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## Distributed, Active Extension in Bransfield Basin, Antarctic Peninsula: Evidence from Multibeam Bathymetry

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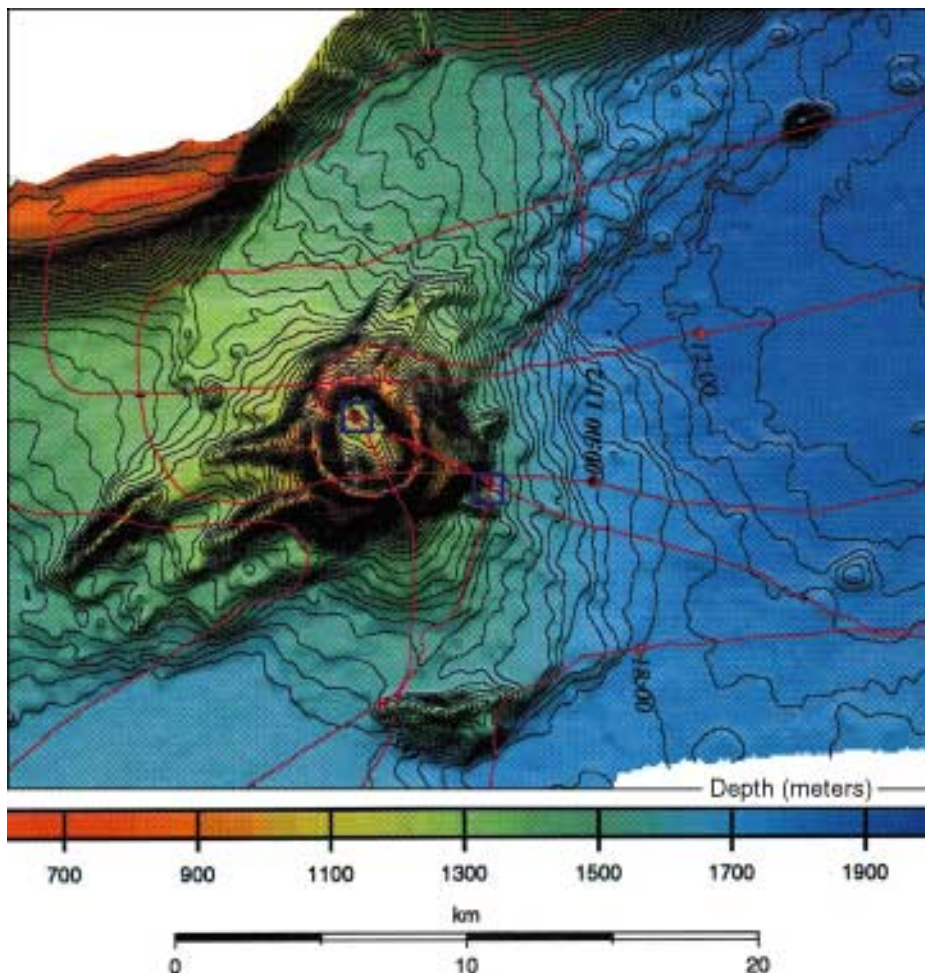
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### ABSTRACT

Bransfield basin, a marginal basin off the west coast of the northern Antarctic Peninsula, lies in a unique tectonic environment with a basement of Paleozoic to Mesozoic accretionary wedge material. Although active subduction occurred during most of the past 200 m.y., it stopped or slowed dramatically at about 4 Ma when the Phoenix-Antarctic spreading center was abandoned offshore, leaving a small remnant of the former Phoenix plate incorporated in the Antarctic plate. Even though geochemical data indicate that unaltered basalt dredged from Bransfield basin is like midocean ridge basalt, there is no clear evidence for normal seafloor spreading. In November 1995, *RVIB N.B. Palmer* spent three weeks mapping the seafloor in Bransfield basin and searching for hydrothermal activity. The multibeam bathymetric chart of the Central Bransfield basin shows submarine volcanoes and striking, lineated seafloor features that dredging indicated were vesicular basalt. The chemistry of the rocks, combined with high heat flow and evidence for active hydrothermal circulation, strongly suggests present-day extension. At least four parallel zones of linear extrusions can be seen in the multibeam data. Whereas the bathymetry provides new insight into the mode of extension in the basin, it does not explain why or



**Figure 1.** Detail of a Seabeam 2112 multibeam bathymetric chart of Bransfield basin (Antarctic Peninsula) showing Volcano Orca (González-Ferrán, 1991). The shallow shelf of the South Shetland Islands is to the upper left. The contour interval is 25 m; depths, in meters, are indicated in the color bar. Deepest values are just greater than 1900 m; shallowest are slightly less than 600 m. The red lines show the ship-track; the one station indicated in the center of the caldera is where the Oregon State University instrument sled was lowered but no evidence of hydrothermal venting was found. Three dredges (see Plate 1, center spread in this issue, for locations) recovered vesicular glassy basalts from this feature (Keller, 1996). Note the northeast-southwest-trending bathymetric steps that intersect the volcano. Radial dikes appear to extend from the volcano and curve into approximate alignment normal to the regional extensional field, particularly immediately to the west of the volcano. In the upper right-hand corner, there appears to be a small volcanic feature about 100 m high that is directly on line with the northeast-southwest trend of the bathymetric steps. The 200-m-high feature at the bottom of the figure is at a distinct angle to the overall northeast-southwest trend.

how extension is occurring. The evidence strongly supports active extension in accretionary wedge-derived continental crust that produces linear cracks that leak magma. The present extensional regime may lead to seafloor spreading, but the thickness of the crust

in Bransfield basin suggests that normal seafloor spreading is yet to occur and any attempt to correlate magnetic anomalies is premature.

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### INTRODUCTION

The origin of Bransfield basin has intrigued researchers for many decades (summarized in Barker and Dalziel [1983] and Lawver et al. [1995]), because the more we learn about its structure and morphology, the more difficult it is to postulate a simple model to explain its tectonic evolution. Subduction has occurred along the southern South America–Antarctic Peninsula margin for most of the past 200 m.y. (Tanner et al., 1982; Barker and Dalziel, 1983; Pankhurst, 1983), which has led some to surmise that Bransfield basin formed as a back-arc basin. Young basalts erupted in Bransfield basin have compositions similar to basalts from back-arc basins in the western Pacific (Keller et al., 1996), so this might not be an unreasonable assumption. In contrast, though, geophysical data (Guterch et al., 1992; Grad et al., 1993) indicate that the crust beneath Bransfield basin is far thicker than that produced by seafloor spreading.

Bransfield basin does not overlie a typical continental cratonic margin; the northern Antarctic Peninsula basement seems to consist of a Paleozoic to Mesozoic accretionary wedge (Dalziel, 1984) that was originally the outboard margin of southern South America during the early Mesozoic. Complicating a simple subducted-slab–back-arc basin story is the fact that the last sections of the Phoenix–Antarctic spreading center ceased spreading at about 4 Ma and now lie abandoned to the northwest of Bransfield basin (see inset, Plate 1, center spread, p. 16–17) (Barker, 1982). The last remnant of the Phoenix plate was incorporated into the Antarctic plate at that time, and subduction at the South Shetland Trench (Plate 1) slowed dramatically but is apparently still active (Barker and Austin, 1994). Exactly how and why active extension now occurs in this unique setting remains a mystery (Lawver et al., 1995). Multibeam bathymetric data (Plate 1 and Gracia et al.,

1996) give us visual clues to the mode of active extension, if not the reason for extension.

### TECTONIC SETTING: NOT A "NORMAL" BACK-ARC BASIN

The magmatic record of the northern Antarctic Peninsula (Graham Land) suggests that subduction of Pacific oceanic crust extended back to at least 200 Ma (Pankhurst, 1983). During the Early Jurassic and possibly throughout the Triassic, the Antarctic Peninsula was located outboard of the southern end of South America (Grunow et al., 1992). Only in the Late Jurassic did the peninsula rotate away from southern South America (Lawver et al., 1992; Cunningham et al., 1995). In the vicinity of Bransfield basin, there is no direct evidence of any Precambrian basement below the Paleozoic to Mesozoic accretionary prism (Dalziel, 1984). To the southwest, some crystalline basement does crop out (Storey and Garrett, 1985), but that is south of 70°S and sufficiently far from Bransfield basin to not be pertinent (Barker et al., 1991). Dalziel (1984) categorized northern Peninsula basement rock as either products of subduction-related accretion (for the metamorphic rocks), or sedimentation in a fore-arc environment along the Pacific margin. Lithology of the regional basement rocks indicates that the metamorphic rocks represent pelagic and volcanic material from the ocean floor tectonically interleaved with slices of oceanic lithosphere. The sedimentary strata, consisting of graywacke and shale of turbidite facies associated with rare mafic pillow lava, were deposited partly in trench-slope basins within the zone of active deformation in the accretionary wedge.

Island-arc volcanism along the South Shetland Islands may have been episodic, with maxima at 130–110 Ma, 90–70 Ma, 60–40 Ma, and finally at 30–20 Ma (Pankhurst and Smellie, 1983; Birkenmajer et al., 1986). There is no arc-related magmatism in the South Shetland Islands much younger than 20 Ma, which Barker

(1982) ascribed as a consequence of the subduction of young oceanic crust. We know from major plate motions (Lawver et al., 1995) that subduction must have continued at the South Shetland Trench from 20 Ma to at least 4 Ma, even though there was no apparent island-arc volcanism during that period. The Phoenix-Antarctic spreading center collided with the subduction zone along the Peninsula to the southwest of Bransfield basin (Plate 1), the last section having been subducted at about 4 Ma (Barker, 1982). Recently active, non-island-arc volcanism is evident in Bransfield basin (Smellie, 1990), both Deception Island (recent eruptions in 1967, 1969, and 1970) and Bridgeman Island (numerous reports of fumarolic activity between 1821 and 1880) being the two main volcanic features (Plate 1).

Seismic reflection data in Bransfield basin have been reported by several different groups as summarized by Barker (1976), Gamboa and Maldonado (1990), the GRAPE team (1990), Larter and Barker (1991), Acosta et al. (1992), and Barker and Austin (1994). The seismic reflection work, as well as continuing active seismicity (Pelayo and Wiens, 1989) confirm that Bransfield basin is undergoing extension. Barker and Austin (1994) addressed the question of the mode of extension by showing multichannel seismic reflection results that document active northwest-southeast extension along several axes. They suggested that some of the normal faults they see in the seismic reflection data are the result of linear subbottom intrusions.

Magnetic anomaly profiles across Bransfield basin produce a strong positive magnetic anomaly over the linear extrusive features. The first paper to discuss magnetics in the Bransfield basin (Roach, 1972) correlated the major positive anomaly with the Central Anomaly (0.7 Ma to present), and suggested that seafloor spreading took place over the past 1.4 Ma. González-Ferrán (1991) concluded, on the basis of aeromagnetic data from Bransfield basin, that rifting produced 5 to 15 km of extension during the past 2 m.y. and gave a total spreading rate of 2.5–7.5 mm/yr. Gracia et al. (1996) gave a maximum age of seafloor spreading of 0.7 Ma and a rate of 0.83 mm/yr total spreading rate.

Heat-flow profiles taken on two earlier cruises (Nagihara and Lawver, 1989; Lawver et al., 1995) yielded 63 measurements, of which 16 were greater than 220 mW/m<sup>2</sup> and one was 626 mW/m<sup>2</sup>. Such high heat-flow values combined with large variability suggest that active hydrothermal circulation is present in Bransfield basin. On a *Palmer* cruise in March 1993, eight dredge hauls were made on bathymetric highs in Bransfield basin, including the northern end of Edifice D (Gracia et al., 1996), which we call the Three Sisters (Plate 1) (named after the Three Sisters

volcanoes in the Cascade Range of Oregon). Keller et al. (1996) found that dredge D1 from the northeastern end of the Three Sisters recovered fresh, glassy vesicular basalt with a chemistry similar to that of the Lau Basin, a “standard” Pacific backarc basin (Hawkins, 1995). Both D1 and the three dredges (D2–D4) from the submarine volcano shown in Figure 1 (Orca Volcano of González-Ferrán, 1991), have low <sup>87</sup>Sr/<sup>86</sup>Sr and high <sup>143</sup>Nd/<sup>144</sup>Nd ratios, similar to depleted upper mantle values of mid-ocean ridge basalt (Keller et al., 1996). These same samples have some of the highest <sup>206</sup>Pb/<sup>204</sup>Pb values found in the Bransfield basin but are still within the range of mid-ocean ridge basalt (MORB). The unaltered basalts show a 0.5% to 2% mixing of subducted sediment with a depleted mantle source, but it is not known whether the sediment component is from the recently subducted Phoenix crust or is contributed by the accretionary wedge basement of Bransfield basin.

## DATA COLLECTION

In November 1995, *R/V B. Palmer* spent three weeks in the vicinity of Bransfield basin using the Seabeam 2112 multi-beam system to map the seafloor and the Oregon State University (OSU) instrument package to look for evidence of hydrothermal venting. The OSU package included a direct-wired CTD (conductivity-temperature-depth) transmissometer, nephelometer, turbidity meter, backscatter sensor, flow-through chemical sensor, 12-bottle rosette, altimeter, and an attitude module to determine tilt, pitch, and heading of the package (Klinkhammer et al., 1995). The high but variable heat-flow data (Nagihara and Lawver, 1989; Lawver et al., 1995) made us confident that we would locate active hydrothermal vents in the central Bransfield basin. Initially, sea-ice conditions dictated that the hydrothermal vent search should concentrate on the bathymetric highs that protrude above the reasonably flat-lying sediments and not at the site of highest heat flow. Bathymetric surveying occupied 10 to 12 hours per day and station work the remainder. For base maps, we used the GPS-controlled bathymetric map of Klepeis and Lawver (1994, 1996), which was a mixture of multibeam Hydrosweep coverage from *R/V Ewing 91-01* and single-beam coverage from *R/V Polar Duke* cruises. We also had a preliminary copy, thanks to Miquel Canals, University of Barcelona, of the Simrad multi-beam bathymetric map produced during the GEBRA 93 cruise (Gracia et al., 1996).

The ice-clogged waters of Bransfield basin not only limited our exploration capability, but also made systematic surveying difficult. Stopping for stations and returning to sites of interest as well as avoiding sea ice resulted in an erratic ship track and a “patchwork quilt” of data

acquisition, with some redundancy. At the redundant localities there was excellent bathymetric agreement, particularly when water-temperature profiles were used to calculate accurate sound velocities. Water-temperature profiles were taken from expendable bathythermographs (XBTs) and from frequent CTD casts. The CTD data were far superior to the XBT data; water temperature at depths between 100 and 400 m resulted in velocity differences of up to 10 m per second. While normal-incidence bathymetric data will give good relative depth results using standard water-velocity corrections, bathymetric data collected at low angles of incidence are highly dependent on temperature variations in this stratified water column. The multibeam bathymetry was recalculated using appropriate velocity models, and the final map (Plate 1) was made using the GMT (Wessel and Smith, 1995) gridding and plotting program. Small gaps in the data were interpolated to produce a nearly seamless map. The gridding program did produce extrapolated data along the edge of the mapped region that extends up to 1 km beyond the real data. These artificial data are most apparent as the “sidewalk” along the South Shetland Islands edge of the mapped region (Plate 1). Once the grid file for the region was created, it was subsampled to produce smaller scale maps that were used to navigate the OSU instrument sled within regions of suspected hydrothermal vent sites.

## MULTIBEAM BATHYMETRY OF THE CENTRAL BRANSFIELD BASIN

We concentrated our survey along the South Shetland Islands side of the basin (Plate 1) because most of the significant bathymetric features are there. The tectonic map of the Scotia Arc (British Antarctic Survey, 1985) suggested that the abrupt bathymetry of the South Shetland Island side of the Bransfield basin is a normal fault, and we found slopes as steep as 22° immediately north of the submarine volcano, Orca Volcano (Fig. 1). The steepest slope (>31°) was on the south wall of the submarine volcano, Orca Volcano, rising almost 600 m in <1 km. The southeastern slope of the Bransfield basin toward the Antarctic Peninsula is at most a few degrees, except in the vicinity of the scarp at 62°18'S, 57°45'W (Plate 1) which is controlled by a subsurface intrusion (Barker and Austin, 1995).

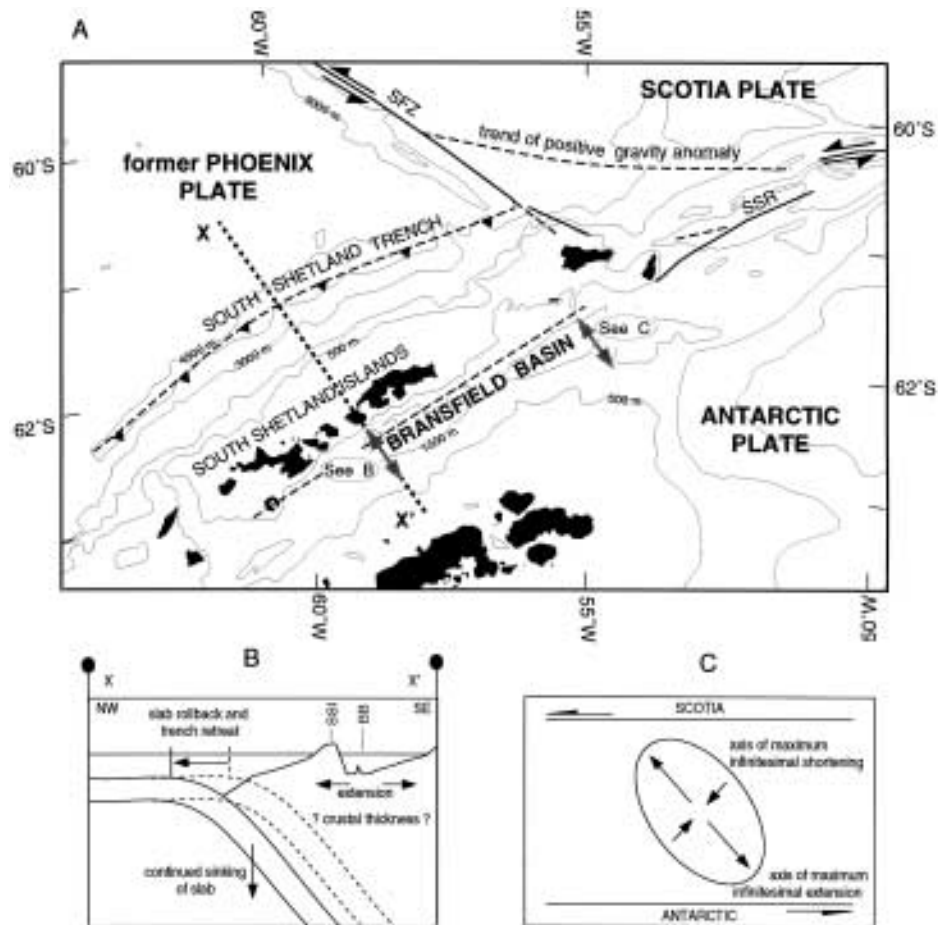
The shipboard gravity data (Ghidella and Holik, 1995) are shown in the upper-left corner of Plate 1. Free air gravity values for Bransfield basin are relatively uniform and correlate with water depth, with the exception of the major volcanic features. Bridgeman Island (62°S) divides the Central Bransfield basin from the deeper

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Eastern Bransfield basin. Deception Island (63°S) produces a gravity high that also spans the width of the Bransfield basin, although its amplitude is smaller than that of Bridgeman Island. Orca Volcano does not have a basin-spanning gravity anomaly, but it has a high amplitude locally because some of the lowest gravity values are found immediately to the southwest of Orca Volcano. Although not as prominent as either the Bridgeman or Deception Island anomalies, the gravity anomaly of the Three Sisters structure extends parallel to the basin-spanning anomalies of the two islands. Edifice A of Gracia et al. (1996) produces a large gravity anomaly in its immediate vicinity comparable to that of Orca Volcano. Although larger than that of the Three Sisters, this anomaly does not span the basin and is oriented more nearly east-west than the other three northwest-southeast basin-spanning anomalies. The zone of subsurface extension recognized by Barker and Austin (1994) at 57°30'W is apparent on the shipboard gravity as well as on satellite gravity data (Sandwell and Smith, 1992). There is a gap in the gravity signature between Edifice F (Gracia et al., 1996) and Bridgeman Island. No gravitational evidence was found for the bathymetric levels suggested by Gracia et al. (1996), and the parallel morphologic steps suggested by them are not seen in our bathymetric data. The changes in depth from shallower near Deception to deeper near Bridgeman Island possibly result from regional doming (uplift) in association with the largest submarine edifices, particularly Edifice A and the Three Sisters. The doming produces cross-basin dams that trap the principally volcanic-ash-derived sediment produced during eruptions of Deception Island.

