillan, Dept. of Geological Sciences, Box 3AB, New Mexico State University, Las Cruces, NM 88003, (505) 646-2708, fax 505-646-1056, E-mail: nmcmilla@nmsu.edu.

1. Lower Mississippian Waulsortian Mounds, Sacramento Mountains.

Kent Kirby, University of Minnesota; and Kate Giles, New Mexico State University.

2. Stratal Architecture of Forestepping and Backstepping Shallow Marine Sequences: The Upper Cretaceous Gallup and Hosta Sandstones, San Juan Basin, New Mexico.

Dag Nummedal, UNOCAL, and Robyn Dunbar, Rice University.

3. Quaternary Landscape Evolution and Geo-Archaeology of the El Paso-Las Cruces Region.

Curtis Monger, New Mexico State University.

4. Ordovician El Paso Group Sequence Stratigraphy, Franklin Mountains, Texas.

Robert Goldhammer, Bureau of Economic Geology, University of Texas at Austin, and Dave Lemone, UT El Paso.

5. Geochronology and Geochemistry of the Potrillo Volcanic Field, New Mexico.

Wendi Williams and Libby Anthony, UT El Paso.

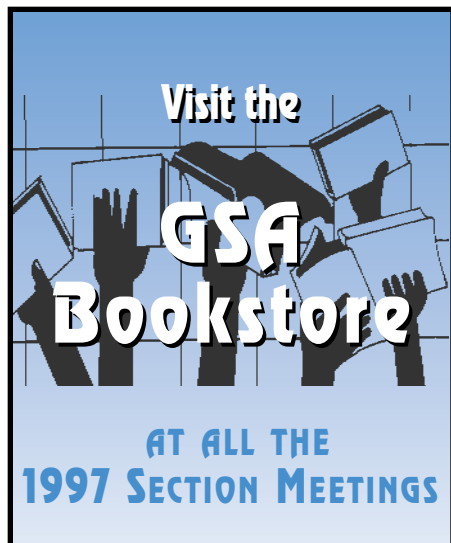
6. Beginning of the Age of Dinosaurs on the Southern High Plains.

Spencer Lucas, New Mexico Museum of Natural History, and Adrian Hunt, Mesalands Museum.

ABSTRACTS

Abstract Deadline: November 25, 1996.

Abstracts for all sessions must be submitted camera-ready on official 1997



GSA section meeting abstract forms.

These forms are available from the Abstracts Coordinator, GSA, P.O. Box 9140, Boulder, CO 80301, (303) 447-2020, E-mail: ncarlson@geosociety.org.

Send an original and five copies of the abstract (for both volunteered and invited papers) to: Elizabeth Y. Anthony, Dept. of Geological Sciences, University of Texas, El Paso, TX 79968-0555.

Indicate on the abstract your preference for a poster or oral session and the symposium (if any) appropriate to your research. GSA rules prohibit individuals from presenting more than one volunteered abstract, although they can be coauthors on additional volunteered abstracts. Abstracts submitted for symposia are not affected by this limitation.

Attendees are encouraged to order an abstract booklet either with their GSA annual dues or with their preregistration for this Section Meeting. There will be only a limited number of abstract booklets available for purchase on-site.

PROJECTION EQUIPMENT

Please bring your own loaded carousel trays. There will be two projectors for each oral session. Overhead projectors will be available upon request. Specifics of the poster session will be published in the final announcement.

EXHIBITS

Exhibit facilities for business, educational, and governmental institutions will be available in the Student Union Building. On-site registration, oral and poster sessions, the welcoming party, and the Thursday evening dinner will be held in this building. Space rental is \$125, which will include one complimentary registration. Exhibitors are encouraged to set up Wednesday afternoon for registration and the welcoming party. For information concerning exhibits, contact Nancy Wacker, Professional and Continuing Education, Assistant Director for Conferences and Special Events, University of Texas at El Paso, 500 West University, El Paso, TX 79968-0602, (915)747-5142, fax 915-747-5538, E-mail: nwacker@mail.utep.edu.

SPECIAL EVENTS

Welcoming Party

There will be a party beginning at 7 p.m. on Wednesday, March 19. On-site registration will be available, and those who have preregistered may pick up their name badges, tickets for the dinner, and programs during this party.

West Texas Mexican Dinner

There will be a Mexican dinner on Thursday, March 20. It will be followed by the special lecture. Tickets for the dinner must be purchased in advance.

STUDENT PAPERS AND TRAVEL GRANTS

Awards will be presented to the best student presentation in both oral and poster formats. Awards will be based on quality of research and effectiveness of presentation. Limited funds for travel expenses are also available. To be considered for both a travel stipend and the best paper awards, students should attach a note to their submitted abstract. William Cornell, UT El Paso, will administer these student awards.

PREREGISTRATION

Preregistration deadline: February 7, 1997

Preregistration by mail will be handled by Professional and Continuing Education at UT El Paso. Registration forms will appear in the November 1996 issue of *GSA Today*. Please take advantage of the lower registration fees and register by February 7. All field trip participants must register for the meeting. Approximate registration fees are as follows. Preregistration: GSA members—\$50, nonmembers—\$60, GSA student member—\$25, nonmember students—\$30, K-12 teachers—\$15, Mexican dinner—\$15. On-site registration: GSA members—\$60, nonmembers—\$70, GSA member students—\$30, nonmember students—\$35, K-12 teachers—\$15, Mexican dinner—\$20.

HOTEL ACCOMMODATIONS AND HOUSING

We have reserved rooms in the Camino Real Paso del Norte Hotel, a historic landmark. The hotel is a short walk from the U.S.-Mexico border and is close to the border trolley, which allows one to shop and eat in Juarez. The special rate is \$75 single and \$80 double. Cutoff date for reserving a room at this rate is February 7, 1997.

