What If the Conveyor Were to Shut Down? Reflections on a Possible Outcome of the Great Global Experiment

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ABSTRACT

Suggestions that the ongoing greenhouse buildup might induce a shutdown of the ocean’s thermohaline circulation raise the questions as to how Earth’s climate would change if such an event were to occur. The answer preferred by the popular press is that conditions akin to those that characterized the Younger Dryas—the last kiloyear cold snap—would return. But this extreme scenario is an unlikely one, for models suggest that in order to force a conveyor shutdown, Earth would have to undergo a 4 to 5 °C greenhouse warming. Hence, the conditions at the onset of the shutdown would be very different from those that preceded the Younger Dryas. Thus, it is unlikely that new climate conditions would be nearly so severe. Unfortunately, because no atmospheric model to date has been able to create the observed large and abrupt changes in climate state of Earth’s atmosphere, we lack even the crudest road map. However, as was the case for each of the abrupt changes recorded in Greenland’s ice, if the conveyor were to shut down, climate would likely flicker for several decades before locking into its new state. The consequences to agricultural production of these flickers would likely be profound.

INTRODUCTION

Past shutdowns of the Atlantic Ocean’s conveyor circulation appear to have played a key role in triggering the large and abrupt global climate changes that punctuated the last period of glaciation including the millennial duration Younger Dryas (Broecker and Denton, 1990). Modeling studies suggest that the ongoing greenhouse warming and consequent strengthening of the hydrologic cycle might trigger yet another such shutdown (Manabe and Stouffer, 1993; Stocker and Schmittner, 1997). To most science writers, this result has been construed as implying that conditions similar to those that prevailed during the Younger Dryas cold event would return. Were this analogy correct, then indeed a shutdown of the conveyor would have awesome consequences. Iceland would become one large ice cap. Ireland’s climate would be transformed to that of Spitzbergen. Winters in Scandinavia would become so cold that tundra would replace its forests. The Baltic Sea would be permanently ice covered, as would much of the ocean between Greenland and Scandinavia. Further, the impacts of such a mode change would not be limited to the northern Atlantic basin; rather, they would extend to all parts of the globe (see Fig. 1). Rainfall patterns would dramatically shift. Temperatures would fall. The atmosphere would become dustier.

But is it realistic to believe that a shutdown of the conveyor a century or so from now would produce the conditions that characterized the last glacial period? The answer is very likely “no,” for several reasons. The first has to do with the fact that during the Younger Dryas, Canada and Scandinavia still had sizable ice caps. The second is that the abrupt part of the warming at the close of the Younger Dryas brought climate only about halfway to its interglacial state (Severinghaus et al., 1998). The other half of the transition was more gradual, reflecting perhaps the post-Younger Dryas retreat of the residual ice caps in Canada and Scandinavia. Finally, modeling studies (Manabe and Stouffer, 1993; Stocker and Schmittner, 1997) that forecast a greenhouse-induced conveyor shutdown do so only after a substantial global warming (4 to 5 °C) has occurred. Hence, the global climate conditions prevailing at the time of the shutdown would be substantially warmer than those that existed just before the onset of the Younger Dryas. For these reasons, the analogy to the conditions that prevailed during the Younger Dryas surely constitutes a worst case scenario.

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If the climate change from Younger Dryas to present is not an apt analogy to that which would accompany a conveyor shutdown, then how might we go about estimating the consequences of such an event? As noted by some readers of my papers that warned of a possible greenhouse-induced conveyor shutdown (Broecker, 1997a, 1997b), I stopped short of presenting a specific scenario, for I was fully aware of the pitfalls associated with any such attempt.

ALLERÖD-YOUNGER DRYAS ANALOGY

A less imperfect analogy to what might happen if the conveyor were to shut down is the climate change that accompanied the abrupt transition from the near interglacial conditions that prevailed during the Allerød to the cold conditions that prevailed during the Younger Dryas (see Table 1). The reasons are as follows. First, this transition represents a shutdown rather than a start-up of the conveyor. Second, the melting of the Northern Hemisphere’s residual ice caps nearly halted during the Younger Dryas. Hence this analogy is flawed neither by the influence of changing ice cap size nor by that of changing sea level. But it is flawed in that the base state (i.e., the Late Allerød climate) was different from today’s and even more different from that which would prevail at the time of a greenhouse-induced conveyor shutdown. Nevertheless, it is worthwhile to compare the climate of the late Allerød with that of the Younger Dryas.

The contrast between climate conditions during the warm Allerød and cold Younger Dryas is recorded in four major ways (see Fig. 2): (1) pollen and beetle remains in lake and bog sediments tell us about differences in continental temperature, (2) moraines formed during the Younger Dryas record advances of mountain glaciers, (3) planktonic foraminifera shells in marine sediments document decreases in surface ocean temperature, and (4) the oxygen isotope records kept in ice and lacustrine calcium carbonate record shifts in hydrological conditions. These records send a consistent message. Conditions during the Allerød were nearly as warm as those that characterized the Holocene. As clearly shown by pollen records, the beginning of the Bolling-Allerød marked a worldwide transition from glacial to interglacial conditions. The lapse back to cold conditions during the Younger Dryas, while documented at many localities throughout the world, has a puzzling signature. It is clearly recorded by the descent of mountain snowlines in the American Rockies (Gosse et al., 1995),

<p>| TABLE 1. CONTRAST IN PROPERTIES OF THE SUMMIT GREENLAND ICE CORES (GISP AND GRIP) DURING THREE PERIODS |
|--------------------------------------------------|--------|--------|---------|</p>
<table>
<thead>
<tr>
<th>Late Allerød</th>
<th>Younger Dryas</th>
<th>Early Holocene*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice accumulation rate</td>
<td>13 cm/yr</td>
<td>8 cm/yr</td>
</tr>
<tr>
<td></td>
<td>(Alley et al., 1993)</td>
<td></td>
</tr>
<tr>
<td>δ18O of ice</td>
<td>–38‰</td>
<td>–41‰</td>
</tr>
<tr>
<td></td>
<td>(Dansgaard et al., 1993)</td>
<td></td>
</tr>
<tr>
<td>CH4 content of trapped air</td>
<td>670pdb</td>
<td>840pdb</td>
</tr>
<tr>
<td></td>
<td>(Chappellaz et al., 1993)</td>
<td></td>
</tr>
<tr>
<td>Dust infall rate</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>(Mayewski et al., 1999)</td>
<td></td>
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</tbody>
</table>

*Full interglacial conditions established. ¹Parts per billion by volume.
in the Swiss Alps (Ivy-Ochs et al., 1996), in the tropical Andes (Van der Hammen and Hooghiemstra, 1995; Clapperton et al., 1997), and in the New Zealand Alps (Denton and Hendy, 1994). The oxygen isotope records in Swiss (Eicher and Siegenthaler, 1983) and Polish (Goslar et al., 1995) lakes, tropical mountain glaciers (Thompson et al., 1995) and in the Greenland ice sheet (Dansgaard et al., 1993) make clear that the hydrologic cycle in the region surrounding the northern Atlantic operated quite differently during the cold episodes (late glacial and Younger Dryas) than during the warm episodes (Allerød and Holocene). That these differences in the hydrologic cycle extended well beyond the region around the northern Atlantic is suggested by the substantially lower rate of global methane production during the Younger Dryas as recorded in ice cores from Antarctica and Greenland (Chapellaz et al., 1993; Brook et al., 1996). As the methane content of the atmosphere is set by the areal extent and temperature of the world’s wetlands, these systems must on the average have been drier and colder. The dust record preserved in Greenland ice implies that storminess in the Asian deserts from which the dust has been shown to originate (Biscaye et al., 1997) must have been more intense during the Younger Dryas than during the Allerød. Finally, the benthic oxygen proxy for the deep Santa Barbara basin (Behl and Kennett, 1996) for the Arabian Sea (Schulz et al., 1998) and for the Carriaco Trench (Hughen et al., 1996, 1998) suggests major alternation in thermocline ventilation between these times. In contrast, the Younger Dryas is weakly expressed in many pollen records, giving rise to numerous claims that it didn’t cause significant climate change outside northern Europe. Even in Switzerland, where the snowline descent and 18O change are large and thoroughly documented, the Younger Dryas pollen change is muted. One interpretation for this seeming dichotomy is that while its impacts were global, the Younger Dryas was not simply a return to glacial state. Rather, it lacks an analog and represents yet another mode of operation of the Earth system.

One other aspect of the Allerød–Younger Dryas oscillation must be mentioned. Ice cores from the polar plateau in Antarctica reveal that the millennial-duration climate changes that punctuated the last glacial period were antiphased with respect to those elsewhere in the world (Blunier et al., 1998). During the Allerød, the ongoing warming of the polar plateau came to a halt. Then, at approximately the time of the onset of the Younger Dryas, the warming commenced once again at an even steeper rate than that in progress before the Allerød pause. Based on reconstructions of the radiocarbon content of surface ocean carbon, Hughen et al. (1996) clearly demonstrated that at the onset of the Younger Dryas, the Atlantic’s conveyor circulation must have shut down, allowing newly produced 14C to be backlogged in the atmosphere and upper ocean. Then, 200 years later, the backlogging ceased and the excess 14C in the atmosphere and upper ocean was gradually drained back down. I suggested that this drain-down was caused by the inception of a new mode of deep water formation in the Southern Ocean, and that this new mode delivered extra heat to the northern Atlantic continent, reinitiating the stalled warming (Broecker, 1998).

When the differences in base conditions between those that prevailed during the Allerød and those that would prevail when the greenhouse warming has become sufficiently intense to threaten a conveyor shutdown is taken into account, then the picture looks quite different. As shown by the simplistic scenario presented in Figure 3, while conditions in the northern Atlantic basin would likely become cooler than now, for the rest of the world this change might only ameliorate part of the accrued greenhouse warming. But of course, even if the temperature change could be adequately assessed, we would still lack information regarding those aspects of the climate change which would matter the most (rainfall patterns, soil moisture, storminess, dustiness, etc.). One must keep in mind that as the physics of mode changes is so poorly understood, diagrams such as that in Figure 3 are unlikely to portray what would happen if the Earth system were to undergo a mode switch. The consequences of such a change defy prediction.

The last point to be made is that the Allerød to Younger Dryas transition was punctuated by flickers (see Fig. 4). Electrical conductivity measurements on the GISP2 ice core (Taylor et al., 1993a, 1993b) show that the onset of the Younger Dryas was marked by a period of increased dust fall onto the Greenland ice cap which lasted for about 5 years. This brief dust episode was followed by a several-year-long respite. Then came a second and a third episode each followed by respite. Finally, about 45 years after the onset of

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**Figure 2.** Records demonstrating the profound change in climatic conditions that occurred in the northern Atlantic basin between the Balling-Allerød (BA) warm interval and the Younger Dryas (YD) cold interval. Left: temperature record based on beetle carapaces (Atkinson et al., 1987). Center: oxygen isotope records from Greenland ice (Dansgaard et al., 1993) and from Swiss lake CaCO₃ (Eicher and Siegenthaler, 1983). Right: abundance of the cold-loving planktonic foraminifera species N. pachyderma (left coiling) in the Norwegian Sea (Lehman and Keigwin, 1992).

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**Figure 3.** Simplistic scenario of possible impact on Earth temperatures of a greenhouse-induced conveyor shutdown based on an analogy to the Allerød to Younger Dryas transition, but taking into account that Earth temperatures just prior to a greenhouse-induced shutdown would be several degrees warmer than those that prevailed during the Allerød. While this change would likely cause temperatures around the northern Atlantic basin to drop below their present values, for the rest of the world, it would merely alleviate some part of accrued greenhouse warming. While seemingly comforting, this analogy says nothing regarding all-important changes in the hydrologic cycle, which would surely accompany such a mode change.
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The first dust episode, Younger Dryas conditions locked in. As similar flickers accompanied all the Dansgaard-Oeschger (D-O) transitions, the likelihood that they would accompany a greenhouse-induced mode switch is reasonably high.

WHAT TRIGGERS THERMOHALINE REORGANIZATIONS

The trigger for the precipitous Younger Dryas cooling as first proposed by Rooth (1982) was likely the large pulse of fresh water released into the northern Atlantic as a result of the sudden switch in the outlet of proglacial Lake Agassiz from the Mississippi to the St. Lawrence drainage. This switch was triggered by the retreat of the Laurentian ice cap, which formed the northern shoreline of the lake. When the ice dam gave way, the lake surface dropped in a series of steps by about 100 m (Teller and Thorliefson, 1983). The water released flooded eastward into the northern Atlantic and presumably reduced the salinity of surface waters there to the point where deep water could no longer form. Radiocarbon dating places the timing of the drop in lake level resulting from this switch at about 11000 14C yr ago (that is, within the dating uncertainty of the time of the onset of the Younger Dryas). Confirmation comes from the record kept in Gulf of Mexico sediments, which reveals that a reduction in the input of low 18O meltwater from the Mississippi occurred at close to this time (Broecker et al., 1989). I published a full account of this scenario as a popularized article entitled “The Biggest Chill” in Natural History (Broecker, 1987). Unbeknownst to me, the editors added the following subtitle: “When ocean currents shifted, Europe suddenly got cold.” Then they went on to say, “Could it happen again?” At the time, this statement greatly annoyed me because I had carefully avoided any mention of the future in the article itself. But now in retrospect, perhaps I should forgive them.

During the course of the 50 000-yr duration glacial period, 20 climate shifts similar to that marking the beginning of the Younger Dryas occurred. It is highly unlikely that each was driven by a sudden influx of ponded meltwater. Rather, there must have been another cause. One possibility is that these shifts were driven by a salt oscillator (Broecker et al., 1990). During times when the conveyor was off, the northern Atlantic region was extremely cold, and fresh water accumulated in the ice caps of Canada and Scandinavia rather than running off to the sea. This allowed the salinity of surface waters in the Atlantic Ocean to rise. When the density of waters in the northern Atlantic became large enough, conveyor circulation was reinitiated. Once in action, the heat released from the conveyor’s upper limb caused the ice caps to recede, releasing fresh water to the Atlantic. Surface water salinities were then driven back down to that level where deep water could no longer form, causing the conveyor to shut down. Viewed in this context, one would conclude that during the Allerød, warm ice cap melting drove down the salinity of the northern Atlantic until the shutdown threshold was reached. Likely the surge of water stored in Lake Agassiz merely pushed the system over the brink; i.e., in the absence of such a surge, the system might well have reached this threshold due to the progressive reduction in salinity caused by the ice cap melting. Similarly, greenhouse-driven polar warming and strengthening of the hydrologic cycle during the coming 100 or so years may push the system over the brink once again, bringing the conveyor to a halt.

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is shut down, a fresh water lid forms in the northern Atlantic, temporarily locking ocean circulation into one of its alternate modes of operation.

MODELS TO THE RESCUE?

But wouldn’t predictions based on conveyor shutdowns carried out in linked ocean-atmosphere climate models be more informative than analogies to past changes? I would contend that to date no model is up to the task. No one understands what is required to cool Greenland by 16 °C and the tropics by 4 ± 1 °C, to lower mountain snowlines by 900 m, to create an ice sheet covering much of North America, to reduce the atmosphere’s CO2 content by 30%, or to raise the dust rain in many parts of Earth by an order of magnitude. If these changes were not documented in the climate record, they would never enter the minds of the climate dynamics community. Models that purportedly simulate glacial climates do so only because key boundary conditions are prescribed (the size and elevation of the ice sheets, sea ice extent, sea surface temperatures, atmospheric CO2 content, etc.). In addition, some of these models have sensitivities whose magnitude many would challenge. What the paleoclimatic record tells us is that Earth’s climate system is capable of jumping from one mode of operation to another. These modes are self-sustaining and involve major differences in mean global temperature, in rainfall pattern, and in atmospheric dustiness. In my estimation, we lack even a first-order explanation as to how the various elements of the Earth system interact to generate these alternate modes. One intriguing proposal implies that excess atmospheric dust lowers the mean residence time of water molecules in the

Figure 4. Electrical conductivity of the Summit, Greenland, GISP ice core measured by scraping a pair of electrodes along a fresh ice surface (Taylor et al., 1993a, 1993b). Periods of high dust fall had low conductivity because CaCO3 in the dust neutralizes proton-bearing acids carried by snow. As annual layers are clearly seen, there is no question regarding duration of each episode.