Edifice A is a particularly interesting seafloor structure at 62°52'S, 59°52'W (Plate 1). Gracia et al. (1996) suggested that it was originally a circular submarine volcano subsequently split apart by a linear extrusion that extends from 59°36'W to 60°05'W parallel to the basin's long axis. In fact, the "split" structure is really circular (a 5.2-km-diameter circle can be laid on the remnants of the crater wall), and the entire volcano is about 16 km in diameter at its base. It is more likely that the linear ridge (extrusion) predates or was coincident with formation of the conical volcano.

Orca Volcano (Fig. 1) is also a nearly circular submarine volcano. It may have erupted with radial dikes preferentially aligned with the regional northwest-southeast extensional field (Barker and Austin, 1994). Although a straight line on the mercator projection of Plate 1 connects the center of the Deception Island caldera with Orca Volcano and with



**Figure 2.** A: The regional extension field in Bransfield basin. B: A cross-sectional view of the continued sinking of the "frozen in place" slab that may produce horizontal extension in Bransfield basin. Extension in the Eastern Bransfield basin may result from major plate interaction between the Scotia and Antarctic plates that are now in the process of reorganizing in the wake of the demise of the Phoenix-Antarctic spreading center (Klepeis and Lawver, 1996). C: The stress field (plan view). SFZ = Shackleton Fracture Zone; SSR = South Scotia Ridge. This figure is adapted from Klepeis (1993).

Bridgeman Island, this alignment does not necessarily imply that these eruptive centers identify the zone of most recent extension. That zone instead seems to lie even farther to the southeast (Barker and Austin, 1994) and may in fact lie to the southeast of the zone of active hydrothermal venting indicated by temperature and suspended-particle anomalies, that were found along the central axis of the Three Sisters, at the southwest extension of the Three Sisters, and at Edifice F (Klinkhammer et al., 1995). A line between those two structures overlies the area of highest heat flow found at 62°18.5'S, 57°42'W (Lawver et al., 1995). This leads us to suggest that magma at depth is preferentially directed to Deception Island and Bridgeman Island. On the basis of gravity data, these islands, and to a lesser extent Orca Volcano, have deep roots. It appears that the most active zone of extension and magmatic activity has shifted to the southeast and is aligned with the Three Sisters, Edifice F, and the zone of highest heat flow. Subsurface extension seen in the multichannel seismic reflection data (Barker and Austin,

1994), the scarp at 62°18'S, 57°45'W (upper left inset of Plate 1) and various small features to the east of Edifice F may mark the zone of the next linear extrusion.

### EVIDENCE FOR EXTENSION WITHOUT SEAFLOOR SPREADING

What we see recorded in the multi-beam bathymetric data may be tectonic processes occurring in a unique environment. Unlike western Pacific back-arc basins (Taylor and Natland, 1995), Bransfield basin is an actively extending former accretionary wedge (Storey and Garrett, 1985) without a currently active seafloor spreading center offshore. There are very few examples on Earth of a spreading center, in this case the former Phoenix-Antarctic spreading center, ceasing to spread and leaving the nearby subducted slab "frozen in place" (Lawver et al., 1995). Normally the spreading center is active until it is subducted and the slab is free to sink into the mantle. A possible analog to the Bransfield basin situation is the west-

ern United States where the subducted slab is anomalously shallow under the extending Basin and Range. Although the lower plate may be gradually sinking below Bransfield basin, it is not free to continue subduction into the mantle (Fig. 2). Therefore, any subduction now occurring at the South Shetland Trench may simply be the result of trench rollback caused by oceanward movement of the South Shetland Islands block. Where the former Phoenix-Antarctic spreading center was subducted immediately to the southwest of Hero fracture zone (Plate 1), the detached descending slab leaves a "slab window" behind (Hole et al., 1991; Hole and Larter, 1993). The only deep earthquakes reported below Bransfield basin (Pelayo and Wiens, 1989) are either related to the present-day volcanic activity, particularly below Deception Island and Bridgeman Island, or are possibly related to tearing along the subducted part of the Hero Fracture Zone (Plate 1, lower right) where the former Phoenix-Antarctic spreading center to the southwest was subducted and the remainder of the former Phoenix plate, now partially below the South Shetland Islands, remains unable to detach and slide into the mantle (Lawver et al., 1995).

Seabeam 2112 multibeam bathymetric charts illustrate episodes of northwest-southeast extension in Bransfield basin, with at least four or more nearly parallel cracks leaking vesicular basalt magma to the seafloor. We believe that there is no evidence in Bransfield basin for seafloor spreading as commonly defined in either a back-arc basin or a mid-ocean ridge sense. Extension is occurring, but the long, linear magmatic intrusions observed at the seafloor are probably filling extensional cracks produced by stretching the Paleozoic to Mesozoic accretionary wedge material. The 5 to 15 km estimate of extension of González-Ferrán (1991) is consistent with the amount of intrusive material observed from multichannel seismic reflection data. The volcanic extrusions produce a large positive anomaly, because the vesicular basalt is chilled at the surface and the present-day magnetic field signal is frozen into it. Even so, the 5 to 15 km of extension may have begun at the time of cessation of spreading on the Phoenix-Antarctic Ridge (4 Ma) or may have begun prior to that time. Since subsurface intrusions do not have an induced magnetic field (Lawver and Hawkins, 1978), it is futile at this time to attempt to suggest a spreading rate for Bransfield basin.

Evidence suggesting hydrothermal venting was found along three of the seafloor highs. It was not found in the submarine Orca Volcano, which leads us to think that Orca Volcano is older than it appears. No evidence for splitting of volcanic calderas by regional extension was observed, and it is most probable that

Orca Volcano and the supposedly split Edifice A are in fact the last stage eruptive activities along their linear rift structures rather than initial ones. Extensional activity seems instead to be shifting to the southeast, as suggested by Barker and Austin (1994).

Opening of Bransfield basin is not produced by typical back-arc basin extension of the type that involves active spreading processes and subduction. No active arc exists, nor is there a subducted slab sliding into the mantle, opening a "slab-window" as was the case along the Antarctic Peninsula to the south (Hole and Larter, 1993) and to the north along the South American margin in southern Patagonia (Ramos and Kay, 1992). Instead, as shown in Figure 2C, the slab is pinned and the plate reorganization resulting from the cessation of spreading at the Phoenix-Antarctic spreading center may be producing stresses (Fig. 2B) that, combined with the effect of vertical slab sinking (Fig. 2C) result in slight trench rollback and a minor amount of extension, almost cracking, that allow linear magmatic intrusions to be emplaced into an extended continental margin.

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## Ethics in the Geosciences

A Geological Society of America Presidential Conference, "Ethics in the Geosciences," will be held July 16–21, 1997, at the Resort at the Mountain, Welches, Oregon, on the flanks of Mount Hood. Cosponsors are GSA and the American Association of Petroleum Geologists.

### Purpose and Goals

Unethical conduct and practices are increasing within the geoscience and other scientific communities. Such unethical practices include, but are not limited to, falsification of data, deliberate misrepresentation of qualifications and/or professional registrations, plagiarism, and willful misrepresentation of scientific knowledge in research or to accommodate a client or legal position. This conference will address the complex issues of ethical behavior by providing a forum for input and discussion of ethics and the geosciences among professionals in the disciplines.

GSA Presidential Conferences operate under Penrose Conference guidelines. The presentation format includes keynote addresses, panel discussions, ad hoc working groups, and poster sessions. As an exception to the Penrose format,

participants are allowed and encouraged to disseminate information after the conference.

The primary goals of the 1997 conference are (1) to promote a dialogue within the geosciences community on ethical issues—issues that are not currently a part of the geoscientist's typical education or professional experience; and (2) to develop a framework for assembly and dissemination of information on ethical issues within the geoscience community. Discussions will focus on:

- identification of the types of ethical systems;
- cultural controls on ethical behavior (conflict of ethical systems);
- case histories of ethics violations or perceived violations;
- professional certification, licensing, registration, and enforcement as applied to an ethical framework;
- legal protection associated with enforcement;
- existing codes of ethics from various professional societies and organizations;
- means of instilling and fostering ethical behavior.

This conference will assemble an interdisciplinary group of participants who will serve as catalysts within the geosciences community in the promotion of ethical behavior. The conference topic—"Ethics in the Geosciences"—is an issue that geoscientists need to address and debate in order to create an effective interface between geology and the public. (Indeed, a requirement for a Presidential Conference is that topics must focus on the interface between geology and the public.) Anticipated results of this conference are:

- establishment of increased and more productive communication between geoscientists and behavioral scientists;
- creation of a focus on ethical issues and concepts that can be readily disseminated to the geoscience community;
- identification of methods for fostering and promoting ethical practices;
- development of an agenda for follow-up and future action;
- preparation of guidelines for developing a uniform code of ethics for consideration and adoption by the geoscience community.

### Conference Participants

The conference will be limited to 100 participants. Of this number, about 75% will be geoscientists, and the balance

*Ethics continued on p. 7*

### Bathymetry continued from p. 5

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Each month, *GSA Today* features a short science article on current topics of general interest. For guidelines on submitting an article, contact *GSA Today* Science Editor S. M. Kay, Cornell University, (607)255-4701, fax 607-254-4780, E-mail: kay@geology.cornell.edu.

(including most invited key participants) will include social scientists, political scientists, attorneys, judges, planners, and journalists. Participants will represent the academic, governmental, and industrial sectors. Participants should share a primary interest in identifying areas in need of ethical standards and should have the ability or position to effectively disseminate and implement concepts that evolve from the conference.

### Conference Schedule

Technical sessions will be held each morning from 8:00 a.m. until noon beginning on July 17. In addition, technical presentations and/or discussions will be held from 1:30 to 5:30 p.m. on the first and third days and from 7:00 to 9:30 p.m. on the second and fourth days of the conference. Nonscheduled times will allow for informal discussions, ad hoc group meetings, planning sessions, or recreation.

### Conference Conveners

The principal convener is **David Stephenson**, past president of GSA (1994–1995), South Pass Resources, Inc., 11259 E. Via Linda, Suite 100-949, Scottsdale, AZ 85259, (602) 948-7171, fax 602-948-7205, E-mail: sprigeo@aol.com.

The co-principal convener is **Pete Rose**, president of the Division of Professional Affairs, American Association of Petroleum Geologists, 711 West 14th St., Austin, TX 78701, (512) 480-9970, fax 512-473-2240, E-mail: prrose@onr.com.

Co-conveners of the conference are **Richard Grauch**, U.S. Geological Survey, M.S. 973, Denver Federal Center, P.O. Box 25046, Denver, CO 80225, (303) 236-5551, fax 303-236-3200, E-mail: rgrauch@helios.cr.usgs.gov; and **Tom Holzer**, U.S. Geological Survey, M.S. 977, 345 Middlefield Road, Menlo Park, CA 94025, (415) 329-5637, fax 415-329-5163, E-mail: tholzer@isdmnl.wr.usgs.gov.

### Applications

Persons interested in participating in this conference should submit a letter of application that includes a statement of interest in the conference topic, a confirmation that attendance would be for the full duration of the conference, and the subject of any proposed poster presentation. **Deadline for applications is February 15, 1997.** Send letters of application to Heidi Horten, South Pass Resources, 11259 E. Via Linda, Suite 100-949, Scottsdale, AZ 85259. The conference fee, which includes lodging, food, and transportation to and from the Portland airport, is expected to be approximately \$725. Direct inquiries and questions to any of the conveners at the above addresses. Invitations to participate will be mailed by March 15, 1997. ■

## CALL FOR NOMINATIONS REMINDERS

### PENROSE AND DAY MEDALS, AND HONORARY FELLOWSHIP

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

### YOUNG SCIENTIST AWARD (DONATH MEDAL)

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

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

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

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

### OFFICERS AND COUNCILORS

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

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

### DISTINGUISHED SERVICE AWARD

The GSA Distinguished Service Award was established by Council in 1988 to recognize individuals for their exceptional service to the Society. GSA Members, Fellows, Associates, or, in exceptional circumstances, GSA employees may be nominated for consideration. Any GSA member or employee may make a nomination for the award. Awardees will be selected by the Executive Committee, and all selections must be ratified by the Council. Awards may be made annually, or less frequently, at the discretion of Council. This award will be presented during the annual meeting of the Society. Deadline for nominations for 1997 is **MARCH 3, 1997.**

### JOHN C. FRYE ENVIRONMENTAL GEOLOGY AWARD

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

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

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

### NATIONAL AWARDS

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

Materials and supporting information for any of the nominations may be sent to GSA Executive Director, Geological Society of America, P.O. Box 9140, Boulder, CO 80301. For more detailed information about the nomination procedures, refer to the October 1996 issue of *GSA Today*, or call headquarters at (303) 447-2020, extension 140.

## MEMORIES ...

For full information on the 1997 GeoVentures, see December *GSA Today*.

# GEOVENTURES 1996

The 1996 GSA GeoVentures Program offered two programs unrelated to the annual or section meetings. The total of 53 participants, ranging in age from 24 to 75, represented a vast range of interests and backgrounds.

This educational program serves professionals who enjoy their geology and the company of other geologists in a field setting. GeoVentures are a special benefit created for members, but are open to guests and friends also.

GeoVentures is the overall name for adult educational and adventure experiences of two kinds: GeoHostels and GeoTrips. Both are known for superior scientific leadership. Fees for both are low to moderate (relative to the destination, length, time of year, and number of participants). GeoHostels are usually five-day, campus-based programs. GeoTrips are anywhere from one to three weeks in length, and the itinerary includes multiple destinations.

### GEOHOSTELS

## Geology of the Glacier Park Region

**36 PARTICIPANTS.**  
**JULY 20–25, 1996**

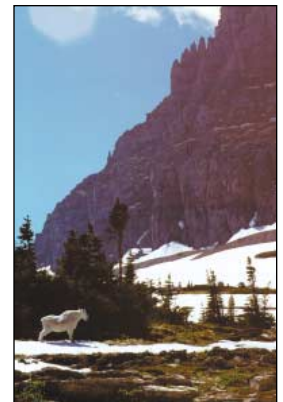
**Leader:** Rob Thomas,  
Western Montana College

*"Rob is an incredible leader—the best we have ever observed in action! Every stop was presented as an intriguing geologic problem. All sides of controversies were clearly and fairly presented,"* wrote Irene and Al Boland of Rock Hill, South Carolina.

*"Rob's presentations made it very interesting even for an 'armchair' geologist!"* wrote Ingeborg West of Mill Creek, Washington.



Glacier gang at St. Mary's Lake. Photo by Rob Thomas.



Logan Pass and Super Belt outcrop with goat. Photo by Janet Combes.

## Geology of the Wine Country in Western Oregon

**17 PARTICIPANTS. AUGUST 17–22, 1996**

**Leader:** Scott Burns, Portland State University

*"This was our second GeoHostel and we are looking forward to many more,"* wrote Pat and Ralph Scott of Red Bluff, California.

*"Scott did an excellent job. He gave a running commentary all day!"* wrote Dolores J. Gable, Arvada, Colorado.



Geology of the Wine Country gang at Crater Lake. Photo by Bill Elliott.

### 1997 Penrose Conferences

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

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

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



# GSA Grants Support Research

June R. Forstrom, Research Grants Administrator

## Grants for Graduate Students

The purpose of the general research grants program is to provide partial support of master's and doctoral thesis research in earth science for graduate students at universities in the United States, Canada, Mexico, and Central America. GSA strongly encourages women, minorities, and persons with disabilities to participate fully in this grants program. Applicants need not be members of GSA. Funding for this program is provided by a number of resources, including GSA's Penrose and Pardee endowments, the National Science Foundation, industry, individual GSA members through the GEOSTAR and Research Grants funds, and numerous dedicated research funds that have been endowed at the GSA Foundation by members and families.

Applications must be on current GSA forms available in geology departments in the United States and Canada, or from the Research Grants Administrator, GSA, P.O. Box 9140, Boulder, CO 80301-9140. Evaluations from two faculty members are required on GSA appraisal forms. The deadline is February 15 each year for grants awarded in April. In 1996, 534 proposals were received, 218 of them were funded. A total of \$349,625 was awarded.

## Specialized Grants

Recipients of special named awards are selected by the Committee on Research Grants from applicants to the general research grants program; the same application forms are used, and they must also be postmarked by February 15. It is not necessary for applicants to indicate that they wish to be considered for a specialized grant. The committee considers all qualified applicants when selecting recipients for special awards.

The Gretchen L. Blechschmidt Award supports research by women interested in achieving a Ph.D. in the geological sciences and a career in academic research, especially in the fields of biostratigraphy and/or paleoceanography, and who have an interest in sequence stratigraphy analysis, particularly in conjunction with research into deep-sea sedimentology.

The aim of the John T. Dillon Alaska Research Award is to support research that addresses earth science problems particular to Alaska, especially field-based studies dealing with the structural and tectonic development, and those that include some aspect of geochronology (either Paleontologic or radiometric) to provide new age control for significant rock units in Alaska.

The Robert K. Fahnestock Memorial Award is made annually to the applicant with the best application in the field of

sediment transport or related aspects of fluvial geomorphology.

The Lipman Research Award is to promote and support graduate research in volcanology and petrology in the western United States and Alaska.

The Bruce L. "Biff" Reed Award is for graduate students pursuing studies in the tectonic and magmatic evolution of Alaska and its mineral deposits.

The Alexander Sisson Award supports research for students pursuing studies in Alaska and the Caribbean.

The Harold T. Stearns Fellowship Award is awarded annually in support of research on one or more aspects of the geology of Pacific islands and of the circum-Pacific region.

## Division Grants

Seven of the 12 GSA divisions award grants for outstanding student research within the respective division's field of interest. The Committee on Research Grants will select candidates from the general research grant applicants for awards by the Engineering Geology, Geophysics (Allan V. Cox Award), Hydrogeology, Sedimentary Geology, and Structural Geology and Tectonics Divisions.

The Coal Geology Division awards the A. L. Medlin Scholarship Award and a Field Research Award to students who submit the best proposals of research projects in the field of coal geology. Guidelines are available from the Division secretary.

The Planetary Geology Division offers two Student Paper Awards in the field of planetary geology annually. Contact the division secretary: Cassandra R. Coombs, Department of Geology, College of Charleston, 66 George Street, Charleston, SC 29424-0001.

The Quaternary Geology and Geomorphology Division awards the J. Hoover Mackin and Arthur D. Howard Research Grants to support graduate student research on Quaternary geology or geomorphology. Applications are available from the division secretary, J. Steven Kite, Department of Geology and Geography, West Virginia University, P.O. Box 6300, Morgantown, WV 26506-6300. The deadline for applications is February 15, for grants awarded in April.

Four GSA divisions—Archaeological Geology, Geoscience Education, History of Geology, and International—do not currently award grants for student research.