We have also reserved dormitory rooms on the UT El Paso campus. Rates are \$15 single and \$12 double and include linen. Dormitory rooms can be reserved through the registration form, which will appear in the November *GSA Today*.

OTHER INFORMATION

It is our goal that this program be accessible to all persons. If you have special dietary or physical needs, please state them on the registration form or contact Nancy Wacker at the address given above.

More detailed information will appear in the November *GSA Today*. If you would like to host a symposium or have questions about the meeting, please contact the general chairperson, Elizabeth (Libby) Anthony (see Call for Papers).

Nos Vemos Pronto! ■

GSA Research Grants Awarded

June Forstrom, GSA Grants Administrator

The GSA Committee on Research Grants met in Boulder, Colorado, March 29–30, 1996, and awarded \$349,625 to 218 graduate student applicants, and \$22,000 for the Gladys W. Cole and W. Storrs Cole Awards to two postdoctoral applicants. Committee members for 1996 are Mary L. Droser (Chair), James P. Hibbard, Noel C. Krothe, Susan A. Longacre, Peter C. Patton, Sheila J. Seaman, and Thomas O. Wright (National Science Foundation conferee).

COLE AWARDS FOR POST-DOCTORAL RESEARCH

The Gladys W. Cole Memorial Research Award for 1996 went to Vance Terrell Holliday, University of Wisconsin, Madison, to support his project "Origin and Evolution of Small Playa Basins on the Southern High Plains." This award is restricted to support research for the investigation of the geomorphology of semi-arid and arid terrains in the United States and Mexico.

The W. Storrs Cole Memorial Research Award, which is restricted to support research in invertebrate micropaleontology, was presented this year to Ellen Thomas, Wesleyan University, for her project "Equatorial Pacific Deep-sea Benthic Foraminifera: Faunal Composition and Diversity Over the Last 450 Kyr."

Eligibility for both Cole awards is restricted to GSA Members and Fellows between 30 and 65 years of age.

STUDENT AWARDS

This year, proposals were received from 534 students, of which 218 (41%) were awarded grants. Of these recipients, 94 were master's candidates, and 124 were doctoral candidates. Proposal requests totaled \$988,435, an average of \$1,851. The average actual award was \$1,604.

The committee determined that an additional 52 proposals were worthy of support. An additional \$80,000 would have been required to fund these proposals at an appropriate level. If these additional proposals had been funded, the funding rate would have risen to 51%.

Twenty alternate candidates were selected by the committee in the event that some of the grantees return all or part of their grant funds because they change their research project or receive funds from another source.

The Committee's budget included \$125,000 from the Penrose Endowment, \$100,000 from the National Science Foundation, \$75,000 from the Joseph T. Pardee Memorial, \$6,000 from the Second Century Fund (donations by Unocal and

the Lipman Research Fund), \$6,000 from the Harold T. Stearns Award Fund, the Sedimentary Geology Division, and the Structural Geology and Tectonics Division; and \$1,924 from funds returned too late in 1995 to be re-awarded last year. The budget also included \$35,200 from the GSA Foundation, which included \$10,000 from the Research Fund (including \$2,000 from Mobil Oil), \$14,950 from GEOSTAR and Unrestricted funds, and \$10,250 from various restricted special funds and the Engineering Geology, Geophysics, and Hydrogeology Divisions.

The recipients of student research grants awarded by GSA Divisions and Sections will be announced in the October issue of *GSA Today*.

Outstanding Mention. The Committee on Research Grants specially recognized 22 of the proposals as being of exceptionally high merit in conception and presentation: Kari M. Cooper, University of California, Los Angeles, "Cenozoic Volcanic Activity Along the Northwestern Margin of the Tibetan Plateau and Implications for the History of the Altyn Tagh Fault"; Lisa A. Doner, University of Colorado, "Decadal-scale Proxy Records of the Last 3000 Years from the Eastern Canadian Arctic and Iceland Based on Lake Sediment Records and Palynology"; Mihai N. Ducea, California Institute of Technology, "Probing the Roots of Batholiths; Lower Crustal Xenoliths from the Sierra Nevada"; Katrina Jane Edwards, University of Wisconsin—Madison, "Microbial Diversity and Mineral-Microbe Interactions in Acid Mine Drainage Environments"; Laurent Godin, Carleton University, "Deformation History and Geochronology of the Hanging Wall Structures of the Annapurna Detachment Fault, Kali Gandaki Valley, Central Nepal Himalaya"; Martin F. Helmke, Iowa State University, "Determination of Hydraulic Conductivity and Effective Fracture Porosity in Till from Large-Diameter, Undisturbed Core Samples"; Mark A. Hemphill-Haley, University of Oregon, "Investigation of Geometry, Mode of Displacement and Activity of Faults Within the Cascadia Back-Arc Region of Central Oregon"; Jeffrey R. Knott, University of California, Riverside, "Cosmogenic Isotope Dating of a Rock Avalanche Offset by the Death Valley Fault Zone, Black Mountains, Death Valley, California"; Barbara M. Martiny, Universidad Nacional Autónoma de México, "Pb Isotopic Compositions of Feldspars in Plutonic and Volcanic Rocks of Tertiary Age in the State of Oaxaca, Southern Mexico"; William W. Montgomery, Western Michigan University,

