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## Evaluating Global Warming: A Post-1990s Perspective

David S. Gutzler, Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM 87131-1116, USA, gutzler@unm.edu

### ABSTRACT

Globally averaged surface-air temperature warmed approximately 0.5 °C during the twentieth century, and the rate of warming has accelerated considerably since about 1980. Proxy climate data suggest that current global temperatures are warmer than at any time in the last millennium. As this trend persists, the likelihood increases that the warming is due at least in part to anthropogenic inputs of atmospheric greenhouse gases. There is no debate over the measured increases in greenhouse gas concentrations, or the anthropogenic origin of these increases, or the direct radiative effect of increased greenhouse gas concentrations.

Public debate and policy development on global warming are stuck, however, in part because it remains exceedingly difficult to specifically attribute current global warming to increases in greenhouse gases, or to make confident predictions of the rate and spatial variability of future warming. Attribution and prediction of global warming both depend on large-scale modeling, and the complexities associated with simulating the climate system are so great that conclusive attribution and prediction will probably not be reached for some time. These uncertainties tend to overshadow the higher degree of certainty associated with observational evidence for global warming. The scientific community should acknowledge that the attribution and prediction problems will not be resolved to the satisfaction of policy makers in the near future, and should instead work toward establishing new

paradigms for partnership with policy makers, with greater emphasis on observations of past and present climate change.

### INTRODUCTION

Earth's climate is warming. The Athabasca glacier shown in Figure 1 has steadily retreated during this century, as



Figure 1. Athabasca glacier in Jasper National Park, Alberta, Canada. A series of signs marks recent retreat of glacier's snout. (Photo courtesy of P. Fawcett.)

have many other glaciers throughout the world (Oerlemans, 1994). Figure 2 shows an instrumental record of globally averaged surface-air temperature since 1880, when sufficient thermometers were in service worldwide to make such an average meaningful. Temperature has increased since 1880 by approximately 0.5 °C. The warming trend has not been steady during the twentieth century; rapid warming during the first and last thirds of the century occurred before and after modest cooling in mid-century. The six warmest years of the 120-year record shown in Figure 2 all occurred in the 1990s. The

warmest year is 1998; the year just ended, 1999, is the fifth warmest in the record.

The temperature data in Figure 2 are subject to significant uncertainties, but these are relatively well constrained. There is no serious doubt that surface temperatures warmed somewhat in the twentieth century and that the warming trend accelerated near the end of the century. In

addition to measurement uncertainties associated with particular thermometers, the network of thermometers over the world oceans is quite sparse, and numerous temperature records over land are taken at urban sites that may be subject to local microclimatic warming as cities grow (although the temperature data in Figure 2 have been processed in an attempt to remove this effect). Furthermore, globally averaged temperatures in the lower troposphere derived from satellites show less rapid warming since 1980 than the surface thermometer data. The difference between surface and satellite records has not been fully reconciled, but a recent comparative study confirms the reality of the twentieth century surface

warming trend (National Research Council, 2000).

During this same period, the atmospheric concentration of carbon dioxide, methane, and several other important greenhouse gases has increased substantially (thick green curve, Fig. 2). There is no debate over the fact that greenhouse gas concentrations are increasing rapidly and the buildup is unequivocally anthropogenic (Intergovernmental Panel on Climate Change, 1995), through burning of fossil fuels and forests and expanding agriculture.

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**Global Warming continued from p. 1**

Although less than a degree of global warming in the twentieth century may seem small, this amount of warming is actually quite large compared to previous climate variability in the late Holocene. Figure 3 shows a time series of estimated Northern Hemisphere temperatures for the past 1000 years (Mann et al., 1999), which suggests that the observed warming in the twentieth century is both large and rapid, resulting in late twentieth century temperatures significantly warmer than at any time in the last millennium.

What, if anything, people should do about greenhouse gas emissions in hopes of mitigating future global warming is one of the most contentious and important

long-term environmental issues facing the world today. In this paper I present one view of why it has been so difficult to create science-based political consensus on global warming. To interact effectively with policy makers, the research community must place climate change into a context meaningful to the public. With this in mind I will present a short description of the policy framework for dealing with global warming and then present progressively more detailed snapshots of climatic conditions in the 1990s, the year 1999, and the boreal winter of 1999–2000.

Discussion of recent climate anomalies leads to a discussion of the difficult, and related, problems of attributing climate change to a particular cause and making quantitative predictions of future



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*"It is not the time to stand still and wait for better times or better moods. Better times will come if we chart a course that creates opportunities for relevant scientific achievement, produces through education a greater influence on the public's understanding of the way Earth works, and enhances sensible management of our planet in the second century of the Geological Society of America."*

—Randolph W. Bromery  
Former Chair, Second Century Capital Campaign  
(1992–1999), GSA Foundation

## Science, Stewardship, and Service: Bringing It All Together, Part 1

Over the past several months, we've explored GSA's organizational values of science, stewardship, and service. These are powerful, evocative concepts, filled with meaning for those of us dedicated to our profession and to GSA. As we draw our discussion of values to a close now, I'd like to share with you my view of one of the most important means by which we're able to manifest these values in concrete and compelling ways.

### The GSA Foundation

Founded in December 1980, the GSA Foundation (GSAF) is an independent not-for-profit corporation that seeks financial support for GSA initiatives. Over the past 20 years, GSAF has raised more than \$16 million. Approximately 70% of all contributions have come from GSA members—both national and international—with the remaining 30% from other individuals, corporations, foundations, and government agencies.

### Strengthening our Working Relationship

When I arrived at GSA in the spring of 1999, the need to improve the relationship between GSA and GSAF was a major priority of mine. Much hinged on GSA's need to set program priorities, develop concrete plans, and improve financial accountability. Once that was accomplished, the stage was set to increase the effectiveness of the GSA-GSAF partnership.

Last year, we also instituted a formal process for communicating and periodically reviewing program and funding priorities. At the same time, GSAF's director of development assumed a seat on the newly established Programmatic Overview Committee, and I accepted the position of vice president of GSAF to provide day-to-day oversight of GSAF headquarters staff and their activities.

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**GSA Foundation Mission Statement**  
*The GSA Foundation exists to fund those education, research, publications, student support, public outreach, and other geoscientific programs of the Geological Society of America that the Society considers necessary to accomplish its purposes of advancing the geosciences, enhancing the professional growth of GSA members, and promoting the geosciences in the service of humankind.*

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In the late summer of this year, GSA and GSAF signed a comprehensive Letter of Understanding, further clarifying the duties and responsibilities of the two organizations. "The intent of the letter is to define how our two organizations will function together as a strategic partnership," said Brud Leighton, Chair of the GSAF Board of Trustees.

### Fuel for Science, Stewardship, and Service

The GSAF Board of Trustees has done a tremendous job over the past two years. Mobilizing a group of dedicated member-volunteers and working with GSAF staff, they led the Foundation in raising over one million dollars in 1999. They established five major new funds in support of research, funding for minorities, and honoraria.

GSAF also signed Subaru of America, Inc., as the first corporate sponsor of GSA's Annual Meeting and two programs, the new Distinguished High School Earth Science Educator in Residence and the Doris M. Curtis Women in Science Award. The trustees also brought the Second Century Capital Campaign to a close, with total revenues of \$10.9 million raised over seven years.

In light of GSA's globalization initiative, one particularly exciting development was significant growth of the El-Baz Fund for Desert Research. Major donations were received from the Sultan of

Oman, the Ruler of Sharjah in the United Arab Emirates, the Royal Academy of Morocco, the Egyptian Prime Minister's office and the Egyptian Ministry of State for Environmental Affairs, and the Kuwait Foundation for the Advancement of Sciences.

### Looking Ahead

A major priority for the GSA-GSAF partnership in the coming months is to increase the proportion of unrestricted to restricted funds. Currently 87% of GSAF assets are restricted in their use, and much more flexibility is needed if it is to partner with GSA to meet program goals. A second priority is to shift emphasis back from the recently completed Second Century Capital Campaign to annual campaigns, cultivating new donors and adding major donors.

Next month, I'll talk about the GSA-GSAF program funding priorities set in May 2000. They represent a major portion of our collective science, stewardship, and service.

change. I argue that fundamental limitations in our ability to model the climate system in terms of forcing and response will preclude resolutions to these problems definitive enough to satisfy skeptical policy makers for years to come. The scientific community should refocus public debate on aspects of climate science that are more tangible and certain, based principally on observations. We should emphasize that model-based prediction is primarily a tool for describing a range of possible future climate scenarios, which cannot be predicted with certainty, and make better use of the observed climate record as the benchmark for these scenarios.

## GLOBAL WARMING POLICY

To provide a framework for constructive scientific input to international climate change policy initiatives, the Intergovernmental Panel on Climate Change (IPCC) was created in 1988 by the World Meteorological Organization (WMO) and the United Nations Environmental Programme. The IPCC's First Assessment Report was released two years later (IPCC, 1990). Following this report, the U.N. Framework Convention on Climate Change, or FCCC, was negotiated in Rio de Janeiro in June 1992. It contains statements of principles regarding the potential impacts of anthropogenic climate change and the desire to stabilize greenhouse gas emissions, but does not include specific emissions quotas or legally binding

enforcement provisions. Climate change in the FCCC is defined as change "attributed directly or indirectly to human activities," making the attribution problem a central component of global warming policy. The FCCC entered into force in March 1994 after having been ratified by 50 countries.

Emissions quotas designed to take steps toward achieving the goals of the FCCC were negotiated at the 3rd Conference of the Parties at Kyoto, Japan, in December 1997, after the release of the IPCC's Second Assessment Report (IPCC, 1995). However the Kyoto Protocol has not entered into force. As of January 2000, the protocol had been ratified by just 22 of the 84 parties that signed it. It will

Global Warming *continued on p. 4*

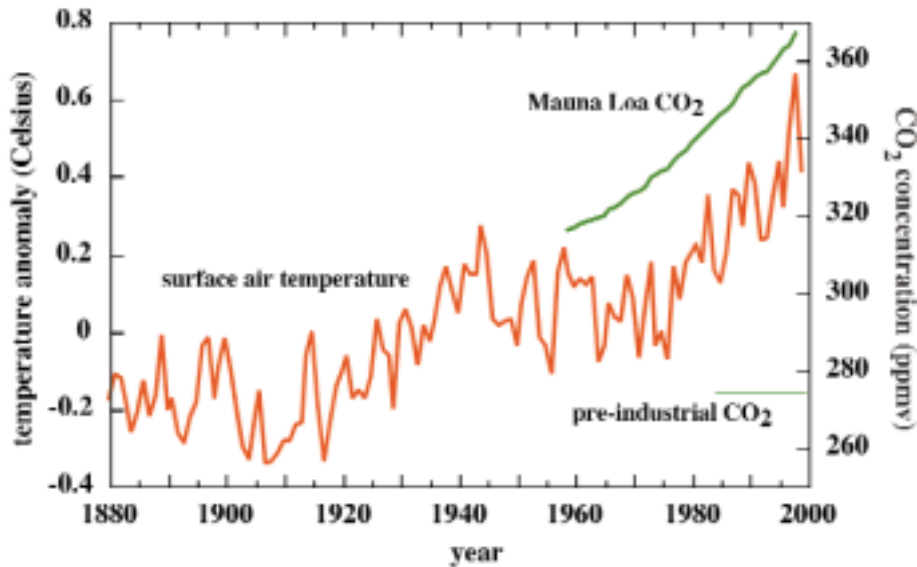


Figure 2. Red curve shows annual global mean surface-air temperature for the period 1880–1999, obtained from U.S. National Climatic Data Center. The mean temperature for period of record has been removed. Thick green curve shows annual mean concentration of CO<sub>2</sub> (ppmv) for the period 1959–1999, sampled at Mauna Loa Observatory, Hawaii (Keeling and Whorf, 1999). The preindustrial CO<sub>2</sub> concentration of about 275 ppmv is marked by lighter green line.

### Global Warming *continued from p. 3*

become legally binding only when at least 55 parties, including parties accounting for at least 55% of developed-country emissions, have ratified it. The most populous of the 22 ratifier nations is Uzbekistan.

### CLIMATE CHANGE IN THE 1990S

The 1990 First Assessment Report was written and released shortly after the accelerated warming of the late twentieth century had commenced (Fig. 2). The report makes a strong distinction between general *detection* of a change in climate that seems to be significantly larger than some estimate of natural variability, and the *attribution* of such a climate change to a specific cause (IPCC, 1990, ch. 8). In 1990, it was possible to state with reasonable certainty that the climate had warmed during the twentieth century. Global mean temperatures then continued to rise in the years leading up to the Rio de Janeiro summit and the adoption of the FCCC in 1992. By 1995, when the Second Assessment Report was released, the detection issue was more firmly resolved than was possible five years earlier. The IPCC's Third Assessment Report, now in preparation and scheduled for release in April 2001, will surely contain even stronger statements on the significance of twentieth century climate change based on improved global estimates of Holocene climate variability such as shown in Figure 3.

The year 1999 marked the end of the warmest decade of an anomalously warm century (Fig. 2). The overall warmth of 1999 is particularly noteworthy considering the presence last year of La Niña con-

ditions in the tropical Pacific. La Niña, the cold ocean phase of the El Niño–Southern Oscillation cycle, has been shown to have a *cooling* effect on globally averaged surface temperatures (Jones, 1988). Thus, the warm anomaly of 1999 occurred in spite of the effects of the El Niño–Southern Oscillation cycle on global temperatures, which almost certainly contributed to the record warm global temperatures of 1997–1998 (Karl et al., 2000) that occurred during an extreme El Niño event. The fact that the fifth warmest year on record occurred during the subsequent La Niña event adds to the evidence that global

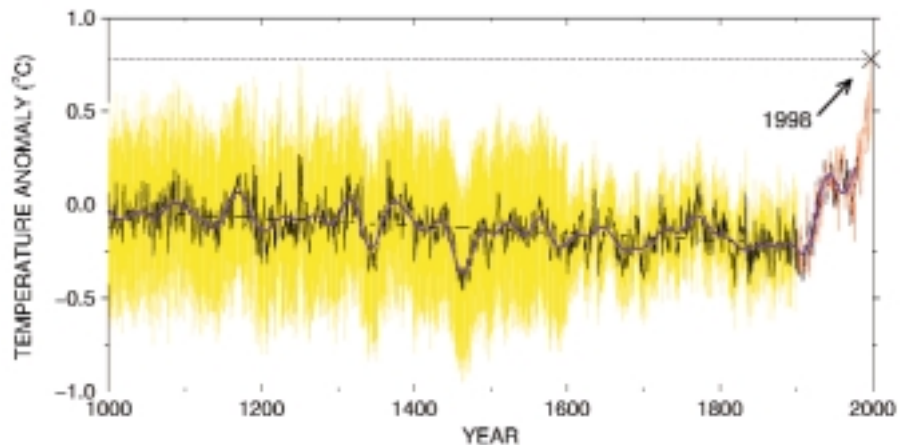


Figure 3. Reconstructed Northern Hemisphere temperatures since 1000 A.D. (Mann et al., 1999), referenced to 1902–1980 mean. Preinstrumental data are derived from a spatially weighted combination of twelve proxy climate indices based on tree ring and ice core data, calibrated against twentieth century instrumental record (red curve). Yellow shading shows an envelope of uncertainty ( $2\sigma$ ) of annual temperature estimates. A modest cooling trend is suggested for most of the millennium, although uncertainties are large prior to 1400 A.D. Twentieth century warming is large, abrupt, and significant in comparison with variability exhibited in earlier centuries.

warmth in 1999—and by extension, the overall warming trend of the 1990s—was associated with some other factor.

As if to end the 1990s with a climatic exclamation point, the most recent boreal winter (December 1999–February 2000) was remarkably warm across much of the globe (Fig. 4). Last winter was the warmest ever recorded across the 48 contiguous United States: There were no regions of the United States that exhibited significant negative temperature anomalies, and a large fraction of the midwest region experienced warm anomalies exceeding 2 °C. The subsequent boreal spring was the warmest ever recorded over the same area, and globally, this spring was the fifth warmest in the instrumental record (National Climate Data Center, 2000b).