Figure 5. The angry beast. Drawing by P. Catanzaro.
Summer Internships for Undergraduate Geoscience Majors: National Park Service Geology Internships through the Institute for Environmental Education of the Geological Society of America

The Institute for Environmental Education at GSA is offering ten National Park Service undergraduate geology internships for the summer of 1999. Some of the internships involve educating visitors about park geology, others involve working with the park’s geologic or paleontologic resources, and some involve both educational and resource management duties. Specific information on the positions and qualifications for each internship are listed in the separate descriptions below.

Internships will be awarded on a competitive basis to junior or senior undergraduate geoscience majors. Applicants must be GSA Student Associates. (Applicants may join GSA by submitting a membership application with their internship application materials.)

Each internship carries a $2,500 stipend to cover transportation, food, and incidental expenses. Park housing will be provided free of charge. Sponsors for the 1999 internships will be announced in the spring of 1999. Funding for 1998 interns was generously provided by Shell Oil Company Foundation, John F. and Carol Mann, Jr., and the Frank A. Campini Foundation.

Internship applications must include the following: (1) A standard letter-size sheet of paper with: (a) your name, (b) your address at school, (c) your telephone number, (d) your e-mail address (if applicable), (e) the dates you are available for an internship this summer, and (f) your GSA membership number (or attach your completed application for GSA Student Associate); (2) One copy of your resume; (3) One copy of your academic transcript (unofficial is acceptable); (4) One letter of reference from a faculty member in your geoscience department (the letter may be included with your application in a separate, sealed envelope with the signature of the reference across the seal, or it may be mailed separately); (5) For each internship you are applying for, a one-page letter explaining your interest in and qualifications for that internship; be sure to specify which internship you are applying for and to specifically address how your education, experience, and interests match the needs and requirements of that particular internship.

Send complete application materials to: Gwenevere Torres, NPS Internship Applications, Geological Society of America, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301.

All application materials must be postmarked no later than February 15, 1999. Electronic submissions will not be accepted. Successful applicants will be notified by April 1, 1999. For more information, call (303) 447-2020, ext. 162, or e-mail gtorres@geosociety.org.

Dates for internships: Three months between May and the end of August 1999, except where indicated; exact starting and ending dates are negotiable.

Capitol Reef National Park, South-Central Utah

Capitol Reef National Park encloses Waterpocket Fold, a 100-mile-long monocline with dramatic sandstone arches, domes, deep narrow canyons, and steep cliffs.

Position: The park needs an intern to assist with public programs, such as geology talks, walks, slide shows, Junior Geologist events, and children’s geology day camps. The intern will help staff the visitor center once a week, where one duty will be broadcasting road and weather information on the park’s radio system.

Qualifications: The intern must enjoy working with the public and be comfortable speaking to a variety of audiences. Experience working with children is required, preferably with upper elementary students in an outdoor setting. Knowledge of Colorado Plateau geology is highly desirable. Introductory course work in geology is required, and course work in education is highly desirable. Personal transportation is recommended; the park is 11 miles from groceries and 75 miles from a major commercial area.

Craters of the Moon National Monument, South-Central Idaho

Craters of the Moon lies in a high desert wilderness at the edge of the Snake River Plain, an hour from Sun Valley and three hours from Yellowstone and Grand Teton national parks. The park preserves a surreal “moonscape” of rugged basalt dotted with cinder cones and cut by hundreds of lava tubes and volcanic caves.

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**Internships continued from p. 5**

Position: The park seeks an intern to assist with locating, mapping, and inventorying the park's volcanic caves and their geologic, hydrologic, biologic, and cultural features. **Qualifications:** For this field-based internship, the intern must be able to hike for long distances over rugged volcanic terrain in extreme summer weather. Caving experience is highly desirable. Course work in introductory geology and field geology is required; mineralogy and/or igneous petrology course work is desirable. The intern must have experience working with computer databases; experience with GPS mapping and ArcView is desirable. Demonstration of strong organizational skills and the ability to integrate information from many sources are required. Personal transportation is recommended; the park is roughly 25 miles from town.

Denali National Park,
South-Central Alaska

Denali's bedrock geology includes Precambrian to Tertiary rock units roughly aligned in east-west belts along the Alaska Range and capped by magnificent 20,320-foot Mt. McKinley, the highest point in North America.

Position: The park needs an intern to assist with public education and other park duties. About 60% of the internship will be giving geology and paleontology talks and programs, leading public tours of active paleontological digs, and staff the visitor center and museum. About 25% will be completing park projects such as preparing exhibits and bulletins, assisting with paleontological digs, collecting natural resource data, or creating new educational programs. About 15% will be participating in training opportunities in fields such as paleontology, geology, park operations, fire management, natural resource management, and/or natural history.

Qualifications: Strong written and oral communication skills are required. The intern must enjoy working with the public and must be able to present geologic information in interesting and understandable ways. Course work in introductory geology, historical geology, and paleontology is required. The intern must be able to hike and work outdoors in the extremes of mountain summer weather. Personal transportation is highly recommended; the park is about 20 miles from a small mountain town.

Dates: About May 26-August 15, 1999; the intern must attend park training in late May.

**Fossil Butte National Monument, Southwest Wyoming**

Fossil Butte lies within the Wyoming Thrust Belt and contains a remarkable fossil record of Tertiary freshwater fish and a variety of insects, snails, turtles, birds, bats, and plants.

Position: The park needs an intern to help with tasks related to developing a virtual fossil quarry. The intern will help collect, document, and digitally photograph fish fossils in a quarry setting, prepare and curate specimens, and compile a computer database for the collection. The intern may also travel with park personnel to do field work at other paleontological sites, depending on the intern’s interests and the park’s needs.

Qualifications: Course work in introductory geology and paleontology is required. Course work in biology is desirable. Experience with computer databases and/or photography is desirable. Photographic equipment is available at the park. Personal transportation is recommended in order to take advantage of the region’s resources.

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**REFERENCES CITED**


**CONCLUSIONS**

The fact that we are unable to provide satisfactory estimates of the probability that a conveyor shutdown will occur or of its consequences is certainly reason to be extremely prudent with regard to CO2 emissions. The record of events that transpired during the last glacial period sends us the clear warning that by adding greenhouse gases to the atmosphere, we are upsetting the current balance.

**ACKNOWLEDGMENTS**

This material is based upon work supported by the National Science Foundation under grant ATM 9730546. This is LDEO contribution 5885.
Great Sand Dunes National Monument, South-Central Colorado

Great Sand Dunes includes 39 square miles of the continent's tallest dunes—some as high as 750 feet—against a spectacular backdrop of 14,000-foot mountain peaks.

Position: The park seeks an intern to assist with all aspects of visitor education, including developing and giving geology talks and slide projects, creating a park geology pamphlet, and helping staff the visitor center. About 10% of the internship will be spent assisting staff with field projects and research on hydrogeology and dune migration.

Qualifications: The intern must have excellent oral and written communication skills, a desire to work with park visitors, and an ability to present geologic information to the public in an interesting, understandable way. Course work in introductory geology and geomorphology is required. Course work or experience in education is highly desirable. Field work will require the ability to hike at high altitude (8,200+ feet) in extreme summer weather. Interns must bring sleeping bags and cooking and eating utensils. Personal transportation is highly recommended; the park is 35 miles from the nearest town.

Lake Roosevelt National Recreation Area, Northeast Washington

Lake Roosevelt stretches for 130 miles along the Columbia River behind Grand Coulee Dam. The park includes two distinct regions: Paleozoic sedimentary rocks exposed in mountains bordering the northern half of the lake and Tertiary basalt terrain, modified by huge Pleistocene flooding events, surrounding the southern half of the lake.

Position: The park needs an intern to assist with visitor education by giving campfire talks, making visitor contacts in day-use areas, participating in guided canoe trips, and helping with environmental education and Junior Ranger programs. Other projects may include revising and creating park educational materials. The intern will also assist with evening talks, children’s programs, and other visitor services at the Dry Falls Visitor Center, a nearby site operated by the State of Washington.

Qualifications: The intern must enjoy working with the public and must be able to summarize area geology and present it to the public in an interesting, understandable way. Course work in introductory geology and geomorphology is required; course work in glaciology and/or volcanology is desirable. Course work and/or experience in education is highly desirable. The intern may be able to earn field-geology credit during the summer. Intern must bring her or his own linens. Personal transportation is recommended in order to take advantage of the area’s resources.

Dates: Three months, approximately May 23 to Labor Day 1999.

Mount Rainier National Park, South-Central Washington

Mount Rainier, on the Pacific Ring of Fire, is an outstanding example of Cascade Range volcanism. Today, the volcano hosts the largest single-peak glacial system in the contiguous United States, but its history of eruptions and mudflows warrants its reputation as a significant hazard to surrounding communities.

Position: The park needs an intern to assist with visitor education. About 40% of the intern’s time will be spent presenting geology programs for adults and children. About 30% will be spent staffing the visitor center and roving park trails to provide general information. The remaining time will be spent in training, program preparation, and completing park projects such as creating volcano fact sheets, helping to develop activities for an educators’ guide to volcanic hazards, or writing geology training information for staff and volunteers.

Qualifications: The intern must be interested in public education, have strong oral and written communication skills, and be able to effectively convey geologic information to the public. Course work in introductory geology, and course work or experience in geomorphology, glaciology, and/or volcanology is required. Course work and/or experience in education is highly desirable. The park is located in a remote area, and personal transportation is highly recommended.

Dates: Approximately June 1 through August 31, 1999.

Oregon Caves National Monument, Southwest Oregon

Oregon Caves is located in geologically complex ophiolitic terrain in the Siskiyou Mountains. The caverns are contained in a metamorphosed Triassic reef that originally developed in a back-arc basin.

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Manuscript received October 8, 1998; accepted November 16, 1998.
Position: The park needs an intern to develop and present geologic educational programs and materials for the public as well as to assist park staff with geologic fieldwork. Specific field assignments will depend partly on the interests and experience of the intern but could include caving, fire ecology as it relates to soil science and history, or Pleistocene fossil identification.

Qualifications: The intern must be reliable, self-motivated, and able to communicate effectively with the public. Course work in field geology and mineralogy and/or igneous petrology is required. Experience with thin-section identification and knowledge of regional metamorphism, ophiolite geology, and/or Pleistocene vertebrate paleontology are highly desirable. Experience in caving, photography, graphic drawing skills, basic computer skills, and Internet skills are also desirable. The park is in a remote location, and personal transportation is required to travel from housing to the job site.

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Welcome to the Newly Adopted GSA Strategic Plan!

The new GSA Strategic Plan consists of mission and vision statements and six goals, each goal having several objectives expressing ways in which the goals can be achieved. The goals and objectives give equal weight to continuing existing programs and to embarking on new activities, all intended to assure the quality and value of GSA’s service to its members, to the geosciences, and to society. Notable new ventures include the integrated natural systems science goal 2 and the proposed changes to the Society’s governance model in goal 6.

The plan had its genesis in an 11-member task force convened by Eldridge Moores during his presidency in 1995–1996. The group’s deliberations were enhanced by input over the past three years from GSA headquarters staff, some GSA committee chairs, and various ad hoc groups. Throughout the plan’s development, the task force provided regular updates to GSA Council and, at the 1998 Annual Meeting, in Toronto, Council approved this final draft, together with recommended action items, timelines, costs, and responsibilities.

In approving the plan, Council emphasized that it is to be regarded as an evolving document. This is where you come in. We are asking you to share any ideas and experiences that can help us in implementing the plan’s activities, and we encourage you to look at the plan as an opportunity to participate as a volunteer to extend GSA’s contributions to geoscience professionalism, education, and outreach.

Be assured that Council welcomes your input in building GSA’s future. With your assistance, the plan will grow and evolve as intended. Please take time to read and consider the plan and then to send your comments to: stratplan@geosociety.org or Don Davidson, GSA Strategic Plan, P.O. Box 9140, Boulder, CO 80301-9140.

On behalf of the planning task force:

Eldridge Moores, Chair
Sue Beggs Edward Geary
Valerie Brown Sharon Mosher
Bruce Clark Daniel Sarewitz
Donald Davidson David Stephenson
George H. Davis George Thompson

MISSION STATEMENT AND STATEMENT OF VISION

MISSION:

The mission of GSA is to advance the geosciences, to enhance the professional growth of its members, and to promote the geosciences in the service of humankind.

VISION:

GSA will be a broad unifying scientific society
• fostering the human quest for understanding Earth, planets, and life;
• catalyzing new scientific ways of thinking about natural systems;
• and applying geoscience knowledge and insights to human needs, aspirations, and stewardship of Earth.

GOALS AND OBJECTIVES

GOAL 1. To advance the discovery, development, dissemination, and stewardship of geoscience knowledge.

Objective 1. To maintain the quality and increase the vitality of meetings and conferences.
Objective 2. To maintain the quality and increase the vitality of publications.
Objective 3. To identify and implement new and more effective ways to communicate science.
Objective 4. To promote innovative research.

GOAL 2. To catalyze cooperative interactions among earth, life, planetary, and social scientists who investigate natural systems over varying scales of time and space.

Objective 1. To build a focus on integrative science into the infrastructure and culture of GSA.
Objective 2. To generate cooperative interactions with other organizations.
Objective 3. To promote GSA membership participation in integrated research.
Objective 4. To publish and disseminate the results of integrative natural systems investigations.

GOAL 3. To promote geoscience in the service of society.

Objective 1. To actively foster dialogue with the public and decision-makers on relevant geoscience issues.
Objective 2. To encourage and support member participation in education and societal outreach.
Objective 3. To strengthen the role of geoscience in formal and informal science education.

SUSTAINING

GOAL 4. To attract and sustain a dynamic and viable membership.

Objective 1. To increase and ensure the value of GSA to its members.
Objective 2. To increase and retain the membership base of the Society.
Objective 3. To increase the cultural, disciplinary, professional, and international diversity of the membership.

GOAL 5. To maintain GSA and GSA Foundation as financially viable entities.

Objective 1. To exercise due diligence in management and expenditure of Society assets.
Objective 2. To maintain an active development program ensuring supplemental financial support for GSA programs and activities.
Objective 3. To exercise due diligence in management and expenditure of Foundation assets.

GOAL 6. To optimize GSA’s governance and organizational structure in fulfillment of GSA’s mission.

Objective 1. To assess and enhance the effectiveness of GSA governance, committees, and headquarters organization.
Objective 2. To evaluate and strengthen relations among GSA Divisions, Sections, Associated Societies, and Council.
Objective 3. To promote internationalization of the Society.

SUSTAINING

Penrose Conference
Volcanic Rifted Margins
Nov. 14–19, 1999
Sana’a, Yemen
Application deadline: May 14, 1999
Co-conveners: Ian Davison, davison@gl.rhbnc.ac.uk, Joel Baker, joel@gl.rhbnc.ac.uk, and Martin Menzies, menzies@gl.rhbnc.ac.uk—all at Dept. of Geology, Royal Holloway University of London, Egham Hill, Surrey TW20 0EX, United Kingdom, 44-1784-443615, fax 44-1784-471780.
See February 1999 GSA Today for full announcement.
Catalysis and Integrated Science: Goal 2 of GSA’s Strategic Plan

Cathleen May, Director for Policy and Environmental Issues, Gail Ashley, President, GSA

In adopting the GSA Strategic Plan (see outline in this issue), Council endorsed an adventurous intellectual direction for our Society. The architects of the plan, your representatives in this process, believe that GSA can, and should be, a catalyst for integrated scientific approaches to the Earth system. Goal 2 of the strategy reads, “To catalyze cooperative interactions among earth, life, planetary, and social scientists who investigate natural systems.”