"Groundwater Hydraulics and Slope Stability Analysis—Elements for Prediction of Shoreline Recessions"; Britt Norlander, University of Minnesota, "Dating the Propagation of Deformation in the Greenschist-facies Pennine Nappes, Western Alps, Switzerland, Based on $^{40}\text{Ar}/^{39}\text{Ar}$ and Rb-Sr Methods"; Julie Pickrell, University of Idaho, "Stoichiometry and Thermodynamics of Pd Hydroxide Complexes and PGE Bisulfide Complexes"; Stephen J. Porder, University of Montana, "Metamorphism of Wet Semi-Pelitic Sediments Adjacent to a Large Basaltic Sill"; Peter William Reiners, University of Washington, "Critical Test of Melt Migration Models from Sequences of Alkali Basalts Erupted from Monogenetic Volcanic Vents, Kauai, Hawaii"; Douglas Reusch, University of Maine, "Have Arc-Continent Collisions Cooled the Earth? Exhumation of New Guinea, $^{187}\text{Os}/^{186}\text{Os}$ – $^{87}\text{Sr}/^{86}\text{Sr}$ – P CO_2 Links, and Miocene Climate"; Mark Skidmore, University of Alberta, "Rates of Chemical Denudation and CO_2 Drawdown in a Glacier-covered High Arctic Catchment"; Gary S. Solar, University of Maryland, "Tracking Granite Magma Migration Through the Crust: Constraints from Field Relations of Migmatites and Sr in Garnet"; Bruce Randall Tufts, University of Arizona, "Early or Late? The Timing of Crustal Block Rotation in the Eastern Transverse Ranges, Southern California: Structural and Geomorphic Tests at Pinto Wells"; Olivier Vanderhaeghe, University of Minnesota, "The Role of Partial Melting during the Late-Orogenic Collapse: The Shuswap Metamorphic Core Complex, British Columbia, Canada"; Amy M. Wadell, University of Montana, "The Inception of the Purcell Anticlinorium in Relationship to Provenance and Paleocurrent Analysis of the Upper Cretaceous Virgelle and Golden Spike Formations"; Chris Willoughby, University of Nevada, Reno, "Range Front Faulting on the West Side of the Stillwater Range, West-Central Nevada"; Nicholas S. F. Wilson, Dalhousie University, "Sulfide Formation Related to the Bacterial Degradation of Petroleum Reservoirs."

Gretchen L. Blechschmidt Research Award. The fund established in memory of Gretchen Louise Blechschmidt is to support research for women in the geological sciences. This year's award recipient is Heather M. Stoll, Princeton University, for her project "Rapid Sea Level Change and Climatic Variability in the Cretaceous: Evidence from Land Sections in Italy."

John T. Dillon Alaska Research Award. John Dillon was particularly noted for his radiometric dating work in the Brooks Range, the results of which have had a major impact on the geologic

Grants continued on p. 27

understanding of this mountain range. The recipient of this award is Michael P. Bunds, University of Utah, for "Permeability Barriers, Elevated Fluid Pressures and Deformation on the Castle Mountain Fault, Southern Alaska."

Robert K. Fahnestock Award.

This award honors the memory of Ken Fahnestock, who was a member of the Committee on Research Grants. It is awarded to the applicant with the best proposal in sediment transport or related aspects of fluvial geomorphology. The 1996 recipient is Gregory Dick, University of California, Santa Cruz, for "Cosmogenic Radionuclide Dating of Fluvial Terraces, Wind River, Wyoming."

Lipman Research Award.

The Lipman Research Fund is supported by gifts from the Howard and Jean Lipman Foundation to promote and support student research grants in volcanology and petrology in the western United States and Alaska. The 1996 recipients are James Rogers, University of Oregon, for "The Explosive/Effusive Transition in Small Silicic Eruptions," and Kurt A. Shoemaker, Miami University, for "Quantification of the Lithospheric and Sublithospheric Contributions to Northwestern United States Basaltic Volcanism."

Bruce L. "Biff" Reed Scholarship Award.

The Bruce L. "Biff" Reed Scholarship Award was established to provide grants to graduate students pursuing studies in the tectonic and magmatic evolution of Alaska and its mineral deposits, and also can fund other geologic work in Alaska. This year's recipient is David L. Taylor, University of Alabama, for "Sm/Nd Garnet Ages and Thermobarometric Analysis of Mid-Cretaceous Metamorphism, Central SE Alaska."

Alexander Sisson Research Award.

Family members of Alexander Sisson established a fund in his memory in 1994 to promote and support research for students pursuing studies in Alaska and the Caribbean. The first recipient of the award was named this year. He is Kurt R. Yuengling, University of Alaska, for "Determination of Ages and Formation Rates of Alaskan Tors: An Exposure History Study Using $^{26}\text{Al}/^{10}\text{Be}$."

Harold T. Stearns Fellowship Award.

The recipients of this award, for research on aspects of the geology of the Pacific Islands and the circum-Pacific region are: Barbara M. Martiny, Universidad Nacional Autónoma de México, "Pb Isotopic Compositions of Feldspars in Plutonic and Volcanic Rocks of Tertiary Age in the State of Oaxaca, Southern Mexico"; Peter William Reiners, University of Washington, for "Critical Test of Melt Migration Models from Sequences of Alkali Basalts Erupted from Monogenetic Volcanic Vents, Kauai, Hawaii," and Douglas



The Geological Society of America

Congressional Science Fellowship 1997-1998



The Geological Society of America is accepting applications for the 1997-1998 Congressional Science Fellowship. The Fellow selected will spend a year (September 1997-August 1998) in the office of an individual member of Congress or a congressional committee for the purpose of contributing scientific and technical expertise to public policy issues and gaining firsthand experience with the legislative process. The American Association for the Advancement of Science conducts an orientation program to assist the Fellow seeking a congressional staff position in which he or she can work on major legislative issues.

Criteria

The program is open to highly qualified postdoctoral to mid-career earth scientists. Candidates should have exceptional competence in some area of the earth sciences, cognizance of a broad range of matters outside

the Fellow's particular area, and a strong interest in working on a range of public policy problems.