## Section Grants for Undergraduate and Graduate Students

Recipients for graduate research grants from the South-Central Section are selected from applicants to the GSA general research grants program who are recommended by the Committee on Research Grants to the Management Board of the section for final selection. Eligibility is restricted to graduate students attending a college or university within the geographic area of the section.

The South-Central Section also awards grants to undergraduate students; applications are available from the section secretary, Rena M. Bonem, Department of Geology, Baylor University, P.O. Box 97354, Waco, TX 76798-7354. The deadline is October 15, for grants awarded in December.

The North-Central Section awards grants to undergraduate students within the geographic boundary of the section. For further information contact the section secretary, George R. Hallberg, University of Iowa Hygienic Laboratory, 102 Oakdale Campus, H101 OH, Iowa City, IA 52242-5002.

The Southeastern Section awards grants for both undergraduate and graduate GSA student members who are enrolled in institutions within the geographical boundaries of the section. Application forms can be obtained from the section secretary, Harold H. Stowell, Department of Geology, Box 870338, University of Alabama, Tuscaloosa, AL 35487-0338. The deadline is February 15 for grants awarded in April.

The Northeastern Section offers research grants for undergraduate students who are enrolled at institutions within the section and are Student associates of GSA. Contact the Section secretary, Kenneth N. Weaver, Maryland Geological Survey, 2300 St. Paul St., Baltimore, MD 21218, for application forms. Applications must be postmarked by February 7 for grants awarded in April.

The remaining two sections—Rocky Mountain, and Cordilleran—do not currently offer research grants. ■

## About People

GSA Fellow **Thomas J. Freeman, Jr.**, University of Missouri—Columbia, has been named a University of Missouri Distinguished Teaching Professor of Geological Sciences.

Fellow **Michel T. Halbouty**, Michel T. Halbouty Energy Co., Houston, Texas, has been elected a member of the Chinese Academy of Engineering.

The International Society for Reef Studies has awarded Fellow **Ian G. Macintyre**, Smithsonian Institution, Washington, D.C., its Darwin Medal.

Robert L. Fuchs

## Valerie G. Brown appointed Director of Development

Valerie G. Brown has joined the GSA Foundation staff as Director of Development, a newly created, permanent full-time position at GSA's Boulder headquarters. She will manage and coordinate the Foundation's fund-raising activities such as the Second Century Fund, annual campaigns, and planned giving. In this position, Brown will be handling much of the work of Foundation President Robert L. Fuchs, who is retiring in December but will continue as president on a reduced schedule during 1997.

The Director of Development position carries a wide range of responsibilities and duties. While direct solicitation of endowment, program, and planned gifts is generally thought of as the principal function, a broad range of activities makes up an effective development program. Such activities include publicity and public relations, creation of promotional materials, organization and supervision of volunteers, continuing donor relations, and research into potential sources of funding such as companies, institutions, and individuals. Grant writing in cooperation with other GSA departments such as SAGE and IEE is very important, and the results of this joint work are evident in the outside financial support that has been obtained

in recent years from the National Science Foundation, companies, and private foundations. Day-to-day staff management and administration round out the duties.

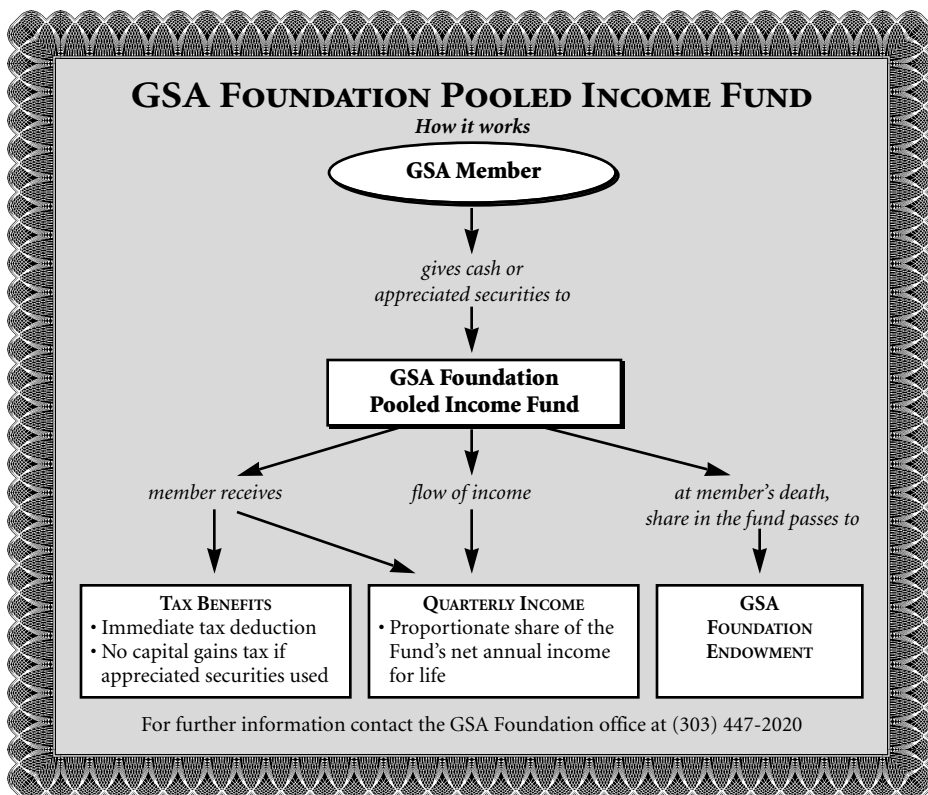
A Denver resident, Brown was employed by the University of Colorado Foundation, at the Health Sciences Center campus, first as director of grants and later as senior development officer. Over a 12-year period from 1984 she was engaged in a broad range of fund-raising, managerial, and administrative duties and was a key participant in a successful \$77 million capital campaign. Her work entailed close interaction with the doctors and scientists of this large medical facility. For the previous four years Brown was assistant director of development at the Craig Hospital Foundation in Englewood, Colorado.

Development work entails not only fund-raising, but also some knowledge of estate law, taxation, finance, and banking. Brown brings this added experience to the Foundation, for earlier in her career she was a personal trust officer at the former United Bank of Denver and has also been in the private practice of law. She has a B.A. degree from the University of Colorado and a J.D. degree from the University of Denver College of Law.



Valerie G. Brown

GSA Treasurer David E. Dunn was a principal proponent of establishing and filling the position of Director of Development. He said, "GSA will have a continuing need into the next millenium to raise money both from its members and from outside sources in order to protect the endowment from inflation and to continue funding all programs at appropriate levels. Since the Foundation was established in 1981, more than \$13 million of such additional money has been received, enabling GSA not only to undertake initiatives in education, environment, and public outreach, but also to increase its historical support of the science. This continuing need means that a development professional on GSA staff is essential. Valerie Brown brings to the Society and the Foundation just the right background and experience, and we are fortunate to have her at GSA." ■



## It's Really Not Too Early To ...

Think about maximizing your 1996 charitable deductions, and minimizing your income taxes. This has been a year of significant gains for many who have investments in stocks. Instead of selling shares and paying capital gains taxes on the appreciation, donate the actual shares to the Foundation. The value of your contribution will be the value of those shares on the day of the transfer. This is a particularly attractive and economic way to participate in the Foundation's Pooled Income Fund and build retirement income. The December GSAF Update will have more on year-end matters.

# Donors to the Foundation, August 1996

## Birdsall Award

Leonard Alton Wood\*

## Shirley Dreiss Memorial Fund

Jean M. Bahr  
Leonard F. Konikow

## J. Hoover Mackin Award

Dwight L. Schmidt

## Memorial Fund

Linda S. Potter  
*(in memory of my uncle,  
Howard Edwin Simpson,  
with love and gratitude to  
him)*

## Publications Fund

Richard A. Hoppin\*

## Bruce "Biff" Reed Scholarship

ARCO Foundation, Inc.\*  
Susan S. Reed\*

## SAGE

Jean M. Bahr  
Leonard F. Konikow

## Second Century Fund

Troy P. Bernier

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Pamela C. Burnley

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Leon T. Silver\*

## Unrestricted— Foundation

William S. Fyfe

Russell G. Slayback

## Unrestricted—GSA

Margaret S. Woyski

## Women in Science

Roger L. Duba

\*Century Plus Roster  
(gifts of \$150 or more).



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*Supporting The Advancement of Research*

GSA Foundation  
3300 Penrose Place  
P.O. Box 9140  
Boulder, CO 80301  
(303) 447-2020  
drussell@geosociety.org

- The gift annuity sounds interesting. Tell me more.
- How do I make a gift of stock to the Foundation?
- My pledge to the Second Century Fund is \$\_\_\_\_\_ per year for \_\_ years.
- Enclosed is my contribution in the amount of \$\_\_\_\_\_ for:
  - Foundation—Unrestricted     GSA—Unrestricted
  - The \_\_\_\_\_ program or fund.

### PLEASE PRINT

Name \_\_\_\_\_

Address \_\_\_\_\_

City/State/ZIP \_\_\_\_\_

Phone \_\_\_\_\_

## What on Earth is a Charitable Gift Annuity?

Most people are familiar with an annuity, which the dictionary defines as a sum of money payable yearly or at regular intervals. The charitable gift annuity, or simply gift annuity, can be defined the same way, but with a few added features and modifications that benefit both the annuitant and the Foundation.

Simplicity is a leading attribute of the gift annuity. The donor and the Foundation enter into a simple, one-page contract, the terms of which set an amount in cash or securities that will be donated to the Foundation in return for regular, lifetime, annuity payments to the donor. Gift annuities can be established for two individuals—donor and spouse, for example.

What benefits apply? The Foundation receives funds that are immediately added to its assets, subject, of course, to the contractual liability to make annuity payments. The donor receives a charitable deduction at the time of the gift, the amount determined by such factors as age and life expectancy, the size of the gift, applicable federal interest rates, and the planned annuity payment rate. The donor or designated beneficiary receives regular annuity payments for life. A spouse, child, or some individual other than the donor may receive the payments. A portion of the annuity payments are tax-free. Appreciated securities may be used to make the contribution, thereby deferring any capital gains tax over a period of years.

The annuity payment or payout rate warrants some further discussion. Generally, charities follow guidelines set by the

American Council on Gift Annuities in determining payout rates. Thus, for an individual age 70 the recommended rate is 6.9%. For every \$1,000 of contribution, the charitable deduction would be \$455 and the annuity payment would be \$69. Of this \$69, \$34.25 would be tax-free income each year. The "effective" payout rate is a different matter. Because of the tax attributes, this same 70-year-old would actually be enjoying a 9.4% effective payout rate in the 28% income tax bracket, increasing to 11.2% in the 39.6% bracket.

Gift annuities are quite flexible and can be set up in several ways: one-life donor annuitant; two-life joint and survivor annuitants; one-life lump sum or installment

payments; and others. A member was recently discussing with the Foundation the relative merits of contributing through the Pooled Income Fund or a gift annuity. It developed that he did not have an immediate need for the income, so a deferred gift annuity was the obvious solution. The annuity is set up now, but first payments will begin several years in the future, when the donor needs the income because of retirement. Interestingly, the delay creates two positive results—a larger current charitable deduction and a larger payout rate.

Please call or write the Foundation office to investigate how a gift annuity might apply in your own situation. ■

## In Memoriam

### William F. Barbat

Oakland, California  
August 16, 1996

### John Chronic

Tulsa, Oklahoma  
July 15, 1996

### Milford W. Goering

Aurora, Colorado  
August 31, 1996

### Walter W. Higgins

Chillicothe, Illinois

### Karl V. Hoover

Camp Hill, Pennsylvania  
February 1996

### Martin B. Lagoe

Austin, Texas

### Raymond T. Laird

Oakland, California  
June 27, 1996

### William A. Petersen

Green Valley, Arizona  
August 2, 1996

### Glenn W. Stewart

Union, New Hampshire

Edward E. "Dr. Ed" Geary, Educational Programs Coordinator



# The Earth and Space Science Technological Education Project (ESSTEP):

## An Opportunity for Teams of College and Secondary School Faculty to Make Effective Use of Computer-Based Technologies in Their Classrooms

The Geological Society of America, in collaboration with Cypress Community College and the Space Science Institute, has recently been awarded a three-year grant from the National Science Foundation to promote more effective use of computer-based technologies in secondary school and college science classrooms. Teams of educators and media specialists from grades 8 to 14 who teach science, mathematics, geography, or related fields will receive hands-on experience in state-of-the-art data acquisition, manipulation, and presentation technologies, experiment with innovative strategies for using technology in the field, classroom, and laboratory, have the opportunity to participate in internships with science and technology businesses, and gain access to a wide variety of technology-based education resources.

More specifically, ESSTEP will assist faculty in exploring ways that technologies such as the Internet, Geographical Information Systems, Global Positioning Systems, multimedia, image processing, CD-ROMs, and virtual reality can be used to enhance student learning, promote science and technology careers, and catalyze the development of new instructional modules and materials. Our goal is to create classrooms in which all students have the opportunity to increase their knowledge and appreciation of Earth's history, processes, and resources, while at the same time enhancing their problem-solving, creative thinking, analytical, and communication skills—the same skills that businesses and industries are looking for in their employees.

### THE PROBLEM

In the earth and space sciences, access to and effective use of computer, information, and remote sensing technologies are critical for students considering technical careers in environmental, natural hazards, land-use planning, and resource development fields. Currently, most secondary and undergraduate students do not have adequate exposure to or experience with these technologies. Many undergraduate faculty use computer and information technologies in their research, but there are few incentives and little time for fac-

ulty to effectively integrate these technologies into their courses (Massy and Zemsky, 1995). Despite evidence that students learn science more effectively when they are actively involved in doing science (e.g., American Association for the Advancement of Science, 1989), lecture-based instruction is still the most common teaching practice in undergraduate and secondary school classrooms. This type of instruction rarely provides the training and experiences for faculty or students to realize the potential inherent in doing science with these versatile technological tools (Committee for Economic Development, 1995). Even more disturbing, because of limited training opportunities, the vast majority of science teachers in secondary schools, even if they have access to good equipment and facilities, use technology to do traditional things faster (e.g., producing reports, delivering instruction), rather than using these tools to create more powerful educational experiences (Peck and Dorricott, 1994).

### PROGRAM OBJECTIVES

ESSTEP is designed to achieve the following objectives:

- *Increase faculty knowledge* of and access to computer, information, and remote sensing technologies so that they can better understand the potential uses and limitations of technology.
- *Enhance faculty expertise* in the use of technology including: the Internet, GIS, GPS, multimedia, and image processing, so that they gain hands-on experience and confidence using technology to teach and do research.
- *Encourage the development of dynamic, technology-rich learning environments* in undergraduate and secondary school science classrooms so that all students have opportunities to learn about and use technologies in their scientific investigations.
- *Improve faculty pedagogical knowledge and skills* with respect to integrated science-technology education, so that they can become more effective teachers and facilitators of student learning.
- *Promote faculty and student awareness* of the skills and knowledge needed to pursue careers and majors in the earth,

space, and environmental sciences, so that students are better prepared to make the transitions from school to college, and from college to work.

In addition, ESSTEP will strengthen interactions between college faculty and educators in grades 8–12, promote technology innovation in earth and space science education, and create a laboratory manual of computer-based earth and space science activities.

### PROGRAM PLAN

Over the course of four summers (1997–2000) ESSTEP staff will develop, implement, and assess a series of two- and one-week summer workshops for undergraduate and secondary school faculty. First-summer workshops will be two weeks, and second-summer workshops will be one week. Each ESSTEP workshop will have an average of 20 participants, and two separate workshops will be held each year.

Scientific investigations of real processes and problems will provide the contextual focus for workshop activities. Among the topics that have been proposed for investigation are: (1) hazardous waste disposal, (2) ground-water and surface-water contamination, (3) land-fill siting, (4) seismic and volcanic hazards assessment, (5) flooding-risk analysis, (6) planetary and solar processes, and (7) resource exploration.

During the time between the first and second summer workshops, project participants will develop and implement at least two integrative, technology-rich activities into their science curriculum. Project staff will assist participants with activity development and provide technical support throughout the project via an ESSTEP World Wide Web site. Beginning in year two and continuing through year four, project staff and a subset of ESSTEP participants will review, select, and edit the best classroom activities for inclusion in an ESSTEP laboratory manual.

ESSTEP staff and instructors will model and promote a constructivist approach to science education. Workshop activities will be inquiry-based and stu-

ESSTEP continued on p. 13

dent-centered. Topics will be introduced and developed using the learning cycle. The learning cycle is an instructional model that: (1) *engages* prior student knowledge, (2) lets students *explore* relevant, thought-provoking problems through hands-on investigations, (3) encourages students to develop, clarify, and construct meaningful *explanations*, and (4) challenges students to *extend and apply* their understanding of concepts and skills to different situations (Hackett, 1993). In ESSTEP workshops, students will be active learners, and instructors will be facilitators and coaches rather than dispensers of information. By modeling and discussing these pedagogical techniques we hope to encourage experimentation with new teaching practices in participant classrooms.

ESSTEP workshops will showcase best pedagogical and assessment practices and instructional modules from several exemplary science education projects and institutions. Collaborators include the Image Processing for Teaching program (University of Arizona), Astronomy Village (NASA Classroom of the Future), the Joint Education Initiative (University of Maryland), and Kids as Global Scientists (University of Colorado at Boulder). Additional instructors will come from Cypress and Navajo Community Colleges, Dakota State University, the University of Colorado at Boulder, the Colorado School of Mines, Pioneer High School in Ann Arbor, Michigan, and other institutions. Instructors will include undergraduate faculty from two- and four-year institutions, secondary school faculty, and practitioners from environmental, geotechnical, aerospace, and land-use fields.

## **ADDITIONAL ESSTEP COMPONENTS**

1. *Follow-up Support.* In the year between workshops, ESSTEP participants will be expected to integrate at least two technology-rich, ESSTEP-based units into their science curricula. To assist faculty with this task, ESSTEP staff will maintain regular E-mail contact with workshop participants. Project staff will also create a World Wide Web ESSTEP home page for participants and will enroll participants in the Geo-Ed listserv. The Web page and E-mail will function as a vehicle for sharing information and solutions to technical problems, while the Geo-Ed listserv will provide participants with interactive discussions of pedagogical techniques, curriculum issues, assessment strategies, and other topics. Project staff and instructors will also be available to participants by fax and by telephone. Voluntary follow-up meetings for ESSTEP participants will be held each fall and spring at the annual and one section meeting of the Geological

Society of America, and/or at a National Science Teachers Association meeting. During summer workshops, ESSTEP participants will have access to a wide variety of computer, information, and remote-sensing products. Some of these products will be made available to workshop participants during the academic year on a limited loan basis to support classroom activity development.

2. *ESSTEP Internships.* To provide ESSTEP participants with additional educational enrichment and professional development opportunities, ESSTEP has formed partnerships with several organizations, including the Colorado Alliance for Science and the very successful Industrial Initiatives for Science and Math Education (IISME) project in California. These organizations are part of a loose confederation of 26 organizations that provide Scientific Work Experience Programs for Teachers (SWEPT) (Horton, 1995) across the country. Key leaders from these organizations have agreed to use their existing structures to help us place ESSTEP participants in science-technology-research internships. ESSTEP-SWEPT internships will be designed to enhance faculty technical knowledge and pedagogical skills. Faculty will apply science and mathematical concepts and learn the approaches used in the modern workplace, such as team building and problem solving. The goal of these internships is to make classroom instruction more relevant and compelling to students. Typical internships will be for eight weeks in the summer, and will usually include a weekly stipend of several hundred dollars.

3. *Laboratory Manual.* During the four years of ESSTEP, participant teams will develop and field test a series of earth and space science technology investigations for grades 8–14. The ESSTEP Web site and the Journal of Geoscience Education will serve as dissemination and discussion vehicles for sharing and improving individual activities. The best activities, as delineated by project participants, staff, and the external evaluation team, will be published in an ESSTEP laboratory manual. The manual will be published in print or electronic form and disseminated via a commercial publisher. The National Association of Geoscience Teachers and the National Earth Science Teachers Association have agreed to assist us with development of the manual.