The Earth-system science movement is sweeping forcefully through academia and government. Leaders of scientific societies, eyeing trends in funding agency priorities, are scrambling to demonstrate their ability to collaborate across disciplines. The National Science Foundation is funding curriculum development in Earth-system science, while Stanford’s Earth System Program is already graduating and placing bachelor’s and master’s level achievers. Government science and land management agencies finally have a mandate to treat natural systems as whole systems, and to adjust scientific approaches accordingly. If this movement were just another aberrant wave, we would all recognize it as ephemeral. We know, however, that this is a true “sea change,” not just another wave. We know it as scientists because we know that the world is complex and must be understood eventually in wholes, as well as in parts. Society knows this too; it is intuitive, and often more sensible to the lay person than reductionism.

GSA is well equipped to be a leader in the Earth-system science movement. Our scientific and professional diversity is a pooled resource of disciplinary depth and breadth, both of which are essential to systems science. Individually and collectively, we are prone to care about how science can beneficially affect society. As a whole, our members, our sibling geological societies, and the variety of other organizations with whom we collaborate. To begin, the president and executive director of the Society will appoint a task force on Earth-system science that will work with the Institute for Environmental Education to generate an explicit scheme for achieving our goal. We will solicit and use input from all interested members in designing this “strategy within a strategy.” At the same time, we will step up our interactions with other organizations, such as the Ecological Society of America (ESA), and begin planning joint efforts.

• We need to generate cooperative interactions with other organizations at a minimum of two scales. At the organizational scale, we have already developed successful joint ventures on the topic of integrated science with ESA and the USGS. We are planning other efforts, focused topically, with these and other organizational partners. At the scale where science is actually done, by members of organizations, we hope to build a network of member liaisons. Liaisons will be members of other organizations with which we would like to build interactions. They will do such things as serve on committees of the other organization, convene interdisciplinary technical sessions at the meetings of the other organization, and report items or activities of interest to GSA members, perhaps via the Web site. We would like to begin this process right away, by identifying individuals with cross-disciplinary member affiliations. If you are one of these people and are interested in furthering goal 2, please contact us.

• To promote participation in integrative systems research by GSA members, we plan to use many of our existing vehicles to highlight and encourage such research. These include Penrose Conferences; the new Field Conferences; Pardee Symposia, topical sessions, and technical sessions at GSA Annual Meetings; and Graduate Research Grant Awards.

• To publish and disseminate the results of integrative natural systems investigations requires exploring traditional and alternative publication venues. Possibilities may include soliciting manuscripts for our current publications, creating an electronic publication or a new journal, books or book series, and co-publication.

Goal 2 is intended to be an adaptive strategy that will guide GSA into leadership on behalf of the geosciences. Thus, we expect this strategy to evolve over time, reflecting changing constraints and opportunities, and striving always to contribute to the mission of our Society. This is perhaps the most challenging of the goals in the Strategic Plan, as it moves our Society in new directions intellectually and organizationally. It requires growing a “collaborative culture” among scientists, and a “consortium culture” among scientific organizations.

Your imagination, creativity, intellect, and commitment are essential to achieving this goal. This is not something that headquarters staff can invent and carry off, or that committees can achieve at once-a-year meetings. If bringing geoscience into productive interactions with life and social sciences is not achieved by and for you, the individual member, then the goal is meaningless. Please see yourself as integral to the shaping of this goal, and communicate your perspective, ideas, experience, and wishes to us as soon and as often as you like. Webster’s Dictionary defines a catalyst as “an agent that provokes or speeds significant change or action.” We can’t think of a more appropriate term for your role in the Earth-systems science movement.

About People

GSA Fellow Harmon Craig, Scripps Institution of Oceanography, has been awarded the Balzan Prize (International Balzan Foundation of Milan, Italy), for fundamental contributions to the field of geochemistry.

Fellow Tom Freeman, University of Missouri—Columbia, has received the university Alumni Association’s Distinguished Faculty Award for 1998.

Fellow Robert Ginsburg, University of Miami, is the 1998 recipient of the Hollis D. Hedberg Award in Energy from the Institute for the Study of Earth and Man, Southern Methodist University.

Member John C. Steinmetz is the new director of the Indiana Geological Survey (in Bloomington) and state geologist of Indiana.
The primary role of the Research Grants Program is to provide partial support for research in earth science by 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. Eligibility is not restricted to GSA members. New application forms are available each fall in the geology departments of colleges and universities offering graduate degrees in earth sciences. Forms are mailed to GSA Campus Representatives, department secretaries, and chairpersons in the United States, Canada, and Mexico. Application forms and information are available on GSA's Web page, http://www.geosociety.org. Applications may be downloaded from the Web but may not be submitted by e-mail. They are also available upon request from the Research Grants Administrator, Geological Society of America, P.O. Box 9140, Boulder, CO 80301. Please use only the current 1999 application and appraisal forms.

Confidential evaluations from two faculty members are required from candidates for the M.S. or Ph.D. degree and must accompany applications submitted. PLEASE USE THE "APPRaisal OF APPLICANT" FORMS, WHICH ACCOMPANY THE 1999 APPLICAtION FORMS. APPLICATION FORMS WILL NOT BE ACCEPTED BY FACSIMILE OR E-MAIL.

The Geological Society of America awarded over $300,000 in grants in 1998. The grants went to 187 students doing research for advanced degrees. The average amount awarded was $1654. The largest grant was $2500, but there is no predetermined maximum amount. Funding for this program is provided by a number of sources, 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.

The Committee on Research Grants will meet in April to evaluate applications and award grants. In April, all applicants for grants will be informed of the committee's actions by the Executive Director of the Geological Society of America.
**1998 GSA PRESIDENTIAL ADDRESS**

**Victor R. Baker**

**Geosemiosis**

**ABSTRACT**

Geology is both (1) a body of knowledge about Earth, and (2) a way of thinking about Earth. Many geologists, including G. K. Gilbert, T. C. Chamberlin, and W. M. Davis, among others, emphasized the latter. Their vision of geology as a “science of hypothesis” places emphasis on the mode of reasoning by geologists; that is, on the “-ology” of “geology.” The logic in “-ology” involves a formal science of sound reasoning, but much current philosophy of science denies that there is a logic to hypothesis generation. Does this mean that the methodological writings of Gilbert, Chamberlin, and others are quaint anachronisms in our modern age of predictive computer models, rigorous theory testing, and high-tech experimental laboratories?

The above question is not merely a matter of arcane epistemology. If geology is just physics, chemistry, mathematics, etc., applied to the earth, then its future will be a reduction of those more fundamental sciences. However, if geology has its own unique mode of reasoning, then cultivation of that reasoning will be critical to advancing understanding of Earth, the home to all humankind.

Geologists have always considered their science to be revealed in rocks, sediments, fossils, and other signs of Earth’s processes. Thus, Earth logic is not detached from its objects of study. Instead, the best reasoning (“logic”) of geologists is closely tied to a complex system of signs, a semiotic, that is continuous from the natural world through the thought processes of geological investigators. Moreover, this geological thought is profoundly enriched by a structure of one thing following from another, with antecedent flowing to consequent in logically pure deduction. The realization of that structure, which informs geology as no other science, we call “time.”

Nearly a century ago, former GSA President H. L. Fairchild wrote, “Geologists have been far too generous in allowing other people to make their philosophy for them.” Even today, some geologists waste a lot of time reading philosophy of science books, in the hope of making their discipline “more scientific.” Geology’s great intellectual strength does not lie in some generic “scientific method” for testing purported “truths.” Geology is a science of connection to our real environment, informed by the action of signs, a semiosis, that leads investigators on a fruitful course of hypothesis generation. This mode of inquiry has profound implications for public understanding of science, for achieving a habitable planet, and for advancing creative thought about Earth as a planet. Geologists should be proud of their intellectual tradition, and they need to proclaim its merits if our species is to survive and flourish. Hypthesize outrageously, geologists; you have nothing to lose but your paradigms!  

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**Note:** The full text of Victor Baker’s 1998 GSA Presidential Address will be published in the GSA Bulletin in spring 1999.

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**CALL FOR**

**GSA Today Correspondent for Student Matters**

GSA seeks a Member or Fellow willing to coordinate and be responsible for a regular (monthly) contribution for GSA Today dealing with matters of interest to undergraduate and graduate student members of the Society. GSA headquarters will provide administrative support for the correspondent. The one-year renewable appointment begins in March 1999.

Please send a statement of interest and a short vita to:

Director of Publications  
Geological Society of America  
P.O. Box 9140  
Boulder, CO 80301  
plehr@geosociety.org

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**Coal Geology Division Seeks Nominations for Cady Award**

The Coal Geology Division of the Geological Society of America seeks nominations for the Gilbert H. Cady Award for the year 1999. The Cady Award is made for outstanding contributions in the field of coal geology. As defined in the bylaws of the Coal Geology Division of the Society, “coal geology refers to a field of knowledge concerning the origin, occurrence, relationships, and geologic characteristics of the many varieties of coal and associated rocks, including economic implications.” The award will be made for contributions considered to advance the field of coal geology within and outside North America. It consists of a certificate and an engraved silver tray. Presentation of this award will be made at the Coal Geology Division Business Meeting and Mixer at the 1999 GSA Annual Meeting in Denver.

Nominations for the Cady Award will be evaluated by the Gilbert H. Cady Award Panel. For the year 1999, the panel consists of members James Staub (Southern Illinois University) and Brenda Pierce (USGS, Reston), and it is chaired by Thomas Demchuk (Conoco, Houston).

Nominations should include: name, office or title, and affiliation of the nominee; date and place of birth, education, degree, honors and awards; major events in the professional career including a brief bibliography; and outstanding achievements and accomplishments that warrant the nomination. Three copies of the nomination are required. For a list of past recipients, see http://www.mysite.com/coalgeology/page8.html.

Send nominations to: Thomas D. Demchuk, Conoco Inc., Permian 3048, P.O. Box 2197, Houston, TX 77252-2197, (281) 293-3189; thomas.d.demchuk@usa.conoco.com.

Deadline for submission of nominations is February 28, 1999.

The Coal Geology Division established the award in honor of Gilbert H. Cady; the first award was presented in 1973. Monies for this award are derived from the annual interest income from the Gilbert H. Cady Memorial Fund, which is administered by the GSA Foundation.
CALL FOR NOMINATIONS REMINDERS

PENROSE AND DAY MEDALS, AND HONORARY FELLOWSHIP

Nominations for 1999 Penrose and Day Medals and for Honorary Fellowship in the Society are due by FEBRUARY 1, 1999.

YOUNG SCIENTIST AWARD (DONATH MEDAL)

The Young Scientist Award is for outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the earth sciences. The award consists of a gold medal called the Donath Medal and a cash prize of $15,000.

For the year 1999, only those candidates born on or after January 1, 1964, are eligible for consideration. In choosing candidates for the Young Scientist Award, scientific achievement and age will be the sole criteria. Nominations for the 1999 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); and supporting letters from five scientists in addition to the person making the nomination.

Deadline for nominations for 1999 is FEBRUARY 1, 1999.

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 service in 2000 is FEBRUARY 5, 1999.

DISTINGUISHED SERVICE AWARD

The GSA Distinguished Service Award recognizes individuals for 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 are selected by the Executive Committee, and all selections are ratified by the Council. Deadline for nominations for 1999 is MARCH 1, 1999.

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 $1,000 cash prize from the endowment income of the GSA Foundation's John C. Frye Memorial Fund.

The paper must be selected from GSA or state geological survey publications; it must be selected from those published during the preceding three full calendar years; and the 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 1999 is MARCH 1, 1999.

NATIONAL AWARDS

The deadline is APRIL 30, 1999, for submitting nominations for these four awards: William T. Pecora Award, National Medal of Science, Vannevar Bush Award, Alan T. Waterman Award.

Technical Program and Hot Topics Chairs: Call for Nominations

The Technical Program Chair for GSA Annual Meetings, starting in 2001, and the Hot Topics Chair, starting in 1999, will no longer be tied to the meeting site location. This change will give more people the opportunity to organize the Annual Meeting Technical Program or the Hot Topics lunchtime forums.

The Technical Program Chair (TPC) has the final responsibility over the entire technical program, including the review and acceptance of keynote and topical session proposals (January–February) and the scheduling of all sessions for the GSA Annual Meeting (July–early August) in coordination with the Joint Technical Program (JTPC) representatives. This chairmanship also includes active participation over a three-year commitment in the Annual Program Committee, which meets twice a year (usually March and August). GSA reimburses the chair for all travel expenses, including full expenses for attending the prior year's and current year’s annual meeting.

The Technical Program Chair must have a broad perspective on the geological sciences and be efficient, organized, fair-minded, flexible, and committed to organizing a dynamic meeting. Some experience with technical program scheduling would be helpful, especially membership on the GSA Joint Technical Program Committee (JTPC) within the past 5 years, but is not required. In addition, the TPC must be able to work regularly and interactively on the Web and Internet, and must be a GSA member.

The Hot Topics Chair organizes four spirited lunchtime debates during the GSA Annual Meeting and makes sure that the titles of the debates reflect their controversial and lively nature. Responsibilities include locating, organizing, and securing debate organizers who will identify topics and speakers.

If you know of someone who would be an effective Technical Program or Hot Topics Chair, or are interested yourself, please contact the GSA Meetings Department for a nomination form: (303) 447-2020, ext. 186, snace@geosociety.org. Nominations are due January 31, 1999.
HAPPY NEW YEAR!

January. Named for Janus, the ancient Roman god of portals, portrayed with two faces—one looking back and one looking ahead.

January. By the Gregorian calendar, the commencement of the next succeeding year and, by custom, a time of reflection and resolution. What’s more, by common consent, this particular January begins the last year of the 20th century, a fact that is both sobering and exhilarating.

So this January is a particularly good time to look back and look ahead, and to give due consideration to our well-being. To that end, we offer a suggestion for inclusion in your new year’s resolutions: that 1999 is the year in which to review your estate plans.

Looking Back...

At the time of writing, the stock market is in the vicinity of 8900 (Dow-Jones index). Do you remember the market valuation at the end of 1994? It was 43% of today’s Dow. In four years, your equity investments may have doubled in value. Moreover, in many areas of the country, real estate values have also appreciated at dizzying rates. Therefore, your net worth may now be much greater than you think it is (or thought it ever would be). That’s the good news.

On the other hand, at present, while the highest federal income tax rate is 39.6%, the incremental estate tax rate is 37% imposed on taxable estates of $625,000, increasing to 55% on estates of $3 million or more. At a minimum, a $625,000 estate can have a potential tax of $202,050. While the unified credit can generally shelter the tax at this level, if the estate is larger the tax bill starts to add up quickly. For example, a $1 million estate would be liable for $143,750 in taxes, a $1.5 million estate for $358,750. This pain is before any state tax bite. That’s the bad news.

Owing to high rates of appreciation in investments and real property, people who hadn’t anticipated estate tax liabilities now find that the value of their assets has reached or exceeded the amount that can be transferred free of tax.

Looking Ahead...

New Year’s resolutions frequently focus on physical and spiritual well-being. In fact, financial well-being is equally important. Good financial health includes...
periodic reviews of your estate plan to ensure that it’s still appropriate for the size and nature of your assets and the circumstances of your life.