Award

The GSA Congressional Science Fellowship carries with it a \$42,000 stipend, and limited health insurance, relocation, and travel allowances. The fellowship is funded by GSA and by a grant from the U.S. Geological Survey. (Employees of the USGS are ineligible to apply for this fellowship. For information about other programs, contact AAAS or the Geological Society of America.)

To Apply

Procedures for application and detailed requirements are available in the geology departments of most colleges and universities in the United States or upon request from: Executive Director, Geological Society of America, P.O. Box 9140, Boulder, CO 80301.

DEADLINE FOR RECEIPT OF ALL APPLICATION MATERIALS IS FEBRUARY 1, 1997

Reusch, University of Maine, for "Have Arc-Continent Collisions Cooled the Earth? Exhumation of New Guinea, $^{187}\text{Os}/^{186}\text{Os}$ - $^{87}\text{Sr}/^{86}\text{Sr}$ - P CO_2 Links, and Miocene Climate."

Industrial Donations and Awards. Industrial donations this year amounted to \$7,000 (\$2,000 from Mobil Oil Corporation, and \$5,000 from Unocal Corporation). The 1996 recipients are: Sean T. Brennan, University of Kansas, for "Fluid Migration History of an Exhumed Petroleum Reservoir, the Abra Limestone (Mid-Cretaceous), Northeastern Mexico"; Elias Gomez, Cornell University, for "A Quantitative Approach to the Tertiary Tectono-Stratigraphic Development of the Middle Magdalena Basin and Adjacent Foothills of the Eastern and Central Cordilleras in Colombia"; Eric Mueller, University of Oklahoma, for "The Tertiary Petroleum System of the Uinta Basin, Utah, USA—Characterization and Migration of Hydrocarbons in a Lacustrine Basin Setting"; and Nicholas S. F. Wilson, Dal-

housie University, for "Sulfide Formation Related to the Bacterial Degradation of Petroleum Reservoirs."

Other Successful Applicants.

Other applicants recommended for funding are the following:

Christon Mark Achong, Rhonda Adkins, Brian Altheim, Rachel A. Ames, Lorin Jean Amidon, Christopher L. Andronicos, Anthony Arendt, Janice Lynne Arnett, Audrey Aronowsky, Sherif A. M. Awadallah, Brian J. Axsmith, Carolyn A. Bachl, Laura Ann Banfield, Huiming Bao, Rebecca L. Beavers, Kathleen Counter Benison, Deborah Bergfeld, Mairi M. R. Best, Glenn Bixler, Jodi K. Blakely, David M. Borrok, John F. Bratton, Nancy Ann Brauer, Kitty Alicia Brown, Volker Bruchert, David A. Burch, James R. Burke, Rion H. Camerllo, Barry I. Cameron, David C. Campbell, Matthew R. Campbell, Jonathan M. Castro, Phillip L. Chaney, Shawn Chartrand, David G. Coler, John

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- 1197-1198 Guidelines for authors of papers submitted to the *Geological Society of America Bulletin*. Part 2

1996 Penrose Conferences

October 1996

October 8-14, **Exhumation Processes: Normal Faulting, Ductile Flow, and Erosion**, Island of Crete. Information: Uwe Ring, Institut für Geowissenschaften, Universität Mainz, Becherweg 21, D-55099 Mainz, Germany, 49-6131-392164, fax 49-6131-394769, E-mail: ring@mzdmza.zdv.unimainz.de.

1997 Penrose Conferences

April 1997

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. For more information, see <http://www.nmt.edu/~haneberg/Fluids.html>.

September 1997

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@mailhost.nmt.edu.

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@ucs.indiana.edu.

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

1996 Meetings

September

September 12–14, **Arizona Hydrological Society 9th Annual Symposium**, Prescott, Arizona. Information: Abe Springer, (520)523-7198, E-mail: abe.springer@nau.edu.

October

October 21–24, **Contaminated Soils 11th Annual Conference**, Amherst, Massachusetts. Information: Linda Rosen, Environmental Health and Sciences, N344 Morrill, University of Massachusetts, Amherst, MA 01003, (413)545-2934, fax 413-545-4692.

October 29–November 2, **Mineral Raw Resources of the CIS**, St. Petersburg, Russia. Information: Minerals, P.O. Box 215, 199004, St. Petersburg, Russia, U.S. phone (812) 355-7952 or 218-927, fax 812-112-2348 or 213-5926, E-mail: root@restec.spb.su, Web: <http://www.spb.su/restec>.

November

November 10–15, **Society of Exploration Geophysicists Annual Meeting**, Denver, Colorado. Information: F. Don Stoddard, Box

702740, Tulsa, OK 74170-2740, (918)493-3516, fax 918-493-2074.

1997 Meetings

March

March 23–26, **Symposium on the Application of Geophysics to Environmental and Engineering Problems** (SAGEEP) 10th Annual Symposium, Reno, Nevada. Information: Jayne Sturges, (303)771-2000, fax 303-843-6232.

June

June 9–13, **Changing Water Regimes in Drylands**, Lake Tahoe, California. Information: Nicholas Lancaster, Desert Research Institute, P.O. Box 60220, Reno, NV 89506, E-mail: nick@maxey.dri.edu, Web: <http://www.dri.edu>.

June 18–19, **Coastal Tectonics**, London, UK. Information: Iain Stewart, Dept. of Geography & Earth Sciences, Brunel University, Borough Rd., Isleworth TW7 5DU, UK, phone 44-181-8910121, fax 44-181-8918237, E-mail: iain.stewart@brunel.ac.uk; or Claudio Vita-Finzi, Dept. of Geological Sciences, University College London, Gower St., London WC1E 6BT,

UK, phone 44-171-3877050, fax 44-171-3887614, E-mail: ucfbvfv@ucl.ac.uk.