Much, but not all, of the planet was also warm last winter, including Europe, central Africa, and mid-latitude oceans in both hemispheres. However, temperatures across a large swath of the central equatorial Pacific were cooler than normal, corresponding to La Niña conditions. Across Australia, the austral summer of 1999–2000 was also somewhat cooler than normal. So this year, Australians may be inclined to dismiss global warming as a non-issue, despite twentieth century warming there consistent with the global average (IPCC, 1998). Mongolia and nearby regions of southern Siberia and northern China were cool and snowy. Individual short-term regional climate anomalies are part of the natural variability from which long-term climate signals must be separated. Yet these short-term, small-scale anomalies are what people feel and remember; the longer-term records (Figs. 2 and 3) allow us to put such short-term anomalies into the proper climatic context.

## UNCERTAINTIES IN ATTRIBUTION AND PREDICTION OF CLIMATE CHANGE

The evidence for recent, rapid global warming is clear and seems very significant compared to current estimates of climate change in the Holocene. Thus, the debate over *detection* of climate change is drawing to a close. Nevertheless, it remains extraordinarily difficult to *attribute* the warming trend to any particular forcing function with sufficient certainty to satisfy policy makers. To address the attribution problem it is necessary to (1) understand the spatially varying response of the climate system to the forcing in question, i.e., define a particular signal; (2) estimate the expected spatial and temporal variability of the system in the absence of such forcing, i.e., define climate noise; and (3) demonstrate that observed climate change is sufficiently like the former and unlike the latter to confidently make an attribution, i.e., calculate the signal/noise ratio (Hasselmann, 1997). These are essentially the same steps required to make quantitative predictions of the forced response of the climate system to future increases in greenhouse gases.

A single variable such as global-mean temperature is not sufficient to differentiate a greenhouse-gas-induced climate change from other possible sources of variability. Large-scale numerical models provide the only means of estimating the answer to 1, above, and, in the absence of sufficient high-resolution, preindustrial climate data, the only practical way of assessing 2, above (IPCC, 1995, ch. 8; Hasselmann, 1997). Multivariate greenhouse fingerprints are derived by comparing patterns of variability in a numerical simulation in which greenhouse gas concentrations are kept fixed, thereby simulating natural variability, with another run of the same model in which greenhouse gases increase (IPCC, 1995, ch. 8; Hegerl et al., 1997; North and Stevens, 1998). Statistical tests are applied to determine the multivariate spatial pattern of climate anomalies—the fingerprint—that most clearly distinguishes variability in the two runs. Observed data are then examined for variations of the fingerprint pattern as evidence of greenhouse-gas-forced climate change.

Fingerprint techniques thus rely on large-scale models to characterize both the signal and the noise in the climate system. Although tremendous progress in coupled-ocean-atmosphere modeling has been achieved in recent decades, such models still contain numerous known limitations and deficiencies (IPCC, 1995, ch. 5; Ledley et al., 1999). These include the small-scale parameterizations of clouds, precipitation and turbulence in atmospheric models, the variability of temperature and currents in ocean models, charac-

terization of energy exchanges among the atmosphere, ocean, and biosphere, and the sensitive nonlinear feedback processes that crucially affect the evolution of the coupled climate system (IPCC, 1995, ch. 4). The uncertainties of large-scale modeling are illustrated by the significant discrepancies in climates simulated by different models forced by exactly the same boundary conditions in controlled comparative runs (Barnett, 1999; Bell et al., 2000).

The First Assessment Report flatly stated that it was not possible to attribute twentieth century climate change to increases in greenhouse gases (IPCC, 1990, p. 254). Between 1990 and 1995, substantial model-based research was conducted to constrain the structure and magnitude of the greenhouse warming signal and the climate noise (steps 1 and 2 in the attribution process). As a result, the Second Assessment Report included a positive, but cautious, declaration of attribution, stating

but uncertain conclusions are far from sufficient to help policy makers reach consensus on this issue.

Attribution studies have reached modestly more definitive conclusions since 1995 (Hegerl et al., 1997; North and Stevens, 1998; Knutson et al., 1999). Next year's Third Assessment Report will probably include a statement on attribution that is somewhat stronger than the second report, but it will likely not be sufficient to sway policy makers who are reluctant to accept the considerable economic challenges associated with CO<sub>2</sub> emission limitations. The climate community's slowly increasing confidence in formally attributing observed recent temperature change to greenhouse gas forcing will remain controversial. Furthermore, attribution of regional-scale climate anomalies, such as the warm winter of 1999–2000 across North America, is simply not possible, yet it is just such smaller-scale variability that is of most concern to policy makers and

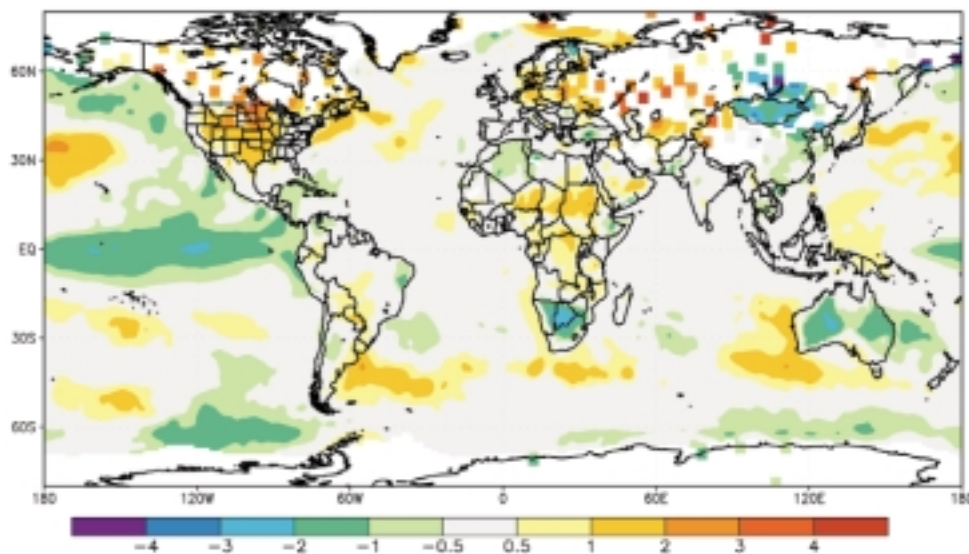


Figure 4. Seasonal surface-air temperature anomalies for boreal winter December 1999–February 2000, obtained from the U.S. NOAA National Climatic Data Center (NCDC, 2000a). Values are referenced to the 1992–2000 mean.

that, "The balance of evidence suggests a discernible human influence on global climate," (IPCC, 1995, p. 4; see also ch. 8).

The Second Assessment Report explains further that the greenhouse-gas-induced warming signal should emerge gradually from the climate noise over the coming decades, and that the signal/noise ratio would be largest on large spatial scales. Thus, there is an inherent mismatch between the large time and length scales most important for attribution of the causes of global warming and the smaller time and length scales important to the public. Five years of acrimonious debate (based largely on uncertainties in large-scale modeling) over the Second Assessment Report's attribution statement make it clear that its rigorous

the public.

Limitations in our ability to make definitive attribution of climate change go hand in hand with the difficulties in making quantitative predictions of climate change. These vary considerably, although at least modest global warming (at least as much as the twentieth century trend) is common to all the predictions considered by the IPCC in 1995. At regional spatial scales, the global warming signal is still a small component of interannual variability (cf. Fig. 4). Climatic variables other than temperature (especially precipitation) are still harder to model and predict with certainty. Climate prediction is an uncertain enterprise and will remain so.

Global Warming *continued on p. 6*

## A COUNTEREXAMPLE: THE MONTREAL PROTOCOL

It is instructive to compare the FCCC and its Kyoto Protocol with the development of policy in response to stratospheric ozone depletion. The international community acknowledged the importance of the ozone depletion problem (analogous to the FCCC) in the Vienna Convention in 1985. The goals of the Vienna Convention were addressed by the Montreal Protocol on Substances that Deplete the Ozone Layer (including chlorofluorocarbons, or CFCs, and other halons), which was negotiated in September 1987 and entered into force at the beginning of 1989 (Benedick, 1991) with subsequent strengthening amendments. The effort to restrain CFC production and promote more ozone-friendly substitutes for CFCs has been widely regarded as a success. Production of CFCs and halons is severely restricted. CFC concentrations have decreased in the troposphere and model predictions, based on confident attribution of the cause of stratospheric ozone depletion, suggest that the ozone hole should be repaired by late in the 21st Century (WMO, 1998).

In some important ways, the observed twentieth century increase in ozone-depleting substances is analogous to increases in greenhouse gases: The buildup is unequivocally anthropogenic, the gases in question have long atmospheric lifetimes so emissions are mixed worldwide and remain in the atmosphere for decades or longer, and anthropogenic emissions are generated internationally. The basic challenges of policy formulation aimed at mitigating ozone-depleting emissions are therefore also analogous. In particular, emission controls must be implemented internationally, causing tension between industrialized countries (the largest current emitters who, therefore, caused the current problem) and the lesser-developed countries, whose emissions are increasing rapidly but who want to avoid having their economic development options limited by new emissions controls.

However, there are several critical intrinsic differences in the temporal and spatial scales of the environmental problems associated with CFCs or greenhouse gases that make the global warming attribution and prediction problems much more difficult. (There are also large differences in the social and economic impacts of CFC versus CO<sub>2</sub> emissions restrictions, but I will concentrate on climate effects here.) The most dramatic manifestation of ozone depletion, the Antarctic ozone hole, is an annual event that occurs at a fixed time of year at a known latitude and altitude. The ozone hole was first documented by Farman et al. (1985), after the

adoption of the Vienna Convention but, perhaps significantly, before the Montreal Protocol was signed.

The Antarctic ozone hole was a nasty surprise that focused international attention on the stratospheric ozone layer. How ozone policy would have evolved had there been no ozone hole is actively debated (Benedick, 1991; Ungar, 1995; Betsill and Pielke, 1998), but several sharp distinctions between ozone depletion and global warming are clear. The ozone hole is observable every year. Policy makers and the public obtained direct experience with ozone hole observations and predictions, making them meaningful and believable, like day-to-day weather forecasts (Pielke et al., 1999). In contrast, global warming is a slow, continual, global-scale process that is much harder to define and separate from other climatic variability; it does not occur repeatedly and discretely. A warmer climate is not unequivocally bad for everyone, unlike a stratosphere with less ozone. It is difficult to convince policy makers and the public of the importance of hypothetical climate changes, and correspondingly much easier to explain that an event like the ozone hole seen previously might reoccur or amplify.

Furthermore, the predictable seasonal cycle of Antarctic ozone depletion allowed annual hypothesis testing to take place, leading to rapid progress on the attribution problem. In the late 1980s, predictions of the extent and magnitude of Antarctic ozone depletion were made each year based on testable theories for what caused it. Measurement campaigns were designed to test these theories. The annual repetition of the ozone hole allowed the implementation of a concentrated scientific campaign to both measure and model the processes involved, culminating in an extraordinarily definitive attribution: halocarbons are the culprit (WMO, 1994).

In contrast, there is just one global climate record for the past few centuries to use in assessing model performance, and the research community gets just one chance to predict the slow global change associated with greenhouse gas increases. The public cannot see this phenomenon occurring repeatedly. Global warming predictions made now will not be verified for decades. Even if the warming trends evident in Figures 2 and 3 continue into the twenty-first century, definitive attribution of these trends will be difficult and uncertainties will be large enough to provoke skepticism and debate. So long as policy development hinges on attribution and prediction of climate change, scientific uncertainties will seem large even if the climate continues to warm up.

## RECOMMENDATIONS AND CONCLUSIONS

The IPCC will issue its Third Assessment Report next year. It will encapsulate

some excellent science, but we should anticipate that it will not serve to move policy forward in a significant way. Two of the principal scientific sticking points— attribution and prediction of climate change—are related to inherent limitations in our ability to model the climate system with sufficient confidence to assuage skepticism and debate on those issues. Emphasizing the aspects of climate change that are most uncertain is a sound basis for scientists to generate research plans but a poor basis for us to interact with the public. We will not truly be able to attribute global warming to greenhouse gas increases until the climate has already warmed a great deal relative to pre-twentieth century temperatures. We cannot predict with certainty how much climate change will occur on local or regional scales decades in advance.

Constructive scientific input to global warming policy discussion should focus on the more tangible and certain aspects of climate science, grounded in observations. Our knowledge of climate change in the recent geological past is broad and deep, the means for refining curves such as Figure 3 still further are known, and our ability to put current change into late Holocene context is advanced relative to our ability to capture this variability in large-scale models. The past and present cannot serve as a complete guide to the future, especially since current levels and rates of change of greenhouse gases have no known analog in the past, but observations provide a much firmer foundation for public discussion than model-based research.

Emphasizing detection and monitoring of climate change would decrease public confusion over what is known versus what is uncertain. The policy-making community and the public should be guided to anticipate, and plan for, climate changes that cannot be predicted with certainty. Even if we cannot now say for sure how much of the warming in Figures 2 and 3 is due to increased CO<sub>2</sub>, we can say that recent change is certainly consistent with plausible expectations of greenhouse warming and that there is no indication that recent climate changes will reverse or abate. We should use observations to describe previous episodes of extreme climate anomalies that may become more common as the climate warms up. Policy guidance of this sort, grounded in observation augmented by a range of model-generated future scenarios, would lead to greater emphasis on adaptation to uncertain climate futures and “no regrets” economic policies (Pielke et al., 1999).

Waiting for the attribution and prediction problems to be solved, which is the current *de facto* policy, is itself an important policy decision and should be acknowledged as such. A more fruitful approach to scientific involvement in the

policy process would begin by emphasizing improved descriptions of past climate change, and enhanced monitoring and detection of current climate change.

#### ACKNOWLEDGMENTS

Exceptionally constructive critical reviews by E. Barron, P. Fawcett, M.F. Miller, R. Pielke Jr., and M. Roy were extremely helpful. I thank M. Mann and T. Ross for Figures 3 and 4. My research at the University of New Mexico has been supported by the National Science Foundation.