If you don’t have a formal will, you should. Even if you have a will, changes in asset values, changes in family situations, or changes of residence may mean that the will no longer carries out your intentions. Changes of perspective may mean that you can envision new, philanthropic intentions. By looking back, you can measure and appreciate what you have gained for yourself and your family. By looking ahead, you may find ways of investing some of that gain for the common geological good. For further information about investments in GSA’s program activities, please contact the GSA Foundation office at 1-800-472-1988, ext. 154.

Digging Up the Past
Most memorable early geologic experience: Walking on outcrops in Northeast Greenland in 1939 where no geologist had trod before me.

—F. Eyolf Bronner
Re-Discover the Earth
Layer by Layer

International Trade Fair for Geotechnology and Applied Earth Science

A trade fair as plentiful as the earth itself. And as futuristic as the entire Geo industry itself. GEOSPECTRA 99 presents the entire spectrum for geotechnology and applied earth science. From deposit prospecting and exploration to rock engineering, tunneling, soil excavation and foundation. From geothermal energy to geosensors. From geoinformation technology and geoclassification to geoinformatics.

You will experience the complete range of products for technology, processing and equipment. Whether it is subsurface investigation, exploitation and protection of natural resources, geo-environmental technology, the use of former mine locations, remote sensing or geoinformation technology – GEOSPECTRA is the authority in all these areas.

Order your entrance passes and show directories in advance of the show at a 20% discount!

Technology Forum International

In time for the new millennium GEOSPECTRA is an integral part of the Technology Forum International, comprised of five thematically related trade shows: GIFA (foundry technology), METEC (metallurgical technology), THERMPROCESS (thermal processing technology) and MINETIME (mining technology).

For show information:
Messe Düsseldorf North America
150 North Michigan Avenue
Suite 2920
Chicago, IL 60601
Tel. (312) 781-6180
Fax (312) 781-6188
http://www.mdna.com

For hotel and travel information:
Travel Trade International
Tel. (212) 674-3476
Fax (212) 674-3477
Lufthansa
Official Airline

June 9-15, 1999 Düsseldorf, Germany
CORDILLERAN SECTION, Centennial Meeting—1899–1999
95th Annual Meeting
Berkeley, California, June 2–4, 1999
Century of the Pacific Rim: The Past as Prologue to the Future

SETTING

The spectacular San Francisco Bay Area is the setting as Pacific Rim geologists celebrate the centennial of the GSA Cordilleran Section. The program, which commemorates the first meeting of the Section, held in the Bay Area in December 1899, will take place at the University of California, Berkeley, on June 2–4, 1999. The Centennial is hosted by the Department of Geology and Geophysics, the Museum of Paleontology, and the Earth Resources Center of UC Berkeley. Co-sponsors include the Association for Women Geoscientists (San Francisco Bay Area Chapter), Paleontological Society, Seismological Society of America, San Francisco Section of the Association of Engineering Geologists, and the Society of Economic Geologists.

The Cordilleran Section Centennial meeting takes place as California celebrates three sesquicentennial years: the 1848 discovery of gold, the 1849 Gold Rush, and statehood in 1850. The state’s focus on California’s mining history provides the perfect backdrop for the Cordilleran Centennial meeting.

The Centennial theme focuses on the impact of Cordilleran geoscience on the global geological framework. Technical sessions and field trips will highlight the many geological, geophysical, and paleontological studies that have originated with Cordilleran geoscientists over the past 100 years, and we will look to the future and the contributions that geoscientists and educators can make to the global environment in the next 100 years.

CALL FOR PAPERS

Papers are invited for presentation at symposia and general sessions in both oral and poster format. Symposia will include both invited and volunteered papers. Additional discipline sessions will be scheduled on the basis of submitted abstracts. There will be no separate theme sessions. You may volunteer a paper to be considered for any of the symposia listed below. Indicate its number on the abstract form. Please submit only one volunteered abstract as speaker or poster presenter in symposia or discipline sessions to avoid scheduling conflicts.

Technical sessions will allow 12 minutes for presentation and three minutes for discussion. A few symposia will allow additional time at the discretion of the organizer. Posters will be on display for four hours, and authors will be present for two hours. Equipment for each technical session consists of two 35 mm carousel projectors and one overhead projector. If you need video projection, or computer display equipment, you must specifically request it with your abstract. Details for poster sessions will be sent to participants.

ABSTRACT DEADLINE: February 19, 1999

Abstracts for all sessions must be submitted camera-ready on official 1999 GSA Section meeting abstract forms. Forms are available from Abstracts Coordinator, GSA, P.O. Box 9140, Boulder, CO 80301, (303) 447-2020, ext. 161, ncarlson@geoscience.org.

Send an original and five copies of each abstract directly to George Brimhall, Technical Program Co-chair, Dept. of Geology and Geophysics, University of California, Berkeley, CA 94720-4767.

TECHNICAL PROGRAM

A total of 23 symposia are scheduled for the meeting. These symposia deal with a wide variety of subjects covering the past history of Cordilleran exploration, as well as future directions in Pacific Rim research and major outstanding issues related to tectonics, geologic hazards, resources, and environmental quality.

General questions should be addressed to the program co-chairs: Eldridge Moores, Dept. of Geology, University of California, Davis, CA 95616, (916) 752-0352, moores@geology.ucdavis.edu; or George Brimhall, University of California, Berkeley, (510) 642-5868, brimhall@socrates.berkeley.edu;

 Eldridge Moores, Dept. of Geology, University of California, Berkeley, CA 95616, (510) 752-0352, moores@geology.ucdavis.edu; George Brimhall, University of California, Berkeley, (510) 642-5868, brimhall@socrates.berkeley.edu;

 Cordilleran Centennial Symposia and Technical Sessions


2. History of the Cordilleran Section and Its Geoscientists. William Berry, Dept. of Geology and Geophysics, University of California, Berkeley, CA 94720-4767; (510) 642-3925, bberry@uclink4.berkeley.edu; Michele Aldrich, Hatfield, Massachusetts, 73061.2420@compuserve.com.

3. The Franciscan Complex:

Archetype or Atypical Subduction Complex? Sarah Roeseke, Dept. of Geology, University of California, Davis, CA 95616, (530) 752-4933, roeseke@geology.ucdavis.edu; John Wakabayashi, Hayward, California, (510) 887-1796, wak@dl.com; Alison Till, U.S. Geological Survey, Anchorage, Alaska, (907) 786-7444, atill@undra.wr.usgs.gov.


5. Earthquake Processes: Seismological Society of America Symposium. Barbara Romanowicz, Doug Dreger, and Tom McEvilly, Dept. of Geology and Geophysics, University of California, Berkeley, CA 94720-4767, (510) 643-5690, barbara@seismo.berkeley.edu, dreger@seismo.berkeley.edu, tom@seismo.berkeley.edu.

6. Great Earthquakes in the Cordilleran: The Geologic Record, Facts, Myths, and Fiction. Bill Lettis, Wm. Lettis & Assoc., 1777 Botelho Dr., Walnut Creek, CA 94596, (925) 256-6070, lettis@lettis.com.

7. Cordilleran Plutonism in the Americas. Susan DeBari, Dept. of Geology, Western Washington University, Bellingham, WA 98225, (360) 650-3588, debari@cc.wwu.edu; Brendan McNulty, California State University, Dominguez Hills, Carson, (310) 243-3412, bmcnulty@dhvx20.csudh.edu; Calvin Barnes, Texas Tech University, Lubbock, (806) 742-3106, gcjtal@ttacs.ttu.edu.

8. Evolutionary History of Pacific Rim Biota: Paleontological Society Symposium. Jere Lipps, Museum of Paleontology, University of California, Berkeley, CA 94720-4780, (510) 642-9006, jlipps@cmpl.berkeley.edu; Carol M. Tang, Arizona State University, Tempe, (602) 965-9878, tang@asu.edu.


10. Estuaries and Coast Watersheds of the Pacific Rim. B. Lynn Ingram,
Dep. of Geology and Geophysics, University of California, Berkeley, CA 94720-4767, (510) 643-1474, ingram@berkeley.edu; Roger Byrne, University of California, Berkeley, (510) 643-9170, arbyrne@uclink4.berkeley.edu.


12. The Effect of Stratigraphic Controls+on+Subsurface+Contaminant+Remediation. See Han Hoose, 10394 Bret Ave., Cupertino, CA 95014, (408) 252-5811, hoose@x.netcom.com.

13. Engineering Geology and Natural Hazards in the Cordillera. Nick Stair, Dep. of Civil and Environmental Engineering, University of California, Berkeley, CA 94720, (510) 643-8623, nsstar@ece.berkeley.edu; Bob Wright, Halan, Tate & Assoc., San Francisco, (415) 625-0765, rhw@earthlink.net.

14. El Niño Revisited—Projections, Predictions, Preparations, and Policy. Scott Burns, Dep. of Geology, Portland State University, P.O. Box 751, Portland, OR 97207-0751, scott@ch1.ch.pdx.edu.

15. Tectonics and Volcanism of Western Mexico. Ian Carmichael, Dep. of Geology and Geophysics, University of California, Berkeley, CA 94720-4767, (510) 642-2577, ian@socrates.berkeley.edu; Joanne Stock, Division of Geological and Planetary Science, California Institute of Technology, Pasadena, CA 91125.

16. Undergraduate Research Posters (Council on Undergraduate Research). Susan DeBar, Geology Dept., Western Washington University, Bellingham, WA 98225, (360) 650-3588, debar@ccwwu.edu. Poster mode only.


19. China Geology and Metallurgy. Xuane Mo, China University of Geosciences, 29 Xueyuan Road, Beijing 100083 China, 10-6231-2244 x3106, mxx@sky.edu.cn.

20. Impacts and Remediation of Base-Metal Mining. Charles Alpers, USGS, Placer Hall, 6000 J St., Sacramento, CA 95819-6129, (916) 278-3134, cnalpers@usgs.gov.


22. Circum-Pacific Metallogenic. Shunzo Ishihiara, shunso@gis.go.jp; Warren Nokleberg, USGS, MS 901, Menlo Park, CA 94025, (650) 329-5732, wnokleberg@sdml.wr.usgs.gov.


FIELD TRIPS

Northern and central California are regions of great scenic beauty and intriguing geology. That geology, well displayed in outcrops that range from seafloor to alpine mountainside, has played an important role in shaping concepts in earth sciences for a century. Field trips offered in conjunction with the Centennial meeting were carefully selected to highlight the breathtakingly diverse range of the exciting geology of northern and central California. These trips look back at geologic relations that influenced society and current scientific thought, as well as forward to challenges that will face earth scientists in the coming century. Because many field trip opportunities lie within easy distance of the GSA Cordilleran Section meeting site in Berkeley, one-day field trips are emphasized in order to afford participants maximum opportunity to sample the superb geology of the region. One-day trips will run over pre- and postmeeting weekends, from Saturday, May 29 to Sunday, June 6. There will be both pre- and postmeeting multi-day trips. A field guide will be published by the California Division of Mines and Geology. For additional information, contact Field Trip Chair Steve Graham at graham@pangea.Stanford.edu.

Multi-Day Trips


2. Sutter Buttes Volcano. Brian Hausback, Dep. of Geology, California State University, Sacramento, CA 95819-6043, (916) 278-6521, hausback@csus.edu.

3. Mesozoic Convergent Margin of Central California. Ray Ingersoll, Dept. of Earth and Space Sciences, University of California, Los Angeles, CA 90095, (310) 852-8634, ringer@ess.ucla.edu.


One-Day Trips

7. Hayward Fault—Source of the Next Big One? Sue Hirschfeld, Dep. of Geological Sciences, California State University, Hayward, CA 94542-3088, (510) 885-3000, shirsch@gauss.sci.csuhayward.edu.

8. Sequence Stratigraphy and Mining History of the Black Diamond Mines Regional Preserve. Ray Sullivan, Dept. of Geosciences, San Francisco State University, San Francisco, CA 94132-4001, (415) 338-7730, sullivan@sfu.edu.


10. Depositional and Other Features of the Merced Formation in Sea Cliff Exposures South of San Francisco, California. H. Edward Clifton, Conoco Inc., Permian 3050, P.O. Box 2197, Houston, TX 77252-2197, (281) 293-6775, h-edward.clifton@conoco.dupont.com.


13. Tour of a Classic Subduction Complex: The Franciscan Complex of the San Francisco Bay Area, California. John Wakabayashi, 1329 Sheridan Lane, Hayward, CA 94544-4332, (510) 887-1796, wako@tdci.com.

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WORKSHOPS

The following workshops are planned:
(1) Digital Geological Mapping Using GPS and Laser Range Finders (2) Texture Analysis of Geologic Materials (3) a number of workshops directed to science educators (K–16).

The Roy Shlemon Mentors in Applied Geology Program will hold a workshop for upper-level undergraduate and graduate students. This one-day workshop will address practical aspects of engineering geology. There is no charge for students, but space is limited. Students wishing to attend should write a short note expressing their interest by April 10 to General Chair Doris Sloan (see Detailed Information).

STUDENT SUPPORT

The GSA Cordilleran Section will give awards for the best graduate and undergraduate papers (oral or poster). Papers will be considered for any of the symposia or discipline sessions listed, and students should submit their abstracts on the standard form. Student must be both first author and presenter, and must follow the guidelines for speakers sent out by GSA, and must be a student member or student associate of the Cordilleran Section. We encourage students to present their work at this Centennial meeting.

EXHIBITS

Exhibits will be located in the Pauley Ballroom along with the poster sessions and food concessions. The central location will ensure maximum exposure to meeting participants. The anticipated large attendance at the GSA Cordilleran Section Centennial meeting will provide exhibitors an easy and cost-effective way to market their products and services. The exhibits area will be open 6–8 p.m. on Tuesday during the Welcoming Party, 9 a.m. to 5 p.m. Wednesday and Thursday, and 9 a.m. to noon on Friday. Exhibitor fees are $400 for for-profit organizations and $150 for nonprofit organizations. Please contact Exhibits Chairman Ivan Wong at (510) 874-3014 or e-mail igwongx0@wcc.com for further information and applications. Exhibit space is limited, so early reservations are strongly encouraged.

SPECIAL EVENTS

The Welcoming Party will be held on Tuesday evening, June 1, from 6 to 8 p.m. Business meetings of co-sponsoring organizations and the Cordilleran Section and its committees are planned. Additional events will be announced in the March GSA Today.

The Centennial is an occasion for the entire family! A special guest hospitality room will enable guests to plan activities for young and old to take advantage of the Bay Area's spectacular scenery and cultural resources. Look for information on local events, tours, theater, museums, and exhibits, and transportation guides to help you make the best use of your time here. A public lecture by Wm. Muehlberger on "The Earth from the Space Shuttle: what the astronauts see" will highlight spectacular aerial views of the Pacific Rim and elsewhere from NASA's collection.

One evening is scheduled for alumni get togethers. If you are interested in arranging an alumni party for your school, please contact General Chair Doris Sloan (see Detailed Information).

HOUSING

Blocks of rooms have been reserved at the UC Berkeley campus and will be available at modest rates to all participants. Information on additional housing is available at the GSA web site.
Sustaining America

“The latest, nebulous, environmental buzz-phrase boils down to green-tinted, populist, economic responsibility...”
—Reporter Don Hopey of the Pittsburgh Post-Gazette, describing sustainable development, in his September 26, 1998, article "Sustainable Development—What’s up?"