June 29–July 2, **36th U.S. Rock Mechanics Symposium**, New York, New York. Information: Kunsoo Kim, Columbia University, Mail Code 4711, 500 West 120th St., New York, NY 10027, (212) 854-8337, fax 212-854-8362, E-mail: kk21@columbia.edu, Web: <http://www.columbia.edu/~kk21>. (Abstracts deadline: October 1, 1996.)

September

September 9–14, **Alaska/Yukon Gold Rush Centennial Symposium on Mining**, Fairbanks, Alaska. Information: William R. Wood, Festival Fairbanks, 514 Second Ave., Suite 102, Fairbanks, AK 99701, (907)456-1984, fax 907-452-8878.

September 27–October 5, **Association of Engineering Geologists Annual Meeting**, Portland, Oregon. Information: Gary Peterson, Squire Assocs., P.O. Box 1317, Lake Oswego, OR 97035, (503)635-4419, fax 503-635-1430, E-mail: 102763.3233@compuserve.com.

October

October 7–11, **American Institute of Professional Geologists Annual Meeting**, Houston, Texas. Information: AIPG, 7828 Vance Dr., Suite 103, Arvada, CO 80003, (303)431-0831, fax 303-431-1332.

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.

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The Planetary Geology Division

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Positions Open

GEOCHEMISTRY

The Department of Geology and Geophysics at the University of Missouri-Rolla (UMR) invites applications for an entry-level, tenure-track position in geochemistry. Applicants must have completed a Ph.D. degree before the effective starting date of January 1, 1997 (or September 1, 1997 depending on the candidate's availability). The successful candidate will be expected to teach undergraduate and graduate courses in introductory, applied, and aqueous geochemistry, with emphasis on the geochemistry of groundwater and other environmental problems. In addition, the applicant will be expected to develop a strong research program, and direct graduate research (M.S. and Ph.D. level) in geochemistry. Although the areas of geochemical emphasis will be groundwater and environmental problems, expertise and interest in applications of geochemistry to sedimentology, petroleum, and ore deposits will be considered a plus.

The department is moderate in size and is closely associated with five other mineral industries departments in the new nearly 20 million dollar McNutt Hall. The department collaborates with the regional United States Geological Survey (groundwater and topographic divisions) and Missouri Geological Survey offices that are located in Rolla, Missouri. The department works closely with the Department of Geological Engineering, which is strongly oriented toward environmental problems.

The department maintains computer-automated atomic absorption equipment in spacious teaching and research laboratory facilities. Also available on the UMR campus

are inductively coupled plasma spectroscopy (ICP), high-performance gas chromatograph, and equipment for organic carbon analysis at the University of Missouri Environmental Trace Substances Laboratory, and modern X-ray diffraction and electron microbeam equipment (SEM-EDS and WDS, TEM, and AES, ESCA, STM, and AFM) at the Center for Materials Research and within the School of Mines and Metallurgy.

Starting salary and rank are commensurate with research record and experience.

Applications, accompanied by a resume, statement of research interests, and complete bibliography references should be sent to: Dr. Richard Hagni, Chairman, University of MO-Rolla, Department of Geology and Geophysics, 125 McNutt Hall, Rolla, MO 65409-0410; Phone: 573-341-4616; fax: 573-341-6935; E-mail: rhagni@umr.edu

Three letters of reference should also be sent directly to Dr. Hagni.

Application deadline: To ensure consideration, applications and letters of reference must arrive before November 1, 1996, but we will continue to accept applications until the position is filled.

The University of Missouri-Rolla is an equal opportunity, affirmative-action employer.

The Department of Marine Science of the University of South Florida, St. Petersburg, FL invites applications for a Visiting Assistant Professor (duration nine months) which will include the spring and summer semesters of 1997. A Ph.D. with an emphasis in Geological Oceanography or Marine Geochemistry is required. A successful candidate's research record must emphasize work in low temperature sedimentary geochemistry including observa-

GSA MEETINGS

1997 ANNUAL MEETING

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*

Field Trip Chairs: *Bart Kowallis, Brigham Young University*
Paul Link, Idaho State University

CALL FOR

1997 CONTINUING EDUCATION COURSE PROPOSALS

Proposals Due by December 1

The GSA Committee on Continuing Education invites those interested in proposing a GSA-sponsored or cosponsored course or workshop to contact GSA headquarters for proposal guidelines. Continuing Education courses may be conducted in conjunction with all GSA annual or section meetings. We are particularly interested in receiving proposals for the 1997 Salt Lake City Annual Meeting or the 1998 Toronto Annual Meeting.

Proposals must be received by December 1, 1996. Selection of courses for 1997 will be made by February 1, 1997. For those planning ahead, we will also consider courses for 1998 at that time.

For proposal guidelines or information, contact:

Edna Collis, Continuing Education Coordinator,

GSA headquarters 1-800-472-1988, ext. 134.

E-mail: ecollis@geosociety.org

1997 SECTION MEETINGS

NORTHEASTERN SECTION, March 17-19, Sheraton Valley Forge Hotel, King of Prussia, Pennsylvania. Submit completed abstracts to: Allan M. Thompson, Department of Geology, University of Delaware, Newark, DE 19716-2541, (302) 831-2585, thompson@bach.udel.edu. *Abstract Deadline: November 12, 1996.*

SOUTH-CENTRAL and ROCKY MOUNTAIN SECTIONS, March 20-21, University of Texas, El Paso, Texas. Submit completed abstracts to: Elizabeth Y. Anthony, Department of Geological Sciences, University of Texas, El Paso, TX 79968-0555, (915) 747-5483, anthony@geo.utep.edu. *Abstract Deadline: November 25, 1996.*

SOUTHEASTERN SECTION, March 27-28, Auburn University, Auburn, Alabama. Submit completed abstracts to: Charles E. Savrda, Department of Geology, Auburn University, Auburn, AL 36849-5305, (334) 844-4893, savrdce@mail.auburn.edu. *Abstract Deadline: December 2, 1996.*