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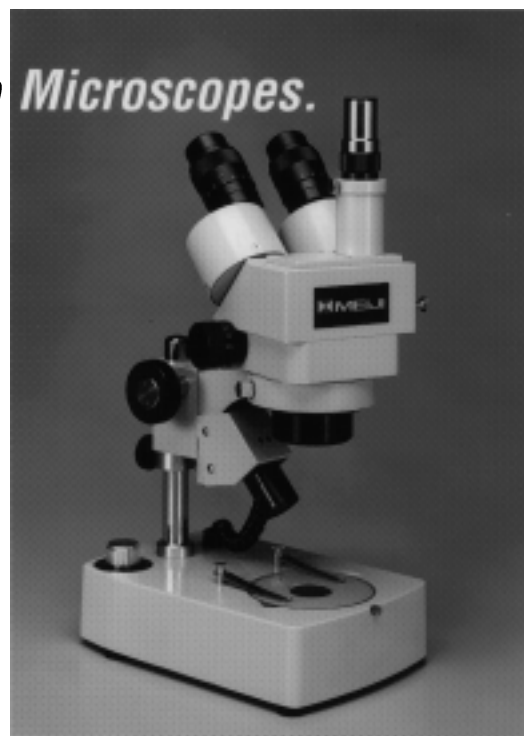
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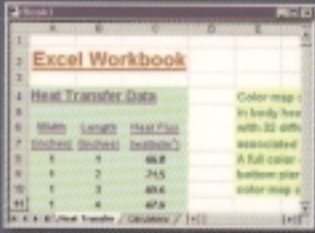
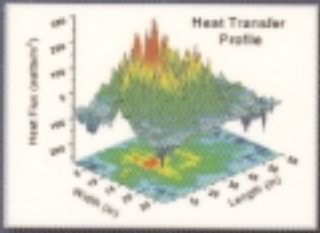


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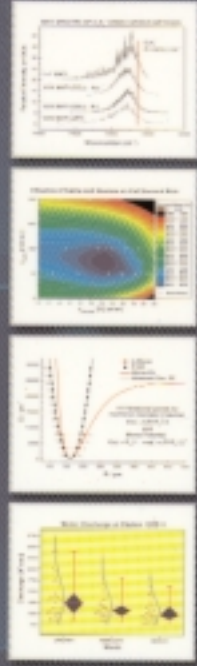
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# Boston

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(617) 373-3181, fax 617-373-4378  
[rbailey@numet.neu.edu](mailto:rbailey@numet.neu.edu)

David P. West Jr.  
Department of Geology  
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### SUNDAY, NOVEMBER 12

Session	Title	Time	Location
1	Janus II: Mineral Exploration for the 21st Century I ( <i>Society of Economic Geologists</i> )	8:00 a.m.–noon	B8 & 9
2	T77. Sources, Synthesis, Transformations, and Sinks of Organic Matter on the Earliest Earth I ( <i>Organic Geochemistry Division of the Geochemical Society</i> )	8:00 a.m.–noon	B16 & 17
3	Janus II: Mineral Exploration for the 21st Century II ( <i>Society of Economic Geologists</i> )	1:30–5:30 p.m.	B8 & 9
4	T77. Sources, Synthesis, Transformations, and Sinks of Organic Matter on the Earliest Earth II ( <i>Organic Geochemistry Division of the Geochemical Society</i> )	1:30–5:30 p.m.	B16 & 17

### MONDAY, NOVEMBER 13

5	Aqueous Geochemistry I	8:00 a.m.–noon	B11
6	Clastic Sediments I: Provenance, Tectonics, and Diagenesis of Siliciclastic Rocks	8:00 a.m.–noon	Ballroom A (ATL)
7	Paleontology I (Posters)	8:00 a.m.–noon	Hall C
8	Quaternary Geology I: Glacial Geology	8:00 a.m.–noon	B13
9	Quaternary Geology and Geomorphology (Posters)	8:00 a.m.–noon	Hall C
10	Structural Geology I: Folds, Faults, and In Situ Stresses	8:00 a.m.–noon	B2
11	Tectonics I: Tectonometamorphic and Exhumational Processes: Appalachians, Caledonides, and Asia	8:00 a.m.–noon	B6
12	K1. Geology in the New Millennium I: Resource Collapse, Environmental Catastrophe, or Technological Fix?	8:00 a.m.–noon	Hall B
13	T2. Frontiers in Gas Hydrate Research I ( <i>Geochemical Society</i> )	8:00 a.m.–noon	B5
14	T3. Environmental Aspects of Fossil Fuel Use ( <i>GSA Coal Geology Division; U.S. Geological Survey</i> )	8:00 a.m.–noon	B19 & 20
15	T4. Structure and Tectonics of Planets and Satellites ( <i>GSA Planetary Geology Division</i> )	8:00 a.m.–noon	Ballroom D (ATL)
16	T10. The Colorado Plateau: Its Origin, Boundaries, Lithospheric Structure, and Evolution I ( <i>GSA Geophysics Division</i> )	8:00 a.m.–noon	Ballroom B (ATL)
17	T20. Reconstructing Miocene and Younger Extension Across the Northern Basin and Range Province (Posters) ( <i>GSA Structural Geology and Tectonics Division</i> )	8:00 a.m.–noon	Hall C

Session	Title	Time	Location
18	T21. New Developments in the Mesozoic Tectonic Evolution of the North American Cordillera I ( <i>GSA Structural Geology and Tectonics Division</i> )	8:00 a.m.–noon	B16 & 17
19	T37. Sulfate Minerals: Hydrothermal Systems (A Tribute to Robert O. Rye) ( <i>Mineralogical Society of America; Society of Economic Geologists; Geochemical Society</i> )	8:00 a.m.–noon	Ballroom C (ATL)
20	T42. Eruption or Intrusion? Volatiles, Magmas, and Porphyry Copper Deposits I ( <i>American Geophysical Union</i> )	8:00 a.m.–noon	Ballroom E (ATL)
21	T45. Metamorphic Petrology from Experiments to the Field: A Session Honoring M.J. Holdaway I ( <i>Mineralogical Society of America</i> )	8:00 a.m.–noon	Chianti (ATL)
22	T63. Geology and Geophysics of the Lower Mississippi Valley: In Memory of Roger Saucier ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	8:00 a.m.–noon	B18
23	T65. Landslides: From the Summits to the Plains ( <i>GSA Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division</i> )	8:00 a.m.–noon	B10
24	T82. Surface Water–Ground Water Connections I ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	B3
25	T88. Groundwater Flow, Geologic Processes, and Climate Change ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	A4
26	T90. Flow in Fractured Aquifers—From Field Characterization to Model Construction ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	B1
27	T104. Redox Manipulation for Groundwater Remediation ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	B12
28	T109. Long-Term Changes in Seawater Chemistry: Causes and Responses	8:00 a.m.–noon	B4
29	T112. Reactive Transport Modeling: Theory and Applications ( <i>Geochemical Society</i> )	8:00 a.m.–noon	B7
30	T117. Developing Paleontology: The Emerging Developmental Biology–Paleobiology Synthesis ( <i>Paleontological Society</i> )	8:00 a.m.–noon	B8 & 9
31	T137. The Role of the World Wide Web in Successfully Augmenting Geoscience Education I ( <i>National Association of Geoscience Teachers</i> )	8:00 a.m.–noon	A3
32	T148. The Role of Departments in Preparing Graduate Students for Teaching (Posters) ( <i>National Association of Geoscience Teachers</i> )	8:00 a.m.–noon	Terrace (ATL)
33	Aqueous Geochemistry II	1:30–5:30 p.m.	B11
34	Clastic Sediments II: Insights into Process Sedimentology Through Outcrop Studies and Experiments	1:30–5:30 p.m.	Ballroom A (ATL)
35	Coal Geology	3:30–4:50 p.m.	Ballroom B (ATL)
36	Economic Geology (Posters)	1:30–5:30 p.m.	Hall C
37	History of Geology	1:30–5:30 p.m.	B18
38	Hydrogeology I: Volcanic Ground-Water Flow Regimes	1:30–5:30 p.m.	A4
39	Micropaleontology: Environmental Change, Human Impact, and Evolution	3:30–5:30 p.m.	A3
40	Organic Geochemistry (Posters)	1:30–5:30 p.m.	Hall C
41	Paleoclimatology and Paleooceanography (Posters)	1:30–5:30 p.m.	Hall C
42	Paleontology II: Marine Paleoecology	1:30–5:30 p.m.	B7
43	Structural Geology II: Shear Zone Kinematics, Fabrics, and Rheology	1:30–5:30 p.m.	B2
44	K4. A New Age of Planetary Exploration: Sample Returns, In Situ Geological Analysis, and Human Missions to Other Worlds ( <i>GSA Planetary Geology Division</i> )	1:30–5:30 p.m.	Hall B
45	T2. Frontiers in Gas Hydrate Research II ( <i>Geochemical Society</i> )	1:30–5:30 p.m.	B5
46	T10. The Colorado Plateau: Its Origin, Boundaries, Lithospheric Structure, and Evolution II ( <i>GSA Geophysics Division</i> )	1:30–5:30 p.m.	Ballroom B (ATL)
47	T19. The Walker Lane: An Evolving Transform Plate Boundary ( <i>GSA Structural Geology and Tectonics Division</i> )	1:30–5:30 p.m.	B6
48	T21. New Developments in the Mesozoic Tectonic Evolution of the North American Cordillera II ( <i>GSA Structural Geology and Tectonics Division</i> )	1:30–5:30 p.m.	B16 & 17
49	T38. Sulfate Minerals: Low-Temperature Environments ( <i>Mineralogical Society of America; Geochemical Society; Society of Economic Geologists</i> )	1:30–5:30 p.m.	Ballroom C (ATL)
50	T42. Eruption or Intrusion? Volatiles, Magmas, and Porphyry Copper Deposits II ( <i>American Geophysical Union</i> )	1:30–5:30 p.m.	Ballroom E (ATL)
51	T45. Metamorphic Petrology from Experiments to the Field: A Session Honoring M.J. Holdaway II ( <i>Mineralogical Society of America</i> )	1:30–5:30 p.m.	Chianti (ATL)
52	T49. Ice-Dammed Lake Floods and Subglacial Lake Outbursts; Mechanism, Causes, and Consequences	1:30–5:30 p.m.	B13

Session	Title	Time	Location
53	T62. Stochastic and Deterministic Origins of Surface Processes and Landforms ( <i>American Geophysical Union</i> )	1:30–5:30 p.m.	B1
54	T69. Analysis of Active and Potentially Active Faults: Challenges and Case Histories ( <i>GSA Engineering Geology Division</i> )	1:30–5:30 p.m.	B10
55	T82. Surface Water–Ground Water Connections II ( <i>GSA Hydrogeology Division</i> )	1:30–5:30 p.m.	B3
56	T96. Coupled Hydrologic and Geochemical Processes in Mining Wastes and other Highly Heterogeneous Media ( <i>GSA Hydrogeology Division</i> )	1:30–5:30 p.m.	B4
57	T100. Phytoremediation and Natural Attenuation ( <i>GSA Hydrogeology Division</i> )	1:30–5:30 p.m.	B12
58	T115. Frontiers in the Palynological Sciences I ( <i>American Association of Stratigraphic Palynologists</i> )	1:30–5:30 p.m.	B19 & 20
59	T118. Evolving Biodiversity: From the Field to the Database ( <i>Paleontological Society</i> )	1:30–5:30 p.m.	B8 & 9
60	T137. The Role of the World Wide Web in Successfully Augmenting Geoscience Education II ( <i>National Association of Geoscience Teachers</i> )	1:30–5:30 p.m.	A3
61	T138. The Use of Multimedia in Geoscience Instruction: Yet Another Example of the No Significant Difference Phenomenon? ( <i>National Association of Geoscience Teachers</i> )	1:30–5:30 p.m.	Ballroom D (ATL)

## TUESDAY, NOVEMBER 14

62	Economic Geology I	8:00 a.m.–noon	B16 & 17
63	Environmental Geoscience I: Organic Chemicals in the Environment: Risk, Remediation, and Post-audits	8:00 a.m.–noon	B10
64	Hydrogeology II: Groundwater Sustainability and International Management Issues	8:00 a.m.–noon	B4
65	Micropaleontology (Posters)	8:00 a.m.–noon	Hall C
66	Mineralogy and Crystallography Science (Posters)	8:00 a.m.–noon	Hall C
67	Paleoceanography and Paleoclimatology I	8:00 a.m.–noon	B5
68	Petrology (Posters)	8:00 a.m.–noon	Hall C
69	Stratigraphy I: Applications of Sequence Stratigraphy	8:00 a.m.–noon	Ballroom A (ATL)
70	Tectonics II: Microplates and extensional tectonics: Western North America and Europe	8:00 a.m.–noon	B2
71	Volcanology (Posters)	8:00 a.m.–noon	Hall C
72	K7. Nuclear Waste Disposal: Bridging the Gap Between Science and Policy ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	Hall B
73	T6. Impact Crater Excavation, Modification, and Ejecta Distribution Mechanisms ( <i>GSA Planetary Geology Division</i> )	8:00 a.m.–noon	Ballroom D (ATL)
74	T16. Deep Structure of Archean Cratons ( <i>GSA Geophysics Division; GSA International Division</i> )	8:00 a.m.–noon	Ballroom B (ATL)
75	T19. The Walker Lane: An Evolving Transform Plate Boundary (Posters) ( <i>GSA Structural Geology and Tectonics Division</i> )	8:00 a.m.–noon	Hall C
76	T21. New Developments in the Mesozoic Tectonic Evolution of the North American Cordillera I (Posters) ( <i>GSA Structural Geology and Tectonics Division</i> )	8:00 a.m.–noon	Hall C
77	T25. Rates of Magmatic and Host Rock Processes in Arcs ( <i>GSA Structural Geology and Tectonics Division</i> )	8:00 a.m.–noon	B6
78	T26. Paleomagnetic Applications to Geologic Problems (Posters) ( <i>American Geophysical Union</i> )	8:00 a.m.–noon	Hall C
79	T27. Evolution of the East African and Related Orogens, and the Assembly of Gondwana (Posters) ( <i>GSA Structural Geology and Tectonics Division; GSA International Division</i> )	8:00 a.m.–noon	Hall C
80	T33. Carbonate Allostratigraphy and Sequence Stratigraphy (Posters) ( <i>North American Commission on Stratigraphic Nomenclature</i> )	8:00 a.m.–noon	Hall C
81	T38. Sulfate Minerals: Low-Temperature Environments (Posters) ( <i>Mineralogical Society of America; Geochemical Society; Society of Economic Geologists</i> )	8:00 a.m.–noon	Hall C
82	T58. Colluvium: Recent Advances in Applying Geomorphology, Stratigraphy, and Sedimentology to Interpret Late Cenozoic Slope Processes ( <i>GSA Quaternary Geology and Geomorphology Division; GSA Archaeological Geology Division</i> )	8:00 a.m.–noon	A2 & A6
83	T83. Artificial Recharge Through the Vadose Zone ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	A4
84	T86. Physical Modeling for Process Understanding and Model Validation in Subsurface Flow and Transport ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	B3
85	T99. Rare Earth Elements in Groundwater Flow Systems ( <i>GSA Hydrogeology Division</i> )	8:00–10:00 a.m.	B12