“A sustainable development, a fuzzy buzz-phrase, turns out to be as hard and real as houses on a mountain of slag overlooking a sewage-polluted creek”
—Reporter Don Hopey of the Pittsburgh Post-Gazette, in his September 29, 1998, article "Building a Better Community: Sustainable Planning Under Way in the City"

“A future that includes sustainable development will require continued attention to the reduction of pollution and consumption, a broad-based public education process, and input from many usually silent sectors of the Pittsburgh community.”
—Reporter Don Hopey of the Pittsburgh Post-Gazette, in his September 30, 1998, article "Development Panel Plans for ‘Sustainable’ Future"

U.S. Environmental Protection Agency Administrator Carol Browner defines “sustainable development” as “not having to choose between a healthy environment and a healthy economy. It means having both...” The Center of Excellence for Sustainable Development defines it as “a strategy by which communities seek economic development approaches that also benefit the local environment and quality of life.” My definition includes “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” In the United States, this sustainable development issue is now receiving the attention of the Executive Office of the President, if not that of the populace.

On September 28 and 29, 1998, in Pittsburgh, Pennsylvania, the President’s Council on Sustainable Development (PCSD) held its latest meeting. In June 1993, the PCSD was established by Presidential Executive Order 12852 to advise the White House on the “emerging topics of sustainable development and sustainability, and to develop new approaches to achieve US economic, environmental, and equity goals, and to create a Sustainable America.” The PCSD is administered as a federal advisory committee under the guidance of the Federal Advisory Committee Act.

The Council’s 29 members are nominated by the President and represent business, government, community, and environmental leaders. Co-chairs are Ray C. Anderson, chairman, president, and CEO of Interface, Inc. and Jonathan Lash, president of the World Resources Institute. Members include John H. Adams, executive director of the Natural Resources Defense Council; Secretary of Interior Bruce Babbitt; Fred D. Krupp, executive director of the Environmental Defense Fund; William D. Ruckelshaus, chairman and CEO of Browning-Ferris Industries, Inc; John C. Sawhill, president of The Nature Conservancy; and Browner.

To implement this mission, the PCSD charter directs the Council to advise the President on: (1) the next steps in building the new environmental management system for the 21st century by reviewing current environmental management reforms; (2) domestic implementation of policy options to reduce greenhouse gas emissions; (3) policies and approaches that promote sustainable communities; and (4) policies that foster U.S. leadership in sustainable development internationally and facilitate sustainable development in the flow of financial capital from developed to less developed countries. To assist in the development of recommendations on these policy areas, an Environmental Management Task Force, a Climate Change Task Force, a Metropolitan and Rural Strategies Task Force, and an International Task Force have been established.

The PCSD has developed ten national goals for sustainable development. These are: (1) Health and the Environment—Ensure that every person enjoys the benefits of clean air, clean water, and a healthy environment at home, at work, and at play. (2) Economic Prosperity—Sustain a healthy U.S. economy that grows sufficiently to create meaningful jobs, reduce poverty, and provide the opportunity for a high quality of life for all in an increasingly competitive world. (3) Equity—Ensure that all Americans are afforded justice and have the opportunity to achieve economic, environmental, and social well-being. (4) Conservation of Nature—Use, conserve, protect, and restore natural...
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resources—land, air, water, and biodiversity—in ways that help ensure long-term social, economic, and environmental benefits for ourselves and future generations. (5) Stewardship—Create a widely held ethic of stewardship that strongly encourages individuals, institutions, and corporations to take full responsibility for the economic, environmental, and social consequences of their actions. (6) Sustainable Communities—Encourage people to work together to create healthy communities where natural and historic resources are preserved, jobs are available, sprawl is contained, neighborhoods are secure, education is lifelong, transportation and health care are accessible, and all citizens have opportunities to improve the quality of their lives. (7) Civic Engagement—Create full opportunity for citizens, businesses, and communities to participate in and influence the natural resource, environmental, and economic decisions that affect them. (8) Population—Move toward stabilization of U.S. population. (9) International Responsibility—Take a leadership role in the development and implementation of global sustainable development policies, standards of conduct, and trade and foreign policies that further the achievement of sustainability. (10) Education—Ensure that all Americans have equal access to education and lifelong learning opportunities that will prepare them for meaningful work, a high quality of life, and an understanding of the concepts involved in sustainable development.

The Pittsburgh meeting generated a number of policy recommendations that are to be transmitted to the President before the end of January 1999. These include early action principles and technology policies to address global climate change, sustainable communities recommendations, a description of a sustainable Pittsburgh initiative, and a finalization of a set of principles to encourage “early action” and technological innovation to reduce greenhouse gas emissions. The Climate Task Force, chaired by Steve Percy, chairman and CEO of British Petroleum, is charged with advising the President on domestic policy options and activities that could reduce greenhouse gas emissions. They announced that the risk of climate change is of sufficient concern and that timely and effective actions should be taken to reduce those risks. They reached agreement on a set of principles for the design of a voluntary program to reduce emissions before any binding requirements are in place. They recommend an incentive-based early action program that encourages broad-based participation, learning, innovation, flexibility, and experimentation; grants formal credit for legitimate and verifiable measures to protect climate; ensures accountability; is compatible with other climate protection strategies and environmental goals; and includes local, state, and federal government leadership. They desire to “engage community lending institutions and Wall Street CEOs” on climate change.

“Credits for early action will produce earlier reductions in greenhouse gas emissions. The sooner companies get on a gradual ‘glide path’ towards reductions, the better,” said Jonathan Lash, president of the World Resources Institute and co-chair of the President’s Council. “Even before any binding treaties or other requirements are in place, America’s businesses, communities, government agencies and individuals need to get ready to tackle the challenge of climate change. With early action we can develop a program that encourages prosperity while contributing to significant emissions reductions,” said Steve Percy.

The Council also unveiled its plans for a May 2-5, 1999, National Town Meeting for a Sustainable America, to be held in Detroit with more than 3,000 attendees, and to be joined by several thousand more via satellite links and the Internet. Additionally, many thousand more will participate at coordinated local events during the three weeks between Earth Day on April 22, 1999, and the start of the summit on May 2, 1999.

The three purposes of this event are: (1) to present the concepts and opportunities of sustainable development to the public; (2) to showcase ideas, technologies, and practices that reflect an integrated approach to economic, environmental, and social equity goals; and (3) to spark further action and national dialogue on sustainable development. The PCSD anticipates that this event will: (1) result in the development of a pledge to a sustainable future for citizens, communities, and the country; (2) foster new projects and multi-level partnerships among government, industry, community groups, and academia; and (3) publicize existing and planned sustainable communities to increase the nation’s awareness of sustainable development options. For more information contact: National Town Meeting Coordinator, PCSD, 730 Jackson Pl., NW, Washington, DC 20503, (202) 408-5296, infopcsd@aol.com, http://www.sustainableamerica.org.
New GSA Members

The following Members were elected by Council action during the period from February to October 1998. (An asterisk indicates a transfer from Student Associate to Member status.)

*Andrew P. Abban
*Bill Abrahams-Dematte
*Nancy K. Adams
*Elizabeth A. Addington
*Russell Agostaro
*Naved Aftab
*Said M. Al-Rashidy
*Abdussalam A.S. Alamoudi
*Arshad Ali
*James A. Almedinger
*Helge Alseben
*Elizabeth L. Ambos
*Lee Amoroso
*Dianna Elder Anderson
*Kai S. Anderson
*Gretchen H. Andreasen
*Frank G. Andrews
*Robert E. Andrews
*Charles T. Andrus
*Vladimir E. Andrusovich
*Ruslan M. Anisimov
*George P. Aponte Clarke
*Kai S. Anderson
*Lee Amoroso

New Members

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*James V. Jones
*Murray I. Jones
*Patricia K. Jones
*Maurice E. Kaesa, Jr.
*Takeshi Kakegawa
*Biggitta E. Kalinowski
*David S. Kane
*Connie L. Kaplan
*Daniel B. Karner
*Sandeep Karwa
*Mary E. Kaufman
*Nathan K. Kehoe
*William R. Keller
*Meredith A. Kelly
*Sandy N. Kehoe
*Robert S. King
*Michael Kirchenbauer
*Dirk M. Kirste
*Grycie M. Kissell
*Robert T. Klein
*Katrin Kleinert
*Steven J. Klick
*Kurt M. Knese
*Chris G. Knickerbocker
*Jasper Knight
*Rebecca L. Knight
*Stuart R. Knoep
*Kevin G. Koenig
*Patrick C. Koepele
*Irina Kogan
*Bryan M. Kommeth
*Joseph K. Konczyk
*Michael K. Konken
*Carla M. Koretsky
*Gotthard M. Kowalczyk
*Ronald A. Kral
*Juergen Kraus
*Gary W. Krzanich
*William J. Kvitnicki
*Russell J. Kyle
*Nuruddin Ladha
*Melissa J. Lafreniere
*Leonardo E. Lagoeiro
*Melissa J. Lafreniere
*Nuruddin Ladha
*Gary W. Krizanich
*William J. Kvitnicki
*Russell J. Kyle

Jing Li
*Sheila M. Lindenberg
*Ulf G. Linnemann
*Mike K. Liquori
*John H. Loeffel
*Leslie Kahn Logan
*Shannon L. Logan
*Ann L. Lombardo
*Robert Lopez
*Andrew M. Lorrey
*Sara S. Low
*Adrian M. Lowe
*Anthony R. Lowry
*Kenneth L. Loy
*Justin L. Ludlum
*Sebastian Luening
*Donald K. Lumm
*Sara A. E. Lytle
*James R. Lyons
*Suzanne N. Lyons
*Kerry V. Magruder
*Margaret M. Maher
*Doris Maicher
*Adam C. Malof
*Ned Mamula
*Sara A. Marcus
*Jeffrey Mariga
*Michael L. Medley
*Adam R. Mars
*Heather L. Marsh
*Jennifer P. Martin
*Ronald E. Martin
*Christine R. Martinez
*Cynthia M. Martinez
*Graydon Martz
*Audeliz Matias
*Ari Matmon
*Jeffrey M. Matthews
*Scott H. Matthews
*Sara E. Matyk
*J. Craig Mauldin
*Agnieszka Mazott
*Brian W. McArdell
*Randolph A. McBridge
*Constance E. McCambridge
*Paul J. McCarthy
*Phil J. A. Caudland
*Richard G. McLean
*Melanie M. McCleary
*Jennifer M. McClung
*Clifford R. McCrory III
*Michele Marie McGee
*Rebecca E. McGuire
*Gordon C. McEachan
*Noel C. McKenzie
*John S. McKeown
*Timothy R. McKinsey
*Jerry F. McManus
*Marcia K. McNutt
*Kevin R. Meal
*Monique E. Meier
*Igen A. Mekik
*Erik B. Melchiorre
*Shari J. Mendrick
*John W. Merck, Jr.
*Matthew F. Mercurio
*Mandana Merianou
*Audrin A. Merle
*Edward G. Meyers
*Scott C. Michaud
*Elizabeth J. Miksa
*Brian L. Millard
*Amy A. Miller
*Jonathan E. Miller
*David K. Mitchell
*Karen J. R. Mitchell
*Mark D. Mitchell
*David M. Mixon
*Richard W. Mixter
*Stephen J. Mojisola
*G. Mann Molinex
*G. William Monaghan
*Salma B. Monani
*Laura J. Moore
*Ann B. Morgan
*Lee H. Morse
*Andrea Moscioni
*Angela M. Moss
*Claire E. Muriehead
*Stephanie K. Mulica
*Lona D. Mullinax
*Matthew D. Murdock
*Peter C. Naiden
*Remo Nardini
*Enrique H. Nava-Sanchez
*Virginia Anne Newburn
*Mark D. Nicholas
*Mary H. Nichols
*Chrissie Nienaber-Roberts
*A. Wade Nollamper
*Katy Farness N’C’Tornier
*Philip M.
*Novack-Gottshall
*Don H. Norkos
*Patrice Z. Nsogah Mahbo
*Francisco E. Nullo
*Emilie E. Nyberg
*Andrew A. Nylblade
*Yuet-Ling O’Connor
*Kyoko Ohashi
*Jill A. Oliver
*Lynn K. Oliver
*Margaret M. Olsen
*Alana A. Olson
*Dan J. Oros
*Ryan M. Ott
*Rick E. Ott
*William M. Pagano
*Patricia A. Painter
*Stephen L. Petras
*Uyen Phan
*Robert Panek
*James D. Parkey
*Phillip A. Partlow
*Mary A. Parke
*Erika L. Parkin
*David S. Parks
*Kathi A. Peacock
*Jason R. Pemberton
*Jason T. Penina
*Katarina S. Persson
*Andreas Peterlik
*James W. Peters
*Mark A. Petersen
*Curt D. Peterson
*Vladislav A. Petrov
*Ludmila Petrunji
*Paul R. Pichon
*Janette M. Piemonte
*Valerie Jill Pidet
*Eric R. Pogue
*Dennis M. Poland
*Vikas J. Polak
*Bryan P. Popov
*John P. Pope
*Nicholas J. Preston
*Gretchen M. Price
*Paul J. Prijatel
*Sian H. Proctor
*Calvin K. Prothro
*Bruce D. Pugh
*Per K. Pufahl
*Keth D. Puttika
*Patrick S. Rabideau
*Brian A. Rafferty
*Margaret A. Rafter
*Audrey Hughes Rager
*David W. Ramsey
*John W. Randell
*Usha Rao
*R. Ragnor Rasmussen
*Christophe C. Rauber
*Alessa C. Rayas
*Steven P. Recio
*Thomas M. Reed
*Leslie F. Reid
*Samantha L. Reif
*Jonathan W. Remo
*Joseph M. Renda
*Matthew T. Richards
*Scott W. Richards
*Tobey C. Richards
*Peter E. Riemersma
*Andrew W. Rigor
*Krista A. Rikansrud
*Richard K. Rinkenberger
*Tammy M. Ritenauer
*Elizabeth A. Robbins
*Meredith S. Robertson
*Beverly D. Robinson
*Mark S. Robinson
*Lizzette A. Rodriguez
*Jack V. Rogers II
*Hugh R. Rollinson
*Miriam J. Gomez Roman
*John J. Romano
*Mark A. Rosin
*Deborah-Ann C. Rowe
*Peter C. Ruthard
*Christopher L. Rupe
*Bryan G. Rusk
*Erin Z. Ryan
*Mark D. Sackett
*James C. Sagebiel
*Ted L. Sager
*Anna M. Salvagno
*Irene C. Sanchez Montero
*Rajeev K. Sasidharan Nair
*Peter E. Sauer
*Edward W. Sawyer
*Michael O. Sawyer
*Peter A. Schert
*Daniel S. Scheirer
*William M. Schill
*Renata da Silva Schmitt
*Keri Ann Schneider
*Matthew O. Schrenk
*Werner F. Schreyer
*William A. Schroeder
*Michael Schulz
*Karen R. Shurr
*Eric M. Schwartz
*Bridget D. Sconzas
*Ross Secord
*Sin C. Sehn
*M. Steve Shackley
*Charu Sharma
*Danielle R. Sharp
*Shawn W. Sheen
*Purmina A. Shivdasan
*Heather A. Short
*A. Abdulahman A. Shujoen
*John C. Singh
*Roger G. Sigler
*Jagmohan Singh
*Michael J. Singleton
*Darren B. Sogren
*Sophie L. Skellner
*Kathleen F. Skillet
*Jane A. Skinner
*Bryan R. Sladky
*Jennifer E. Slater

Mark L. Slater
*Thomas J. Slusser
*Angela E. Smith
*Heather Laurita Smith
*Jeffrey J. Smith
*Letitia Male Smith
* Lynne E. Smith
*Nancy J. Smith
*Robin L. Smith
*Ute D. Smith
*Joseph P. Smoot
*Derek A. Sondergaard
*Leanne V. Spurgeon
*Jeanine M. St. Clair
*Hilary D. Star
*Carol J. Stack
*Leslie C. Stanberry
*Richard J. Stancil
*Richard A. Statom
*Douglas H. Steil
*Seth A. Stein
*Robert W. Stephenson
*Liane M. Stevens
*Michelle N. Stevens
*Emily M. Stewart
*Shawn E. Stickler
*Joanne C. Scott
*Nicholas H. Stater
*Luther M. Strayer IV
*Richard A. Stump
*Christopher Sumner
*Kerang Sun
*Aivauss Sussman
*George E. Sutton Jr.
*Susan K. Suwono
*Brett D. Swartz
*Gary E. Tackman
*Katsumi Takayasu
*Yuhong Tang
*Richard J. Taylan
*Bruce B. Taylor
*Maria Luisa G. Tejada
*Jane L. Teranes
*Dennis O. Terry Jr.
*Mya Mya Thun
*Lisa D. Thiere
*Charley S. Thompson
*David T. Thompson
*Jimmie Tian
*David H. Tomlinson
*John R. Toth
*Craig H. Tozer
*David W. Trabert
*David L. Trauger
*Cara treadmill-Seitz
*Janis D. Trevorrowy
*Esther Trivino
*Chadah A. Truesdell
*Gia C. Truong
*Christian A. Tryon
*Rita To"Ou"
*John R. Tunks
*Anthony F. Turano
*Brad W. Turner
*Michael A. Urban
*Jessica A. Ustick
*George H. Uzzelle IV
*Martin C. Van Boskirk
*Mark M. Vanderbilt
*Oliver Vanderhaeghe
*Sarah J. VanGelder
*Kenneth J. Vernon
*Richard F. Viso
*Randall H. Wade
*Hugo E. Wagner
*Kristoffer T. Walker
*John W. Walsh
*Robert S. Warrender
New GSA Associates

The following Associates became affiliated with the Society during the period from February to October 1998.