NORTH-CENTRAL SECTION, May 1-2, The Concourse Hotel, Madison, Wisconsin. Submit completed abstracts to: Bruce Brown, Wisconsin Geological & Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705, (608) 263-3201, babrown1@facstaff.wisc.edu. *Abstract Deadline: January 9, 1997.*

CORDILLERAN SECTION, May 21-23, Kona Surf Resort and Convention Center, Kailua-Kona, Hawaii. Submit completed abstracts to: Fred MacKenzie, Department of Oceanography, University of Hawaii-SOEST, 1000 Pope Road, Honolulu, HI 96822, (808) 956-6344, fredm@soest.hawaii.edu. *Abstract Deadline: January 24, 1997.*

FOR INFORMATION ON ANY GSA MEETING CALL THE GSA MEETINGS DEPARTMENT 1-800-472-1988 or (303) 447-2020, ext. 133

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tional field programs. The incumbent is expected to teach a graduate level course on the Geochemistry of Marine Sediments. Pending availability of funds, the Department of Marine Science plans to advertise for a candidate to fill a permanent position of similar description beginning in 1998.

Salary range: \$35,000 — negotiable.

Applicants should submit a resume with career objectives, a list of publications and accomplishments and names and phone numbers of three references to Dr. Robert H. Byrne, Faculty Recruiting Chair, Department of Marine Science, University of South Florida, 140 Seventh Avenue South, St. Petersburg, Florida 33701.

Deadline Date: 9/6/96

USF is an EO/EA/AA institution. For ADA accommodations, call (813) 893-9508.

VASSAR COLLEGE

The Department of Geology and Geography at Vassar College is searching for a dynamic, broadly-thinking earth scientist for an assistant professor tenure-track position beginning August, 1997. A Ph.D. is required for hiring at the assistant professor level, although candidates will be considered at the instructor level if they are Ph.D. candidates or the Ph.D. is pending. As an assistant professor or instructor, this individual will teach two geology courses each semester. The four courses will include structural geology and an introductory course whose focus will depend on the individual's expertise and interests. The other two courses, one of which must be taught at the senior level, could be in the fields such as geomorphology, tectonics, engineering geology, hazards or remote sensing. We are particularly eager to find an earth scientist who 1) works at the intersection of surface processes and tectonics, 2) appreciates the importance of doing science which is relevant to society; 3) perceives the advantages of a department that knits together geology and geography; 4) understands the significance of educating a diverse scientific work force for the 21st century; 5) will develop an active research program that involves undergraduate students; and 6) will employ creative approaches to teaching and emphasize field experiences and studies. Familiarity with tools such as computer modeling, geodetics, GPS, GIS, or laser altimetry would be advantageous.

Vassar College is a private, liberal arts institution of approximately 2200 students located in the Mid-Hudson River Valley in Poughkeepsie, NY. The Geology and Geography Department at Vassar involves three geologists and three geographers and utilizes a newly renovated building with XRD, sedimentology, rock preparation, and GIS laboratories. The Patricia Bullitt Collins Field Station on the 500 acre Vassar College farm also functions as an integral element in our geology and environmental sciences programs. Vassar is an affirmative action, equal opportunity employer. Since we will conduct preliminary job interviews at the annual meeting of the Geological Society of America in Denver, Colorado, applications should be sent by October 21, 1996 to Chair, Search Committee, Professor Jill S. Schneiderman, Department of Geology and Geography, Maildrop 312, Poughkeepsie, NY 12601. Question? Call 914-437-5540 or fax 914-437-7577.

MINERALOGIST / PETROLOGIST

The Department of Geology at Bowling Green State University announces a tenure-track position at the Assistant Professor level. Fields of expertise and research interests should include mineralogy and/or petrology; a component of field-based research is highly desirable. The successful candidate will teach undergraduate mineralogy and/or petrology and other undergraduate and graduate courses in geology, participate in our summer field course in the western U.S., maintain an active research program, and supervise master's level graduate students. A Ph.D. is required.

Facilities include: Microscopy laboratory (transmitted, reflecting, cathodoluminescence, and fluid inclusion microscopes); Mineral kinetics laboratory (cold-seal hydrothermal vessels and one atmosphere furnaces); Geochemistry laboratory (XRD; XRF; SEM; AAS); Sample preparation facilities; Field vehicles; Remote sensing laboratory; GIS Laboratory; Unix Workstations; ARC/INFO, ERMapper, AVS; and Geophysical facilities (magnetometer, gravity meter, shallow seismic, resistivity, GPS).

To assure full consideration, applications including a complete resume, statements of teaching and research interests, three original letters of recommendation, and transcript showing highest degree should be sent by November 15 to: Chair, Search Committee, Department of

Geology, Bowling Green State University, Bowling Green, OH 43403. Bowling Green is an AA/EOC employer. Applications from underrepresented/protected groups are urged to apply.