## **PARTICIPANT RECRUITMENT AND SELECTION**

Two-thirds of ESSTEP participants will be undergraduate faculty from two- and four-year institutions. Secondary school science teachers (grades 8–12) will com-

pose the final one-third of project participants. We have designed ESSTEP for faculty in grades 8–14 for three reasons. First, a 1993 matriculation study by the California State University system revealed that in the geosciences, over 60% of the California students who receive bachelor's degrees have attended a community college sometime during their undergraduate education. Second, with the recent publication of the National Science Education Standards (National Research Council, 1996) and revisions in many state science frameworks, faculty in grades 8–12 are searching for innovative ways to introduce earth and space science concepts and technology into their curricula. Finally, by bringing geographically proximal faculty together from different grade levels we hope to encourage better local curriculum articulation in grades 8–14.

Because the majority of geoscience majors have attended a two-year institution sometime in their academic career, *faculty from community college science, geography, and mathematics departments will be given priority during participant recruitment and selection.* ESSTEP will also target the recruitment of faculty teams from community colleges and secondary schools with high percentages of Native American students. The Council of Energy Resource Tribes, the American Indian Science and Engineering Society, the Utah–Colorado–Arizona–New Mexico (UCAN) Rural Systemic Initiative, Navajo Community College, and GSA's Committee on Minorities and Women will help us with this effort.

To enhance curriculum articulation and provide long-term support for project participants, faculty will be required to apply in teams of two to five and be from a single institution or a group of institutions within a local geographic community. Participants will also need to provide evidence of support by their host institutions for (a) student computer and Internet access, (b) some software and technical support (e.g., for a GIS), (c) release time for classroom activity development during and after the workshops, and (d) time to conduct their "mini" ESSTEP workshops. ESSTEP staff will work with teams from resource-poor institutions to identify alternative sources of equipment, software, and personnel support.

All ESSTEP participants will receive stipends (\$50/workshop day), subsistence (lodging and meals), and a variety of great workshop materials (e.g., texts, software, maps). In addition, teachers in grades 8–12 will receive travel assistance and college or professional development credit. In return, participants must commit to the project for two years. Between their first and second summer workshops, each participant will be asked to set aside

**ESSTEP** *continued on p. 14*

# Cincinnati Fossil Festival: Professional and Amateur Geologists Work Together To Celebrate the City's Fossil Heritage

Nigel C. Hughes, Geier Collections and Research Center, Cincinnati Museum Center, Cincinnati, OH 45202

There are few cities so fossiliferous that they have a series named after them, so when the Paleontological Society started looking for a venue to support the first Fossil Festival, Cincinnati was a natural choice. Being the first of its kind, the Cincinnati Fossil Festival was a test case for what may become a regular event, rotating among centers of exceptional fossil wealth throughout the country.

The focus of the festival, held in April 1996, was on public education, because the local fossils provide a dramatic tool for opening people's minds to Earth's history of environmental change. The concept that Cincinnati was under an ocean and 25° south of the equator when our rocks were muds on the seafloor is a powerful one, and the festival was designed to use the different strengths of amateur and professional paleontologists to increase public appreciation of local geology. The aim was to offer the public the thrill of using their own finds and minds to enter the world of Cincinnati in deep time. We wanted to offer people the wonder of cracking open a rock, seeing a fossil, and realizing that the last thing that looked at it was probably a trilobite, alive 450 m.y. ago.

Cincinnati's fossils have nurtured a distinguished list of paleontologists who began their careers as amateur collectors on the bluffs overlooking the town—Charles Schuchert, Ray Bassler, E. O.

Ulrich, and Dick Bambach, to name only a few. This tradition is continued today by the Dry Dredgers, the area's amateur fossil collectors society. To call some of its members "amateurs" is misleading—I use the term "nonprofessional professionals" for those who diligently record the data on their collections, publish their investigations in leading journals, and deposit their specimens in the public trust. They constituted a group of willing volunteers for the festival, in addition to paleontologists from area universities and colleges. Financial support from the Paleontological Society and augmented by generous donations from the Procter and Gamble Company,

the University of Cincinnati, and two local foundations, allowed us to mount a publicity campaign and to make sure that much of the festival was free of charge. Mailings were sent to more than 1,000 schools in the region, and flyers were placed in coffee shops, hotels, libraries, and bookstores.

## MUSEUM-BASED ACTIVITIES

The Fossil Festival opened with short talks, by professional and amateur paleontologists, on the Cincinnati area 450 m.y. ago. Discussions of the Ordovician world, dramatic photos of hurricanes like those responsible for the Cincinnati shellbeds, and descriptions of "Bad Days in the Ordovician" set the scene. The animals were introduced by focusing on modern analogs in an attempt to bring the fossils to life. Jack Kallmeyer, president of the Dry Dredgers, described the pleasure he finds in paleontology as a hobby, and his meticulous collecting has provided the

Fossil Fair continued on p. 15



Roger Cuffey demonstrates bryozoan feeding habits to a crowd at the fossil identification table, Cincinnati Fossil Festival.

## ESSTEP continued from p. 13

at least five days, during the school year, to work on their own learning and to develop and field test their two ESSTEP-based activities. Finally, participants must agree to conduct at least two full-day or three half-day workshops for non-ESSTEP faculty and/or other interested members of their communities. These workshops may be done collaboratively (e.g., with their team members or other ESSTEP participants and staff) or individually, but all of these workshops must be completed within two years of attendance at second-summer workshops. We are currently seeking additional financial support from non-NSF sources, to aid "resource-poor" participants in conducting these mini-workshops.

## TO PARTICIPATE

If you are interested in participating in the Earth and Space Science Technological Education Project or have any questions, please contact Ed Geary, (303) 447-2020, ext. 145, egeary@geosociety.org. Application forms for the first two-week workshops (currently scheduled for July 7-19 and August 4-16, 1997) will be available in December 1996. With only 40 spaces available each year we anticipate that the workshops will fill quickly.

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basis for a series of publications on local crinoids. In these times of shrinking funding, this kind of research is an important future direction for geology, especially for descriptive work that has long-term impact, rather than immediate return.

Entries for the Spineless Wonders art competition, a chance for young citizens to recreate what Cincinnati communities looked like 450 m.y. ago, were displayed in the Center's Museum of Natural History and Science. Collectors of Cincinnati fossils from Kentucky and Ohio generously displayed the pick of their collections in a special exhibit area. The best fossil material for exhibit is in private hands; nonacademic paleontologists have considerable skill and knowledge in collecting and preparation. Displays of trilobites, rare complete crinoids, and edrioasteroids, in addition to selections of common and not-so-common Cincinnati fossils, drew crowds.

Adjacent to the displays were identification tables, with microscopes and lenses, so that the public could bring in their collections for identification by experts, both professional and amateur. Rows of people waited patiently for their turn at the tables. We encouraged collectors to ensure that locality data are always recorded along with the specimens, so that any scientific value is preserved.

Parents and their kids packed the "Monsters of the Ordovician" program and during the question period, Carl Brett asked why it's rare to find complete trilobites. One of the children stated, "They were broken up when the dinosaurs stood on them." Carl tactfully replied, "Well, I like the first part of your answer." Paleontology has incredible potential for teaching science to kids, and the challenge is not to make children love fossils—they all do anyway—but to nurture that interest so that it continues into adolescence and beyond.

While all this was going on in the exhibits part of the Cincinnati Museum Center, the Tri-City Paleontology Conference was providing the chance for research students from Cincinnati, Bloomington, Columbus, and anywhere in between to present their research in an informal manner. A recent renaissance in research on the local paleontology is timely because in terms of the quality of preservation, exposure, and research accessibility, the Cincinnati Series is the most significant suite of Upper Ordovician rocks in the world. Application of sequence stratigraphic approaches to the Cincinnati is unlocking the potential of these units for high-resolution studies of patterns of faunal change, and this is attracting a strong paleontology graduate group to the University of Cincinnati. The Fossil Festival was a convenient way to share this

renewed research excitement in the Cincinnati with the public at large.

### FIELD PROGRAM

To make the field trips as flexible and easy to run as possible, we staffed the sites throughout the day and let people come and go as they pleased, rather than providing transportation for them. The Dry Dredgers and University of Cincinnati graduate students staffed the three collecting sites, situated in each of three states where the Cincinnati crops out and giving complete stratigraphic coverage through the series. The Limper Museum at Miami University (Ohio), with its excellent displays of local fossils, was an added attraction. Locality details, instructions on collecting and safety, and some basic information on fossil groups had been made available previously. Each site had an introduction table where people could see identified specimens collected from the locality, gather information sheets, and sign responsibility waivers. Visiting professionals identified finds, and it was also a chance for amateurs to link up with professionals with a common collecting or research interest.

Final tallies showed that 500 people participated in the field trips, and it is likely that the festival as a whole attracted more than 1,000. Together the local museum, university, colleges, and interested public spread the message of Cincinnati's fossils to a new audience and reinforced the links between amateur and professional paleontologists. By lowering the barriers that make professional paleontology seem too technical or esoteric, we can give people the chance to be involved in the science again, as in the vibrant early

days of Cincinnati paleontology at the end of the last century. That was the message of the Fossil Festival: It is by telling people why Earth's history is important and by involving people in the adventure of discovering this history at all levels that we can best ensure research progress and financial support for academic geology. ■

*The Coalition for Earth Science Education  
Announces*

## **Geo Sci Ed II**

**Second International Conference on  
Geoscience Education**

**July 28-August 1, 1997  
University of Hawaii at Hilo**

### **LEARNING ABOUT THE EARTH AS A SYSTEM**

This conference follows on the success of the first international conference in Southampton, England, in 1993. The Conference focus on Earth System Science is further explored through conference sub-themes: Earth Science Education for All; Role of Business, Industry, and Government agencies in Education; The Need for Public Literacy in the Earth Sciences.

For information contact:

Dr. M. Frank Watt Ireton  
GeoSciEd II  
American Geophysical Union  
2000 Florida Avenue, NW  
Washington, DC 20009  
E-mail: fireton@kosmos.agu.org

## **GSA Offers Awards in Geomorphology and Micropaleontology**

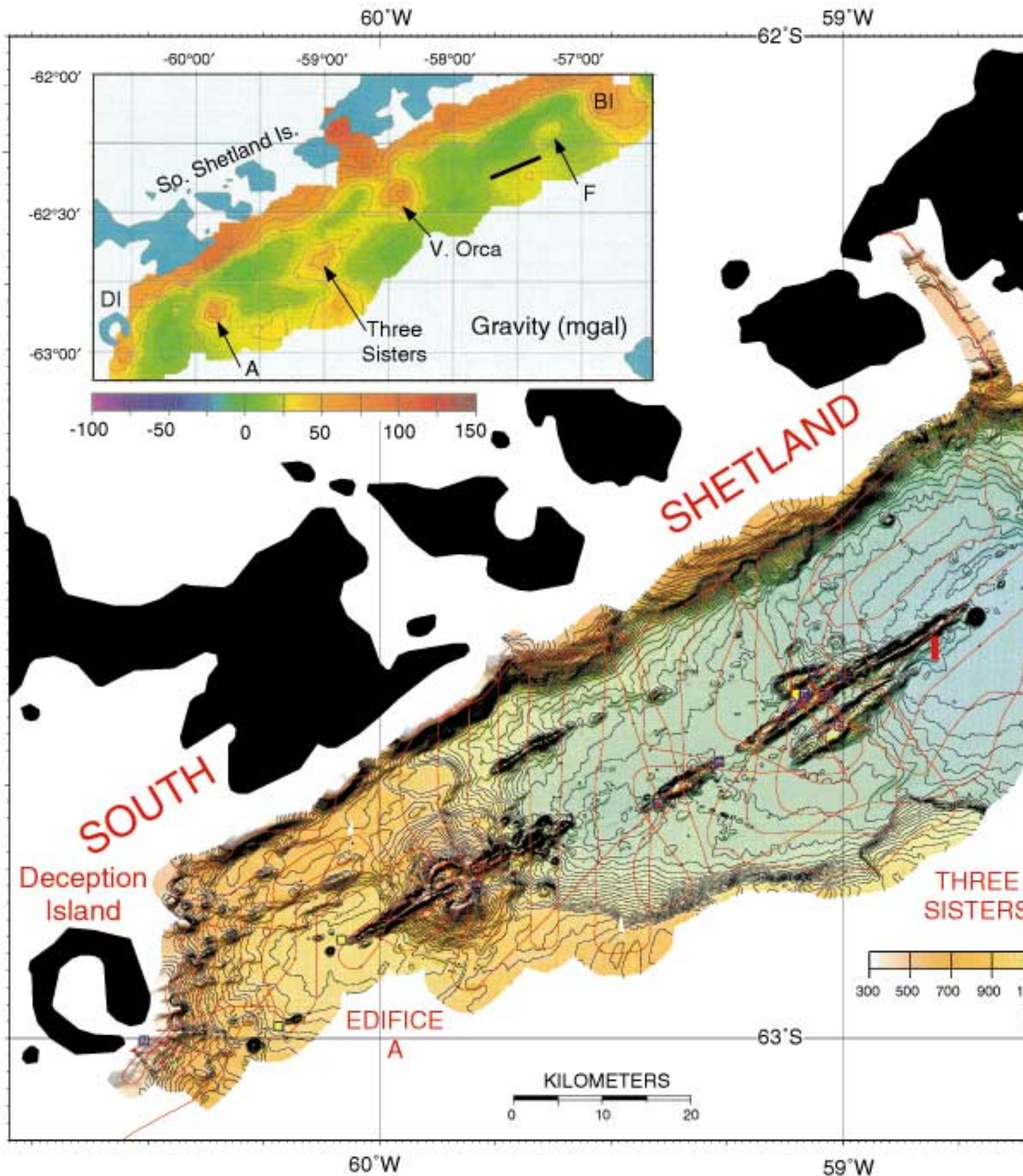
Through the generosity of W. Storrs Cole, two awards for support of research are offered through GSA. The Gladys W. Cole Memorial Research Award provides support for the investigation of the geomorphology of semiarid and arid terrains in the United States and Mexico. It is to be given to a GSA Member or Fellow between 30 and 65 years of age who has published one or more significant papers on geomorphology. Funds cannot be used for work already accomplished, but recipients of a previous award may reapply if additional support is needed to complete their work. The amount of this award in 1997 will be \$11,500.

The second award, the W. Storrs Cole Memorial Research Award, has been established to support research in invertebrate micropaleontology. This award will carry a stipend of \$9,500 in 1997, and will be given to a GSA Member or Fellow between 30 and 65 years of age who has published one or more significant papers on micropaleontology.

Additional information and application forms may be obtained from the Research Grants Administrator, GSA, P.O. Box 9140, Boulder, CO 80301.

All applications must be postmarked on or before **February 15, 1997**. Actions taken by the Committee on Research Grants will be reported to each applicant in April.

These are two of GSA's most prestigious awards; all qualified researchers are urged to apply.

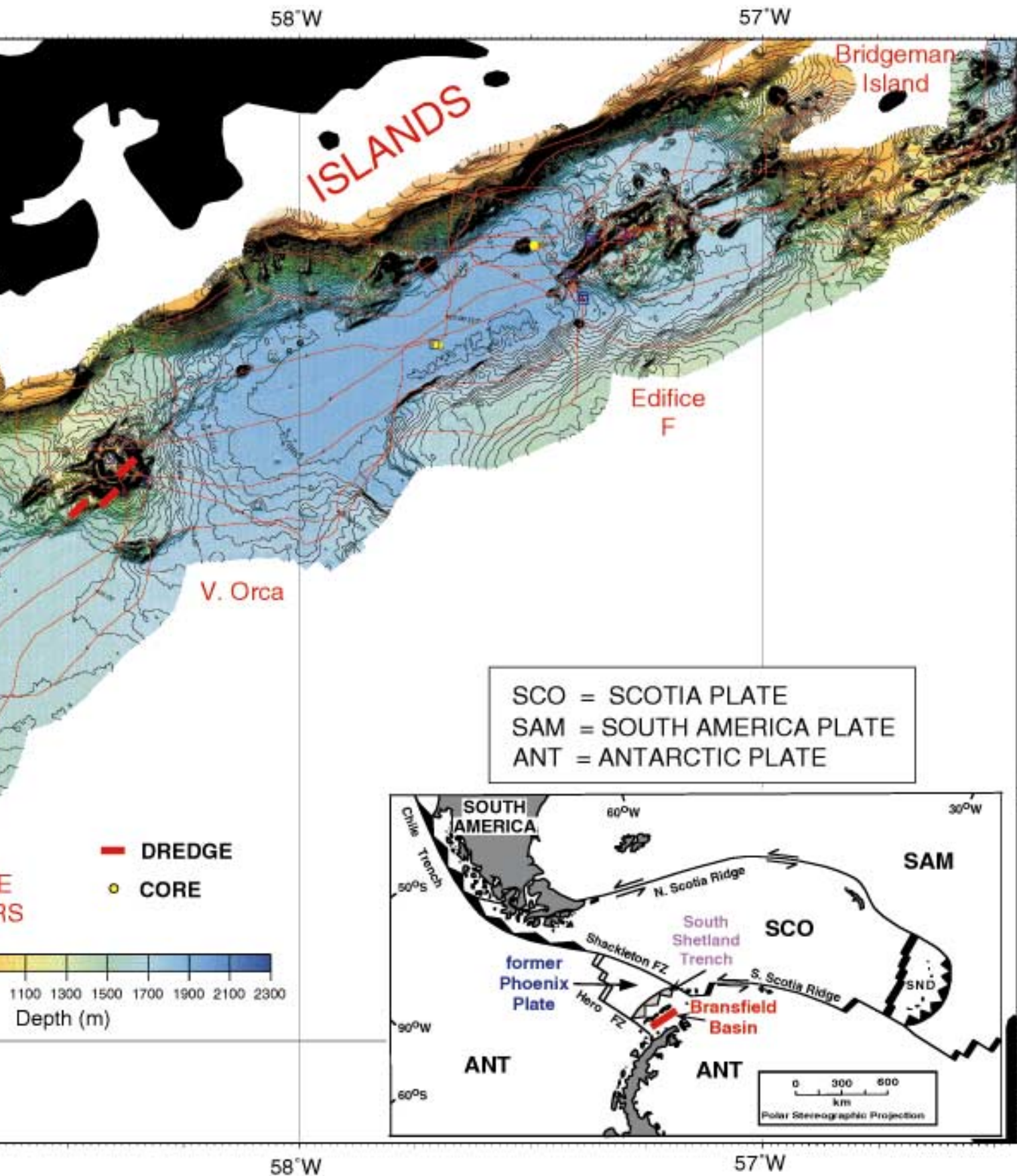


**Plate 1.** Seabeam 2112 multibeam bathymetric chart of Bransfield basin (Antarctic Peninsula). The contour interval is 25 m. The color bar shows depths in meters. The deepest section of the basin is about 1970 m. The shallowest is the margin along the island on the upper left of the map, <200 m depth. Red indicates the track of *RVIB N.B. Palmer*. V. Orca marks the location of the submarine volcano shown in Figure 1. Edifices A and F are features named in Gracia et al. (1996). The Three Sisters is the prominent lineated triple ridge that crosses

59°W. Upper left inset: Free air gravity anomaly map of *RVIB N.B. Palmer* cruise. BI = Bridgeman Island. DI = Deception Island. V. Orca marks the location of the submarine volcano identified by Barker and Austin (1995). The Bransfield basin taken from the tectonic map of the Scotia Arc (British Antarctic Survey, 1996). The location of the Bransfield basin data is indicated in red and labeled Bransfield basin. Active



# D BASIN BATHYMETRY



of Bransfield basin produced from data collected on the reception island. The line at 57°30'W is the subsurface line (1995). **Lower right inset:** Location map of Bransfield basin (British Antarctic Survey, 1985). The area of bathymetric data is shown as solid black teeth, the South

Shetland Trench (gray) is indicated as being mostly inactive. The Phoenix-Antarctic Ridge is shown as having ceased while the South Sandwich backarc spreading center is shown on the right of the figure as a solid heavy line. SND = Sandwich plate. Opposed arrows indicate left-lateral strike-slip motion along the North and South Scotia Ridges.