Rubens Acvedo
Ruben Acosta
Sherry L. Adams
C. Shawn Adkins
Maziar Ahvari
James A. Allen
Vincent A. Amoroso
Alison M. Anders
Megan L. Anderson
Norman Andree
Karen L. Andrus
Elyse J. Apicello
Kathleen A. Arford
Tahira Arshed
Ariel D. Auffant
Shannon H. Baer
Stephen M. Balou
Theresa Barber
Kelly Batten
Blakely R. Bear
Delia L. Beckman
Mark C. Begley
Ronald M. Bek
Leta M. Berardi
Kelly L. Bergman
Melissa A. Berke
Robyn E. Berne
Ren Irene F. Bensik
Robert A. Bevlacqua
R. Jason Biga
Robert A. Goodl
John T. Corkery
Timothy N. Cosma
Matthew M. Council
Brendan T. Cox
Danielle C. Cox
Thomas M. Cox
Patrick S. Craig
Raymond L. Dagley
Anthony A. Dame
Noah Daniels
Nicholas C. Davatzes
Robert I. Davies
Andy L. Davis
Michael D. Deats
Stephanie M. Deckard
Jason M. Dell
James R. Denniston
Kimberly D. Dimmick
Kelly M. Donahue
Eron D. Drew
Shana G. Driscoll
Pamela J. Dugan
Gregory Dumond
Kevin R. Eastham
Shawn A. Eichelberger
Aaron L. Eide
Don Elder
Leah D. Ellis
Jennifer L. Erdman
Ira Eric
Vanessa M. Escolar
James J. Essex
Robin L. Evensen
Michael W. Fawns
Theresa M. Feil
Andrew R. Fetterman
Thomas A. Fewless
Bryan A. Finseth
Erika E. Flemming
Geoffrey K. Force
Julie Fretas
Edwin R. Friend
Chase B. Fulk
Jordan E. Furnans
Justin J. Gallagher
Richard J. Gallo
Dawn M. Gallondom
John C. Galloway
R. Natasha Galvez
Samuel S. Garland
Duncan Thomas Gibson
Filip M. Gieczyszkiewicz
Lisa D. Gilley
Laura A. Gilpin
Natalie B. Givens
Rima M. Givot
Danney R. Glaser II
Heather R. Golding
Maurocio A.
Gonzalez Guillot
Jose E. Gonzalez
Sarah H. Gonzalez
Bill A. Goodman
Robert A. Goodl
John H. Gordon, Jr.
Eric S. Gottlieb
Catherine A. Gough
Trevor G. Graff
Michael Gregory
Zackry S. Guido
Edward C. Hakanson
Kash J. Haley
Paul R. Hanson
Paul G. Harnik
Joseph C. Harrison
Samuel V. Harvey
Eric J. Hawkins
Hillary Haworth
Melissa A. Hayes
Kathryn M. Heiden
Ryan C. Heise
Melodie M. Hessling
Heather A. Hibert
Melissa K. Hicks
Erik J. Hiemstra
Maya J.
Hildebrand-Garcia
Tessa M. Hill
David B. Hisz
Julie A. Hoefer
Gregory D. Hoke
Matthew H. Hoskins
Christian Huber
Deana M. Hudgins
John W. Huntley
Lauren B. Interess
Eric A. Itle
Catherine M. Jamet
Andrew Jeans
Micha J. Jessup
Brian R. Jicha
Priyanka Jori
David S. Jones
Benjamin R. Jordan
Aaron N. Kander
Aprille E. Kinchloe
Karen S. King
Susan L. Klosterman
Beth B. Knauer
Tara A. Kniskem
Marie E. Knotwell
James J. Kocsis
David Kozlowski
Jill C. Krukowski
Alexandra E. Krull
Jill R. Kurtz
Gene A. Kurz
Scott W. Kutza
Paul D. Lake
Susan S. Lane
Andrew W. Larrabee
Tino Laubrock
Chris P. Leverack
Charles E. Leiserson, Jr.
Loretta A. Leist
Larry S. Levine
Elijah M. Levitt
Kriket Little
Nancy F. Little
Carrie J. Lofgren
Anna L. Loose
Derrick W. Lucey
John B. MacCormack
Matthew W. Magner
Julie A. Malburg
Maureen C. Mann
D. Jason Manzo
Jessica F. Marcus
Uwe C. Martens
Elizabeth L. Mascia
Renee L. McCarter
Kerry M. McClain
Amanda J. McCutcheon
Gary S. McDowell
Sean P. McGinnis
Chris R. W. McIntosh
Claire M. McKee
Kirsten J. Mclaughlin
Ariane M. Mercadante
Joseph R. Michalski
Tara T. Middleton
Michael J. Mikutaitis
Kari L. Miller
Kurtz K. M. Miller
Steven C. Miller
Jesse T. Milligan
Jamie M. Monte
Michele Vale Moreno
Daniel P. Morris
Stephen A. Morrow
Jack K. Moulton
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Heidi Munk
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POSITION AVAILABLE

Executive Director

The Geological Society of America (GSA) is seeking an individual to assume the duties of Executive Director as early as June 1, 1999. The selected individual will:

• Work with the Executive Committee and Council of GSA to implement a newly adopted Strategic Plan. Work closely with GSA Foundation Board and staff to coordinate and promote the directions and policies of the GSA Council.

• Maintain collaborative relationships with representatives of other national and international geoscience societies and organizations and actively pursue joint ventures that enhance the financial and scholarly status of the Society.

• Lead the GSA Headquarters staff of 65 persons. Articulate the vision and mission of the Society to staff and members through teamwork and collaborative efforts. Society activities include membership services, meetings, publications; education, public policy, and outreach; marketing/strategic communications; financial services; and information technology activities.

The new Director will work at the GSA headquarters in Boulder, Colorado, and will hold a position with competitive compensation and benefits.

REQUIREMENTS

• Provide leadership to diverse groups such as committees, associated societies, staff, and volunteers through collaborative teamwork.

• Commitment to strong interpersonal communication among and between staff, members, and volunteers. Proven record of motivating staff to develop new sources of revenues and to use technology to improve efficiencies.

• Master’s degree in geosciences; Ph.D. preferred. Extensive management experience and achievements in the areas of accrual budgeting, financial planning and investments, and personnel management. Additional preparation in education, marketing, and/or business management encouraged.

• Commitment to geoscience research, public outreach and education programs, and scholarly publishing.

• Familiarity with marketing and public relations important.

• Demonstrated familiarity with the geoscience community and GSA programs.

Submit a resume, the names and addresses of three references, and a letter describing your interest in the position to:

Executive Director Search Committee
The Geological Society of America
P.O. Box 9140
Boulder, CO 80301-9140

The deadline for applications or nominations is March 15, 1999.

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1999 GSA SECTION MEETINGS


ROCKY MOUNTAIN SECTION — April 8–10, 1999, Pocatello, Idaho. Information: Scott S. Hughes, Dept. of Geology, Idaho State University, 785 South 8th Ave, Pocatello, ID 83209-8072, (208) 236-4387, hughscot@fs.isu.edu. Preregistration deadline: March 5, 1999.


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To Promote Geoscience in the Service of Society

With the approval of Council in October 1998, GSA has released its new strategic plan for comment and review (see this issue of GSA Today). We hope that you will take the time to review it and make suggestions to strengthen it. This plan has been developed over the last two years by over 100 GSA members. It is the result of heated debate, constructive dialogue, and creative synthesis of the ideas generated by GSA members, councilors, division officers, and committee representatives, as well as staff. We feel it is an exciting and dynamic vision of GSA’s future. This plan is about YOU, our members, and how to serve you better, it is about the future of our science and profession, and it is about our responsibility to the Earth on which we live.

Goal 3 of the plan is a “call to arms” to all GSA members “to get involved.” If we are to thrive as a scientific society and as a profession in the 21st century, all of us in the geosciences must reach beyond the boundaries of our discipline to other organizations, and to the public, the decision-makers, and the children who will shape our future. To do this, we must stress the importance and relevance of the geosciences and actively “Promote Geoscience in the Service of Society.” Under goal 3 there are three main objectives: (1) To actively foster dialogue with the public and decision-makers on relevant geoscience issues, (2) To encourage and support member participation in education and societal outreach, and (3) To strengthen the role of geoscience in formal and informal science education. Following is a brief summary of what we are currently doing to promote geoscience in the service of society, and what we are thinking about doing in the near future.

Current Activities
Fostering dialogue with the public and decision-makers on relevant geoscience issues:

- The Congressional Science Fellowship Program supports the placement of outstanding earth scientists in the offices of members of Congress or congressional committees. This ongoing partnership between GSA and the U.S. Geological Survey has yielded a cadre of professional scientists and policy advisors. The unique experiences of the Fellows are an enduring and important resource for the geoscience community and for society.
- Our mentor programs, the Roy J. Shlemon Mentorship and the Mann Mentorship in Applied Hydrogeology connect the applied and academic geology communities, for the express benefit of graduate and advanced undergraduate students. Their common goals are to: expose geology students to the scientific challenges presented by the applied fields and inform students about professional opportunities outside academia. We hope to institute "virtual mentorships" covering the entire breadth of our science as well as Earth-system science via the World Wide Web, as GSA’s web technology improves.
- Special workshops, designed to focus a disparate group of experts on a single, complex topic, are a primary tool for policy outreach. In 1998, IEE cosponsored two such workshops, one examining the utility and credibility of predictive modeling of natural systems, and one examining the social, cultural, and scientific impediments to conducting integrated, multidisciplinary science. Workshops in 1999 will address the needs of national parks for integrated science dealing with coastal ecosystems, and methods for increasing the scientific literacy of the media.

Encouraging and supporting member participation in education and outreach:

- Partners for Education Program (PEP): One of GSA’s great success stories, this program has grown by leaps and bounds during the past six years. Now, with over 1800 active volunteers (including 600 e-mail partners), PEP builds connections between geoscientists, educators, students, and parents. PEP volunteers may visit classrooms, lead geology field trips, volunteer as docents at local museums, or answer student questions about the geosciences via the Internet. The opportunities are endless and the rewards are tremendous. If you want to make a difference in your community, this is a program you should learn more about.
- Annual and Section Meetings: Six years ago, there was only one topical session on education at the GSA Annual Meeting and not much talk about education at the Section meetings. Today, at almost every GSA meeting, you will find a variety of dynamic technical sessions, workshops, field trips, and social activities for geoscientists and K-12 faculty interested in education. If you have never been to one of these events, you may want to save some room on your 1999 Annual Meeting schedule to help urban Denver students learn about the Earth via "Geoscience Day," a geo-field trip sponsored by our Committee on Minorities and Women. If you don’t have an entire day to spend, we suggest you sign up for, or stop by, one of the education workshops or technical sessions at our 1999 Annual or Section meetings.
- National Park Internships: This program began two years ago with two undergraduate student interns in two national parks. Last year, we had six student interns in six different national parks. This year we hope to place ten interns in ten national parks. Undergraduate student interns do a variety of activities, from mapping fossil localities and creating resource databases using GPS and GIS, to collecting and curating samples, helping with field mapping, leading campfire talks, and improving the geology information and materials available to the park staff and the public. This program has turned out to be a great learning experience for the students and a great benefit to the parks.
- Earth Science Week: Started last year by the American Geological Institute, and endorsed by President Clinton and over 30 state governors, Earth Science Week provides all of us in the geoscience community with the opportunity to get involved in geoscience outreach. Look for this event to become one of the premier public geoscience events in the country over the next two to three years. This year, Earth Science Week, will be from October 10-17, 1999. If you would like to get involved in the fun and festivities, and promote the geosciences in your community, just give us a call or send us an e-mail.

Strengthening the role of geoscience in formal and informal science education:

- The Earth and Space Science Technological Education Project (ESSSTEP): This is a fantastic professional development opportunity for teams of faculty in grades 8 through 16. Funded in part by a grant from the National Science Foundation, faculty participating in this project learn how to effectively integrate computer, information, and visualization technologies into their classrooms and
Future Plans

As we move forward to achieve the goals and objectives of goal 3 during the coming years, we look forward to developing a number of new education and outreach initiatives. Ideas that are currently under discussion or development include:

- The Colorado Rock Park Project, a large area and place them in a spatial context. Visitors will explore the connections among landscape, geology, our cultural and natural history, and their daily lives. This prototype rock park is intended to foster appreciation, understanding, and curiosity about the landscape that will lead to further discoveries. If our initial efforts are successful, look for state, regional, and local rock parks to spring up around the country.
- Collaborating with other members and organizations to develop a clearinghouse for information and resources on Earth-systems science.
- Developing more mentorship and internship opportunities for undergraduate and graduate students in national parks, government agencies, and geoscience businesses and industries.
- Encouraging and supporting the development of student PEP chapters at colleges and universities across the country.
- Working with other organizations to build a world-class Web site for geo- and Earth-systems science information, resources, educational materials, and career opportunities.
- Catalyzing the development of a strategic plan that would help school districts and high schools around the country with implementation of the Earth and Space Science Standards.
- Experimenting with new presentation and audience participation techniques for education workshops and technical sessions at GSA Annual and Section meetings.
- Developing educational product lines for our members, educators, and the public.

During the past six years we have seen member involvement in education and outreach activities increase from less than 1% to over 10%. During the next five years we would like to see even more GSA members taking an active role in promoting the geosciences. We invite you to join us as we reach out beyond the borders of our discipline to the public, to the decision makers, and to the children who will shape the future of our planet.

There are numerous opportunities to be involved, and there are numerous excuses not to be involved. Yes, it does take time, but the rewards are well worth the effort, both personally and for the people you interact with. In any event, it is up to you to decide how much time you can spend and what type of outreach you would like to do. Here are just a few examples of the ways you can be involved:

- Become a PEP volunteer or recruit another PEP volunteer.
- Help to organize a PEP student chapter at your college or university.
- Review educational and scientific Web sites for us.
- Translate your research in geo- and Earth-systems science into interesting, easy-to-read articles that we can disseminate to educators and the public.
- Send us examples of your best educational activities in geo and/or Earth-systems science.
- Let us know what types of outreach activities you are already doing or would like to do in your state or community.