Session	Title	Time	Location
86	T108. Geomicrobiology: Microbial Communities and Geochemistry I ( <i>Geochemical Society</i> )	8:00 a.m.–noon	B11
87	T113. Sources, Transport, Fate, and Toxicology of Trace Metals in the Environment: A Tribute to Ron Fuge ( <i>International Association of Geochemistry and Cosmochemistry</i> )	8:00 a.m.–noon	B18
88	T116. Pattern and Process in Land Plant Evolution ( <i>Paleontological Society</i> )	8:00 a.m.–noon	B8 & 9
89	T119. Tropical Marine Paleoenvironments Through Time: Biodiversity, Ecology and Evolution ( <i>Paleontological Society</i> )	8:00 a.m.–noon	B19 & 20
90	T127. Electronic Information Summit: New Developments and Their Impacts ( <i>Geoscience Information Society</i> )	8:00 a.m.–noon	B13
91	T128. Geological Sequestration of Carbon Dioxide Released from Burning of Fossil Fuels	8:00 a.m.–noon	B7
92	T136. Geoscience Education in a Changing World: New Discoveries, New Technologies, New Opportunities ( <i>Digital Library for Earth System Education</i> )	8:00 a.m.–noon	Ballroom C (ATL)
93	T147. From the Introductory Classroom to Capstone Experience—Integrating Research into the Undergraduate Curriculum (Posters) ( <i>Council on Undergraduate Research; Keck Geology Consortium; National Association of Geoscience Teachers</i> )	8:00 a.m.–noon	Terrace (ATL)
94	T152. Paleoclimatology and Climatology of South America I ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	8:00 a.m.–noon	B1
95	Aqueous Geochemistry (Posters)	1:30–5:30 p.m.	Hall C
96	Aqueous Geochemistry III	1:30–5:30 p.m.	B19 & 20
97	Carbonate Sediments I: Mineral Precipitation, Diagenesis, and Disrupted Fabrics	1:30–5:30 p.m.	B12
98	Extended Hot Topic: Kinematics vs. Mechanics: in Understanding Rock Deformation ( <i>GSA Structural Geology and Tectonics Division</i> )	1:30–5:30 p.m.	B3
99	Geochemistry (Posters)	1:30–5:30 p.m.	Hall C
100	Paleoceanography/Paleoclimatology II: Quaternary	1:30–5:30 p.m.	B5
101	Paleontology III: Terrestrial Paleocology and Taphonomy	1:30–5:30 p.m.	B7
102	Quaternary Geology II: Geomorphology	1:30–5:30 p.m.	B4
103	Stratigraphy II: Applications of High-Resolution Stratigraphy and Investigations into Shales	1:30–5:30 p.m.	Ballroom A (ATL)
104	Structural Geology (Posters)	1:30–5:30 p.m.	Hall C
105	Structural Geology III: Western U.S., Arcuate Fold and Thrust Belts, and Appalachians	1:30–5:30 p.m.	B2
106	Tectonics (Posters)	1:30–5:30 p.m.	Hall C
107	K6. Living with Uncertainty: Scientific, Political, and Societal Perspectives ( <i>GSA Committee for Geology and Public Policy; U.S. Geological Survey INCLUDE Project</i> )	1:30–5:30 p.m.	Hall B
108	T7. Weathering Processes: The Message in Martian Meteorites ( <i>GSA Planetary Geology Division</i> )	1:30–5:30 p.m.	Ballroom D (ATL)
109	T8. Integrated Studies of Active Western North America Tectonics ( <i>American Geophysical Union</i> )	1:30–5:30 p.m.	Ballroom B (ATL)
110	T17. Evolution of the Lake Tahoe Basin: Geologic Framework, Neotectonics, Seismology, Geophysics, Geomorphology, Hydrology, and Environment ( <i>GSA Structural Geology and Tectonics Division</i> )	1:30–5:30 p.m.	B16 & 17
111	T26. Paleomagnetic Applications to Geologic Problems ( <i>American Geophysical Union</i> )	1:30–5:30 p.m.	B18
112	T27. Evolution of the East African and Related Orogens, and the Assembly of Gondwana ( <i>GSA Structural Geology and Tectonics Division; GSA International Division</i> )	1:30–5:30 p.m.	B6
113	T34. Gold Deposits of the Great Basin ( <i>Society of Economic Geologists</i> )	2:00–5:30 p.m.	B8 & 9
114	T55. Geomorphic and Geologic Controls on Surficial and Ground-Water Hydrology in Deep Alluvial Basins ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	1:30–5:30 p.m.	B13
115	T56. Ancient Dust: Documentation and Significance of Eolian Silt in the Pre-Cenozoic Record ( <i>GSA Sedimentary Geology Division</i> )	1:30–5:30 p.m.	A3
116	T108. Geomicrobiology: Microbial Communities and Geochemistry II ( <i>Geochemical Society</i> )	1:30–5:30 p.m.	B11
117	T111. Secondary Mineralization in the Unsaturated Zone at Yucca Mountain, Nevada ( <i>Geochemical Society</i> )	1:30–5:30 p.m.	Ballroom C (ATL)
118	T121. Geoarchaeology of Colluvial Landscapes ( <i>GSA Archaeological Geology Division; GSA Quaternary Geology and Geomorphology Division</i> )	1:30–5:30 p.m.	B10

Session	Title	Time	Location
119	T125. Geology in the National Parks; Research, Mapping, Interpretation, and Education ( <i>National Park Service</i> )	1:30–5:30 p.m.	A4
120	T140. Research on Teaching and Learning in Geoscience ( <i>National Association of Geoscience Teachers</i> )	1:00–5:00 p.m.	Chianti (ATL)
121	T142. Mining as Geoscience Education: Programs, Curricula, and the Case of Black Mesa, Arizona ( <i>National Association of Geoscience Teachers; Environmental Response/4th World Project, Natural Resources Department, University of New Hampshire—Durham</i> )	1:30–5:30 p.m.	B1
122	T149. Student Research (Posters) ( <i>Sigma Gamma Epsilon</i> )	1:30–5:30 p.m.	Hall C
123	T152. Paleoclimatology and Climatology of South America II ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	1:30–5:30 p.m.	A2 & A6

## WEDNESDAY, NOVEMBER 15

124	Archaeology	8:00 a.m.–noon	B10
125	Carbonate Sediments II: Depositional Systems and Microbial Structures	8:00 a.m.–noon	B12
126	Economic Geology II	8:00 a.m.–noon	B6
127	Engineering Geology	8:00 a.m.–noon	Ballroom C (ATL)
128	Environmental Geoscience (Posters)	8:00 a.m.–noon	Hall C
129	Geochemistry I	8:00 a.m.–noon	B11
130	Geology Education I: Public Outreach and Policy	8:00 a.m.–noon	Ballroom A (ATL)
131	Geoscience Information (Posters)	8:00 a.m.–noon	Hall C
132	History of Geology (Posters)	8:00 a.m.–noon	Hall C
133	Metamorphic Petrology	8:00 a.m.–noon	Chianti (ATL)
134	Paleoceanography/Paleoclimatology III: Isotopic and Fossil Evidence	8:00 a.m.–noon	B5
135	Paleontology IV: Early Animals	8:00 a.m.–noon	B8 & 9
136	Planetary Geology: Insights Into Mars	8:00 a.m.–noon	Ballroom D (ATL)
137	Planetary Geology: Insights into Mars (Posters)	8:00 a.m.–noon	Terrace
138	Sediments (Posters)	8:00 a.m.–noon	Hall C
139	K2. Sedimentary Extremes: Modern and Ancient ( <i>GSA Sedimentary Geology Division</i> )	8:00 a.m.–noon	Hall B
140	T12. Superplume Events in Earth History: Causes and Effects I ( <i>GSA International Division</i> )	8:00 a.m.–noon	Ballroom B (ATL)
141	T22. Antler and Ancestral Rocky Mountain Orogenesis of Western and Central North America (Posters) ( <i>GSA Structural Geology and Tectonics Division; Friends of the Ancestral Rocky Mountains</i> )	8:00 a.m.–noon	Hall C
142	T24. Proterozoic Tectonic Evolution of Western Laurentia: Continental Accretion to Breakup of Rodinia I ( <i>GSA Structural Geology and Tectonics Division</i> )	8:00 a.m.–noon	B2
143	T39. Mineralogy of the Mixed Layer Clays with Applications for Understanding Earth Processes and History, a Session to Honor Robert C. Reynolds, Jr., the Year 2000 Winner of the Roebling Award ( <i>Mineralogical Society of America</i> )	8:00 a.m.–noon	Ballroom E (ATL)
144	T41. Recent Results on the Causes and Consequences of Oceanic Island Volcanism: Where Are We Going Next? ( <i>International Association of Volcanology and Chemistry of the Earth's Interior; GSA International Division</i> )	8:00 a.m.–noon	A3
145	T46. Advances in Quaternary Geochronometry I ( <i>GSA Quaternary Geology and Geomorphology Division; American Geophysical Union</i> )	8:00 a.m.–noon	B16 & 17
146	T47. The Interaction between Soil and Biologic Processes in Landscape and Ecosystem Dynamics ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	8:00 a.m.–noon	B18
147	T50. Glacial Erosion at the Scales of Individual Alpine Glaciers, Mountain Ranges and Continental Ice Sheets: Current Understanding and Future Directions I ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	8:00 a.m.–noon	B1
148	T53. The Physical Geology and Geomorphology of Large Lakes: Relationships to Climate and Paleoclimate ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	8:00 a.m.–noon	B13
149	T61. Communicating Geohazards Information Effectively ( <i>GSA Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division</i> )	8:00 a.m.–noon	A2 & A6
150	T87. 25 Years of Groundwater Modeling: A Special Session in Honor of Professor Mary Anderson I ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	B4
151	T92. Integrated Geoscience Strategies Applied to Regional Groundwater Modeling: Death Valley Regional Groundwater Flow System ( <i>U.S. Geological Survey</i> )	8:00 a.m.–noon	A4
152	T95. Mining Impacts on Hydrologic Systems ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	B3
153	T115. Frontiers in the Palynological Sciences II ( <i>American Association of Stratigraphic Palynologists</i> )	8:00 a.m.–noon	B19 & 20

Session	Title	Time	Location
154	T131. Water Quality in the Arid West: Controls on Inorganic Anthropogenic By-Products ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	B7
155	Geochemistry II	1:30–5:30 p.m.	B11
156	Geology Education (Posters)	1:30–5:30 p.m.	Hall C
157	Geomicrobiology (Posters)	1:30–5:30 p.m.	Hall C
158	Hydrogeology III: Carbonate Ground-Water Flow Regimes (Posters)	1:30–5:30 p.m.	Hall C
159	Hydrogeology IV: Isotope Hydrology and Hydrogeochemistry (Posters)	1:30–5:30 p.m.	Hall C
160	Hydrogeology V (Posters)	1:30–5:30 p.m.	Hall C
161	Mineralogical Society of America Combined Topical Sessions II: Sulfates, Mixed-Layer Clays, and Metamorphic Petrology	1:30–5:30 p.m.	Chianti (ATL)
162	Neotectonics and Paleoseismology	3:30–5:30 p.m.	B2
163	Paleontology V: Extinctions and Recoveries	1:30–5:30 p.m.	B5
164	Paleontology VI: Morphology and Taxonomy	1:30–5:30 p.m.	B12
165	Planetary Geology: Remote Sensing and GIS	1:30–5:30 p.m.	Ballroom D (ATL)
166	Planetary Geology: Remote Sensing and GIS (Posters)	1:30–5:30 p.m.	Terrace (ATL)
167	Precambrian Potpourri: Everything from Air Quality to Earth as a Snowball	1:30–5:30 p.m.	B18
168	K8. Lamont and Plate Tectonics: History of Geology Division Millennium Symposium: Lamont 1949–1999 ( <i>GSA History of Geology Division; History of Earth Sciences Society [HESS]</i> )	1:30–5:30 p.m.	Hall B
169	T12. Superplume Events in Earth History: Causes and Effects II ( <i>GSA International Division</i> )	1:30–3:30 p.m.	Ballroom B (ATL)
170	T14. Geophysical and Tectonic Signatures of Triple Junction Migration: Mendocino and Others ( <i>GSA Geophysics Division</i> )	1:30–5:30 p.m.	Ballroom C (ATL)
171	T22. Antler and Ancestral Rocky Mountain Orogenesis of Western and Central North America I ( <i>GSA Structural Geology and Tectonics Division; Friends of the Ancestral Rocky Mountains</i> )	1:30–5:30 p.m.	B6
172	T24. Proterozoic Tectonic Evolution of Western Laurentia: Continental Accretion to Breakup of Rodinia II ( <i>GSA Structural Geology and Tectonics Division</i> )	1:30–3:30 p.m.	B2
173	T29. Xenolith-Based Studies of the Physical and Chemical Evolution of the Deep North American Lithosphere	1:30–5:30 p.m.	B3
174	T30. Lake Basins as Archives of Continental Tectonics and Climate I ( <i>GSA Sedimentary Geology Division</i> )	1:30–5:30 p.m.	Ballroom A (ATL)
175	T32. Global Stratotype Section and Point (GSSP) for Middle Ordovician Series: Biostratigraphy and Candidate Sections ( <i>Subcommission on Ordovician Stratigraphy, International Commission on Stratigraphy [IUGS]; GSA International Division</i> )	1:30–5:30 p.m.	B13
176	T35. Deep Crustal Controls On Mineral Trends—Evidence From the Subsurface ( <i>Society of Economic Geologists</i> )	1:30–5:30 p.m.	B8 & 9
177	T40. Interpreting the Morphology of Mafic and Ultramafic Lava Flows	1:30–5:30 p.m.	Ballroom E (ATL)
178	T43. Magmatism in Mojavia: Geology, Geochemistry, and Correlation	3:30–5:30 p.m.	Ballroom B (ATL)
179	T44. Granite Revisited: Anomalies, Problems, and Novel Approaches	1:30–5:30 p.m.	A3
180	T46. Advances in Quaternary Geochronometry II ( <i>GSA Quaternary Geology and Geomorphology Division; American Geophysical Union</i> )	1:30–3:30 p.m.	B4
181	T50. Glacial Erosion at the Scales of Individual Alpine Glaciers, Mountain Ranges, and Continental Ice Sheets: Current Understanding and Future Directions II ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	1:30–3:30 p.m.	B1
182	T59. Vegetation Response to Late Quaternary Climate Variability and Disturbance Regimes in the Pacific Western United States ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	1:30–5:30 p.m.	B19 & 20
183	T82. Surface Water–Ground Water Connections (Posters) ( <i>GSA Hydrogeology Division</i> )	1:30–5:30 p.m.	Hall C
184	T87. 25 Years of Groundwater Modeling: A Special Session in Honor of Professor Mary Anderson II ( <i>GSA Hydrogeology Division</i> )	3:30–5:30 p.m.	B4
185	T91. Studies on Water Movement and Solute Transport in Arid Regions ( <i>GSA Hydrogeology Division</i> )	1:30–5:30 p.m.	A4
186	T94. Heterogeneity in Granular Hydrogeologic and Reservoir Systems (Posters) ( <i>GSA Hydrogeology Division</i> )	1:30–5:30 p.m.	Hall C
187	T115. Frontiers in the Palynological Sciences (Posters) ( <i>American Association of Stratigraphic Palynologists</i> )	1:30–5:30 p.m.	Hall C
188	T124. The Employment of Geological Techniques for Archaeological Provenance Studies ( <i>GSA Archaeological Geology Division</i> )	1:30–5:30 p.m.	B10

Session	Title	Time	Location
189	T133. The Impact of Mercury on the Global Environment ( <i>U.S. Geological Survey; GSA Coal Geology Division; GSA Institute for Earth Science and the Environment; GSA International Division; Nevada Bureau of Mines and Geology</i> )	1:30–5:30 p.m.	B7
190	T144. Tools or Technology for Teaching 21st Century Geoscience (Posters) ( <i>National Association of Geoscience Teachers; GSA Education Division</i> )	1:30–5:30 p.m.	Hall C