The associated article begins on p. 1.

# 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.

## Biological Resources Division Joins New Geological Survey

*“Now that the Biological Resources Division part of our USGS community is here (or almost here), and with the transfer of the Minerals Information team from the former Bureau of Mines this past winter, we can finally say that the foundation for a New USGS has truly been laid. All the pieces are now in place for the full integration of physical and biological science within the Department of the Interior.”*

— Gordon Eaton, Director, USGS, September 25, 1996

On October 1, 1996, the U.S. Geological Survey (USGS) added a new discipline and a new program division as the National Biological Service became the Biological Resources Division (BRD). BRD began its current incarnation on November 11, 1993, as the National Biological Survey (NBS), when Congress passed and President Clinton signed into law the FY 1994 Department of Interior (DOI) Appropriations Act. NBS was formed by the combination of biological science programs from seven DOI bureaus: Fish and Wildlife Service, National Park Service, Bureau of Land Management, Minerals Management Service, USGS, Bureau of Reclamation, and Office of Surface Mining. However, the roots of the NBS date back more than 110 years, to July 1, 1885, when the first biological survey was formed in the Department of Agriculture's Division of Entomology. In the intervening 110 years, the original survey was moved to the DOI and has been reorganized (and renamed) more than a dozen times (eleven reorganizations and six name changes since 1907, when its then Director C. Hart Merriam convinced his friend President Theodore Roosevelt to keep Congress from cutting its budget).

In welcoming the BRD to the USGS, Director Eaton stated “One of my primary goals as Director during these last three years has been to break down the artificial walls that have separated our various research activities and scientists, and encourage the development of multidisciplinary teams to solve the complex problems that face our society today.” He continued that “the transformation goes much deeper. During the past year, every part of the USGS has undergone profound, sometimes wrenching, change as we adapt to the new and evolving forces of the

political and economic landscape in which we live and work. It has been hard work, very hard and very trying work, but it has laid a solid foundation on which we are building a new USGS. These changes are as profound, if not more profound, than any in our long and distinguished history as a Federal bureau.... With our rich scientific heritage and our unique mix of expertise, we are happily very well poised to reach for a new understanding of our Earth.”

The BRD has about 1700 employees housed at nearly 140 facilities around the country. These locations include 16 science centers, 80 field stations, 41 cooperative research units, and a Center for Biological Informatics (which is already sharing a building with the USGS Rocky Mountain Mapping Center at the Denver Federal Center). BRD headquarters staff moved to the USGS National Center on September 21–22.

BRD's Strategic Science Plan defines its mission as: “to work with others to provide the scientific understanding and technologies needed to support the sound management and conservation of our Nation's biological resources.” The primary responsibility of the BRD is to assist resource and land managers, particularly in the DOI, by providing them with sound biological information and with assistance in applying the information to their needs. The primary means of gathering this information is through the use of scientific methods applied to monitoring resources and conducting experiments. Subsequently, pertinent information must be made available to those who must use it to make important resource management decisions. The Strategic Science Plan provides general guidelines regarding the major scientific emphases of the BRD and

major approaches to meeting the division's responsibilities. A companion Science Implementation Plan outlines specific actions and pathways to accomplish the division's goals.

Fulfilling this mission depends on effectively balancing the need for immediate technical assistance and information to guide the management of biological resources with the need for long-range, strategic information to understand and predict emerging patterns and trends in ecological systems. Broad areas of BRD research include fisheries and aquatic habitats; wildlife health; ecosystem studies; exotic species such as zebra mussels, purple loosestrife, and lampreys; endangered species, including the black-footed ferret, desert tortoise, whooping crane, and Florida manatee; migratory birds and waterfowl; environmental chemistry, with a particular focus on materials; social, economic, and institutional analysis such as evaluation of economic trends as they relate to environmental policies; biological information transfer; and inventory and monitoring—for example, vegetation mapping in our national parks.

The goals and objectives of the BRD are as follows. Goal 1: Assess and report the condition of the nation's biological resources. Objectives: (A) Initiate a systematic process for working with resource managers and other partners to identify critical data and gaps in the current knowledge of biological resource status and trends. (B) Develop partnerships at all levels with federal, state, university, museum, and other cooperators to conduct surveys and monitoring programs at multiple scales applicable to important management and conservation objectives. (C) Develop, evaluate, and disseminate new methods and technical capabilities for assessing status and trends of biological resources of concern to the DOI and cooperating states. (D) Develop new and improved means to provide results to resource managers, converting data to synoptic information, and communicating findings in an accessible, useful format. (E) Report regularly to the nation on the “status and trends of the nation's biological resources.”

Goal 2: Characterize natural processes and identify factors that influence the quality or quantity of the nation's biological resources at all levels of biological organization. Objectives: (A) Establish multidisciplinary science teams to identify and investigate key natural and human-induced processes that affect species and populations and the structure and function of ecological systems. (B) Expand existing efforts to evaluate the impact of non-native species on native species and ecosystem structure and function.

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(C) Work with other USGS divisions to develop and promote an integrated national program to characterize and interpret land cover and land-use history and the impact of land-use change on biological and other natural resources.

Goal 3: Facilitate sound management of the nation's biological resources by collaborating with partners in all phases of our work. Objectives: (A) Continue and improve the mechanisms for collaborative identification and definition of high-priority biological information needs of DOI bureaus, states, and other partners. (B) Actively promote and reward partnerships, both within the USGS and with external entities, to develop scientific information specific to addressing natural resource problems. (C) Develop predictive models to assist resource managers and establish multidisciplinary teams to work with managers in an adaptive management framework to monitor the consequences of management decisions. (D) Develop and evaluate restoration strategies and techniques for degraded ecosystems and declining populations.

Goal 4. Provide national and international leadership for the development of a biological information infrastructure to provide access to, disseminate, share, and use biological data, information, and technology. Objectives: (A) Establish partnerships with other government agencies, universities, museums, international organizations, the private sector, and others to support efforts to make more sources of biological data and information electronically accessible. (B) Establish standards and methodologies for biological data collection and documentation to facilitate comparison, exchange, and integration of databases. (C) Accelerate efforts to develop new information products targeted to the needs of partners, resource managers, scientists, educators, and the public. (D) Identify, develop, adapt, and implement technological applications for gathering, analyzing, integrating, and displaying biological data in support of natural resources management.

Goal 5: Integrate biological resources research, inventory, and monitoring efforts with those directed at other natural resources, throughout the USGS. Objectives: (A) Identify collaborative opportunities in which several USGS divisions can jointly contribute to scientific activities carried out in support of biological resources stewardship. (B) Develop and implement a strategy for integrating earth and life sciences data in information products that report on the status and trends of the nation's natural resources. (C) Adopt administrative and operational policies and procedures that encourage and sup-

port cross-divisional communication and collaboration as a way of doing business within the USGS. (D) Encourage interdivisional efforts by rewarding successful collaboration and by identifying and eliminating roadblocks as they arise.

Eaton concluded his welcoming remarks by stating that "America's abundant biological, water, land, energy, and mineral resources provide the foundation for much of our Nation's wealth and the well-being of its citizens. We at the New USGS are uniquely able to provide the knowledge and understanding needed for careful stewardship and sustainable use of these resources to ensure the health, prosperity and quality of life enjoyed by current and future generations. So, let's get on with engaging in what we do best—science in the public service."

Detailed information about the BRD and its science centers is available on the World Wide Web at URL <http://www.usgs.gov> and on the USGS EarthFax system at 703-648-4888. ■

## Annual Meeting Sponsors

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

**Cameca Instruments**  
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*The Geological Society of America*

## Congressional Science Fellowship 1997-1998



**T**he 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 3, 1997**

## **NORTH-CENTRAL SECTION, GSA 31st Annual Meeting**

**Madison, Wisconsin**

**May 1–2, 1997**

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

### **CALL FOR PAPERS**

Papers on all topics listed on the GSA abstract form are invited from students and professionals for presentation in oral or poster general sessions and theme (volunteered) sessions. Presentations that may fit into one of the symposia (volunteered and invited papers) are also solicited. Those interested in presenting a paper at a symposium are encouraged to contact the convener of the symposium and/or request on the submitted abstract form that the abstract be considered for a particular symposium. Special sessions focused on specific themes or subjects will be arranged by the local program committee after review of the abstracts. Oral presentations will be allotted 15 minutes followed by 5 minutes for discussion. Two four-hour poster sessions are planned for each day.

### **SYMPOSIA**

Planning for several symposia and theme sessions is underway. To date, the following symposia have been scheduled for the 1997 North-Central GSA meeting.

**1. Temporal Trends in Ethology, Ecology, and Taphonomy.** (*Sponsored by North-Central Section of Paleontological Society.*) Joanne Kluessendorf, Dept. of Geology, University of Illinois, 1301 W. Green St., Urbana, IL 61801, (217) 367-5916, fax 217-244-4996.

**2. History of Wisconsin Geologists.** Allan F. Schneider, University of Wisconsin—Parkside, 900 Wood Road, Box 2000, Kenosha, WI 53141-2000, (414) 595-2326, fax 414-595-2056.

**3. Paleoglaciology.** (*Sponsored by Midwest Glaciology Meeting.*) David Mickelson, Dept. of Geology and Geophysics, University of Wisconsin—Madison, Lewis G. Weeks Hall, Room 256B, Madison, WI 53706; (608) 262-7863, fax 608-262-0693, mickelson@geology.wisc.edu; John Attig, WGNHS, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 262-6131, fax 608-262-8086, jwattig@facstaff.wisc.edu.

**4. Importance of Field Trips in Undergraduate Education.** (*Sponsored by Central Section of National Association of Geology Teachers.*) David Malone, Dept. of Geography-Geology, Illinois State University, Campus Box 4400, Normal, IL 61790-4400, (309) 438-2692, fax 309-438-5310, dhmalone@rs6000.cmp.ilsta.edu.

**5. Basement Structural Influences on Phanerozoic Sedimentation in the Mid-Centroid Area.** (*Sponsored by Great Lakes Section of SEPM.*) Robert E. Sloan, Dept. of Geology and Geophysics, University of Minnesota, 108 Pillsbury Hall, 310 Pillsbury Dr., Minneapolis, MN 55455-0219, (612) 624-5543, bsloan@maroon.tc.vmn.edu.

**6. Gilbert O. Raasch Symposium: Paleozoic Geology and Paleontology of the Central United States.** Donald G. Mikulic, Illinois State Geological Survey, 615 E. Peabody Dr., Champaign, IL 61820, (217) 244-2518, fax 217-244-7004.

**7. Special Poster Session on Undergraduate Research.** (*Sponsored by the Council on Undergraduate Research.*) These posters, written and presented by undergraduate students, will form a separate poster session or be part of another poster session, depending on the response. Co-authored papers for which the student is senior author will also be considered. Undergraduate students who have been involved in research are strongly urged to submit abstracts on their research projects, activities, techniques, and/or preliminary results for this session. For additional information, contact Karen G. Havholm, Dept. of Geology, University of Wisconsin—Eau Claire, Eau Claire, WI 54701, (715) 836-2945, fax 715-836-2380, havholkg@uwec.edu; or Robert D. Shuster, Dept. of Geography-Geology, University of Nebraska at Omaha, Omaha, NE 68182,

(402) 554-2457, fax 402-554-3518, bshuste@cwis.unomaha.edu.

**8. New Ideas for Field Trips in the Upper Midwest.** (*Special poster session sponsored by Central Section of NAGT.*) David Malone, Dept. of Geography-Geology, Illinois State University, Campus Box 4400, Normal, IL 61790-4400, (309) 438-2692, fax 309-438-5310, dhmalone@rs6000.cmp.ilsta.edu.

**9. K–16 Teachers: Collaborative Educators for Earth Science Literacy.** Reports of collaborative projects between K–12 and college teachers are especially encouraged, including field programs, hands-on projects, and in-service programs. K–12 teachers are particularly invited to participate. C. Patrick Ervin, Dept. of Geology, Northern Illinois University, DeKalb, IL 60115-1943, (815) 753-1942, fax, 815-753-1945, ervin@geol.niu.edu; and William F. Kean, Jr., Dept. of Geosciences, University of Wisconsin—Milwaukee, Milwaukee, WI 53201, (414) 229-5231, wkean@cgsd4.uwm.edu.

**10. Recent Studies in Precambrian Geology of the Mid-Centroid Region.** L. G. Medaris, Jr., Dept. of Geology and Geophysics, University of Wisconsin—Madison, Lewis G. Weeks Hall, 1215 W. Dayton St., Madison, WI 53706, medaris@geology.wisc.edu; Bruce A. Brown, WGNHS, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 262-1705, babrown1@facstaff.wisc.edu; Frank R. Luther, Dept. of Geology, University of Wisconsin—Whitewater, Whitewater, WI 53190-1790, (414) 472-5257.

**11. Hydrogeology of Non-Point-Source Pollution.** George Kraft, Central Wisconsin Groundwater Center, University of Wisconsin—Stevens Point, Stevens Point, WI 54431, (715) 346-2984, fax 715-346-2965, gkraft@uwspmail.uwsp.edu; Ken Bradbury, WGNHS, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 263-7921, fax 608-262-8086, krbradu@facstaff.wisc.edu.

**12. Hydrogeologic Studies in Fractured Media.** Ken Bradbury, WGNHS, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 263-7921, fax 608-262-8086, krbradu@facstaff.wisc.edu; Maureen Muldoon, WGNHS, same address, (608) 262-1580, fax 608-262-8086, muldoon@macc.wisc.edu.

### **POSTER SESSIONS**

Students and professionals are encouraged to take advantage of this effective means of presentation. Please indicate Poster Session on the GSA abstract form. Each poster booth will contain two areas, 4' x 4' each, arranged at table height. Poster sessions will be located in the same area as exhibits and will be available for viewing for four hours.

Undergraduate students are especially encouraged to submit posters for sympo-

sium 7. Please contact one of the organizers listed for more information.

## ABSTRACTS

Abstracts must be submitted camera-ready on official GSA abstract forms in accordance with the instructions on the forms. Abstract forms are available from Abstracts Coordinator, Geological Society of America, P.O. Box 9140, Boulder, CO 80301-9140; (303) 447-2020, ncarlson@geosociety.org. Abstract forms may also be obtained from Bruce A. Brown, North-Central Section Program Coordinator, WGNHS, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 262-1705, babrown1@facstaff.wisc.edu, and from GSA Campus Representatives at most colleges and universities in the North-Central Section area.

## ABSTRACT DEADLINE:

**January 9, 1997**

Send one original and five copies to Bruce A. Brown, North-Central Section Program Coordinator, WGNHS, 3817 Mineral Point Rd., Madison, WI 53705-5100. Abstracts submitted for inclusion in symposia should be sent directly to the first symposium organizer listed for each symposium.

All abstracts will be reviewed for informative content, proper format, and originality. Contributors desiring acknowledgment of receipt of the abstract should include a stamped, self-addressed envelope or postcard. Authors will be notified of acceptance of their paper well in advance of the meeting.

## CORE WORKSHOP

A core workshop to study recently drilled cores of the Ordovician and Silurian rocks of eastern Wisconsin will be presented by Mark Harris, University of Wisconsin—Milwaukee and J. A. Simo, University of Wisconsin—Madison. Participants will receive a guide with an introduction to the geologic setting and core descriptions. This workshop will be of particular interest to those participating in field trips 2, 9, and 11. Further details and registration information will be provided in the final announcement for the meeting.

## FIELD TRIPS

The field trip coordinator is Michael G. Mudrey, Jr., University of Wisconsin—Extension, assisted by Allan Schneider, University of Wisconsin—Parkside. Information regarding field trips may be obtained from Michael G. Mudrey, Jr., WGNHS, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 262-1705, fax 608-262-8086, mgmudrey@facstaff.wisc.edu. A final listing of trips, schedules, and costs will be available in the February 1997 issue of *GSA Today*.

## Premeeting

**1. Geology Traverse of East-Central Wisconsin.** Steve Dutch, (414) 465-2370, dutch@uwgb.edu; Ronald D. Stieglitz, Joseph M. Moran, and Donn Quigley, University of Wisconsin—Green Bay.

**2. Facies, Sequence Stratigraphy, and Hydrology of the Silurian of the Door Peninsula, Northeastern Wisconsin.** Mark T. Harris, (414) 229-5777, mtharris@csd.uwm.edu, University of Wisconsin—Milwaukee; Ken Bradbury and Maureen Muldoon, Wisconsin Geology and Natural History Survey; and Ronald D. Stieglitz, University of Wisconsin—Green Bay.

**3. Precambrian Structure, Geochronology and Tectonics of the Baraboo-Devils Lake Area, South-Central Wisconsin.** David H. Malone, (309) 438-2692, dhmalon@rs6000.cmp.ilstu.edu, Illinois State University; and Nicholas Van Wyck, Kennecott Exploration.

**4. Three Hundred Years of Mining History and Geology in the Upper Mississippi Valley Zinc-Lead District, Southwestern Wisconsin.** M. G. Mudrey, Jr., (608) 263-5495, mgmudrey@facstaff.wisc.edu, Wisconsin Geology and Natural History Survey; and W. A. Broughton, University of Wisconsin—Platteville.

**5. Petrology, Structure, and Industrial Use of the Waterloo Quartzite, Southern Wisconsin.** Frank R. Luther, (414) 472-5257, University of Wisconsin—Whitewater.

**6. Conditions Around the Margin of the Green Bay Lobe During the Height of Wisconsin Glaciation.** Lee Clayton, (608) 263-6839, lclayton@facstaff.wisc.edu, and John Attig, Wisconsin Geological and Natural History Survey.

## Postmeeting

**7. Early Paleozoic Shelf Sedimentation on the Eastern Edge of the Hollandale Embayment: Cambrian and Ordovician Clastic Strata of the Upper Mississippi Valley.** J. Brian Mahoney, (715) 836-4952, mahonej@uwec.edu, and Karen G. Havholm, University of Wisconsin—Eau Claire; and Anthony C. Runkel, Minnesota Geological Survey.

**8. Glacial Geomorphology and Glaciology of the Green Bay Lobe, Southeastern Wisconsin.** David M. Mickelson, (608) 262-8960, mickelson@geology.wisc.edu, and Patrick M. Colgan, University of Wisconsin—Madison; and Lee Clayton and John Attig, Wisconsin Geological and Natural History Survey.

**9. Sequence Stratigraphy, Depositional Environments, and Conodont Biostratigraphy of the Classic Silurian Strata of Southeastern Wisconsin.** Donald G. Mikulic, (217) 244-2518, Illinois State Geological Survey; and Joanne Kluessendorf, University of Illinois.

**10. Pleistocene Geomorphology and Stratigraphy of the Door Peninsula, Northeastern Wisconsin.** Allan F. Schneider, (414) 595-2439, schneide@cs.uwp.edu, University of Wisconsin—Parkside; and Ronald D. Stieglitz, University of Wisconsin—Green Bay.

**11. Sequence Stratigraphy, Sedimentology, and Paleogeography of the Middle Ordovician of Eastern Wisconsin.** J. A. Simo, (608) 262-5987, simo@geology.wisc.edu, Luke Choi, P. A. Freiberg, Charles W. Byers, Robert H. Dott, Jr., University of Wisconsin—Madison.