SURFICIAL PROCESS GEOMORPHOLOGIST

The Conservation and Survey Division, University of Nebraska-Lincoln, invites applications for an Assistant Professor, 12-month, tenure-track appointment. Will develop and implement research with respect to surficial processes and their stratigraphic record in the Quaternary of Nebraska, emphasizing some combination of glacial, fluvial and/or eolian processes and utilizing field data collection, remote sensing and geographic information systems (GIS). Grant sponsored research in continental interior outside Nebraska will also be encouraged. Will be expected to provide expertise/service to members of the public and private sectors; develop linkages with scientists within CSD, UNL, and other institutions; obtain external, grant sponsored funding; present research at conferences and symposia; and publish research in scholarly journals, CSD publications and other outlets. Will have the opportunity to participate in workshop instruction, classroom teaching, and advising graduate students in allied departments when feasible and desirable. Requires Ph.D. in geology, physical geography, soil science or closely related field earned by the date of appointment, and experience with remote sensing and GIS. Applicant should have an appreciation for environmental concerns and appropriate use of natural resources. Send curriculum vitae, university transcripts, description of current and planned future research, and the names, addresses and telephone numbers of three references postmarked by December 31, 1996 (or until suitable candidate is found) to: Dr. F. Edwin Harvey, Chair, Geomorphologist Search Committee, Conservation and Survey Division, University of Nebraska-Lincoln, 113 Nebraska Hall, Lincoln, NE 68588-0517. Telephone: (402) 472-8237; fax: (402) 472-2410; or E-mail: fehavrey@unlinfo.unl.edu. UNL is committed to a pluralistic campus community through Affirmative Action and Equal Opportunity, is responsive to the needs of dual career couples, and assures reasonable accommodation under the Americans With Disabilities Act. Contact Dr. Harvey for additional information.

GEOPHYSICS

The Department of Geology and Geophysics at the University of Missouri-Rolla (UMR) invites applications for an entry-level, tenure-track position in environmental and engineering geophysics. The successful applicant will be expected to teach applied and theoretical courses at both the undergraduate and graduate levels. In addition, the applicant will be expected to develop a strong research program and direct graduate students in their areas of interest. Applicants must have completed the Ph.D. degree or equivalent in science or engineering before the probable appointment date of September 1, 1997. Applicants with experience in engineering and environmental applications are especially invited to apply.

The department is moderate in size and is closely associated with five mineral engineering departments in the modern and spacious, 145,000 square foot, 20 million dollar McNutt Hall. The department has strong ties to the regional United States Geological Survey and Missouri Geological Survey offices that are located in Rolla, Missouri.

The department maintains state-of-the-art Zonge Engineering resistivity, induced potential and electromagnetic equipment, a Bison 24-channel seismograph with borehole and roll-a-long capabilities, a GSSI ground-penetrating radar unit with three antennas, a magnetometer and a gravimeter. In support of this equipment, the department has acquired significant processing, modeling and interpretational computer hardware and software.

Starting salary and rank are commensurate with research record and experience.

Applications, accompanied by a resume, statement of research interests, and complete bibliography references should be sent to: Dr. Richard Hagni, Chairman, University of MO-Rolla, Department of Geology and Geophysics, 125 McNutt Hall, Rolla, MO 65409-0410; Phone: (573) 341-4616; fax: 573-341-6935; E-mail: rhagni@umr.edu

Three letters of reference should also be sent directly to Dr. Hagni.

Application deadline: To ensure consideration, applications and letters of reference must arrive before January 1, 1997, but we will continue to accept applications until the position is filled.

The University of Missouri-Rolla is an equal opportunity, affirmative action employer.

STRATIGRAPHY / BASIN ANALYSIS

The Department of Geological Sciences of Rutgers, The State University of New Jersey (New Brunswick) seeks to fill an anticipated tenure-track position at the Assistant Professor level in the field of Stratigraphy and Basin Analysis beginning in September 1997. Exceptionally accomplished applicants at more senior levels will be considered.

We seek candidates with proven research capability in integrating geochemical, geophysical, and stratigraphic data. While the subdiscipline is open, we desire expertise in isotopic stratigraphy, magnetostratigraphy, biostratigraphy, or cyclostratigraphy to complement current faculty strengths. The successful candidate should interact with ongoing regional and inter-regional studies; these include current projects on the rift, passive margin, and foreland basins represented in the New Jersey region and their global counterparts. Our goal is to establish and maintain a gas mass spectrometry or magnetostratigraphy/multi-sensor track laboratory in collaboration with the new faculty member. In addition to developing an innovative, forward-looking research program, a solid commitment to undergraduate and graduate teaching is required.

A curriculum vitae, statement of research interests, and the names of four references should be sent by 15 November, 1996 to Dr. Kenneth G. Miller, Chair of the Search Committee, Department of Geological Sciences, Rutgers University, Piscataway, NJ 08855-1179. Rutgers University is an equal opportunity/affirmative action employer.

HYDROLOGY / HYDROGEOLOGY DARTMOUTH COLLEGE

The Earth Sciences Department at Dartmouth College seeks applications for a tenure-track faculty position in hydrology/hydrogeology at the assistant professor level. Exceptional candidates may be considered for appointment at a higher level. Candidates will be expected to display excellence and leadership in both teaching and research, establish an active research program, advise student research at the undergraduate and graduate levels, and participate in the interdisciplinary Earth, Ecosystems and Ecological Sciences graduate program. Applications are encouraged from individuals in all sub-disciplines of hydrology.

A curriculum vitae, list of publications, description of proposed research and teaching activities, and names, addresses, and FAX numbers of three references should be sent to: Hydrology Search Committee, Dartmouth College, Department of Earth Sciences, 6105 Fairchild, Hanover, NH 03755. The appointment will be effective July 1, 1997. Evaluation of applications will begin September 1, 1996 and continue until the position is filled.

Dartmouth College is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply.

Opportunities for Students

JOI/USSAC Ocean Drilling Fellowships. JOI/U.S. Science Advisory Committee is seeking doctoral candidates of unusual promise and ability who are enrolled at U.S. institutions to conduct research compatible with that of the Ocean Drilling Program. Both one-year and two-year fellowships are available. The award is \$20,000 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. Research may be directed toward the objectives of a specific leg or to broader themes.

Proposals and applications for "shorebased research" should be submitted to the JOI office for the following deadlines: 11/15/96 and 4/15/97. Shorebased research may be based on any DSDP or ODP leg. The next "shipboard research" deadline is 4/15/97 and is for proposals based on future ODP legs 176 to 181.

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 (Andrea Johnson; Tel: 202-232-3900, ext. 213; Internet: ajohnson@brook.edu).