## THURSDAY, NOVEMBER 16

191	Archaeology (Posters)	8:00 a.m.–noon	Hall C
192	Economic Geology III	8:00 a.m.–noon	B8 & 9
193	Geology Education II: K–12 and Teacher Education	8:00 a.m.–noon	B5
194	Geophysics (Posters)	8:00 a.m.–noon	Hall C
195	Hydrogeology VI: Biological and Colloidal Processes	8:00 a.m.–noon	B12
196	Igneous Petrology I	8:00 a.m.–noon	Ballroom E (ATL)
197	Marine and Coastal Science (Posters)	8:00 a.m.–noon	Hall C
198	Mineralogy and Crystallography	8:00 a.m.–noon	Ballroom C (ATL)
199	Neotectonics and Paleoseismology (Posters)	8:00 a.m.–noon	Hall C
200	Paleontology VII: Evolutionary Trends and Phylogenetics	8:00 a.m.–noon	B19 & 20
201	Paleontology VIII (Posters)	8:00 a.m.–noon	Hall C
202	Planetary Geology: Impacts, Io, Asteroids, and Ishtar (Venus) (Posters)	8:00 a.m.–noon	Hall C
203	Precambrian Extravaganza: Chemistry, Ages, Supercontinents, Snowballs, and Planetary Encounters (Posters)	8:00 a.m.–noon	Hall C
204	Stratigraphy (Posters)	8:00 a.m.–noon	Hall C
205	K3. Causes and Consequences of Floods: Geologic, Climatologic, Ecologic, and Human Dimensions ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	8:00 a.m.–noon	Hall B
206	T15. Cenozoic Basin and Range Tectonics and Geophysical Constraints I ( <i>GSA Geophysics Division; Nevada Seismological Laboratory, University of Nevada—Reno</i> )	8:00 a.m.–noon	B16 & 17
207	T18. Earthscope—A Look into Our Continent: Opportunities for Interdisciplinary Research in Geophysics and Geology ( <i>GSA Geophysics Division; Nevada Seismological Laboratory</i> )	8:00 a.m.–noon	Ballroom B (ATL)
208	T22. Antler and Ancestral Rocky Mountain Orogenesis of Western and Central North America II ( <i>GSA Structural Geology and Tectonics Division; Friends of the Ancestral Rocky Mountains</i> )	8:00 a.m.–noon	B6
209	T28. Mexico: Four Centuries of Geological Exploration ( <i>GSA International Division</i> )	8:00 a.m.–noon	B11
210	T30. Lake Basins as Archives of Continental Tectonics and Climate II ( <i>GSA Sedimentary Geology Division</i> )	8:00 a.m.–noon	Ballroom A (ATL)
211	T51. Reshaping Glacial Geomorphology: New Age Controls on Late Pleistocene Alpine Glaciation I ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	8:00 a.m.–noon	B1
212	T68. Joints and Other Discontinuities ( <i>GSA Engineering Geology Division; American Rock Mechanics Association</i> )	8:00 a.m.–noon	B10
213	T74. Environmental Restoration of Abandoned Mine Lands ( <i>GSA Engineering Geology Division</i> )	8:00 a.m.–noon	B18
214	T79. Application of Hydrologic and Geologic Studies to the Performance of a Potential Geologic Repository at Yucca Mountain, Nevada I ( <i>United States Department of Energy</i> )	8:00 a.m.–noon	B2
215	T97. Environmental Isotopes in Hydrogeology ( <i>GSA Hydrogeology Division</i> )	8:00 a.m.–noon	B4
216	T98. Solute Cycling in Groundwater and Surface Water ( <i>GSA Hydrogeology Division; Geochemical Society</i> )	8:00 a.m.–noon	B3
217	T110. Paleosols, Soils and the Composition of Ancient Atmospheres I ( <i>GSA International Division</i> )	8:00 a.m.–noon	B13
218	Environmental Geoscience II: Heavy Metals and Radionuclides in the Environment	1:30–5:30 p.m.	B4
219	Geology Education III: Undergraduate and Graduate	1:30–5:30 p.m.	B7
220	Geomicrobiology	1:30–5:30 p.m.	B12
221	Hydrogeology VII: Stress and Strain in Subsurface Flow Systems	1:30–5:30 p.m.	B6
222	Igneous Petrology II	1:30–5:30 p.m.	Ballroom E (ATL)
223	Paleontology IX: Vertebrate Distribution in Time and Space	1:30–5:30 p.m.	B19 & 20
224	Public Policy	3:30–5:30 p.m.	B1



Session	Title	Time	Location
225	Volcanology	1:30–5:30 p.m.	Ballroom C (ATL)
226	K5. Great Science in the Great Basin ( <i>U.S. Geological Survey; Nevada Bureau of Mines and Geology</i> )	1:30–5:30 p.m.	Hall B
227	T13. Recent Advances in Our Understanding of Flat Slab Subduction: A Comparison Between Modern and Ancient Subduction Settings in the Americas; South American Tectonics ( <i>GSA Structural Geology and Tectonics Division; American Geophysical Union</i> )	1:30–5:30 p.m.	B11
228	T15. Cenozoic Basin and Range Tectonics and Geophysical Constraints II ( <i>GSA Geophysics Division; Nevada Seismological Laboratory, University of Nevada—Reno</i> )	1:30–5:30 p.m.	B16 & 17
229	T48. Causes and Consequences of Floods: Geologic, Climatologic, Ecologic, and Human Dimensions (Posters) ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	1:30–5:30 p.m.	Hall C
230	T51. Reshaping Glacial Geomorphology: New Age Controls on Late Pleistocene Alpine Glaciation II ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	1:30–3:30 p.m.	B1
231	T54. Big Storms of the Past: Evidence and Importance of Paleostorms in the Geologic Record ( <i>GSA Quaternary Geology and Geomorphology Division</i> )	1:30–5:30 p.m.	B8 & 9
232	T70. High Technology Tools for Geologic Research and Practice (Posters) ( <i>GSA Engineering Geology Division</i> )	1:30–5:30 p.m.	Hall C
233	T72. Academic Training of Engineering Geologists ( <i>GSA Engineering Geology Division; GSA Geoscience Education Division</i> )	1:30–5:30 p.m.	B10
234	T79. Application of Hydrologic and Geologic Studies to the Performance of a Potential Geologic Repository at Yucca Mountain, Nevada II ( <i>U.S. Department of Energy</i> )	1:30–5:30 p.m.	B2
235	T103. Innovative Applications in Water Supply and Environmental Investigation, Remediation, and Risk Assessment ( <i>GSA Hydrogeology Division</i> )	1:30–5:30 p.m.	B3
236	T110. Paleosols, Soils, and the Composition of Ancient Atmospheres II ( <i>GSA International Division</i> )	1:30–3:30 p.m.	B13

## PARDEE KEYNOTE SYMPOSIA

The Pardee Keynote Symposia are made possible by a grant from the Joseph T. Pardee Memorial Fund. For a description of each symposium, see the June, August, or September issues of *GSA Today*, or visit [www.geosociety.org](http://www.geosociety.org). See Technical Program for locations.

### MONDAY

K1—Geology in the New Millennium I: Resource Collapse, Environmental Catastrophe, or Technological Fix? Stephen L. Gillett, Mackay School of Mines, Reno, Nevada. Mon., Nov. 13, 8 a.m.–noon.

K4—A New Age of Planetary Exploration: Sample Returns, In Situ Geological Analysis, and Human Missions to Other Worlds. *GSA Planetary Geology Division*. Ralph Harvey, Case Western Reserve University, Cleveland, Ohio; Cassandra Coombs, College of Charleston, Charleston, South Carolina. Mon., Nov. 13, 1:30–5:30 p.m.

### TUESDAY

K7—Nuclear Waste Disposal: Bridging the Gap Between Science and Policy. *GSA Hydrogeology Division*. Jane C.S. Long, Mackay School of Mines, Reno, Nevada; Kevin D. Crowley, Board on Radioactive Waste Management, Washington, D.C.; Jean M. Bahr, University of Wisconsin—Madison. Tue., Nov. 14, 8 a.m.–noon.

K6—Living with Uncertainty: Scientific, Political, and Societal Perspectives. *GSA Institute for Earth Science and the Environment*. Christine Turner, U.S. Geological Survey, Denver, Colorado; Robert Frodeman, University of Colorado—Boulder. Tue., Nov. 14, 1:30–5:30 p.m.

### WEDNESDAY

K2—Sedimentary Extremes: Modern and Ancient. *GSA Sedimentary Geology Division*. Marjorie A. Chan, University of Utah, Salt Lake City; Allen W. Archer, Kansas State University, Manhattan. Wed., Nov. 15, 8 a.m.–noon.

K8—Lamont and Plate Tectonics: History of Geology Division Millennium Symposium: Lamont 1949–1999. *GSA History of Geology Division; History of Earth Sciences Society (HESS)*. Gerald M. Friedman, Northeastern Science Foundation, Inc., Troy, New York. Wed., Nov. 15, 1:30–5:30 p.m.

### THURSDAY

K3—Causes and Consequences of Floods: Geologic, Climatologic, Ecologic, and Human Dimensions. *GSA Quaternary Geology and Geomorphology Division*. Jim E. O'Connor, U.S. Geological Survey, Portland, Oregon; Kyle House, University of Nevada, Reno. Thurs., Nov. 16, 8 a.m.–noon.

K5—Great Science in the Great Basin. *U.S. Geological Survey; Nevada Bureau of Mines and Geology*. Benita L. Murchey, U.S. Geological Survey, Menlo Park, California; Jonathan G. Price, University of Nevada, Reno. Thurs., Nov. 16, 1:30–5:30 p.m.

## GSA-SPONSORED SHORT COURSES

For registration information and course descriptions, see the June issue of *GSA Today*, or contact Edna Collis, GSA Headquarters, (303) 447-2020, ext. 134, [ecollis@geosociety.org](mailto:ecollis@geosociety.org), or see [www.geosociety.org](http://www.geosociety.org).

1. **Characterization and Modeling Fluid Flow in Fault and Fracture Zones: The Reality and the Idealized.** Sat.–Sun., Nov. 11–12, 8 a.m. to 5 p.m. both days. Reno Hilton. *Cosponsored by GSA Structural Geology and Tectonics Division.* Faculty: James P. Evans—Utah State University; Ph.D., Texas A&M University; Jonathan S. Caine—U.S. Geological Survey, Denver; Ph.D., University of Utah; Craig B. Forster—University of Utah; Ph.D., University of British Columbia. Limit: 40. Fee: \$470, students \$450; includes course manual and lunches. CEUs: 1.6.
2. **Digital Mapping Systems: Digital Data Capture and Analysis for the Field Geoscientist.** Sat.–Sun., Nov. 11–12, 8 a.m. to 5 p.m. both days. Reno Hilton. *Cosponsored by GSA Structural Geology and Tectonics Division.* Faculty: Kent Nielsen—Dept. of Geosciences, University of Texas at Dallas; Ph.D., University of British Columbia; Carlos Aiken—Dept. of Geosciences, University of Texas at Dallas; Ph.D., University of Arizona; Xueming Xu—Dept. of Geosciences, University of Texas at Dallas; M.S., Chinese Academy of Science. Limit: 30. Fee: \$470, students \$450; includes course manual, lunches, and field trip transportation. CEUs 1.6.
3. **Science of Earthquakes: Earthquake Geology and Paleoseismology.** Sat., Nov. 11, 8 a.m. to 5 p.m., Sun., Nov. 12, 8 a.m. to noon. Reno Hilton. *Cosponsored by GSA Structural Geology and Tectonics Division; GSA Engineering Geology Division.* Faculty: Charles M. Rubin—Central Washington University, Ellensburg; Ph.D., California Institute of Technology; Thomas K. Rockwell—San Diego State University; Ph.D., University of California, Santa Barbara. Limit: 40. Fee: \$370, students \$350; includes course manual and lunch on Saturday. CEUs: 1.6.
4. **Applications of Environmental Isotopes in Groundwater Studies.** Sun., Nov. 12, 8 a.m. to 5 p.m. Reno Hilton. *Cosponsored by GSA Hydrogeology Division.* Faculty: Ramon Aravena—University of Waterloo, Ontario; Ph.D., University of Waterloo; Ian D. Clark—University of Ottawa, Ontario; Ph.D., Université de Paris-Sud, Orsay, France. Limit: 50. Fee: \$340, students \$320; includes course manual and lunch. CEUs: 0.8.
5. **Field Methods for Estimation of Spatial Variations in Hydraulic Conductivity: Recent Advances and Practical Ramifications.** Sun., Nov. 12, 8 a.m. to 5 p.m. Reno Hilton. *Cosponsored by GSA Hydrogeology Division.* Faculty: James J. Butler Jr.—Kansas Geological Survey; Ph.D., Stanford University; Vitaly A. Zlotnick—University of Nebraska, Lincoln; Ph.D., National Institute of Hydrogeology and Engineering Geology, Moscow, Russia. Limit: 40. Fee: \$350, students \$330; includes course manual and lunch. CEUs: 0.8.
6. **Mobilization of Metals from Fossils Fuels: Impacts to the Environment and Human Health.** Sun., Nov. 12, 8 a.m. to noon. Reno Hilton. *Cosponsored by GSA Coal Geology Division.* Faculty: Robert B. Finkelman—U.S. Geological Survey, Reston, Virginia; Ph.D., University of Maryland; Allan Kolker—U.S. Geological Survey, Reston, Virginia; Ph.D., State University of New York at Stony Brook; Leslie Ruppert—U.S. Geological Survey, Reston, Virginia; M.S., George Washington University. Limit: 40. Fee: \$230, students \$210; includes course manual. CEUs: 0.4.
7. **Practical Methods in Applied Contaminant Geochemistry: From Characterization to Remediation.** Sun., Nov. 12, 8 a.m. to 5 p.m. Reno Hilton. *Cosponsored by GSA Hydrogeology Division.* Faculty: Donald I. Siegel—Dept. of Earth Sciences, Syracuse University; Ph.D., University of Minnesota. Limit: 40. Fee: \$300, students \$280; includes course manual and lunch. CEUs: 0.8.
8. **GIS for the Geosciences.** Fri.–Sat., Nov. 17–18, 8 a.m. to 5 p.m. both days. Reno Hilton. *Cosponsored by GSA Planetary Geology Division.* Faculty: Richard Bedell—Homestake Mining Company, Sparks, Nevada; M.Sc., University of London; M.Sc., University of Toronto. Limit: 60. Fee: \$370, students \$350; includes course manual and lunches. CEUs: 1.6.

**INFORMATION ON OTHER COURSES** offered during the Annual Meeting was published in the June issue of *GSA Today*, available at [www.geosociety.org](http://www.geosociety.org).

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## Geologists say earthquake response by U.S. hampered

FRONT PAGE

# MEDIA RELATIONS WORKSHOP

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Reno/Sparks Convention Center  
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## EARTH SCIENCE AND THE ENVIRONMENT EVENTS

**T**he following events promote interaction between the private and public sectors and the geological community on matters of the environment. These events are for those who want to know more about:

- ❖ *how the geosciences are integral to global efforts for sustainable resource development, management, and use; and*
- ❖ *how the geosciences are critical to the effective management of healthy ecosystems.*

### Topic: Aging dams

*Science and Policy Issues about Dam Removals*  
Geology and Public Policy Forum  
Tradewinds Conference Center, Atlantis Casino Resort  
Wed., Nov. 15, 1:30–3:30 p.m.  
For more information, see *GSA Today*, June 2000, p. 27.

### Topic: Earth scientists on Capitol Hill

*Report from Melody Brown Burkins, GSA 1999–2000 Congressional Science Fellow*  
Special Report  
Tradewinds Conference Center, Atlantis Casino Resort  
Wed., Nov. 15, noon–1 p.m.  
For more information, see *GSA Today*, June 2000, p. 27.

### Topic: Geology in government

*Free student luncheon and panel discussion by the American Association of State Geologists, Bureau of Land Management, National Park Service, USDA Forest Service, and U.S. Geological Survey Representatives*  
Exhibit Hall event  
Tues., Nov. 14, noon–1:30 p.m.  
For more information, see *GSA Today*, June 2000, p. 27.

### Topic: Geology in National Parks

*Geology in the National Parks: Research, Mapping, Interpretation, and Education*  
Technical Session 119  
Reno/Sparks Convention Center, Room A4  
Tues., Nov. 14, 1:30–5:30 p.m.  
For more information, see *GSA Today*, June 2000, p. 23.

### Topic: NSF Earth Sciences Division

*Town Hall Meeting*  
Tradewinds Conference Center, Atlantis Casino Resort  
Mon., Nov. 13, 1:30–3:30 p.m.  
For more information, see *GSA Today*, September 2000, p. 22.

### Topic: Internships

*Talk with GSA's USDA Forest Service and National Park Service interns*  
Exhibit Hall event  
Sun., Nov. 12, 5–7:30 p.m., Mon., Nov. 13, 1–4 and 5–7:30 p.m., and Tues., Nov. 13, 9–11 a.m.

### Topic: Mercury

*The Impact of Mercury on the Global Environment*  
Technical Session 189  
Reno/Sparks Convention Center, Room B7  
Wed., Nov. 15, 1:30–5:30 p.m.  
For more information, see *GSA Today*, June 2000, p. 23.