**12. Geoenvironmental Problems and Solutions, South-Central and South-eastern Wisconsin.** Jack W. Travis, (414) 472-5258, travisj@uwwvax.uww.edu, University of Wisconsin—Whitewater; Douglas S. Cherkauer, University of Wisconsin—Milwaukee; Joanne Kluessendorf, University of Illinois; Donald G. Mikulic, Illinois State Geological Survey.

## STUDENT PAPER AWARDS AND TRAVEL ASSISTANCE GRANTS

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

Grants for travel assistance of up to \$200 (exclusive of field trip fees) may be made to student members and associates. The assistance will be offered on a first-come, first-served basis, with priority given to students presenting oral or poster papers. To be eligible for travel assistance grants, students must be currently enrolled in an academic department and certify their student membership in GSA. Applications for travel assistance grants may be obtained from Thomas Evans, General Chairman for North-Central Section, Wisconsin Geology and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100, (608) 263-4125, tevans@facstaff.wisc.edu. Applications for travel assistance must be received no later than *March 22, 1997*.

## PROJECTION EQUIPMENT

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

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## Preliminary Announcement and Call for Papers

# CORDILLERAN SECTION, GSA 93rd Annual Meeting

Kailua-Kona, Hawaii

May 21–23, 1997

The Department of Geology and Geophysics, of the School of Ocean and Earth Science and Technology, University of Hawaii, will host the 1997 meeting of the Cordilleran Section of the Geological Society of America. Meetings will be held at the Convention Center of the Kona Surf Resort and Country Club, on the west coast of Hawaii about 10 km (6 miles) south of Kailua-Kona.

### SETTING AND ACCESS

Kailua is a coastal town in the North Kona District of the island of Hawaii ("Big Island") in the State of Hawaii. It lies on the west side of Hawaii, and of Hualalai, a dormant volcano that last erupted in 1800–1801.

Air access to Kona is through the Keahole Airport, about 11 km (7 miles)

north of Kona. The airport has daily direct flights to and from San Francisco, Los Angeles, and Tokyo. There are about two flights per hour to and from Honolulu on interisland airlines, and Honolulu has numerous daily direct or connecting flights to West Coast and inland cities. Keahole (Kailua-Kona) also has numerous flights to other airports within Hawaii.

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### BUSINESS MEETINGS AND SOCIAL EVENTS

The **GSA North-Central Section Management Board** will hold its business meeting with breakfast on Thursday morning, May 1, 1997, beginning at 7:00 a.m. The location will be published in the *Abstracts with Programs* volume.

A **Welcoming Reception** will be held on Wednesday evening, April 30, 1997. The **Annual Banquet** will be held on Thursday evening, May 1, preceded by a social hour beginning at 6:00 p.m. A special address by Robert H. Dott, Jr. will follow the dinner and brief business meeting.

The **GSA North-Central Section Campus Representatives breakfast** and meeting will be held Friday morning, May 2, 1997, at 7:00 a.m. The **North-Central Section of the Paleontological Society** (in conjunction with the **Great Lakes Section of SEPM**) and the **Central Section of the National Association of Geoscience Teachers** will hold **luncheon meetings** on Thursday and Friday, respectively, beginning at 12 noon. An **Association for Women Geoscientists breakfast meeting** is being planned.

### SPECIAL ACTIVITIES AND EVENTS

Alternative opportunities for registrants and guests will be available during the meeting, including trips to local museums, nearby natural history sites, and Madison highlights. A full listing of these special activities and events will be published in the final announcement in the February 1997 of *GSA Today*.

The meeting site is relatively isolated. Air transport and hotel accommodations will be adequate for the meeting if attendees plan their travel, registration, housing, and field trip choices in accord with the normal deadlines.

### REGISTRATION

**PREREGISTRATION DEADLINE:**  
*April 18, 1997*

Forms for registration and housing will accompany the Final Announcement in the February 1997 issue of *GSA Today*.

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### 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.

please let us know of your requirements by the deadline for preregistration, March 28, 1997, so appropriate arrangements can be made.

Abstracts may be purchased with your GSA membership or on-site in the registration area. Cost for the abstracts volume is \$12 for members and \$15 for nonmembers.

### GETTING TO MADISON

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

### DETAILED INFORMATION

Information concerning registration, hotel and motel accommodations, alternative opportunities in the Madison area, technical sessions and symposia, and field trips will appear in the February 1997 issue of *GSA Today* and the North-Central Section *Abstracts with Programs* for 1997. Inquiries, requests, or suggestions should be directed to Thomas Evans, North-Central Section GSA General Chair, Wisconsin Geology and Natural History Survey, 3817 Mineral Point Rd., Madison, WI 53705-5100 (608) 263-4125, tevans@facstaff.wisc.edu. ■

### HOUSING

A large block of rooms has been reserved in the Madison Concourse Hotel and Governor's Club, and special room rates have been negotiated. Other accommodations including blocks of rooms and special room rates in hotels nearby have also been arranged. A list of names, telephone numbers, and room rates will be available in the February 1997 issue of *GSA Today*. Registrants are responsible for making their own housing arrangements and are encouraged to stay at the headquarters hotel, where all activities related to the meeting will be held.

### REGISTRATION

*Preregistration Deadline: March 28, 1997.* The registration form will be in the February 1997 issue of *GSA Today*.

Preregistration fees will be \$60 for professional GSA members or members of associated societies participating in this meeting, and \$20 for GSA student members. For those not affiliated with GSA or the associated societies, preregistration will be \$65 for professionals and \$25 for students. K–12 teachers are invited to register for a cost of \$20. On-site registration will be \$10 more for professionals and students. One-day registration, at a reduced rate, will be available.

GSA is committed to making every event at the 1997 North-Central Section Meeting accessible to all people interested in attending. If you have special requirements, such as an interpreter or wheelchair accessibility, there will be a place to indicate this on the registration form, or you can call Thomas J. Evans at (608) 263-4125, fax 608-262-8086. If possible,

## **Cordilleran** *continued from p. 22*

GSA and Kona Surf are committed to making every event at the 1997 Cordilleran Section Meeting accessible to all people interested in attending. All areas of the hotel and its Convention Center are wheelchair-accessible except the salt-water pool. Equipment for the hearing-impaired is available. If you have such special requirements, there will be space to indicate this on the registration form, or you can contact Ralph Moberly, ralph@soest.hawaii.edu. If possible, please let us know by *April 1, 1997*.

*Abstracts with Programs* for the meeting may be purchased with your GSA membership, or on site in the registration area.

## **HOUSING**

### **HOUSING DEADLINE:**

**March 21, 1997**

Housing registration by mail will be handled by the Kona Surf, where a block of rooms has been reserved; overflow registrants will be booked into the nearest adjacent hotel. For this meeting, room rates at the two hotels are identical, in the \$95 to \$105 range (plus applicable taxes)—considerably less than for most other destinations in Hawaii. The Kona Surf will provide free transportation between the two hotels, less than 2 km (1.2 miles) apart. Earlier registrants will have a better chance to be in the meeting hotel. Upgrades, reduced rates for students sharing rooms, accommodation for children, and other specific information will be with the registration forms in the Final Announcement in the February 1997 issue of *GSA Today*.

## **CALL FOR PAPERS**

Papers are invited for presentation in oral technical sessions, symposia, theme sessions, and poster sessions. Technical sessions and poster sessions might include any of those listed on the GSA abstract form. Symposia and likely theme sessions are listed below. Potential contributors are encouraged to contact the organizers of the specific symposium or theme for information.

Papers dealing with any aspect of the Cordilleran region will be considered for presentation. For this meeting, the scope will be enlarged to include the Pacific and circum-Pacific region, where the applicability to geology of areas within the Cordilleran region is evident. Technical sessions will allow 12 minutes for presentation and 3 minutes for discussion. Symposia may allow the same 12 minutes for presentation, or longer at the option of the conveners.

### **ABSTRACTS DEADLINE:**

**January 24, 1997**

An original and five copies are required of each abstract. Authors of sym-

posium papers should send their abstracts directly to the appropriate convener (see lists below). All other abstracts should be sent directly to Fred Mackenzie, Technical Sessions Chair, Department of Oceanography, University of Hawaii, 1000 Pope Road, Honolulu, HI 96822, fredm@soest.hawaii.edu. Abstracts will be reviewed for information content and format, appropriate geographic coverage, and originality. Only one volunteered paper may be presented by each individual, although that person may also co-author papers presented by others, and may present additional papers if invited for symposia.

## **ABSTRACT FORMS**

Abstracts must be submitted camera-ready on official GSA 1997 abstract forms, available from Abstracts Coordinator, Geological Society of America, P.O. Box 9140, Boulder, CO 80301-9140, ncarlson@geosociety.org, or from Ralph Moberly, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, ralph@soest.hawaii.edu, or from GSA Campus Representatives at colleges and universities.

## **PRESENTATION**

It is likely that there will be some restrictions to the width and nature of posters, and that only one 35 mm projector and screen will be in each meeting room. All slides must be 2" x 2" and in standard 35 mm carousel trays. Please plan to bring loaded trays, if at all possible. If you require overhead projectors or video projectors, make that clear when you submit the abstract.

## **SYMPOSIA**

- 1. Hawaiian Islands as a Natural Laboratory for Soil-Weathering and Ecosystem Studies.** Oliver A. Chadwick, Dept. of Geography, University of California, Santa Barbara, Santa Barbara, CA 93106, oac@geog.UCSB.EDU; Robert Gavenda, USDA Soil Conservation Service, P.O. Box 636, Kealahou, HI 96750.
- 2. Formation of Authigenic Marine Minerals.** FROMAGE Symposium (Friends of Marine Authigenesis; SEPM Research Group on Marine Authigenesis.) Craig R. Glenn, Dept. of Geology and Geophysics, University of Hawaii, Honolulu, HI 96822, glenn@mano.soest.hawaii.edu; William C. Burnett, Dept. of Oceanography, Florida State University, Tallahassee, FL 32306-3048, wburnett@mail.fsu.edu.
- 3. Sediment, Pollutants, and Chemical Fluxes in Terrestrial, Estuarine, and Coastal Waters.** Frank Peterson, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, peterson@soest.hawaii.edu; Eric DeCarlo, Dept. of Oceanography, University of Hawaii, 1000 Pope Road, Honolulu, HI 96822, edecarlo@soest.hawaii.edu; Khalil Spencer, Dept. of Geol-

ogy and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, khal@soest.hawaii.edu.

## **4. Biotic Reactions to Global Warmth: Clues from the Fossil Record.**

Co-sponsored by the West Coast Section of the Paleontological Society. Johanna Resig, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, jresig@soest.hawaii.edu; Paula Noble, Dept. of Geology, California State University, Sacramento, CA 95819-6043, noblepj@csus.edu.

## **5. Landslides and Tsunamis, Hawaii and Elsewhere.**

Barbara Keating, Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI 96822, keating@soest.hawaii.edu; James G. Moore, USGS, M.S. 910, 345 Middlefield Road, Menlo Park, CA 94025, jmoore@mojave.wr.usgs.gov; Wilfred B. Bryan, Dept. of Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, MA 02543.

## **6. Volcanic-Gas Geochemistry:**

### **Present Status; Future Methods.**

Donald Thomas, Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI 96822, dthomas@soest.hawaii.edu; Jeff Sutton, Hawaii Volcano Observatory, P.O. Box 51, Hawaii Volcanoes National Park, Volcano, HI 96718, jsutton@tako.wr.usgs.gov.

## **THEME SESSIONS**

Preliminary expressions of interest suggest that oral or poster sessions, or both, will develop in these themes. Prospective contributors are encouraged to contact the listed individuals for information.

**Comparative Volcanology, Submarine and Subaerial.** Alex Malahoff, Dept. of Oceanography, University of Hawaii, 1000 Pope Road, Honolulu, HI 96822, malahoff@soest.hawaii.edu.

**Fabric and Microfabric of Sediment and Rock.** Roy Wilkens, Hawaii Institute of Geophysics and Planetology, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, wilkens@soest.hawaii.edu.

**Geologic Hazards, Circum-Pacific, and Intra-Pacific.** Steve Self, Dept. of Geology and Geophysics, University of Hawaii, Honolulu, HI 96822, self@soest.hawaii.edu; Barbara Keating, Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI 96822, keating@soest.hawaii.edu.

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

**Hydrogeology of Island and Coastal Aquifers.** Charles D. Hunt, Jr., U.S. Geological Survey, 677 Ala Moana Blvd.,

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Suite 415, Honolulu, HI 96813, cdhunt@usgs.gov.

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

Michael Bevis, Hawaii Institute of Geophysics and Planetology, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, bevis@soest.hawaii.edu; Paul Okubo, Hawaiian Volcano Observatory, U.S. Geological Society, P.O. Box 51, Hawaii Volcanoes National Park, HI 96718, pokubo@liko.wr.usgs.gov; Fred Duennebier, Dept. of Geology and Geophysics, University of Hawaii, Honolulu, HI 96822, fred@soest.hawaii.edu.

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

**Present and Past Subduction and Collision on Pacific Convergent Margins.**

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

**Remote Sensing of Geology from Airborne and Space-based Platforms.**

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

**Structure and Morphology of the Pacific Seafloor.** Charles Helsley, Sea Grant, University of Hawaii, 1000 Pope Road, Honolulu, HI 96822, chuck@soest.hawaii.edu.

**FIELD TRIPS**

Preregistration forms, costs, and updated information on dates and coverage will be printed in the Final Announcement in the February 1997 issue of *GSA Today*. For details before then contact the field-trip leaders listed below. General questions should be addressed to Field-Trip Chair Floyd W. McCoy, Jr., Natural Sciences, Windward Community College, 45-720 Keaahala Road, Kaneohe, HI 96744, fmccoy@hawaii.edu, or co-chair Patty Lee, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, plee@soest.hawaii.edu.

**Premeeting**

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

Pow-foong Fan, pffan@soest.hawaii.edu, University of Hawaii; Alex Malahoff, University of Hawaii; Janet Babb, and Glenn Shepherd.

**2. North Hawaii: Weathering and Soil Formation in Response to Variation of Age, Surface, and Climatic**

**Conditions.** Robert Gavenda, USDA Soil Conservation Service, P.O. Box 636, Kealahou, HI 96750; Carolyn G. Olson, USDA Soil Conservation Service, Lincoln, Nebraska; and Oliver A. Chadwick, University of California, Santa Barbara.

**3. Petrology and Volcanology of Maui.**

John Sinton, sinton@soest.hawaii.edu; and Scott Rowland, University of Hawaii.

**4. Field Workshop: Active and Young Basalt Lava Flows.**

Steve Self, self@soest.hawaii.edu, University of Hawaii; Carl Thornber, Hawaii Volcano Observatory; and Katherine Cashman, University of Oregon.

**5. Field Workshop: Volcanic-Gas Sampling at Kilauea Fumaroles.**

Jeff Sutton, jsutton@tako.wr.usgs.gov, Hawaii Volcano Observatory; Donald Thomas, University of Hawaii; and Werner Giggenbach.

**6. Inquiry-Based Field Trips for Introductory-Geology Instructors: Example: Evidence for Global Change at Kaena Point, Oahu.**

Martha Sykes, mlsykes@soest.hawaii.edu, University of Hawaii.

**During Meeting**

**7. Natural History of the Kona Coast: Geology, Marine Biology, Botany, and Applied Science.**

Sara Peck, Sea Grant, c/o Natural Energy Laboratory of Hawaii, 73-4460 Queen Kaahumanu Highway, Kailua-Kona, HI 96740; and Charles Helsley, University of Hawaii.

**Postmeeting**

**8. Volcanoes and the Sea: Geologic Processes on Hawaii and Maui.**

Patty Lee, plee@soest.hawaii.edu, University of Hawaii; Alex Malahoff, University of Hawaii; Janet Babb, and Glenn Shepherd.

**9. Kauai: Volcanic and Sedimentary Development of a Mid-Plate Island.**

Floyd W. McCoy, Jr., fmccoy@hawaii.edu, Windward Community College; Doak C. Cox.

**10. Summit and Northeast Rift Zone, Mauna Loa.**

John P. Lockwood, geohaz@aloha.net, Hawaii Volcano Observatory.

**11. Hydrogeology of Oahu.**

Frank Peterson, peterson@soest.hawaii.edu, University of Hawaii.

**12. GMT Map-making Workshop (Oahu).**

Paul Wessel, wessel@soest.hawaii.edu, University of Hawaii.

**13. Phreatomagmatic Volcanism and Geology of Southeast Oahu.**

Steve Self, self@soest.hawaii.edu; Ralph Moberly and Charles Fletcher, University of Hawaii.

**14. Giant-Wave Deposits on Lanai and Molokai.**

James G. Moore, jmoore@mojave.wr.usgs.gov, U.S. Geological Survey, Menlo Park; Wilfred B. Bryan, Woods Hole Oceanographic Institution.

**EARTH-SCIENCE EDUCATION PROGRAM**

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

**STUDENT SUPPORT**

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

The local committee has funds available for partial support of students who will assist with the audio-visual equipment at the meetings. Apply to Student Coordinator Steve Martel, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, (808) 956-7797, martel@soest.hawaii.edu. Applications should state the student's interest in attending the meeting. *All letters must be received by February 15, 1997.*

**DETAILED INFORMATION**

Further information about meeting functions, housing, and activities will be in the final announcement in the February 1997 issue of *GSA Today*, and in the *Abstracts with Programs* for the Cordilleran Section meeting in Hawaii. Some symposia, workshops, field trips, and other activities are still in the planning stages, and further suggestions are welcomed. Direct general questions and suggestions to the local chair, Ralph Moberly, Dept. of Geology and Geophysics, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822, ralph@soest.hawaii.edu, or the co-chair, Rodey Batiza, rbatiza@soest.hawaii.edu, at the same address. ■



Proposals Due January 2, 1997

## Theme for 1997 Meeting Is Global Connections

John Bartley, Chair, and Erich Petersen, Co-Chair

ANNUAL MEETING

Making connections is one of the principal tasks of geoscientists. Such connections range from the straightforward and familiar, such as closing a gap in the mapping of a geologic contact, to the indirect and seemingly outrageous, such as linking trace quantities of polycyclic aromatic hydrocarbons found in an Antarctic meteorite to ancient life on Mars. A global scope is important to geoscience in more than one sense. Plate tectonics and Earth system science are paradigms for placing local data into a global spatial framework, but they also are frameworks for seeking interdisciplinary answers that are "global" in the sense of holistic.

We seek to assemble a scientific program for the 1997 GSA Annual Meeting, in Salt Lake City, Utah, that features **Global Connections**. We are actively soliciting colleagues from outside the United States to participate in the meeting, and hope to host one of the most cosmopolitan GSA meetings ever. Field trips will examine the justly renowned geology of Utah and surrounding areas, and exciting new scientific results from the Rocky Mountain and Basin and Range regions are certain to be featured in technical sessions during the meeting. However, we urge symposium conveners and theme session advocates to help us build from such regional geologic phenomena to a technical program that is truly global in scope.

For example, rather than a theme session on the hydrology of the Bonneville basin, a session might include work on all internally drained lake basins,

thus also including results from elsewhere in North America and on other continents. A session on continental plateaus will provide more opportunities for global connections than one focused only on the geology of the Colorado Plateau, although new work on the Colorado Plateau still can be featured within the more inclusive topic. The Intermountain Seismic Belt can be viewed as a natural laboratory for the study of intraplate active tectonics; a field trip to study neotectonic features of the Intermountain Seismic Belt could be complemented by a technical session on intraplate seismotectonics and seismic hazards.

Ultimately, our goals really are twofold: first, to be inclusive rather than exclusive, encour-

aging the attendance and participation of geoscientists from all disciplines and geographic areas; and, second, to build the technical program around study of processes and problems that are priorities shared by geoscientists regardless of where they live or work. A program constructed with these priorities will foster productive connections among geoscientists; such connections are, after all, the real reason for the meeting.