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AVALONIAN AND RELATED PERI-GONDWANAN TERRANES OF THE CIRCUM-NORTH ATLANTIC

edited by R. D. Nance and M. D. Thompson, 1996

Along the southeastern margin of the Appalachian-Caledonide orogen lies a collection of suspect terranes traditionally associated with the eastern (Avalonian/Gondwanan) margin of the early Paleozoic Iapetus ocean, but which record histories of Neoproterozoic subductions that predate the inception of the Iapetus cycle. Recent advances in our knowledge of these terranes have dramatically improved our understanding of Neoproterozoic tectonics and the Paleozoic evolution of the Appalachian-Caledonide orogen, and are proving central to the development of continental reconstructions for the critical Precambrian-Cambrian boundary interval. These advances are the result of the use of precise zircon geochronology and discriminative geochemical and isotopic studies, the application of sequence stratigraphy and faunal analysis to sedimentary overstep successions, and the interpretation of these data in terms of Neoproterozoic continental configurations and peri-Gondwanan paleogeography. This volume documents these aspects with examples from all parts of the belt.

SPE304, 398 p., indexed, paperback, ISBN 0-8137-2304-3, List price \$95.00, Member price \$76.00

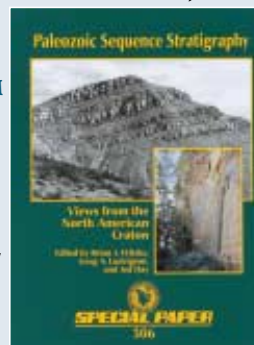


PALEOZOIC SEQUENCE STRATIGRAPHY: VIEWS FROM THE NORTH AMERICAN CRATON

edited by B. J. Witzke, G. A. Ludvigson, J. E. Day, 1996

Modern sequence stratigraphic ideas evolved in the petroleum industry during the 1970s and 1980s primarily from seismic investigations of Mesozoic-Cenozoic strata in basinal and continental margin settings. This volume refocuses on the Paleozoic cratonic heritage of sequence stratigraphy, with the additional perspectives from adjoining continental margins and foreland basins. Individual contributions evaluate a variety of stratigraphic, sedimentologic, diagenetic, geochemical, and paleontological problems within the common theme of sequence stratigraphy and depositional cycles. The authors adopt or adapt modern sequence stratigraphic concepts to varying degrees, and some examine the applicability of standard sequence stratigraphic terminology and paradigms to their Paleozoic examples. This volume covers topics spanning the Cambrian through the Permian, and provides a diversity of views focused within the North American craton.

SPE306, 452 p., indexed, ISBN 0-8137-2306-X, List price \$115.00, Member price \$92.00

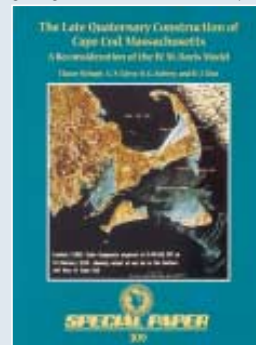


THE LATE QUATERNARY CONSTRUCTION OF CAPE COD, MASSACHUSETTS: A RECONSIDERATION OF THE W. M. DAVIS MODEL

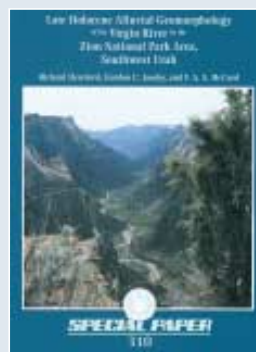
edited by E. Uchupi, G. S. Giese, D. G. Aubrey, and D.-J. Kim, 1996

The authors of this reconstruction of the geologic history of Cape Cod and southeast coastal Massachusetts support W. M. Davis's contention that Cape Cod was formed by glacial deposition during the late

Pleistocene and by marine and eolian processes since. However, their geological reconstruction of Cape Cod varies from that of Davis: they



believe that the glacial lower cape extended east of its present shore for nearly double Davis's estimate and that it took more than twice the time Davis estimated to attain its present form. Davis also inferred that all detritus eroded on the east side was transported northward to create the Provincetown Hook, whereas Uchupi et al. propose that prior to 9500 years ago this material was transported southward to fill a depression at the cape's elbow; only during the past 6500 years was the material transported northward to form the hook. 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, have



played a significant role in creating the present morphology of Cape Cod.

SPE309, 70 p., paperback, ISBN 0-8137-2309-4, List price \$30.00, Member price \$24.00

LATE HOLOCENE ALLUVIAL GEOMORPHOLOGY OF THE VIRGIN RIVER IN THE ZION NATIONAL PARK AREA, SOUTHWEST UTAH

by R. Hereford, G. C. Jacoby, and V. A. S. McCord, 1996

The Virgin River, in the spectacular canyons of Zion National Park near

the southwest margin of the Colorado Plateau, is well suited for geomorphic research; it has a relatively wide alluvial valley and is free flowing, retaining the presettlement discharge regime. The research described in Special Paper 310 focused on how variations of water and sediment load modify valley morphology. A specific goal was understanding the timing and causes of arroyo cutting—the catastrophic, widespread degradation of stream channels in the southwest United States beginning in the late 1800s. Large-scale surficial geologic maps portray the terraces and alluvial deposits. Dated by archaeological context and by tree-ring methods, these deposits correlate in time with dated late Holocene alluvium of other streams on the southern Colorado Plateau. Relocated historic photographs show the channel before, during, and after arroyo cutting. Dendrohydrologic reconstruction of streamflow demonstrates that arroyo cutting occurred during unusually wet climate with large floods and was preceded by an interval of very dry climate. SPE310, 46 p., paperback, ISBN 0-8137-2310-8, List price \$25.00, Member price \$20.00

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