### Topic: Geology on public lands

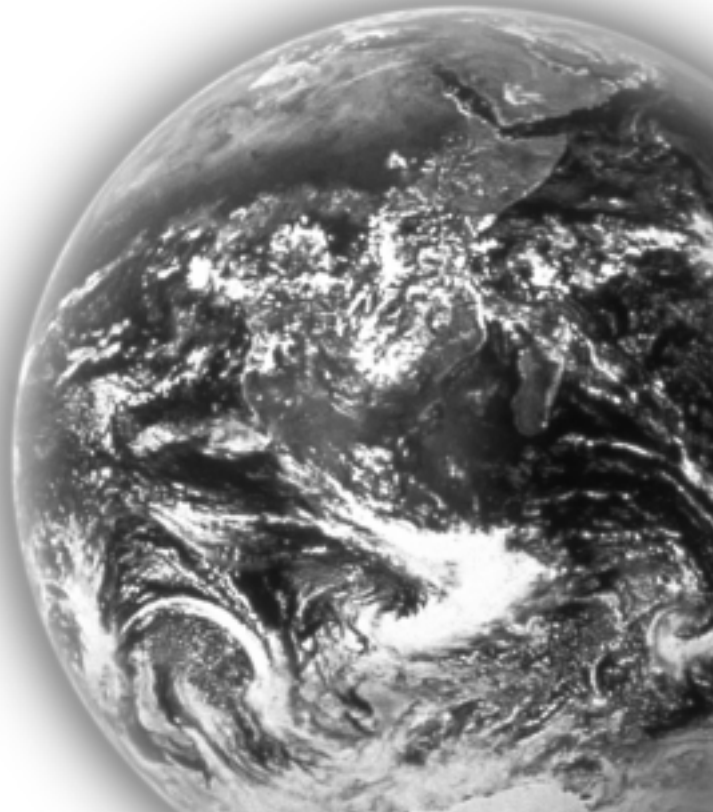
*Geology on Public Lands: A User's Guide*  
Workshop  
Tradewinds Conference Center, Atlantis Casino Resort  
Sun., Nov. 12, 8 a.m.–3 p.m.  
NOTE: \$35 registration fee, limit 75 participants.  
For more information, see *GSA Today*, June 2000, p. 27.

### Topic: Societal problems and public perception

*Living with Uncertainty: Scientific, Political, and Societal Perspectives*  
Pardee Keynote Symposium  
Reno/Sparks Convention Center, Hall B  
Tues., Nov. 14, 1:30–5:30 p.m.  
For more information, see *GSA Today*, June 2000, p. 15.

### Topic: Sustainability

*Toward a Stewardship of the Global Commons: Perspectives for the New Century*  
Institute for Earth Science and the Environment (IEE) Forum  
Reno/Sparks Convention Center, Room B1  
Sun., Nov. 12, 1:30–4:30 p.m.  
For more information, see *GSA Today*, June 2000, p. 27. ■



## GRADUATE SCHOOL INFORMATION FORUM

Reno/Sparks Convention Center, East Hall  
 Sun., Nov. 12, 5-7:30 p.m., Mon., Nov. 13, 9 a.m.-7:30 p.m., and  
 Tues. and Wed., 9 a.m.-5:30 p.m.  
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Summit 2000—and you can meet with representatives from universities across the nation. The schools participating (as of press time) are listed below. For a complete list of schools, including contact information, call or e-mail Brenda Martinez, GSA Exhibit Sales Coordinator, at (303)447-2020, ext. 138, [bmartinez@geosociety.org](mailto:bmartinez@geosociety.org).

Institution	Sun	Mon	Tues	Wed	Institution	Sun	Mon	Tues	Wed
Binghamton University		▲			University of Alaska—Fairbanks		▲	▲	▲
Boston University	▲	▲			University of California—Riverside	▲	▲	▲	▲
Bowling Green State University		▲			University of Chicago		▲	▲	
Central Washington University		▲	▲		University of Delaware		▲		
Clemson University		▲			University of Iowa		▲		
Cornell University		▲			University of Kansas			▲	
Duke University		▲			University of Maryland		▲	▲	
Florida State University		▲			University of Massachusetts—Amherst		▲		
George Washington University		▲			University of Nevada—Reno	▲	▲		
Indiana University	▲	▲	▲	▲	University of North Carolina at Chapel Hill		▲		
Kansas State University			▲	▲	University of North Dakota		▲		
Miami University	▲	▲	▲	▲	University of Notre Dame		▲	▲	
Michigan Technological University		▲			University of Rhode Island			▲	
Montana Tech of the University of Montana	▲	▲			University of South Carolina		▲	▲	
New Mexico Tech	▲	▲			University of Texas at Dallas		▲	▲	
Penn State University			▲		University of Texas at El Paso		▲		
Princeton University	▲	▲	▲	▲	Utah State University		▲		
Purdue University			▲		Vanderbilt University		▲		
Rice University		▲	▲		Virginia Tech	▲	▲	▲	
Texas A&M University		▲	▲		Washington State University		▲	▲	
Texas Tech University	▲	▲			Western Washington University		▲		
University of Alabama		▲			Yale University	▲	▲		

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## HOT topics

**MONDAY THROUGH THURSDAY**  
**12:15 TO 1:15 P.M.**  
**RENO/SPARKS**  
**CONVENTION CENTER, ROOM B3**

Join your colleagues for lunchtime debates and discussions on a few of the burning issues facing geoscientists today.

### MONDAY

A Digital Library to Support Geoscience Education—What is Possible?

Enjoy a demonstration of prototype Digital Library for Earth Science Education (DLESE) searching capabilities and discuss the focus of initial collections, review mechanisms for library holdings, and the role DLESE can play in bringing academic and/or career recognition for contributions to geoscience education.

### TUESDAY

(Extended Hot Topic debate, beginning at 1:30 p.m. in room B3)

Kinematics vs. Mechanics in Understanding Rock Deformation

An extended debate on the relative importance and utility of focusing on either kinematics or mechanics—or both—when attempting to understand rock deformation.

### WEDNESDAY

Wildfires in the West—The Geologic Perspective

This year has seen one of the worst fire seasons in recent years. Speakers in this session will provide a geologic perspective on the frequency and magnitude of wildfires and discuss the effects of fires on erosion and sedimentation.

### THURSDAY

To be announced

## IT'S THE HOTTEST SEAT IN THE HOUSE

Are you interested in the latest issues facing the geosciences? Do you enjoy lively discussions and spirited debates among people in the know? Here's your chance to gather and propose Hot Topics for the 2001 GSA Annual Meeting in Boston: The Annual Program Committee is looking for someone to serve as the Hot Topics Chair for 2001. If you are interested, please contact Tamela White, GSA Senior Meetings Coordinator, (303) 447-2020, ext. 239, tjwhite@geosociety.org.

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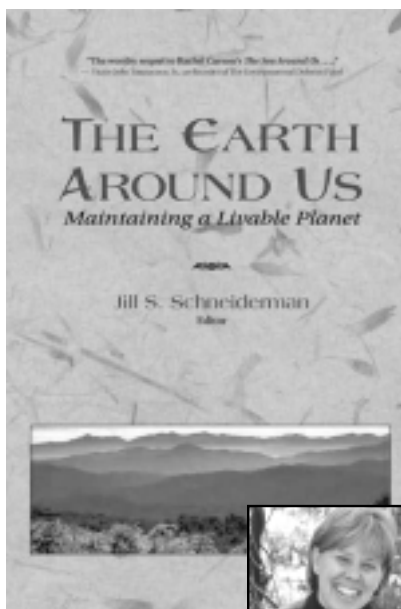
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## BOOK SIGNING AT SUMMIT 2000—RENO

Meet Jill Schneiderman and essayists, Sunday, November 12, 5:00–7:30 p.m. at the GSA Bookstore, during the Welcoming Party in the Exhibit Hall

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Jill S. Schneiderman



Photo Credit: Diane Zuecker

As of press time, the following contributing authors will be on hand to sign copies of the book.

- David Applegate
- Vic Baker
- Paul Bierman
- Ed Buchwald
- Dave Bush
- Gordon Eaton
- Jim Evans
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- Cathy Manduca
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## North-Central Section, GSA 35th Annual Meeting

Bone Student Center, Illinois State University, and Holiday Inn, Normal, Illinois, April 23–24, 2001

### CALL FOR PAPERS

Papers are invited for presentation in oral sessions, symposia, and poster sessions. Volunteered abstracts not included in symposia will be scheduled for regular technical sessions. Most abstracts and any questions should be addressed to James G. Kirchner, North-Central Section Program Coordinator, Department of Geography-Geology, Campus Box 4400, Illinois State University, Normal, IL 61790, jgkirch@ilstu.edu, (309) 438-8922. If the abstract is being submitted for a symposium, send it to the symposium convener. Technical sessions will begin at 8 a.m. on Monday, April 23, 2001.

### ABSTRACTS

Abstracts Deadline:  
January 17, 2001

Abstracts for all sessions must be submitted online at the GSA Web site. Please see the article announcing GSA's new electronic abstracts submittal system on page 25 of this issue. If you have any questions, please contact Robert S. Nelson, (309) 438-7808, rsnelso@ilstu.edu.

### SYMPOSIA

1. Contrasting Records of Different Glacial Episodes or Different Glacial Lobes. Ardith Hansel, (217) 333-5852, hansel@isgs.uiuc.edu, fax 217-244-2785; and Andrew Phillips, (217) 333-2513, phillips@geoserv.isgs.uiuc.edu, Illinois State Geological Survey, 615 E. Peabody Drive, Champaign, IL 61820. How the landforms and sedimentary successions of different glacial episodes or different lobes of the same episode vary and what such variation means in terms of ice sheet dynamics and glacial history.
2. Paleozoic Bio-events. (*Sponsored by the Paleontological Society.*) James E. Day, (309) 438-7865, jeday@ilstu.edu, fax 309-438-5310, Dept. of Geography-Geology, Illinois State University, Normal, IL 61790-4400; Gordon Baird, baird@fredonia.edu; Carl Brett, carlton.brett@uc.edu. The record of Paleozoic bioevents.
3. Probing the Precambrian in the Midwest: Reconciling Geological, Geochemical, and Geophysical Observations. James Walker, T60JAW1@wpo.cso.niu.edu, fax 815-753-1945, Department of Geology and Geophysics, Northern Illinois Univer-

sity, DeKalb, IL 61115; John McBride, Illinois State Geological Survey, 615 E. Peabody Drive, Champaign, Illinois 61820. Discussion and summation of the latest information about the extensive Precambrian terranes that are the basement in the Midwest.

4. Inquiry-Based Learning: Field Work to High Tech. (*Sponsored by the Central Section of the National Association of Geoscience Teachers.*) Lynette Seigley, (319) 335-1598, lseigley@igsb.uiowa.edu, fax 319-335-2754, Iowa DNR—Geological Survey Bureau.
5. Response of the Upper Great Lakes Coasts to Holocene Lake Level Change. Walter L. Loope, walter\_loope@usgs.gov, (906) 387-3116; fax 906-387-5148, U.S. Geological Survey, Munising Biological Station, P.O. Box 40, Munising, MI 49862. Issues of origin and dynamics of coastal features related to lake level and as subjects for scientific inquiry and as biological, cultural, and recreational resources.
6. Groundwater Problems in Expanding Suburban Areas. (*Sponsored by the Illinois Groundwater Association.*) Steve Bennett, (309) 298-1256, SW-Bennett1@wiu.edu, fax 309-298-3399, Dept. of Geology, Western Illinois University, 1 University Circle, Macomb, IL 61455; Colin Booth, (815) 753-7933, colin@geol.niu.edu, fax 815-753-1945, Dept. of Geology and Environmental Geosciences, Davis Hall, Northern Illinois University, DeKalb, IL 60115. Hydrogeological studies and solutions for the new demands for water supply and the new stresses on the quality and replenishment of shallow groundwater resources, resulting from increasing spread of suburban development across previously open areas.
7. Hydrogeological and 3-D Mapping Using Geophysics. Philip J. Carpenter, (815) 753-1523, phil@geol.niu.edu, fax 815-753-1945, Dept. of Geology and Environmental Geosciences, Davis Hall, Northern Illinois University, DeKalb, IL 60115; Timothy H. Larson, (217) 244-2775, tlarson@isgs.uiuc.edu, fax 217-244-2785, Illinois State Geological Survey, 615 E. Peabody Drive, Champaign, IL 61820. The use of geophysics in

hydrogeological investigations, from mapping surficial deposits to identifying hydraulic connections in the subsurface (e.g., buried channels, fractures, karst conduits).

8. Environmental Site Assessments: Applications, Methods, and Resources. Mark Yacucci, (217) 265-0747, yacucci@isgs.uiuc.edu; John Sieving, (217) 244-2406, sieving@isgs.uiuc.edu, Center for Transportation and the Environment, Illinois State Geological Survey, 615 E. Peabody Drive, Champaign, Illinois 61820. Issues related to environmental site assessments, including the impact of assessments on the public sector, educational initiatives, case histories, applications of new technology, information sources, and the influence of site geology on contaminant transport and remediation efforts.
9. Pander Society Symposium. James E. Barrick, (806) 742-3107, Jim.Barrick@ttu.edu, fax 806-742-0100, Dept. of Geosciences, Texas Tech University, Lubbock, TX 79409-1053. All aspects of conodonts.

### POSTER SESSIONS

Students and professionals are encouraged to take advantage of this means of communication of their research endeavors. Please indicate Poster Session on the GSA abstract form.

Special Poster Session on Undergraduate Research. (*Sponsored by the Council on Undergraduate Research—Geology Division.*) Robert D. Shuster, (402) 554-2457, Robert\_Shuster@unomaha.edu, fax 402-554-3518, Department of Geography-Geology, University of Nebraska—Omaha, Omaha, NE 68182-0199; or David J. Matty, (517) 774-3179, david.j.matty@cmich.edu, fax 517-774-3537, Department of Geology, Central Michigan University, Mount Pleasant, MI 48859. These are posters written and presented by undergraduate students on their research projects, activities, techniques, and/or preliminary results. Coauthored papers for which the student is senior author will be considered.

### WORKSHOPS

Workshops 1, 2, 3, and 4 will be scheduled for Saturday and/or Sunday, April 21 and 22, 2001, preceding the regular meeting sessions. Registration for some workshops is limited. For additional information, contact the conveners.

1. Geological Models for Groundwater Flow Modeling. Richard C. Berg, (217) 244-2776, berg@isgs.uiuc.edu, fax 217-244-7004, Illinois State Geological Survey, 615 E. Peabody Drive, Champaign, IL 61820; L.H. Thorleifson, (613) 992-3643, thorleifson@gsc.nrcan.gc.ca, fax 613-992-0190, Geological Survey of Canada, 601 Booth St., Ottawa, ON

- K1A 0E8. This workshop is designed for those working on geologic models for groundwater flow modeling, particularly concerning the development and management of the large diverse data of variable quality that is required for 3-dimensional geologic models. Emphasis will be on the Quaternary and pre-Quaternary deposits that host potable groundwater and that are the context of most waste-disposal issues.
2. Touch Another World. Brian Poelker, (309) 352-2300, Midwest Central Middle School, 121 N. Church Street, Green Valley, IL 61546, bpoelker@ntslink.net. This workshop is designed for middle and high school teachers. Meteorites and Moon rocks can play an integral role in the secondary school earth science curriculum. Highlights of these activity stations include: diagnostic analysis of physical characteristics to distinguish meteorites from Earth rocks, manipulation of experimental variables in crater formation, petrologic comparisons of crystal structure to identify Moon rocks on loan from NASA, and observations and descriptions of several types of meteorites, including meteorites from Mars.
  3. Sequence Stratigraphy for Graduate Students. (Sponsored by ExxonMobil Exploration Company.) Art Donovan, (713) 431-7184, fax 713-431-4114, art.d.donovan@exxon.sprint.com.
  4. Advocacy Workshop. (Sponsored by the American Institute of Professional Geologists.) Learn how your professional expertise and concerns can be effectively communicated to legislators and regulators.
  5. Roy J. Shlemon Mentor Program in Applied Geology. (GSA) Karlon Blythe, kblythe@geosociety.org. Workshop for graduate and advanced undergraduate students about professional opportunities and challenges in resource exploration and evaluation.

#### FIELD TRIPS

Field trips (all premeeting) will be scheduled for Friday, Saturday, and Sunday, April 20, 21, and 22, 2001, preceding the regular meeting sessions. Registration for some field trips is limited. Questions regarding the program should be addressed to David Malone, North-Central Section Field Trips Coordinator, Department of Geography-Geology, Campus Box 4400, Illinois State University, Normal, IL 61790, dhmalon@ilstu.edu, (309) 438-2692. For additional information, contact the field trip convener.