For more information about the Colorado Rock Park Project, please contact Holly Devaul at hdevaul@geosociety.org or if you have any questions.

Geoscience Education Through Intelligent Tutors (GETIT): Another collaborative project funded in part by the National Science Foundation, GETIT is an innovative, interactive, multimedia curriculum that helps students learn about energy in the earth system. Created by Cambrian Systems Incorporated, this CD-ROM learning product promotes individualized student learning about physical and earth science concepts, mathematics, and the nature of science. It is designed primarily for middle and high school students, but many college faculty have told us that they want it for their courses as well! Look for its release in early 1999.

More information about GETIT can be found at http://www.geosociety.org/educational职业技术s.htm.

If you need help getting started, if you need information or educational resources, or if you have a great education or outreach idea to share with us, please give us a call at (303) 447-2020, ext. 162 or 145, or send us an e-mail at educate@geosociety.org.

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

- Research Grant information and application forms are now available on GSA's web page, http://www.geosociety.org. Evaluation from two faculty members are required on GSA appraisal forms. Applications and appraisals may be downloaded from the Web but will not be accepted by e-mail or facsimile. The deadline is February 1st each year for grants awarded in April.

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Appreciation and Thanks

The geoscientists listed here have completed the term 1996–1998 as Associate Editors for the Bulletin or Editorial Board members for Geology. GSA appreciates the contributions these people have made in evaluating manuscripts for the two journals; their volunteer efforts have helped us to maintain high scientific standards in the Bulletin and Geology.

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Cynthia Dusel-Bacon
Donald Easterbrook
David Eby
David Fastovsky
Dana H. Geary
Janet S. Herman
Clark Johnson
L. Paul Knauth
Kevin Maher
William D. McCoy
Elizabeth Miller
Peter C. Patton
Charles Paul
Lisa Pratt
Anne Raymond
Marlh Reheis
Nancy Riggs
John B. Ritter
Joseph P. Smoot
Peter R. Vogt
Peter J. Vrolijk
James Zachos

**CALL FOR APPLICATIONS AND NOMINATIONS FOR Geology Co-Editor**

GSA is soliciting applications and nominations for the position of co-editor of Geology, to serve a three-year term, beginning in January 2000, as one of a two-editor team. Desirable characteristics for the successful candidate include:

1. Broad interest and experience in geology; international recognition
2. Iconoclastic; willing to take risks and try innovations
3. Familiar with many earth scientists and their work
4. Sense of perspective and humor
5. Organized and productive
6. Willing to work closely with GSA headquarters staff
7. Able to make decisions
8. Sense of fairness
9. Familiar with new trends in geoscience
10. Willing to consider nontraditional research in geosciences

GSA provides the editor with a small stipend as well as expenses for secretarial assistance, mail, and telephone.

If you wish to be considered, please submit a curriculum vitae and a brief letter describing why you should be chosen. If you wish to nominate another, submit a letter of nomination and the individual’s written permission and c.v. Send nominations and applications to Peggy S. Lehr, Director of Publications, Geological Society of America, P.O. Box 9140, Boulder, CO 80301, by April 14, 1999.
We encourage you to make your decision as soon as possible.

**Single or Shared Accommodation:** Some trip fees are based on double occupancy. However, if you wish single accommodations, a limited number of rooms are available at extra cost on a first-come, first-served basis. In the case of double occupancies, we will do our best to help find a suitable roommate, but if none is found, the single rate will apply.

**Age Requirement:** Participants must be at least 21 years old.

**Health Recommendations and Special Needs:** You must be in good physical and mental health. Any physical condition requiring special attention, diet, or treatment must be reported in writing when the reservation is made. We will do our best to accommodate special needs, including dietary requirements and physical disabilities. Please feel free to discuss your situation with us; however, we reserve the right to decline any person as a member of a trip. We also reserve the right to require a person to withdraw from the trip at any time when such action is determined to be in the best interests of the health, safety, and general welfare of the group.

**Air Travel:** We urge you to make air travel arrangements via Lethia K. Estigoy of Conventions in America (CIA). Her direct telephone number is (619) 232-4298, flycia@scitravel.com. Lethia is ready to help you find the least expensive routing to your destination. Please call her for a no-obligation price quote at the above number or at CIA’s toll-free number 1-800-929-4242. The fax number is 619-232-6497.

**Cancellation Processing Fee:** Deposits and payments are refundable, less processing fee, up to the cut-off date. Termination by an individual during a trip in progress for any reason whatsoever will not result in a refund, and no refund will be made for unused parts of the trip.

**Full Itineraries:** A detailed itinerary and helpful travel information are available from GSA. Please feel free to contact Edna Collis, GSA Professional Development Department, at 1-800-472-1988, ext. 134, or (303) 447-2020, fax 303-447-0648, ecollis@geosociety.org.
GeoHostel

Geology of the Lewis and Clark Expedition—
The Three Forks of the Missouri River to the River of No Return, Montana and Idaho

Western Montana College of the University of Montana, Dillon, and Stagecoach Inn, Salmon, Idaho
July 17-22, 1999, (Saturday through Thursday)
5 days, 6 nights

Scientific Leaders
Rob Thomas and Sheila Roberts,
Western Montana College, Dillon, Montana

Rob Thomas is currently an associate professor and chair of the Department of Environmental Sciences at Western Montana College in Dillon. Rob developed an interest in the geology of the Lewis and Clark Expedition as a result of 13 years of research and teaching in southwestern Montana. His focus has been on the origin and timing of extensional tectonism in southwestern Montana, the dynamics of carbonate platform development and destruction, Cambrian mass extinctions, and field-based geoscience program development.

Sheila Roberts is currently an associate professor of geology in the Department of Environmental Sciences at Western Montana College in Dillon. Her focus has been on Pleistocene paleoclimates recorded in saline lacustrine sediments. Sheila is also a strong advocate for service-learning in the geosciences, and has mentored her students on a number of community service projects along the Lewis and Clark Trail in southwestern Montana. As a native Montanan, Sheila is an enthusiastic and knowledgeable guide to the history and geology of the Lewis and Clark Expedition.

Description
From 1804 to 1806, Meriwether Lewis and William Clark journeyed through the recently acquired Louisiana Territory on the order of President Thomas Jefferson. Arguably, the pivotal leg of the expedition was in present-day Montana and Idaho, from the three forks of the Missouri River, over the Continental Divide, to the River of No Return. This trip is a geological and historical tour of that famous landscape. Our expedition will have two base camps, Dillon, Montana, and Salmon, Idaho. The geological component of this GeoHostel will include field trips to see Archean metamorphic rocks, Proterozoic and Phanerzoic sedimentary rocks, Quaternary glacial deposits, hot springs and caverns, Sevier and Laramide compressional structures, and Tertiary extensional structures associated with the northern edge of the Yellowstone hotspot track. The historical component will include stops at important landmarks from the Lewis and Clark expedition such as the Three Forks, Beaverhead Rock, Clark’s Lookout, Camp Fortunate, and the Continental Divide. The trip will also include a full-day raft trip on the Salmon River—the “River of No Return”—to see the spectacular geology of the river’s canyon.

Lodging, Meals and Ground Transportation
The group will stay on Saturday, Sunday, Monday, and Thursday nights at Western Montana College, Dillon, and on Tuesday and Wednesday nights at the Stagecoach Inn in Salmon, Idaho. All lodging is based on single occupancy or doubles for couples. Meals will include plenty of hors d’oeuvres at the Welcoming Reception and Orientation on Saturday evening, daily breakfasts and sack lunches, dinner on Sunday, and a hearty farewell dinner on Thursday evening. Field trip transportation will be provided in air-conditioned, 15-passenger vans.

Alternative Housing in Dillon, Montana
Costs of alternative (non-Western Montana College) housing would be in addition to the GeoHostel fee. Reservations should be made directly by the registrant. Several motels are located in Dillon. GSA has reserved a small block of rooms at the following properties:
Centennial Inn, A Victorian Bed & Breakfast. Advance reservations are strongly recommended. Call the Centennial Inn direct at (406) 683-4454. Current double-room rate is $75.00 per night.
Best Western Paradise Inn. Advance reservations are strongly recommended. Call Best Western direct at (406) 683-4214. Current double-room rate is $37.00 per night.

 Fee and Payment
$750 for GSA Members. $800 for Nonmembers. A $100 deposit is due with your reservation and is refundable through June 1, less $20 processing fee. Total balance is due: June 1. Maximum number of participants: 32
Included: Classroom programs and materials; field trip transportation; lodging for six nights (single occupancy, or double for couples); breakfast and lunch daily, dinner on Sunday, river raft trip, and welcoming and farewell events.
Not included: Transportation to and from Dillon, Montana; transportation during hours outside field trips; and other expenses not specifically included.
1999 Penrose Conferences

March

June

August

November
November 14–19, Volcanic Rifted Margins, Sana’a, Yemen. Information: Martin Menzies, Dept. of Geology, Royal Holloway, University of London, Egham Hill, Egham, Surrey TW20 0EX, United Kingdom, 44-1784-443105, fax 44-1784-471780, menzies@gl.rbhnc.ac.uk.

1999 Meetings

February

March

March 18–19, 15th Annual Mining and Land Resource Institute, Reno, Nevada. Information: Mining and Land Resource Institute, American Association of Professional Landmen, 4100 Fossil Creek Blvd., Fort Worth, TX 76137, (817) 847-7700, fax 817-841-7704.


April
April 5–7, CoastalGeoTools ‘99, Charleston, South Carolina. Information: Steve Meador, NOAA Coastal Services Center, 2234 South Hobson Ave., Charleston, SC, 29405-2413, (843) 740-1334, fax 843-740-1315, smeador@csc.noaa.gov.

May
May 10–12, American Water Resources Association Annual Spring Specialty Conference, Atlanta, Georgia. Information: Atlanta Specialty Conference, 950 Hammond Pkwy., Suite 300, Hemdon, VA 20170-5531, (703) 904-1225, fax 703-904-1228, awrhc@aoi.com.

August

September

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

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**Positions Open**

**MINERALOGY / PETROLOGY**

**IDAHO STATE UNIVERSITY**

We seek a Visiting Assistant Professor to fill a sabbatical replacement position for the 1999–2000 academic year, with a possible continuation for one additional year. A Ph.D. is required. Teaching responsibilities will include 3-4 undergraduate classes per semester including mineralogy, igneous/metamorphic petrology, geochemistry, and introductory geology, plus the opportunity to teach a special course of the candidate's choosing. The successful candidate will have expertise in field and petrographic methodology, knowledge of petrographic and geochemical techniques, the ability to work in a university setting, to deal effectively with ethnicity and gender issues, and the desire to make a positive contribution to the department. Send letter of application, curriculum vitae, and at least three references (with addresses, e-mail, phone, and fax numbers) to: Joann Ruz, Chair, Department of Geology, Idaho State University, 241B Purgatory, Pocatello, ID 83209-8072. Position is contingent on funding. Applications will be reviewed beginning February 15, 1999. ISU is an Affirmative Action/Equal Opportunity Employer.

**TECTONICS POSITION**

**UNIVERSITY OF ARIZONA**

The Department of Geosciences invites applications for a tenure-eligible faculty position in tectonics, to be filled by August, 1999. We seek applicants interested in carrying out teaching and research in the framework of large-scale tectonics problems and processes, such as those related to development of orogenic belts, growth of continents, linkages between crustal deformation and mantle dynamics, role of fluids in crustal processes, tectonics and magmatism, and interactions between tectonic processes and global climate. We are looking for individuals who approach broad-based tectonics problems from a geologic perspective, yet who also draw substantially from geochemistry and oceanography, perhaps in part through harnessing data sets issuing from new and emerging technologies. Primarily we wish to attract applicants whose interests reside in understanding the processes that drive and control the dynamics of interaction of major components of Earth-scale tectonic systems. Rank is at the level of Assistant Professor. A Ph.D. or equivalent degree is required.

The Department of Geosciences is committed to sustained excellence in tectonics research, to innovation in the tectonics curriculum both at the undergraduate and graduate levels, and to creative, integrative, and geographically focused training. The selection process will begin January 15, 1999, and will continue until the position is filled. Interested candidates are invited to send a statement of research and teaching interests, and a list of at least three references (with addresses, e-mail, phone, and fax numbers) to: Joann Ruz, Chair, Department of Geosciences, University of Arizona, Tucson, AZ 85721; phone: (520) 621-6024; fax: (520) 621-6272; chair@geo.arizona.edu.

The University of Arizona is an EEO/AA Employer.

**DEPARTMENT OF GEOLOGICAL SCIENCES**

**NORTHERN ILLINOIS UNIVERSITY**

**http://www.earth.niu.edu**

The Department of Geological Sciences invites applications for two tenure-track positions at the rank of assistant professor.

Candidates are expected to complement existing areas of departmental expertise and to develop interdisciplinary teaching and research programs. These positions are funded for five years, and candidates are expected to apply for additional (unfunded) support. Successful candidates are expected to develop a strong research program and to take an active role in departmental and institutional service. The successful candidate should have a Ph.D. in Earth science and be committed to excellence in teaching and research.

Applicants should submit a curriculum vitae, a statement of research and teaching interests, and a list of at least three references (with addresses, e-mail, phone, and fax numbers) to: Dr. Kenneth R. Ford, Chair, Department of Geological Sciences, Northern Illinois University, DeKalb, IL 60115. Applications will be reviewed until March 1, 1999. NIU is an Affirmative Action/Equal Opportunity Employer.

**NICHOLAS CHAIR OF EARTH AND OCEAN SCIENCES**

**DUKE UNIVERSITY**

The Division of Earth & Ocean Sciences (EOS) of the Nicholas School of the Environment (NSOE) at Duke University invites applications for a distinguished, full-professor appointment as a Nicholas Chair of Earth and Ocean Sciences. We seek an outstanding scientist whose research concerns environmental problems, environmental sustainability, and the need for innovative solutions to real-world problems. The successful candidate will have a strong record of interdisciplinary research and teaching in such domains as environmental geology, sedimentology, paleoceanography, marine geophysics, and coastal studies. Successful candidates are expected to have a strong record of significant research and creative teaching in at least one of these areas and an active, research-oriented professional agenda.

The University offers a range of support for the successful candidate, including resources for national and international travel, administrative assistance, and institutional support for graduate students. The University also provides a strong environment for interdisciplinary research and teaching.

Applicants should submit a letter of application, curriculum vitae, a statement of research and teaching interests, and a list of at least three references (with addresses, e-mail, phone, and fax numbers) to: Chair, Department of Earth & Ocean Sciences, Box 90230, Duke University, Durham, NC 27708-0230. The review of applications will continue until the position is filled. Duke University is an Affirmative Action/Equal Opportunity Employer.
1998 Meeting Statistics

TECHNICAL PROGRAM
Abstracts submitted ........................................ 2,433
Abstracts presented ......................................... 2,410
Abstracts rejected or withdrawn ......................... 23
Percentage of abstracts accepted ......................... 98.7%
Poster presentations (including theme posters) ....... 676
Oral presentations ........................................... 1,734
Oral presentations, discipline sessions ................ 605
Oral presentations, theme sessions ..................... 785
Oral presentations, symposia ............................ 344
Highest number of concurrent oral sessions .......... 17
Total number of sessions (including posters) ....... 176
Theme sessions in poster format ......................... 8
Theme sessions in oral format ........................... 53

REGISTRATION
Professional ..................................................... 2,700
Student ......................................................... 1,465
Exhibitor ....................................................... 584
Guest .......................................................... 225
Total attendance ............................................ 5,124

SHORT COURSES
Number of GSA-sponsored courses ...................... 8
Participants .................................................... 161

FIELD TRIPS
Number of trips .............................................. 12
Participants ................................................... 358
Number of participants in one-day trips .............. 223

EXHIBITS
Number of booths ........................................... 217
Number of exhibiting companies ....................... 154

EMPLOYMENT SERVICE
Applicants ..................................................... 172
Employers .................................................... 36
Interviews ..................................................... 271
Positions available .......................................... 90
General Co-Chairs
Mary J. Kraus
(303) 492-7251, fax 303-492-2606, kraus@spot.colorado.edu
David Budd
(303) 492-3988, fax 303-492-2606, budd@spot.colorado.edu
Both at Dept. of Geosciences, Campus Box 250,
University of Colorado, Boulder, CO 80309-0250

Technical Program Chairs
Craig Jones
(303) 492-6994, fax 303-492-2606, cjones@mantle.colorado.edu
G. Lang Farmer
(303) 492-6534, fax 303-492-2606, farmer@terra.colorado.edu
Both at Dept. of Geosciences, Campus Box 399,
University of Colorado, Boulder, CO 80309-0399

For Field Trip Information
Call Edna Collis at GSA (303) 447-2020, ext. 134, ecollis@geosociety.org.
See November GSA Today for a preliminary list of trips.