### PROPOSING THEME SESSIONS

Theme sessions are a set of topically focused, volunteered abstracts. Theme sessions are a way of arranging *volunteered* abstracts into interdisciplinary groupings that make for scientific sense. Themes do not require formal sponsorship by an organization. The stronger theme sessions, however, do benefit from active support (hard work) by those interested in the success of the session.

The sessions, which can be either oral or poster, but not mixed, have variable lengths depending on the submitted number of pertinent and high-quality abstracts. However, a minimum of 16 abstracts is usual for an oral theme session. A minimum of 16 is also usual for a poster theme session. If, at the abstracts deadline, sufficient abstracts have not been received, the theme session will be dropped, and the papers continued in the review process for standard discipline sessions.

*Note:* An abstract submitted to a theme session is considered volunteered, *not* invited. Because a person may be speaker on only ONE volunteered abstract, please remind your colleagues that if an author submits *more than one volunteered abstract with the same person as speaker, all abstracts listing that speaker may be rejected*. This limitation does not apply for those who are invited speakers for symposia.

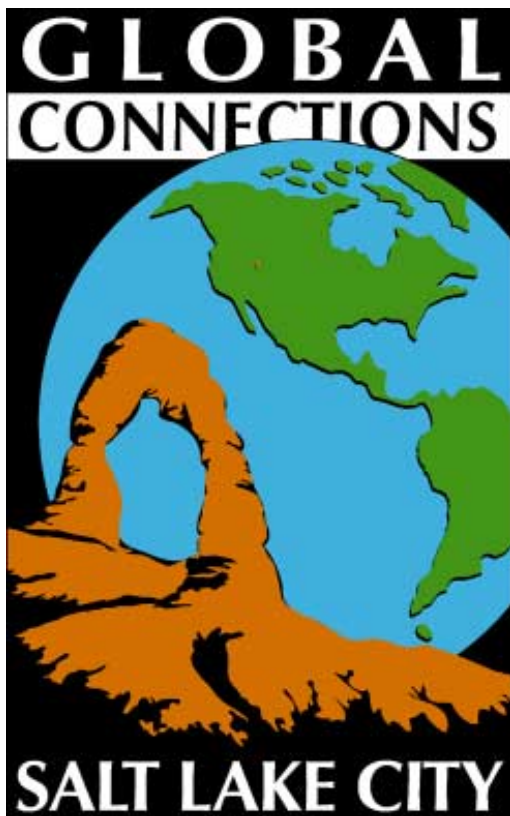
### Process

#### 1. Designate a theme session advocate.

This person would encourage (*not invite*) abstracts that will fit the theme session's concept. Society or division membership may help the advocate in this process. No doubt, when the theme session title is announced, other papers will be voluntarily submitted in addition to those which were solicited or intended. The theme session advocate will serve as liaison with the Joint Technical Program Committee (JTPC). Therefore, the name of the theme session advocate should be included with the proposal. The theme session advocate will generally contribute an abstract to the session. For oral presentations the advocate usually becomes the session chair. The theme session advocate will not otherwise be identified or linked to the theme session in the published *Abstracts with Programs* volume.

2. After choosing a theme title, **select no more than three of the categories which best describe the interdisciplinary aspects of the theme session**. The categories are included with the

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# Mark Person To Be 1997 Birdsall-Dreiss Distinguished Lecturer

Mark Person, the 1997 John Birdsall-Shirley Dreiss Distinguished Lecturer, will speak on one or both of the following topics. Both talks are aimed at audiences with a hydrogeology background but are also appropriate for others in the earth sciences.

## Basin Scale Hydrogeologic Modeling: Problems, Solutions, and Applications

Mathematical modeling of coupled ground-water flow, heat transfer, and chemical mass transport at the sedimentary-basin scale has been increasingly used by earth scientists studying a wide range of geologic processes, including the formation of excess pore pressures, infiltration-driven metamorphism, heat-flow anomalies, sediment metasomatism, basin tectonics, petroleum generation, and migration. These models have provided important new insights into the rates and pathways

of ground-water migration through basins on geologic time scales, the relative importance of different driving mechanisms for fluid flow, and the nature of coupling between the hydraulic, thermal, chemical, and stress regimes. The mathematical descriptions of transport processes, solution methods employed, and application of basin-scale models to reconstruct the paleohydrology of the Great Artesian Basin, Australia, and the Rio Grand Rift system, New Mexico, are the subjects of this lecture.

## Scientific Visualization in Hydrogeology

Much of the research and consulting work in hydrogeology today involves the interpretation of large amounts of time-dependent data and/or the development of computer models of three-dimensional transport processes. Increasingly, tools for the analysis and display of both observational and simulation data involve three-

dimensional visualization. Computer animation of time-dependent hydrogeologic data sets permits analysis of transient hydrodynamic behavior that would be difficult or impossible to detect otherwise. With the recent availability of low-cost visualization computer platforms and software, scientific visualization is now becoming accessible to scientists and practitioners alike. Examples include how visualization has been used in ground flow model calibration, well-head delineation, aquifer pump test analysis, and contaminant plume migration.

Contact Person (Department of Geology and Geophysics, University of Minnesota, (612) 624-1333, fax 612-625-3819, mperson@arcy.geo.umn.edu) as soon as possible to arrange a visit to your institution during his tour. Transportation expenses are paid by the Hydrogeology Division; the host institution is expected to provide for the lecturer's local expenses. ■

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theme session forms. Pick carefully because authors who submit abstracts to a theme session will need to select both the theme session *and* one of the abstract categories. It is the advocate's responsibility to let colleagues know about the submission categories.

**3. Fill in the theme session form and send it with your proposal.** Include a brief (50 words) description of the theme session. It will be used for publication later, in the Call for Papers in *GSA Today* and other GSA mailings. (Descriptions more than 50 words long will not be accepted.)

**4. Advise authors to submit abstracts directly to GSA by July 8.**

**5. Rank abstracts.** Copies of abstracts will be sent to advocates by July 17. All volunteered abstracts (including those for the theme session) also will go to scientific reviewers designated by members of the JTPC.

The theme advocate will have the opportunity at this time to rank the abstracts and to arrange them into a *tentative* order of presentation. This will aid the JTPC in scheduling. THE ORDER OF ABSTRACTS MAY BE CHANGED!!!! If there are a few abstracts too many for the session, some will have to be moved. If there are a few abstracts that are highly appropriate for the session, they will be added. There are any number of reasons why changes to a theme session may occur. The theme advocate has the opportunity at several points to make the priorities and rationale clear to the JTPC. Please keep this in mind. A letter or E-mail to, or phone conversation with, the JTPC orga-

nizer will vastly improve the chances of giving the advocate what she or he wants.

**6. Theme sessions may include a 15 minute introduction OR a 15 minute closing review.** Introduction and/or review periods are best requested by the theme session advocate at the time of theme session submittal and are subject to approval by the Technical Program Chairmen. Abstracts will not be published for introductions and reviews. Remember, however, that such time automatically reduces by one the number of abstracts that may be presented.

**7. An organization may elect to have its JTPC representative coordinate, select, and schedule its theme papers** from among the reviewed and accepted abstracts during the JTPC meeting, August 8-9. Please identify this person to Technical Program Chairmen by July 1. In the absence of a designated theme coordinator, the JTPC chair will assign one of the JTPC representatives.

## Presentation Modes

**Oral Mode.** The standard mode of presentation is a half-day oral session scheduled Monday through Thursday. Usually, 16 papers are presented, with slides or displays as visual support.

**Poster Mode.** Proposals for themes utilizing the poster mode will be considered for *half-day* poster sessions. The poster mode has the same limitations as the oral mode: usually a minimum of 16 papers will be necessary to make the theme session viable.

## Date and Time Preferences:

Sunday through Thursday, 8:00 a.m.-12 noon and 1:30-5:30 p.m.

Although exact times have not been finalized for the 1997 meeting, we anticipate that they will be similar to past meetings. The JTPC chairs will arrange the technical program keeping in mind suggestions from various societies and divisions—as well as those from theme session advocates. The technical chair makes the final scheduling decisions. The *theme advocate does not control the time or date of the session.* Also, because volunteered presentations occur only during the official meeting days, themes are scheduled Monday through Thursday *only*. Theme sessions will not be scheduled on Sunday. Quality of the technical program as a whole takes precedence over all other considerations.

## Abstracts Schedule

**March 1**—Paper 1997 abstract forms will be available from Nancy Carlson at GSA, (303) 447-2020, x161 or E-mail: ncarlson@geosociety.org. Theme advocates will automatically be mailed a set of forms in March.

**May 1**—Electronic abstract form will be on GSA home page for active submission: <http://www.geosociety.org>. (More than 44% of the abstracts for the 1996 Annual Meeting were successfully submitted electronically. Accepted abstracts that are submitted electronically will appear on the Web after September 1. *All* speakers and titles appear on the Web, with links to those abstracts submitted electronically.)

**July 8**—Abstracts deadline. Paper-copy original and five copies due at GSA. Electronic copies accepted until 12 midnight.

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- 
- Middle Jurassic exhumation along the western flank of the Selkirk fan structure: Thermobarometric and thermochronometric constraints from the Illecillewaet synclinorium, southeastern British Columbia  
*Maurice Colpron, Raymond A. Price, Douglas A. Archibald, and Dugald M. Carmichael*
- 
- Paleozoic brachiopod symbioses: Testing the limits of modern analogues in paleoecology  
*J. A. Fagerstrom*
- 
- Ten-million-year history of a thrust sheet  
*Andrew J. Meigs*
- 
- Rapid exhumation of lower crust during continent-continent collision and late extension: Evidence from <sup>40</sup>Ar-<sup>39</sup>Ar incremental heating of hornblendes and muscovites, Caledonian orogen, western Norway  
*T. M. Boundy, E. J. Essene, C. M. Hall, H. Austrheim, and A. N. Halliday*
- 
- The Eocene Big Timber stock, south-central Montana: Development of extensive compositional variation in an arc-related intrusion by side-wall crystallization and cumulate glomerocryst remixing  
*Edward A. du Bray and Stephen S. Harlan*
- 
- Pliocene-Pleistocene asymmetric unroofing of the Irian fold belt, Irian Jaya, Indonesia: Apatite fission-track thermochronology  
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- July 17**—GSA mails abstracts to JTPC reviewers, theme advocates, and symposia conveners.  
**August 1**—Reviews and abstracts due at GSA.  
**August 8-9**—JTPC meets.  
**August 19**—Abstract notices sent.  
*January 2, 1997*, is the deadline for informing the technical chairs about theme sessions.

**Addresses**

**Electronic submission:** <http://www.geosociety.org>.

**Mail or fax:**

**Technical Program Chair:** John Bartley, Dept. of Geology & Geophysics, University of Utah, Salt Lake City, UT 84112, office (801) 581-7062, dept. (801) 581-6553, fax 801-581-7065, jmbartle@cc.utah.edu.

**Technical Program Co-Chair:** Erich Petersen, Dept. of Geology & Geophysics, University of Utah, Salt Lake City, UT 84112, office (801) 581-7238, dept. (801) 581-6553, fax 801-581-7238, eupeters@mines.utah.edu. ■

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- 985 Digital shaded relief image of a carbonate platform (northern Great Bahama Bank): Scenery seen and unseen**  
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*Sandra J. Wyld, Michael J. Quinn, James E. Wright*
- 1041 Strength of chrysotile-serpentinite gouge under hydrothermal conditions: Can it explain a weak San Andreas fault?**  
*D. E. Moore, D. A. Lockner, R. Summers, Ma Shengli, J. D. Byerlee*
- 1045 Influence of preexisting backstop structure on oblique tectonic accretion: The Fiordland margin (southwestern New Zealand)**  
*Jean Delteil, Richard H. Herzer, Marc Sosson, Jean-Frédéric Lebrun, Jean-Yves Collot, Ray A. Wood*
- 1049 High-resolution temporal record of Holocene ground-water chemistry: Tracing links between climate and hydrology**  
*Jay L. Banner, MaryLynn Musgrove, Yemane Asmerom, R. Lawrence Edwards, John A. Hoff*
- 1053 Multistage evolution of Australian subcontinental mantle: Re-Os isotopic constraints from Victorian mantle xenoliths: Correction**

**Forum**

- 1054 Eocene continental climates and latitudinal temperature gradients**  
*Comment: Gregory J. Jordan*  
*Reply: Scott L. Wing, David Greenwood*
- 1055 Early Precambrian gneiss terranes and Pan-African island arcs in Yemen: Crustal accretion of the eastern Arabian shield**  
*Comment: Peter R. Johnson, I. C. F. Stewart*  
*Reply: Martin J. Whitehouse, Brian F. Windley, Mahfood A. O. Ba-Bttat*

## 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, 800-472-1988, ext. 134, E-mail: [ecollis@geosociety.org](mailto:ecollis@geosociety.org).

## 1997 Annual Meeting Field Trips

The 1997 GSA Annual Meeting in Salt Lake City will have a diverse and fascinating slate of field trips. A feature of our program will be several one-day trips on the Sunday prior to the meeting to some of the fascinating geology of the Wasatch Front area. We have both cutting-edge trips and general trips to classic areas in the Colorado Plateau, Basin and Range, Cordilleran Thrust Belt, and Snake River Plain of the area within 1000 km of Salt Lake City. There is also a trip in Mexico to study Holocene volcanoes. As the Salt Lake meeting emphasizes "Global Connections," we will be ready with field trips that will be of interest to geoscientists from all disciplines and all parts of the world.

All pre- and postmeeting field trips are technical in nature, one to four days in duration and led by active field researchers. Professionals and students are strongly encouraged to take advantage of these offerings and with lower airfares on Saturday night stayover flights, costs associated with field trip participation are significantly reduced. Trips begin and end in Salt Lake City or convenient Rocky Mountain area airports. The following list of trips is tentative and subject to change. Further details will be given in the April issue of *GSA Today*.

For further information, contact the 1997 Field Trip Co-Chairs Bart J. Kowallis, Department of Geology, Brigham Young University, P.O. Box 24646, Provo, UT 84602. Phone: (801) 378-3918, fax: 801-378-8143, E-mail: [bart\\_kowallis@byu.edu](mailto:bart_kowallis@byu.edu), and Paul Link, Department of Geology, Idaho State University, Pocatello, ID 83209, Phone: (208) 236-3846, fax: 208-236-4414, E-mail: [linkpaul@isu.edu](mailto:linkpaul@isu.edu).

### PREMEETING

- Devonian Alamo Breccia, Devils Gate and Coyote Knolls Areas, Nevada. *Charles Sandberg and John Warme.*
- Stratigraphy and Structure of Sevier Thrust Belt and Proximal Foreland-Basin System in Central Utah: A Transect from the Sevier Desert to the Wasatch Plateau. *Tim Lawton, Doug Sprinkel, Peter DeCelles, Gautam Mitra, and Aviva Sussman.*
- Sequence Stratigraphy in a Classic Area: Evolution of Fluvial to Marine Architecture in Response to Tectonism and Eustasy, Cretaceous Foreland Basin, Utah. *Peter Schwans.*
- Regional Geologic Tour of Southeastern Utah Emphasizing National Parks. *Lehi Hintze and Helmut Doelling.*
- Late Ordovician Mass Extinction and Glacio-eustasy—Sedimentologic, Biostratigraphic, and Chemostratigraphic Records from Shelf and Basin Successions, Central Nevada. *Stan Finney, John Cooper, and William Berry.*
- Neoproterozoic Sedimentation and Tectonics in West-Central Utah. *Nick Christie-Blick.*
- Pleistocene Volcanic and Sedimentary History of the Snake River Plain. *Mel Kuntz, Steve Anderson, Richard Smith, Mike McCurry, and Bill Hackett.*
- Late Pleistocene–Holocene Cataclysmic Eruptions at Nevado do Toluca and Jocotitlan Volcanoes, Central Mexico. *Jose Luis Macias.*
- Neotectonics, Geologic Hazards, and Fault Segmentation along the Hurricane Fault in Utah and Arizona. *Meg Stewart, Wanda J. Taylor, Philip Pearthree, Barry Solomon, and Hugh Hurlow.*
- Grand Tour of the Ruby–East Humboldt Metamorphic Core Complex, Northeast Nevada. *Arthur W. Snoke, Keith A. Howard, and Calvin G. Barnes.*
- Topaz- and Beryl-Bearing Rhyolites of Western Utah. *Eric H. Christiansen and Jeffrey D. Keith.*
- Structure and Kinematics of a Complex Crater, Upheaval Dome, Canyonlands National Park, Utah. *Bryan Kriens, Ken Herkenhoff, and Eugene Shoemaker.*
- New Explorations along the Northern Shores of Lake Bonneville. *G. C. Oviatt and D. M. Miller.*
- Ghost Ranch, New Mexico, Coelophysis Quarry: 1947–1997. *David D. Gillette, J. Lynett Gillette, and Edwin H. Colbert.*

### Classic Geology and General Interest Trips Along the Wasatch Front.

- Proterozoic Tidal Rhythmites and Estuarine Deposition of Central Utah as Demonstrated in Big Cottonwood Canyon Area: Sedimentology and Astrophysical Implications. *Todd Ehlers, Margie Chan, and Paul Link.*
- Examination of Fault-Related Rocks of the Wasatch Normal Fault. *Jim Evans, W. Adolph Yonkee, Ron Bruhn, and William Parry.*
- Sequence Stratigraphy and Paleocology of the Spence Shale Member of the Langston Formation, Wellsville Mountains, Utah. *Dave Liddell and Scott Wright.*
- Geologic Hazards of the Wasatch Front. *Mike Hylland.*
- Lake Bonneville Classic Depositional Shore Features: Geochronology, Geomorphology, Stratigraphy, and Sedimentology. *Derald Smith, Donald Currey, and Jack Oviatt.*

### HALF-DAY—Concurrent with the Meeting

- Bedrock Geology and Hydrogeology of the Snyderville Basin, near Park City, Utah: A Rapidly Growing, Bedrock-bounded Subalpine Basin. *Jim Evans, Frank Ashland, Kelly Keighley, and W. Adolph Yonkee.*

### POSTMEETING

- Fluvial-Deltaic Sedimentation and Stratigraphy of the Ferron Sandstone. *Tom Chidsey and Paul Anderson. Sponsored by Utah Geological Association.*

**Carbonate Sequences and Fossil Communities from the Upper Ordovician–Lower Silurian of the Eastern Great Basin.** *Mark Harris and Peter Sheehan.*

**Mississippian Stratigraphy and Paleotectonics of the Antler Foreland, Eastern Nevada and Western Utah.**

*N. J. Silberling, J. H. Trexler, Jr., K. M. Nichols, and P. W. Jewell.*

**Sequence Stratigraphy and Taphonomy of Middle Cambrian Rocks, Eastern Great Basin.** *Dave Liddell, Carl Brett, and Dick Robison.*

**Triassic and Jurassic Macroinvertebrate Faunas of Utah: Field Relationships and Paleobiologic Significance.** *Carol M. Tang and David J. Bottjer.*

**Lower to Middle Cretaceous Dinosaur Faunas of the Central Colorado Plateau: A Key to Understanding 35 Million Years of Tectonics, Sedimentology, Evolution, and Biogeography.** *Jim Kirkland, Frank DeCourtin, Rex Cole, Brooks Britt, and Tim Lawton.*

**Hinterland to Foreland Transect through the Sevier Orogen, NE Nevada to SW Wyoming: The Structural Style and Metamorphic and Kinematic History of a Large Contractional Orogenic Wedge.** *Phyllis Camilleri, Jim Coogan, Peter DeCelles, Al McGrew, and Adolph Yankee.*

**Extensional Faulting, Footwall Deformation and Plutonism in the Mineral Mountains, Southern Sevier Desert.** *Drew S. Coleman, J. Douglas Walker, John M. Bartley, and David E. Price.*

**Early Jurassic Tectonism and Magmatism in the Continental Arc: Black Rock Desert, Northwest Nevada.** *Sandra Wyld and Jim Wright.*

**Bimodal Basalt-Rhyolite Magmatism in the Central and Western Snake River Plain, Idaho and Oregon.** *Mike McCurry, Bill Bonnicksen, Craig White, Martha M. Godchaux, and Scott S. Hughes.*

**High Old Pluvial Lakes of Western Nevada.** *Marith Reheis and Roger Morrison.*

**Quaternary Geology and Geomorphology of the Henry Mountains.** *Ben Everitt, Bob Anderson, Greg Dick, Alan Howard, and Andy Godfrey.*

#### **SPONSORED BY THE SOCIETY OF ECONOMIC GEOLOGISTS**

**The Geology and Ore Deposits of the Oquirrh and Wasatch Mountains.** *David John and Geoff Ballantyne.*

## ■ 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) 844-4887, 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.*

## ■ 1998

**Toronto, Ontario, Canada**

**October 26–29**

**Metro Toronto Convention Centre**

**Sheraton Toronto Centre Hotel and Towers**

**General Chairs:** *Jeffrey J. Fawcett, University of Toronto*  
*Emlyn Koster, Ontario Science Centre*

**Technical Program Chairs:**

*Denis M. Shaw, McMaster University*

*Andrew Miall, University of Toronto*

**Call for Field Trip Proposals:**

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

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

Henry Halls  
Erindale College  
Mississauga, ON L5L 1C6,  
Canada  
(905) 828-5363  
Fax 905-828-3717  
hhalls@credit.erin.utoronto.ca

## ■ FUTURE ANNUAL MEETINGS

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

**FOR INFORMATION ON ANY GSA MEETING  
CALL THE GSA MEETINGS DEPARTMENT**

**1-800-472-1988 or (303) 447-2020, ext. 133**

**E-mail: [meetings@geosociety.org](mailto:meetings@geosociety.org) or see GSA's  
World Wide Web page at <http://www.geosociety.org>**

## **GSA Student Associate Member Travel Grants**

The GSA Foundation has awarded matching grants to the six GSA sections. The money, when combined with equal funds from the sections, is used to assist GSA Student Associates traveling to GSA meetings. For information and deadlines, contact your section secretary.