1. Silurian Sequence Stratigraphy and Reef Development in the Kankakee River Valley. Leader: Donald G. Mikulic, mikulic@isgs.uiuc.edu, (217) 244-2518, Illinois State Geological Survey, 615 E. Peabody

Drive, Champaign, IL 61820. Coleaders: Joanne Kluessendorf, University of Illinois and Rod Norby, Illinois State Geological Survey.

2. The St. Francois Mountains of Missouri: Window into the Mesoproterozoic. Leader: Jim Walker, jim@geol.niu.edu, (815) 753-7936, Dept. of Geology and Environmental Geosciences, Northern Illinois University, DeKalb, IL 60115. Coleaders: Gary Lowell, Southeast Missouri State University, and V. Max Brown, University of Toledo.
3. Quaternary and Environmental Geology of the Lower Illinois River Valley and Metro East St. Louis Area. Leader: David A. Grimley, grimley@geoserv.isgs.uiuc.edu, (217) 333-4747, Illinois State Geological Survey, 615 E. Peabody Drive, Champaign, IL 61820. Coleaders: Andrew C. Phillips, Hong Wang, and Leon R. Follmer, Illinois State Geological Survey.
4. Sequence Stratigraphy of Pennsylvanian Cyclothemic Strata in central Peoria County, Illinois. Leader: C. Pius Weibel, weibel@isgs.uiuc.edu, (217) 333-5108, Illinois State Geological Survey, 615 E. Peabody Drive, Champaign, IL 61820.
5. Carboniferous Whitewater: A Raft Trip Through the Pennsylvanian Strata of the Vermilion River Gorge Near Oglesby, Illinois. Leader: Steve Simpson, ssimpson@highland.cc.il.us, (815) 599-3474, Natural Science Dept., Highland Community College, 2998 W. Pearl City Road, Freeport, IL 61032.

#### PROJECTION EQUIPMENT

Two standard 35-mm carousel projectors for 2" by 2" slides and two viewing screens will be provided for each session room. An overhead projector for transparencies will also be provided for each session room. A speakers' ready room with projectors will be available for review of slides and transparencies.

#### BUSINESS MEETINGS AND SOCIAL EVENTS

The special events will be at the Bone Student Center and the Holiday Inn. The location and times of the events will be published in both the onsite program and the *Abstracts with Programs* volume. Events include: welcome reception, Management Board breakfast, North-Central Section of the Paleontological Society/SEPM/Pander Society Luncheon, Section Banquet, AWG breakfast, Campus Representatives breakfast, NAGT Luncheon, and Illinois Groundwater Society Luncheon.

#### EXHIBITS

Exhibits, registration, poster sessions, and hospitality will all be held in the Bone Student Center Ballroom. Exhibit space must be reserved by April 15. For further


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#### REGISTRATION

GSA Headquarters will handle registration. Registration details will appear in the January 2001 issue of *GSA Today*. *Electronic preregistration is encouraged at [www.geosociety.org](http://www.geosociety.org) beginning in January 2001.* The preregistration deadline is March 16, 2001; cancellation deadline is March 23, 2001.

#### ACCOMMODATIONS

Blocks of rooms have been reserved at three properties located on Trader's Circle in Normal. The headquarters hotel is Holiday Inn, (309) 454-6722, \$75 per room. Adjacent properties are Best Western University Inn, (309) 454-4070, \$50 per room, and Super 8 Motel, (309) 454-5858, \$44-54 per room for two. In addition, room tax is 8.5%. Meeting registrants and guests are responsible for making their own lodging arrangements. Reservations should be made no later than March 20, 2001, to guarantee the special room rates that have been negotiated for the meetings. Be sure to indicate that you are participating in the North-Central Section of GSA to receive these special rates. Bus service will be provided, as parking on campus is extremely limited.

#### DETAILED INFORMATION

For further information, see [www.geosociety.org](http://www.geosociety.org) or contact Robert S. Nelson, Dept. of Geography-Geology, Illinois State University, Normal, IL 61790-4400, (309) 438-7808, rsnelso@ilstu.edu. ■

# JOINT MEETING CORDILLERAN SECTION, GSA— 97th Annual Meeting, and PACIFIC SECTION—AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

Universal City, Los Angeles, California, April 9–11, 2001

This meeting is jointly sponsored with Pacific Section–American Association of Petroleum Geologists. The hosts are the Department of Geological Sciences, California State University—Northridge, and the San Joaquin Geological Society. Participating organizations include SEPM (Society for Sedimentary Geology)—Pacific Section, the Association of Women Geologists—Southern California Chapter, the Association of Engineering Geologists—Southern California, the California Science Teachers Association, and the Paleontological Society—Pacific Coast Section. The joint meeting will be held at the Sheraton Universal Hotel adjacent to Universal Studios. Co-chairs are Peter W. Weigand, (818) 677-2564, peter.weigand@csun.edu, and Jeffery E. Shellebarger, (661) 395-6385, jshe@chevron.com.

## CALL FOR PAPERS

Papers are invited for theme and general sessions in both oral and poster format. Submitted abstracts will be considered for any of the theme sessions listed below or any general discipline listed on the GSA abstract form. You may submit only one volunteered abstract as first author and/or presenter.

## Abstracts Deadline: December 20, 2000

Abstracts for all sessions must be submitted online at the GSA Web site. Please see the article announcing GSA's new electronic abstracts submittal system on page 25 of this issue. If you have any questions, contact Peter W. Weigand, (818) 677-2564, peter.weigand@csun.edu, or Jeffery E. Shellebarger, (661) 395-6385, jshe@chevron.com.

## TECHNICAL PROGRAM

The technical chair is Gene Fritsche, (818) 677-3541, a.eugene.fritsche@csun.edu, and the presentations chair is Mike Clark, (661) 395-6493, mscl@chevron.com.

## THEME SESSIONS

- 3-D Visualization and Geologic Modeling. Marc Kamerling, (805) 893-8435, marc@crustal.ucsb.edu.
- Active Tectonics and Paleoseismology of the San Andreas Fault System. Doug Yule, (818) 677-6238, j.d.yule@csun.edu.
- Active Tectonics of the Los Angeles Basin. Scott Lindvall, (661) 775-4990, lindvall@lettis.com.
- Advances in Petrophysics in California Reservoirs. Bob Davis,

- Schlumberger, (661) 864-4724, bdavis@baskersfield.oilfield.slb.com.
- Asian Geology. Greg Davis, (213) 740-6106, gdavis@usc.edu.
  - Climate, Tectonics, and Lakes of the Cenozoic Cordillera. Vicki Pedone, (818) 677-2046, vicki.pedone@csun.edu.
  - Geology, Tectonic, and Engineering Problems of Southern California. (*In Memory of Perry Ehlig.*) Kim Bishop, (323) 343-2409, kbishop@calstatela.edu, with Forrest Hopson.
  - Gulf of California: NSF MARGINS Focus Site for Rifting of the Continental Lithosphere. Gary Axen, (310) 825-6928, gaxen@ess.ucla.edu, with A. Martin-Barajas.
  - Hector Mine and Other Major 1999 Earthquakes. Tom Rockwell, (619) 594-4441, tom.rockwell@geology.sdsu.edu.
  - Magnetostratigraphy of the California Tertiary. Don Prothero, (213) 825-6928, prothero@tiger.cc.oxy.edu.
  - Miocene Reservoirs of California. Tony Reid, (661) 763-6052, tony\_reid@oxy.com, with Jon Schwalbach.
  - Neogene Geology and Paleoclimate. Rob Negrini, (661) 664-2185, Rob\_Negrini@firstclass1.csuak.edu.
  - Paleontology of the West Coast. Dick Squires, (818) 677-2514, richard.squires@csun.edu.
  - Petroleum Geology of California Basins. Frank Cressy, (805) 323-6828, fcressy@prodigy.net, with Tom Hopps.
  - Presentations by Awardees of NSF Grants. Dottie Stout, (703) 306-1665, ext. 5851, dstout@nsf.gov.
  - Provenance Studies: Geochemistry, Petrology, Paleotectonics,

- and Geoarchaeology. Gordon Goles, (541) 346-5588, goles@oregon.uoregon.edu, with Ray Ingersoll.
- San Fernando Valley Geology and Tectonics (Larse II). Gary Fuis, (650) 329-4758, fuis@andreas.wr.usgs.gov, with Tom Wright, and Bob Yeats.
  - Sequence Stratigraphy. Dan Steward, (661) 763-2008, sted@chevron.com, with Mike Clark.
  - Tertiary Tectonic History of California. (*In Honor of Gene Fritsche.*) Ivan Colburn, (323) 343-2413, icolbur@calstatela.edu.
  - Update of Pacific Coast Geochronology. Don Prothero, (213) 825-6928, prothero@tiger.cc.oxy.edu.
  - Argentina: From the Andes to the Atlantic. Jim Reynolds, (828) 230-8405, magstrat@gte.net.
  - What's New in the Mesozoic? Mario Caputo, (909) 594-5611, ext. 4439, mvcaputo@earthlink.net.
  - What's New in the Paleozoic? John Cooper, (714) 278-2662, jcooper@fullerton.edu.

## FIELD TRIPS

- The field trip chair is George Dunne, (818) 677-2511, george.dunne@csun.edu.
- Construction and Tectonic Evolution of Cordilleran Continental Crust: Examples from the San Gabriel and San Bernardino Mountains. Carl Jacobson, (515) 294-4480, cejac@iastate.edu, with Andy Barth.
  - Active Tectonics and Paleoseismic Record of the San Andreas Fault, Wrightwood to Indio: Working Toward a Forecast for the Next Big Event. Doug Yule, (818) 677-6238, j.d.yule@csun.edu.
  - Late Neogene Evolution of Indian Wells Valley and the Coso Range, Inyo County. Doug Walker, (913) 864-7711, jdwalker@ukans.edu, with Frank Monastero and Diane Kamola.
  - Regional Deformation by Strike-slip Faulting, Southern Death Valley: The Eastern California Shear Zone Meets the Garlock Fault. Matt McMackin, (408) 924-5035, mcmackin@pacbell.net.
  - Geology and Tectonics of the San Fernando Valley. Tom Wright, (415) 456-9244, tomwrightgeol@aol.com, with Tom Hopps and Bob Yeats.
  - Geology and Tectonics of the East Ventura Basin. Bob Yeats, (541) 737-1226, yeatsr@geo.orst.edu, with Tom Hopps.
  - The Portuguese Bend Landslide and Other Engineering Geology Features of the Palos Verdes Peninsula. (*Southern California*



*Association of Engineering Geologists)*

Kim Bishop, (323) 343-2409, kbishop@calstatela.edu, with Keith Ehlert.

- To Plate's Edge: San Fernando Valley to Palmdale. (*Dibblee Foundation Field Trip*) Peter Weigand, (818) 677-2564, peter.weigand@csun.edu, with Karen Savage, Helmut Ehrenspeck, and Tom Dibblee.
- Transverse/Peninsular Ranges Connections—Evidence for the Incredible Miocene Rotation. (*Pacific Section—SEPM [Society for Sedimentary Geology]*) Gene Fritsche, (818) 677-3541, a.eugene.fritsche@csun.edu.
- Neotectonics of the Santa Barbara Fold and Thrust Belt. Larry Gurolla, (805) 893-2260, gurolla@geology.ucsb.edu, with Ed Keller.
- Geology of Santa Cruz Island: Key to Understanding the Evolution of the Southern California Borderland. Janet Gordon, (626) 585-7026, jggordon@paccd.cc.ca.us, with Jim Boles.
- Structure and Sedimentology of Ridge Basin. John Crowell, (805) 893-8231, crowell@geol.ucsb.edu, with Marty Link.
- Urban Oil Fields of Los Angeles. Don Clarke, (562) 570-3915, doclark@ci.long-beach.ca.us.

## WORKSHOPS AND SHORT COURSE

The chair for these activities is Jan Gillespie, (661) 664-3040, jan@cs.csusbak.edu.

### Workshops

- Core Workshop. (*San Joaquin Geological Society*) Mark Wilson, (661) 395-6364, malw@chevron.com.
- Formation Microimaging (FMI) and Nuclear Magnetic Resonance (NMR) Workshop. (*San Joaquin Geological Society*) Chris Presmyk, (661)

- 326-1017, presmyk1@slb.com.
- Resume Writing and Career Advice. (*Association of Women Geologists—Southern California Chapter*)
- Roy J. Shlemon Mentor Workshop in Applied Geology. (*GSA*) Karlon Blythe, kblythe@geosociety.org.
- Writing a Good NSF Geoscience or Geoscience Education Proposal. (*National Science Foundation*) Dottie Stout, (703) 306-1665, ext. 5851, dstout@nsf.gov.
- Horizontal Well Technology for Geologists. (*American Association of Petroleum Geologists*) Bob Knoll, (403) 239-4168, htech@cadvision.com.
- Cased-hole Nuclear Technology Made "Easy" (*San Joaquin Geological Society*) Ahmed Badruzzaman, (925) 842-1043, ahmb@chevron.com.

## SHORT COURSE

- Fundamentals of Paleogeographic Reconstruction. (*Pacific Section—SEPM [Society for Sedimentary Geology]*) Gene Fritsche, (818) 677-3541, a.eugene.fritsche@csun.edu.

## K-12 EDUCATIONAL ACTIVITIES

- Workshops for K-16 Teachers. (*California Science Teachers Association*) Judy Scotchmoor, (510) 642-4877, judys@ucmp1.berkeley.edu.
- Field Trip to Urban Oil Fields of Los Angeles. Don Clarke, (562) 570-3915, doclark@ci.long-beach.ca.us.

## STUDENT AWARDS AND SUPPORT

The GSA Cordilleran Section has monies available for partial support of Student Members or Associates who are presenting papers or posters. Apply to Section Secretary Bruce Blackerby, Dept. of Geology, California State University, Fresno, CA 93740, (209) 278-2955, bruceb@

csufresno.edu. Applications should include certification that the student is a GSA Student Member or Student Associate of the Cordilleran Section as of Jan. 31, 2001 and *must be received by Feb. 28, 2001.*

The GSA Cordilleran Section will present cash awards for best and honorable-mention undergraduate and graduate papers (both oral and poster). The student must be both first author and presenter, must be a GSA Student Member or Student Associate, and must be registered for the meeting.

## EXHIBITS

Exhibits will be located in the Grand Ballroom with the poster sessions. The exhibits chair is Chris Presmyk, (661) 326-1017, presmyk1@slb.com.

## REGISTRATION

GSA Headquarters will handle registration. Registration details will appear in the January 2001 issue of *GSA Today*. *Electronic preregistration is encouraged* at [www.geosociety.org](http://www.geosociety.org) beginning in January 2001. The preregistration deadline is March 2; cancellation deadline is March 9.

## ACCOMMODATIONS

Meeting participants will receive special rates at the Sheraton Universal Hotel, Universal City, (818) 980-1212. Single or double—\$129 plus tax. Reservation deadline is *March 19* (be sure to identify yourself as a meeting participant).

## ADDITIONAL DETAILS

Details about social events, business meetings, and student housing will be published in the January 2001 issue of *GSA Today*. See also [www.geosociety.org](http://www.geosociety.org). ■

## New Abstracts System: Try It, You'll Like It!

Last month, we told you about a new abstracts management system that can be accessed from our Web site at [www.geosociety.org](http://www.geosociety.org) (*GSA Today*, September 2000, p. 17). You can also get to the system from your section's page on our Web site. Use the "Abstracts" link.

Based on the software used by the American Association of Petroleum Geologists and the American Chemical Society, the system offers several improvements over our previous system.

- If your Internet connection is lost while you are submitting your abstract, you'll be able to pick up where you left off when you reconnect.
- You'll be able to check your abstract online as soon as you've

sent it (submissions are password-protected), and you can revise it up until the published abstract submission deadline.