GSA Today, January 1999
Classifieds continued from p. 35

PALEOBIOLoGY AND SURFICIAL PROCESSES BOWLING GREEN STATE UNIVERSITY

The Department of Geology invites applications for two tenure-track assistant professor positions starting in August, 1999 or 2000. Successful applicants are expected to teach effectively at the undergraduate and graduate level, maintain an active research program in designated areas of geobiology and/or paleoecology, and have access to state-of-the-art facilities in the School of Planetary Sciences, Massachusetts Institute of Technology, and other institutions in the University of North Carolina system with access to state-of-the-art facilities in the School of Geology and Geophysics housed in the Sarkeys Energy Center, and in the new Sam Noble Oklahoma Museum of Natural History, which is scheduled to be completed in March, 1999.

We seek a field-oriented, specimen-based paleontologist who uses surface or subsurface data from marine and/or terrestrial microfossils, or plant macrofossils, to address major problems in paleoecology, paleoecology, paleoceanography or stratigraphy. The successful candidate is expected to demonstrate expertise in the core paleontological areas of systematics and biostatigraphy. As a museum curator, responsibilities will include extensive scholarly research, and significant dedication to collection care, development and interpretation. In addition to ensuring adequate care of the collections, the curator also assists in the interpretation of the her/his discipline to the public.

Salary will be commensurate with experience. Candidates should have an earned PhD at the time of application; post-doctoral experience is anticipated. Women and minorities are encouraged to apply. The University has a policy of being responsive to the needs of dual-career couples. The University of Oklahoma is an Equal Opportunity/Affirmative Action University.

Florida Atlantic University, Greenville, NC

CHAIR, DEPARTMENT OF GEOLOGY EAST CAROLINA UNIVERSITY, GREENVILLE, NC

Applications are invited for the position of Chair, Department of Geology, College of Arts and Sciences, East Carolina University, effective August 1999. The successful candidate will be charged with the responsibility of a departmental chair, including (1) the development of a dynamic science core curriculum, (2) an increased role in the total educational mission of the campus and its core laboratory, and field vehicles. Teaching interests, a statement of research interests, and three current letters of recommendation should be sent to Chair, Faculty Search Committee, Department of Geology, Bowling Green State University, Bowling Green Ohio, 43403. Applications should be received no later than February 1, 1999, but applications will be considered until the position is filled. All applications will be handled in accordance with policies established under Intergovernmental Personnel Act provisions. Applicants must have a Ph.D. or professional experience in at least one of the major subdisciplinary fields of the Earth Sciences; substantial administrative, leadership, and demonstrated leadership ability. Teaching assignments, including position requirements and approval, will be located on North Carolina page at http://www.unc.edu/ncpage.html. Applicants may also obtain a copy of the announcements by contacting the Executive Personnel and Development Branch on (703) 306-0755 (hearing impaired individuals may call TDD (703) 306-0189). Applications must be received by February 5, 1999.

NSF is an Equal Opportunity Employer.

MIT — PROFESSOR OF GEOBIOLOGY

The Department of Earth, Atmospheric and Planetary Sciences at MIT invites qualified candidates to apply for a new faculty position in Geobiology. The level of the appointment will depend on qualifications. We seek an outstanding scientist deeply interested in both research and teaching who has specific expertise in the interactions between biological organisms and/or systems and geo- logical, petrological, and/or atmospheric processes. Of special interest is the evolution over time of organisms and ecosystems through the joint action of biological and environmental dynamics. One or more of the current positions may be filled in the Earth, atmospheric, hydrologic, oceanic, biological, climatic, and planetary sciences are expected to provide a significant and welcome resource to the new faculty member for interdisciplinary studies. Interes- ted scientists should send a curriculum vitae, a one-page description of research plans, and arrange for three letters of reference to: Professor Ronald G. Prinn, Head, Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technol- ogy, Bldg. 54, 918, Cambridge, MA 02139-4307, or by e- mail: rgp@mit.edu; Fax: 617-253-8298. MIT is an Equal Opportunity/Affirmative Action Employer.

Florida Atlantic University, Boca Raton, Florida

The Museum of Natural History is seeking a Lecturer in Earth Science Education, University of Northern Colorado, to serve as the Director of Community Education and Outreach. Interested or applications should be sent to: Chair, Department of Geology, College of Arts and Sciences, East Carolina University, Greenville, NC 27858-4353. The po- sition is open until filled; screening begins on January 15, 1999.

An Equal Opportunity/Affirmative Action University. Accommodates individuals with disabilities. Applicants must comply with the Immigration Reform and Control Act.

Florida Atlantic University, Boca Raton, Florida

Applications are invited for two positions for the 1999–2000 academic year. Both positions require an earned Ph.D. and appoint- ment and dovetail with the new Ph.D. program. Requirements include: (1) The Ph.D. with a strong record of funded research and service; (2) a high level of interest and infor- mation on NSF's Home-}

Lecturer in Earth Science Education University of Northern Colorado

Earned master's or doctorate from an accredited institution in some area of the earth sciences, with demonstrated expertise in college, high school teaching experience required. College teaching experience and the ability to involve undergraduate and graduate stu- dents in research are desired. Responsibilities include teaching courses in mineralogy, petrology, and geological field work; introductory-level courses, earth science concepts for elementary teachers, and secondary science methods. Participation is required in the teacher education partnership school program. Salary commensurate with qualifications and experience; benefits comprehensive. Starting date: August 18, 1999. For complete position announcement and application procedures, are located on NSF's Home-
Consultants

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Opportunities for Students

Keck Geology Consortium. Undergraduate Research Opportunities. The Keck Geology Consortium has opening for the academic year 1999-2000. The Consortium is funded by the W.M. Keck Foundation. Opportunities are available to all students. All students are encouraged to apply. Activities may include a wide range of topics normally considered as part of the Quaternary, ranging in scale from local to global. Opportunities include but are not limited to, geochemistry, geobiology, global scale environmental systems, fundamental processes in the evolution of the earth, atmospheric and ocean systems, seismology and physics of earthquakes, and planetary science and astronomy.

Applications should include a curriculum vitae, a list of papers, and a statement outlining the applicant's research interests and the program of research he or she proposes to undertake. Applicants should send three letters of reference to the Department of Geology, Oberlin College, Oberlin, OH 44074. Applications must be received by February 21, 1999. Application materials including a curriculum vitae, graduate academic transcripts, and three letters of recommendation should be sent to Steven F. Wojtal, Chair, Department of Geology, Oberlin College, Oberlin OH 44074 (steven.wojtal@oberlin.edu) by February 21, 1999. Application materials received after that date may be considered only if positions are filled. Salary will depend on qualifications and experience. Oberlin College is an Equal Opportunity/Affirmative Action employer and is committed to a diverse faculty, students, and disabled persons are encouraged to apply.

FORT LEWIS COLLEGE

ASSISTANT PROFESSOR OF GEOLOGY

Tenure-track position anticipated Fall, 1999. Ph.D. required. Primary teaching responsibilities include stratigraphy, sedimentology, and geology. Must be active in research/scholarly work, especially undergraduate research. Research in petroleum geology, environmental geology, structural geology, or geophysics desirable. Additional teaching obligations may include general education courses. Send letter of application, resume, statement of teaching and research goals, and names and addresses of three references, postmarked by February 15, 1999, to: Dr. Douglas C. Brew, Department of Geology, Fort Lewis College, 100 Rim Drive, Durango, CO 81301-9969. Offers will be made to qualified applicants who will be requested of semi-finalists. FLC is an AA/EOE.

SEDIMENTARY GEOLOGY/HYDROGEOLOGY

OBERLIN COLLEGE

The Department of Geology at Oberlin College invites applications for a non-continuing faculty position in the College of Arts and Sciences. The appointment is for one year beginning July 1, 1999. The fall semester, the incumbent will teach an introductory course on sedimentary geology. The incumbent will also teach an advanced undergraduate course in either Sedimentary Geology or Surface Processes. In the spring semester, she or he would teach an intermediate undergraduate course in hydrogeology and an additional elective course appropriate to her or his expertise. He or she will also be expected to supervise undergraduate research projects.

Applications are encouraged from outstanding students for graduate work on tectonics and climate change, with emphasis on field work, kinetics, and fault mechanics. The new appointee will possess strong academic skills, be highly motivated, and have demonstrated prior experience in research. Ph.D. applicants preferred. Applicants must also have background and/or expertise in physical, chemical, and/or biological analysis; M.S. degree in geology or geophysics would be an asset. Related attributes include good interpersonal skills along with problem solving and organizational skills. Knowledge of Unix systems; engineering courses would be a plus. UNR is located in a setting ideal for field work and world-class research.

Qualified and interested students should contact Dr. Richard Schultz, Geomechanics-Rock Fracture Group, Geoengineering Program, Department of Geologi
cal Sciences, 172 University of Nevada, Reno, NV 89557-1328; 702-388-3903; 508-289-3459; E-mail: rschultz@lgs. jussieu.edu. For information on specific program areas visit http://www.unr.edu/geophysics/schultz. Application materials and Departmental information are available from ramos@mines.unr.edu.

Graduate Studies in Geology & Geophysics, Boston College

The Department of Geology & Geophysics at Boston College offers both Teaching and Research graduate opportunities. Students can earn M.S. degrees in Geology or Geophysics, or a Masters of Science in Teaching (M.S.T.) in Geology. In addition, we now have a 3-year combined M.S./M.B.A. program in Geology and Business Administration run by a School of Management and the Department of Geology and Geophysics. We seek applicants with undergraduate degrees in a variety of subject areas, including biology, chemistry, computer science, engineering, environmental, and cataloging of fossils, sites, database entries, and research. Qualifications include course work for a degree in geology or biology, with an emphasis in paleontology. Academic credit may be arranged. Applications should include a resume, transcript, two letters of reference, and a letter outlining the applicant's specific interests. Those who propose to use a portion of their time for self-initiated research should include a statement explaining their areas of potential research interest, and, if selected, will be required to submit a formal research proposal. The program is scheduled for June 1 to August 21, although some flexibility may be possible. Benefits consist of housing and a daily stipend of $12. A personal vehicle is strongly recommended. Applicants must be U.S. citizens or permanent residents who can provide travel support. Applications are due by April 1, 1999. For more information, e-mail Herb.Meyer@hp.gov.

Jonathan O. Davis Scholarship, administered by the Quaternary Sciences Center, Desert Research Institute. The family and friends of Jonathan O. Davis, a prominent geologist and geoarchaeologist, have established an endowment which provides a graduate scholarship of $2,000. Jonathan was tragically killed in an automobile accident in December 1990. It is the wish of his family and friends to support graduate students working on the Quaternary geology of the Great Basin and surrounding areas.

The scholarship is open to graduate students enrolled in M.S. or Ph.D. programs at any university in the United States. "Quaternary geology" encompasses a wide range of topics normally considered as part of the Quaternary sciences. The research, however, must have a substantial geological component or demonstrate a strong reliance on geological techniques.

Applications should include: (1) a cover letter explaining how the individual qualifies for the award (please include your social security number); (2) a current resume or vitae; (3) 2-page, single spaced description of the thesis/dissertation research which also clearly documents the geological orientation and research significance; (4) a letter of recommendation from the thesis/dissertation supervisor that emphasizes the student's ability and potential as a Quaternary scientist;

Applications must be post-marked by March 1, 1999. Applications should be addressed to: Executive Director, Quaternary Sciences Center, Desert Research Institute, 7010 Dandini Blvd., Reno, NV 89512. Contact: Mary Ann Moran, (702) 673-7458; or e-mail mmoran@dri.edu.
Military Geology in War and Peace


In warfare, military geologists pursue five main categories of work: tactical and strategic terrain analysis, fortifications and tunneling, resource acquisition, defense installations, and field construction and logistics. In peace, they train for wartime operations and may be involved in peacekeeping and nation-building exercises. The classic dilemma for military geology has been whether support can best be provided by civilian technical-matter experts or by uniformed soldiers who routinely work with the combat units. In addition to the introductory paper this volume includes 24 papers, covering selected aspects of the history of military geology from the early 19th century through the recent Persian Gulf war, military education and operations, terrain analysis, engineering geology in the military, use of military geology in diplomacy and peacekeeping, and the future of military geology.

SPE327, 112 p., ISBN 0-8137-2327-2, $41.00, Member price $33.00

Tectonics and Geochemistry of the Northeastern Caribbean

edited by E. G. Lidik and D. K. Larue, 1998

This up-to-date account of the geology of the northeastern Caribbean region is the first general summation of this region since the publication of the DNAG series volume (H) on the Caribbean region (1990). The primary focus of this Special Paper is on the tectonics and geochemistry of the plate boundary, with emphasis on the island of Puerto Rico, the Puerto Rico trends, and adjacent areas. Following an introductory chapter on tectonic setting and stratigraphic correlations of the volcanic strata in Puerto Rico, five papers deal with geochronological aspects of these related igneous rocks. A second group of three papers explores the tectonics and stratigraphy of Tertiary and younger rocks along the north coast of Puerto Rico and in the adjacent Puerto Rico trench. This volume is an excellent companion to GSA Special Papers 262 and 295; all three concern the circum-Caribbean plate margins.

SPE322, 222 p., indexed, ISBN 0-8137-2322-1, $68.00, Member price $54.40

Architecture of the Central Brooks Range Fold and Thrust Belt, Arctic Alaska


The 17 papers in this volume present the results of a decade of geological and geophysical research centered largely along a north-south transect through the central Brooks Range of Arctic Alaska. Investigations and results center on a comprehensive description of the rocks and their tectonic evolution from the foreland to the hinterland of the orogen; the geometry and kinematics of contractional and extensional structures, regional and local stratigraphic relations, thermochronology, and the deep crustal structure of the Brooks Range and parts of the North Slope; and detailed descriptions of the major lithotectonic assemblages composing the orogenic belt. This volume offers a unique perspective of a fold-thrust belt and should prove useful in the study of other contractional belts around the world.

REG038, 256 p., ISBN 0-8137-4113-0, $70.00, Member price $56.00

Depositional Environments, Lithofacies, and Biostratigraphy of the White River and Arikaree Groups (Late Eocene to Early Miocene, North America)

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The Paleogene-Neogene transition in nonmarine rocks of the North American midcontinent lies within the White River and Arikaree Groups of late Eocene to early Miocene age. This volume presents current lithostratigraphic revision and magnetostratigraphy of these fine-grained volcanioclastic sediments, known for over a century for their abundant fossil mammals. Interbedded tuffs, paleomagnetic zonation and mammalian faunas in the White River and Arikaree rocks provide a revised correlation to other important areas of similar age within North America at a critical time in Earth history—the dawn of the Neogene.