### **Cordilleran**

Bruce Blackerby, (209) 278-2955

### **Rocky Mountain**

Kenneth Kolm, (303) 273-3932

### **North-Central**

George Hallberg, (319) 335-4500

### **South-Central**

Rena Bonem, (817) 755-2361

### **Northeastern**

Kenneth Weaver, (410) 554-5532

### **Southeastern**

Harold Stowell, (205) 348-5098,  
<http://www.geo.ua.edu/segasa/segasa.html>

# CLASSIFIED ADVERTISING

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

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first 25 lines	\$0.00	\$2.35
additional lines	\$1.35	\$2.35
Code number: \$2.75 extra		

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## Positions Open

### SURFICIAL PROCESS GEOMORPHOLOGY

The Department of Earth Sciences at Dartmouth College invites applications for a tenure-track faculty position in geomorphology at the assistant professor level. We are interested in a process-oriented geomorphologist who can interact with existing departmental research programs in areas such as hydrogeology, environmental geochemistry, remote sensing, stratigraphy, and tectonics.

The successful candidate will be expected to demonstrate excellence in both teaching and research, develop a vigorous, externally funded research program, advise student research at both BA and Ph.D. levels in Earth Sciences, as well as participate in the interdisciplinary Earth, Ecosystems, and Ecological Sciences graduate program at Dartmouth.

A curriculum vitae, list of publications, description of proposed teaching and research interests and objectives, and the names, addresses, and fax numbers of at least three references should be sent to: Geomorphology Search Committee, Department of Earth Sciences, Dartmouth College, 6105 Fairchild Hall, Hanover, NH 03755; e-mail: [earth.sciences@dartmouth.edu](mailto:earth.sciences@dartmouth.edu)

Evaluation of applications will begin November 1 and will continue until the position is filled. The appointment will be effective July 1, 1997.

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

### ARIZONA STATE UNIVERSITY / BIOGEOLOGY

The Department of Geology at Arizona State University invites applications for a faculty position in Biogeology. Rank is open. We encourage applications from persons with research interests in fields such as Paleontology, Biostratigraphy, Biogeochemistry, Paleoecology, Paleoclimatology, Origin and Molecular History of Life, and Exobiology. Requirements are a Ph.D. in the geological or related sciences, evidence of research and teaching achievement or potential appropriate to rank, and the ability to teach an undergraduate majors' course that provides a comprehensive understanding of the role of biologic processes in geology. The successful candidate will be expected to sustain a vigorous research program and to be strongly committed to quality teaching at the undergraduate levels. Applicants for Associate or Full Professor must demonstrate an outstanding, established research program. Starting date: 16 August 1997.

Send letters of application describing current research and teaching interests, curriculum vitae, and names and addresses of three potential references to: Edmund Stump, Search Committee Chair, Department of Geology, Box 871404, Arizona State University, Tempe, AZ 85287-

1404; Phone: (602) 965-5081; Fax: 602-965-8102. The closing date for applications is 1 December 1996 and the first day of each month thereafter until the position is filled. Arizona State University of an Equal Opportunity/Affirmative Action Employer.

### DEPUTY DIRECTOR

Kansas Geological Survey, Univ. of Kansas, Lawrence. Full-time. Start 04-06-97 or as soon thereafter as possible. Salary negotiable. Responsible for day-to-day operations and research program. Ph.D. in geological science with strong record of accomplished research, management experience, and successful record of development of research programs are required. Deadline: 01-02-97. For complete description and application procedure (Ref #97W0033), contact B. McClain, (913) 864-3965, [mccclain@pcmail.kgs.ukans.edu](mailto:mccclain@pcmail.kgs.ukans.edu) or <http://crude2.kgs.ukans.edu/kgs.html>

KU is an EO/AA employer.

### ENVIRONMENTAL ENGINEER

40 hours per week, \$31,500 year. Research and develop thermodynamic remediation initiatives for contaminated sites. Conduct treatability studies on thermal desorption of BTEX and PAH contaminated sites. Design abatement plans and specify controls for asbestos and lead-based contaminated sites. Requires B.S. degree in Chemical or Environmental Engineering and 2 yrs. experience. Must have completed and passed examinations for courses in asbestos and lead in compliance with EPA guidelines. Interested applicants apply in person or by resume to the GA Dept. of Labor, Job Order # GA 6013535, 2943 N. Druids Hills Road, Atlanta, GA 30329 or the nearest Dept. of Labor Field Service Office.

### UNIVERSITY OF BRISTOL

#### POSTDOCTORAL RESEARCH ASSISTANT

To work on a 2-year Leverhulme Trust funded project to develop an existing numerical model coupling carbonate sedimentation and diagenesis, developed jointly with Royal Holloway University of London. The project aims to develop a predictive capacity for sediment texture and depositional porosity, incorporating the effects of shallow compaction, to enable the tracking of evolving permeability.

You will be responsible for development of algorithms, parameterisation and testing of the model, and will work in collaboration with a second RA responsible for computer programming. You should have completed a Ph.D. and have an interest in quantitative geology and preferably prior experience in carbonate sedimentology and diagenesis or other relevant fields.

Salary range: £14,317 — £15,986 (Grade 1A). Informal enquiries can be made to Dr. Fiona Whitaker on (0117) 928 7790; e-mail: [fiona.whitaker@bristol.ac.uk](mailto:fiona.whitaker@bristol.ac.uk)

For further details telephone (0117) 925 6450, minicom (0117) 928 8894 or E-mail: [recruitment@bris.ac.uk](mailto:recruitment@bris.ac.uk) (stating postal address only) quoting reference E578.

Closing date for applications: 15th November 1996. An Equal Opportunity Employer.

### SURFACE PROCESSES / BOSTON COLLEGE

The Department of Geology and Geophysics at Boston College seeks a dynamic candidate for a tenure-track faculty position (rank open) in the area of Surface Processes, beginning Sept. 1997. Individuals may have research interests in any of the sub-specialties in this broad field, but those with backgrounds in geomorphology, surface hydrology, wetland dynamics, sedimentation or coastal dynamics are particularly encouraged to apply. A Ph.D. is required and post-doctoral experience desirable. The individual will be expected to teach undergraduate and graduate courses in our geology and environmental programs and to carry out an aggressive research program in his or her specialty. The Department, which also runs the nearby Weston Geophysical Observatory, is well equipped (including flume and GIS laboratories) and is housed in modern, recently renovated facilities on a suburban campus 8 miles west of Boston. Rank of appointment will be commensurate with experience.

A curriculum vitae, statement of research interests, list of references and copies of selected publications should be sent to Christopher Hepburn, Chairman, Dept. of Geology and Geophysics, Boston College, Chestnut Hill, MA 02167 by Jan. 10, 1997. For further information, contact the above at 617-552-3541 or 3642 or via E-mail: [hepburn@bcvms.bc.edu](mailto:hepburn@bcvms.bc.edu)

Boston College is an affirmative action/equal opportunity employer. Qualified women and minorities are encouraged to apply.

### THREE YEAR TEMPORARY POSITION IN SEDIMENTARY GEOLOGY

The Department of Geology at Bucknell University invites applications for a temporary three-year non-tenure track position, beginning Fall, 1997, to cover leaves planned in coming years. We are seeking an individual with primary strengths in the area of sedimentary geology. Ph.D. in Geology preferred; ABD considered. Entry-level assistant professor rank.

The teaching load is two courses with labs per semester. Applicant will be expected to: 1) teach courses for undergraduate majors in sedimentology, paleontology, and possibly in other areas of the applicant's field of expertise; 2) teach introductory courses including historical geology and other courses such as physical geology; and 3) supervise independent research by upper-level undergraduate students. Applicants must be strongly committed to teaching. Bucknell's Geology program is field intensive; we expect candidates to use field opportunities in the central Appalachian area in their courses.

Applicants should send resume, transcripts, statements of teaching interests and objectives, and the names, addresses, and telephone numbers of at least three references to Edward Cotter, Department of Geology, Bucknell University, Lewisburg, PA 17837. Review of applications will begin November 15, 1996 and continue until an appointment is made. Bucknell University encourages applications from women and members of minority groups (EEO/AA).

### PROJECT GEOLOGIST

Lead geological projects, supervise tech/admin staff in environ contamination assessments inc. determine well designs/locations, supervise installation of piezometers, shallow/deep monitor wells, determine/map groundwater flow, sampling protocols, water sampling/analysis of water quality data, soil sampling, area well surveys; delineation of vert/horiz extent of contaminants, determine aquifer properties using hydrogeologic modeling programs, implement/analyze aquifer pump tests, soil vent tests. Design/supervise emergency response to assess/remediate contaminant releases. Design, operate, maintain, monitor remediation systems or prep alternative risk assessments in accord w/state/federal guidelines. Write reports, provide project mgmt of admin staff, subcontractors, budget controls. Quality assurance knowledge for geological investigations. Req: Bachelor's in Geology + 2 yrs exp or 2 yrs as Staff Hydrogeologist &/or Geologist involved in environmental contamination control/remediation. \$38,285/yr, 40 hrs/wk, 8-5. Submit resume to Job Service of Florida, 2660 W. Oakland Park Blvd., Ft. Lauderdale, FL 33311-1327. Re: Job Order #FL 1473149.

### GEOMORPHOLOGY

The Department of Geography at the University of California, Berkeley seeks applications for an entry level tenure-track Assistant Professor position, Starting 1 July 1997 for a Physical Geographer/Earth scientist with primary research in geomorphology. A broad interest in environmental change and human transformation of the earth is desirable. A commitment to a high rate of scholarly productivity and excellence in classroom and field methods teaching is expected. Applicant must have Ph.D. or completed dissertation. Submit letter of application, vita, a complete list of publications, and the names of three references and addresses, by December 15, 1996. Apply: Richard Walker, Chair, Department of Geography, 501 McCone Hall, University of California, Berkeley, CA 94720-4740. The University of California is an Equal Opportunity, Affirmative Action Employer.

### MARINE STRATIGRAPHY/SEDIMENTOLOGY

The Department of Earth Sciences, University of Southern California, continuing a search for a tenure-track faculty member at the assistant professor level in marine stratigraphy/sedimentology to begin September 1997. We seek an accomplished individual with primary research interests in marine sedimentary rocks, linking global paleoenvironmental ecological change through study of the stratigraphic record. A strong land-based field research orientation is desirable, as well as the ability to integrate one or more analytical approaches. The successful candidate will be expected to foster interaction with ongoing programs in paleobiology, marine geology, paleoceanography, marine geochemistry, paleomagnetism and geomorphology. Major USC facilities include XRD and XRF systems, stable and radioisotope labs, a computer/GIS facility and the Center for Electron Microscopy and Microanalysis. Teach-

ing responsibilities will include undergraduate offerings in stratigraphy and sedimentology as well as graduate offerings in the area of speciality.

Applications including curriculum vitae, a statement of teaching and research interests, and the names of three references should be sent directly to: Professor Charles Sammis, Chair, Dept. of Earth Sciences, University of Southern California, Los Angeles, CA 90089-0740. Applications from women and individuals from under-represented groups are strongly encouraged; USC is an AA/EOE.

#### ASSISTANT PROFESSOR / UNIVERSITY OF OREGON

The Department of Geological Sciences solicits applications for an entry-level tenure-track position to begin Fall 1997. We seek an individual who applies quantitative and field-based methods to the study of sediment transport and deposition, or one who studies sedimentary rocks with the aim of understanding tectonics, paleoclimatic, or other processes. The ideal candidate would build on our programs in neotectonics, fluid mechanics, paleontology, paleosols, volcanology, geochemistry, and geophysics and would extend our expertise in environmental geology, geologic hazards, and geological aspects of landscape development.

The successful applicant will be expected to develop an academically-oriented, externally-funded research program, and to teach advanced undergraduate courses in

surficial processes, especially those resulting in the formation of sedimentary rocks, advanced courses in the candidate's speciality, and to contribute to teaching geological and related environmental sciences at the introductory level.

Completion of the Ph.D. is required. Applicants should send a curriculum vitae, a statement of research and teaching interests, and contact information for three referees to [geosearch@ccmail.uoregon.edu](mailto:geosearch@ccmail.uoregon.edu) or Search Committee Chair, Department of Geological Sciences, 1272 University of Oregon, Eugene, OR 97403-1272. We will begin reviewing completed applications by January 1, 1997, and will continue until the position is filled.

The University of Oregon is an equal opportunity/affirmative action institution committed to cultural diversity and compliance with the Americans with Disabilities Act.

#### ENGINEERING GEOLOGY UNIVERSITY OF PAPUA NEW GUINEA

The University seeks a lecturer or senior lecturer to teach and supervise research in engineering geology and hydrogeology, includes environmental geology. Applicants should have a relevant post-graduate tertiary qualification and experience in engineering geology field investigations (mining, construction), and be prepared to teach in other areas of geology. Appointment by three-year contract, leave fares after 18 months, housing provided. Details

from Hugh Davies at [100353.155@compuserve.com](mailto:100353.155@compuserve.com) or fax 675 3260369.

## Services & Supplies

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

## Opportunities for Students

**Graduate Traineeship:** 4-year traineeships available for graduate study in conjunction with interdisciplinary Research Training Group (RTG) in ecology, geology, archaeology, geography, and soils to enhance training in "Paleorecords of Global Change." Only citizens, nationals, or permanent residents of the U.S. qualify for stipends. The University of Minnesota is an equal opportunity educator and employer. Application deadline January 2. For application contact Barbara Eastwold, RTG, University of Minnesota, Ecology, Evolution and Behavior, 1987 Upper Buford Circle, St. Paul, MN 55108. Phone: 612/624-4238; fax: 612/624-6777; e-mail: [eastwold@ecology.umn.edu](mailto:eastwold@ecology.umn.edu).

## CALENDAR

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

#### November

November 21–22, **MINEXPO '96**, Advances in Saskatchewan Geology and Mineral Exploration. Information: MINEXPO '96, P.O. Box 234, Regina, Sask S4P 2Z6, Canada, (306) 787-9181, fax 306-787-2488; E-mail: [bill.slimmon@sasknet.sk.ca](mailto:bill.slimmon@sasknet.sk.ca).

### 1997 Meetings

#### January

January 9–12, **Petrotech '97**, New Delhi, India. Information: Confederation of Indian Industry, 23, 26 Institutional Area, Lodi Rd., New Delhi 110 003, India; phone 91-11-4629994, fax 91-11-4626149, E-mail: [indus%ccii@sirnetd.ernet.in](mailto:indus%ccii@sirnetd.ernet.in).

January 19–24, **International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI), 1997 General Assembly**, Puerto Vallarta, Mexico. Information: Lourdes Godínez, E-mail: [lourdes@igiris.igeograf.unam.mx](mailto:lourdes@igiris.igeograf.unam.mx); (525) 622-4332, 622-4333; 687-9430, 687-9470, 687-9867, fax: 525-550-2486, [http://charro.igeofcu.unam.mx/iavcei97/](http://charro.igeofcu.unam.mx/iavcei97/deadline.html) deadline.html.

#### March

March 10–13, **Contaminated Soils and Groundwater 7th Annual West Coast Conference**, Oxnard, California. Information: Jennifer J. Howland, AEHS, 150 Fearing St., Amherst, MA 01002, (413)549-5170, fax 413-549-0579.

#### April


April 6–9, **Sinkholes and the Engineering and Environmental Impacts of Karst Sixth Multidisciplinary Conference**, Springfield, Missouri. Information: P.E. LaMoreaux & Associates, Inc., 106 Administration Rd., Oak Ridge, TN 37830, (423) 483-7483, fax 423-483-7639, E-mail: [pelaor@usit.net](mailto:pelaor@usit.net), <http://www.uakron.edu/geology/6th.html>.

#### May

May 25–28, **8th Global Warming International Conference & Expo**, New York, New York. Information: Sinyan Shen, Chair, International Program Committee, c/o Global Warming International Center, 22W381 75th St., Naperville, IL 60565-9245, (630)910-1551, fax 630-950-1561, <http://www2.msstate.edu/~krreddy/glowar/glowar.html>.

#### June–July

June 29–July 3, **Water Resources, Education, Training, and Practice: Opportunities for the Next Century**, Keystone, Colorado. Information: American Water Resources Association, 950 Herndon Pkwy., Suite 300, Herndon, VA 22070-5531, (703)904-1225, fax 703-904-1228, E-mail: [awrah@aol.com](mailto:awrah@aol.com).



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Complete application should be sent in time to arrive no later than 1 January 1997, and be addressed to: Chair of Search Committee, Dept. of Geology, Colby College, 5804 Mayflower Hill, Waterville, Maine 04901-8858. For more information about the College, please see the Colby web page at: <http://www.colby.edu>. Colby is an AA/EO employer and encourages applications from women and minority candidates.

#### July

July 7–10, **Airborne Remote Sensing 3rd International Conference**, Copenhagen, Denmark. Information: ERIM/Airborne Conference, P.O. Box 134001, Ann Arbor, MI 48113-4001, (313)994-1200, ext. 3234, fax 313-994-5123, E-mail: [wallman@erim.org](mailto:wallman@erim.org), <http://www.erim.org/CONF/conf.html>.

#### August

August 6–8, **Ninth Peruvian Geological Congress, Lima, Peru**. Information: IX Peruvian Geological Congress Organizing Committee, c/o Sociedad Geológica del Peru, Arnaldo Márquez 2277, Lima 11, Perú, fax 51-1-261-2362.

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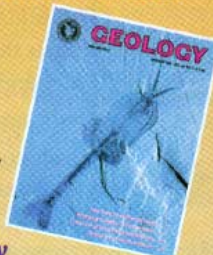
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