- Your coauthors will receive by e-mail a record of the abstract identification number and password. Authors can access their abstracts from any Internet connection.
- If your abstract contains subscripts, superscripts, italic or bold-face type, tables, Greek letters, or equations—no problem. The new system supports these.

If you choose, you can compose your abstract using word-processing programs such as Microsoft Word or WordPerfect, then paste the text into the new system. This allows you to take advantage of layout options and check your spelling.

After submitting your abstract, please feel free to contact Nancy Carlson at [ncarlson@geosociety.org](mailto:ncarlson@geosociety.org) with any comments or questions you have about the new system.

## Call for GSA Committee Service—2002

The GSA Committee on Committees wants your help. The committee is looking for potential candidates to serve on committees of the Society or as GSA representatives to other organizations. You can help by volunteering yourself or suggesting the names of others you think should be considered for any of the openings and submitting your nomination. Younger members are especially encouraged to become involved in Society activities.

Listed below are the number of vacancies along with a brief summary of what each committee does and what qualifications are desirable. If you volunteer or make recommendations, please give serious consideration to the special qualifications for serving on a particular committee. Please be sure that your candidates are Members or Fellows of the Society and that they meet fully the requested qualifications.

### Volunteering or Making a Recommendation

All nominations received at headquarters by February 1, 2001, on the official one-page form will be forwarded to the Committee on Committees. *Council requires that the form be*

*complete.* Information requested on the form will assist the committee members with their recommendations for the 2002 committee vacancies. Please use one form per candidate. The committee will present at least two nominations for each open position to the Council at its May meeting. Appointees will then be contacted and asked to serve, thus completing the process of bringing new expertise into Society affairs.

The nomination form and instructions are available on the GSA Web site at [www.geosociety.org/aboutus/committees/com\\_index.htm](http://www.geosociety.org/aboutus/committees/com_index.htm). A nomination form may also be obtained from the Member Service Center, (303) 447-2020, ext. 774, toll-free at 1-888-443-4472, or [member@geosociety.org](mailto:member@geosociety.org).

You may also go to our Web site to see a list of those currently serving on committees.

### Graduate Students Encouraged to Volunteer!

Graduate students are now eligible to serve on GSA committees as full members. All graduate students are encouraged to volunteer or nominate others for committee service.

## 2002 Committee Vacancies

### Annual Program Committee

(2 vacancies—1 Councilor or former Councilor and 1 member at large)

Develops a plan for increasing the quality of the annual meeting in terms of service, education, and outreach. Evaluates the technical and scientific programs of the annual meeting. Committee members should have previous program experience or experience at organizing an annual meeting, or be actively involved in applying geologic knowledge to benefit society and raise awareness of critical issues.

### Arthur L. Day Medal Award

(2 member-at-large vacancies)

Selects candidates for the Arthur L. Day Medal Award. Committee members should have knowledge of those who have made "distinct contributions to geologic knowledge through the application of physics and chemistry to the solution of geologic problems."

### Education

(2 vacancies—1 member at large and 1 graduate-level educator)

Stimulates interest in the importance and acquisition of basic knowledge in the earth sciences at all levels of education and promotes the importance of earth-science education to the general public. Committee members work with other interested scientific organizations and science teachers' groups to develop precollege earth science education objectives and initiatives.

### Geology and Public Policy

(3 member-at-large vacancies)

Translates knowledge of earth sciences into forms most useful for public

discussion and decision making. Committee members should have experience in public-policy issues involving the science of geology. They should also be able to develop, disseminate, and translate information from the geologic sciences into useful forms for the general public and for the Society membership; they should be familiar with appropriate techniques for the dissemination of information.

### Honorary Fellows

(1 member-at-large vacancy)

Selects candidates for Honorary Fellows, usually non-North Americans. Committee members should have knowledge of geologists throughout the world who have distinguished themselves through their contributions to the science.

### Membership

(2 member-at-large vacancies)

Evaluates membership benefits and develops recommendations that address the changing needs of the membership and attract new members. Committee members must be able to attend one meeting a year. Previous experience in benefit, recruitment, and retention programs is desired.

### Minorities and Women in the Geosciences

(4 member-at-large vacancies)

Stimulates recruitment and promotes positive career development of minorities and women in the geoscience professions. Committee members should be familiar with minority and female education and employment issues and have expertise and leadership experience in such areas as human resources and education.

### Nominations

(2 vacancies—1 member-at-large and 1 non-USA member at large)

Recommends to the Council nominees for the positions of GSA Officers and Councilors. Committee members should be familiar with a broad range of well-known and highly respected geological scientists.

### Penrose Conferences

(1 member who has attended at least two or more Penrose Conferences)

Reviews and approves Penrose Conference proposals and recommends and implements guidelines for the success of the conferences.

### Penrose Medal Award

(1 member-at-large vacancy)

Selects candidates for the Penrose Medal Award. Committee members should be familiar with outstanding achievements in the geological community that are worthy of consideration for the honor. Emphasis is placed on "eminent research in pure geology which marks a major advance in the science of geology."

### Professional Development (formerly Continuing Education)

(2 vacancies—1 student and 1 member at large)

Directs, advises, and monitors the Society's professional development program, reviews and approves proposals, recommends and implements guideline changes, and monitors the scientific quality of courses offered. Committee members should be familiar with professional development programs or have adult education teaching experience.

## Research Grants

(1 member-at-large vacancy)

Evaluates research grant applications and selects grant recipients. Committee members must be able to attend the spring meeting and should have experience in directing research projects and in evaluating research grant applications.

### *Treatise on Invertebrate Paleontology* Advisory Committee

(1 vacancy—paleontologist)

Advises the Council, the Committee on Publications, and the *Treatise* editor in matters of policy concerning this publication.

Representative to the North  
American Commission on  
Stratigraphic Nomenclature

(1 vacancy)


Must be familiar with and have expertise in stratigraphic nomenclature.

The GSA Council acknowledges the many member-volunteers who, over the years, have stimulated growth and change through their involvement in the affairs of the Society.

Each year, GSA asks for volunteers to serve on committees, and many highly qualified candidates express their willingness to serve. Not everyone can be appointed to the limited number of vacancies; however, members are reminded that there are also opportunities to serve in the activities and initiatives of the sections and divisions. Annually, the Council asks sections and divisions to convey the names of potential candidates for committee service to the Committee on Committees.

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# Rock Stars

## William Maurice Ewing: Pioneer Explorer of the Ocean Floor and Architect of Lamont

William Wertenbaker, 358 Granite Street, Rockport, MA 01966

Maurice Ewing was a driving force in marine geology for nearly 40 years until his death at age 67 in 1974. During the extraordinary expansion of marine geology after World War II, he was the indispensable leader of the discipline.

Ewing had an ambitious curiosity. He worked in a range of subjects, making contributions to earthquake seismology, explosion seismology, marine acoustics, sedimentology, and tectonics. He adapted seismic exploration methods to use in the oceans; explicated a large segment of the earthquake seismogram, the coda; did studies of Earth's free oscillations; and described the ocean sound channel and

data, stretching the limits of what could be done at sea and creating a dense body of observations and samples. While he was an exacting scientist with excellent instincts, above all he had a passion to know. It was as an explorer of two-thirds of Earth's crust—directly and through the generations of students he inspired—that he had his greatest and most lasting influence. Before science could explain it, Ewing saw, perhaps better than anyone, how much there was to learn about the seafloor. He encouraged and he pushed and he bullied and he insisted on the collection of data (oceanwide at first and worldwide later) at all times—as much data and of as many kinds as men and machines were capable. Maybe more.

Ewing was an amalgam of unblended traits and contradictions: a Texas farm boy dedicated in mind and body to the sea; an inspirational presence sometimes asleep in his own class; and a courteous Southerner who was a terror to the hidebound.

In 1949, Ewing started the institution he is most often associated with—the Lamont Geological Observatory (now Lamont-Doherty Earth Observatory), a branch of Columbia University, on an estate outside of New York City. Starting with just Ewing and a handful of graduate students, in a few years Lamont became one of the world's leading ocean research establishments.

### School Days

William Maurice "Doc" Ewing (with Maurice pronounced the English way, not the French) was born in 1906 and grew up on a farm in the parched plains of north Texas. He was the oldest of seven children, all but one of whom were sent to college. (The youngest, John, would join him in marine geology.) When Ewing applied to colleges, he was judged unprepared and was repeatedly turned down. However, Rice Institute (now Rice University) in Houston was moved to change its administrative mind after an indignant letter from Ewing's math teacher, rating him over "anyone I ever met—or I guess any-



Maurice Ewing at 38 in 1944. ©Lamont Doherty Geological Observatory. Used with permission.

one you ever met."

He started in electrical engineering, but soon had misgivings. "The engineering students had funny paper with crossing lines on it; they were elaborately careful how they wrote figure eights; an inkblot was a catastrophe. The professors were sarcastic Yankees," Ewing said. "But the three men I'd been learning from in math and physics were such gentle people, the kind of people I liked. The nicest people I ever met taught physics. I came to have essentially as private tutors men straight from the greatest centers of learning in the world. It was the middle of the great revolution of quantum physics.

"All the classic papers came out while I was at Rice, and as soon as the library got them, the physics professor had us read and discuss them and do the experiments—like diffraction of electrons."

Ewing was hooked. "Well, you only get measles from people who have them. And I sure was in contact with people with bad cases."

In 1926, his senior year, Ewing wrote his first research paper, and it was published in *Science*. Walking back to his college room many late nights, sometimes with moonlight glinting in the dew on the grass, he saw something that was both pretty and interesting—and not in the technical literature: "Dew Bows by Moonlight," as he titled his paper.

Many a brilliant man has not fulfilled his promise. Ewing had brilliance, but he had more. At Rice, his labs and classes were from nine in the morning to four in the afternoon. From five in the afternoon to midnight he held jobs to help pay his way. And there was also the need to fit in homework, meals, and time with friends.



Maurice Ewing was always a hands-on scientist. Here, at 43 in 1950, he helps rig some large water samples. Photo ©Woods Hole Oceanographic Institution. Used with permission.

the dispersion of sound in seawater.

He also developed or greatly improved many instruments and techniques for gathering geological and geographical data at sea—the bathythermograph, the piston corer, heat-flow probes, sonar, hydrophones, gravimeters, deep-sea cameras, and even winches. Using some of these, he joined in demonstrating early on the existence and effects of turbidity currents, and he led the first accurate observations of an abyssal plain.

Ewing collected and caused to be collected a huge quantity and breadth of



Catnapping during a cruise on RV *Atlantis*, 1956. Photo by Don Fay. ©Woods Hole Oceanographic Institution Archives. Used with permission.

The resolution for maintaining this schedule was pure Ewing. “In some of my freshman reading, it said that sleep is deepest and most restful in the first two hours. I thought about that. It looked to me that I could just sleep for two hours twice a day and then have time to do all the stuff I had to do.”

It worked pretty well for a while. Then a professor invited Ewing to dinner. Before the meal, his host poured wine for his wife, daughter, Ewing, and himself. Ewing had never so much as seen wine before. He was on his best behavior, sitting chatting at one end of a long sofa. The next thing he knew, he awoke in a bed upstairs and it was daylight.

Years later, sleep still took second place to science. “Once, Doc joined the ship at Nassau,” said colleague Charles Drake. “He looked exhausted. He probably was. He usually is. I took the first watch, he took the second. He looked so pooped that I let him sleep that night, and stood his watch after mine. Along about 4 a.m. up comes this real mad body. ‘Why didn’t you wake me up?’ he asked. ‘Well, you looked tired,’ I said. ‘Don’t you ever do that again!’ he yelled. And bow-wow-wow-wow-wow.”

### From Coal Country to the Continental Shelf

After graduate school, also at Rice, Ewing taught physics, first at the University of Pittsburgh (1929–1930) and then at Lehigh University (1930–1940), where he had 21 class hours weekly. There was little opportunity for research in physics, but he scrounged what he could in the surrounding coal country (“Locating a Buried Power Shovel by Magnetic Measurements” was one topic), and each year, he had a paper to read at the meeting of the new American Geophysical Union (AGU).

On a winter afternoon in 1934, Ewing, then 28, had callers at his basement office at Lehigh. They were Richard

Field of Princeton and William Bowie, head of the Coast and Geodetic Survey. Today, the AGU awards honors named for each of them (one for Ewing, too). They wanted to send Ewing to sea, and they posed a question that Ewing would expand outward in widening arcs across one ocean and into the others.

Bowie and Field thought it an important geological problem to determine the structure of the continental shelf, establishing whether its steep outer edge was a tectonic fault or the edge of a giant wedge of sediment. They had heard Ewing speak at AGU meetings and wondered if the seismic methods he worked with could be done at sea.

“If they had asked me to put seismographs on the Moon I would have agreed, I was so desperate to do research,” he said. (Thirty years later, Ewing would initiate a project that did put seismographs on the moon.)

Ewing solved the problem of putting listening gear under water by sealing stock geophones in reliable over-the-counter rubber sheaths. He demonstrated “by several masterly devices,” wrote the geologist Walter Bucher, that the continental basement sloped evenly down from an outcrop near Richmond, Virginia, to the lip of the continental shelf, where it was covered by 12,000 feet of sediments.

### Seafloor Discoveries

In 1953, soon after founding Lamont, Ewing acquired its first ship, the *Vema*. He secured the use of a second ship, the *Conrad*, in 1962. Instead of making voyages of a few months with defined goals to limited areas, Lamont’s ships soon circled the globe annually, accumulating 40,000 or so miles and 300 days at sea year after year. Work did not stop; information was collected continuously with every usable kind of measurement, whether or not anyone had asked for it. Doc always wanted it. Crews soon had a motto: A core a day keeps the doctor away.

Ewing had the nose of a truffle hound for good questions. Even when his ship was disabled at sea, he had a project that just fit the three days of drifting before a tugboat came. The first notable outcome of Lamont’s global perspective was a realization that Earth’s crust is the same in all ocean basins, yet fundamentally different there from the continents. Ewing delighted in identifying what he called “brutal” facts, which must be taken into account in all subsequent work. The oceanic crust was a brutal fact of the highest order. It did violence to some venerable ideas (like lost continents) that became abruptly untenable.

An equally brutal corollary (1956) was that the then plural mid-ocean ridges were really a single, continuous, worldwide mid-ocean ridge. Moreover, the ridge was

cleft at its midpoint by a rift. Careful recalculation of the positions of seafloor earthquakes showed them strung along the length of the rift like a necklace of precious stones. Out in the middle of the sea, Earth’s crust was active, unstable, and changing.

Lamont also was able to publish the first detailed maps of the seafloor in the North Atlantic (1959), South Atlantic (1961), and Pacific and Indian (1968) ocean basins. The same basic crustal features had been found in every basin—the ridge and its rift, regions of abyssal hills, abyssal plains, trenches, and the continental rise.



Maurice Ewing was devoted to new and ingenious instruments, such as this timed release mechanism, which was triggered by the dissolution of a block of salt, seen at right. Photo ©Woods Hole Oceanographic Institution. Used with permission.

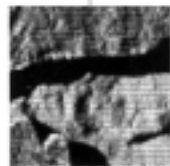
The brutal facts would be the backbone of a new global theory of geology. By the mid-1960s, the dogged old idea of continental drift was turned on its ear, into seafloor spreading. The first motions of tectonics were in the rifted mid-ocean ridge, which was structurally the oceanic lithosphere. To a disproportionate degree, the theory was proved, elaborated, and enlarged—seafloor spreading in turn becoming global tectonics—with Lamont data. Ewing’s conviction about that had paid off handsomely. It still does. Lamont’s libraries of core samples, bottom profiles, magnetic profiles, and heat-flow measurements continue to be mined for data by enterprises like the Ocean Drilling Project.

*The preparation of this profile benefited significantly from comments and suggestions by Kennard B. Bork, N. Terence Edgar, Edward L. Winterer, and J. Lamar Worzel. ■*

The Rock Stars series is produced by the GSA History of Geology Division and edited by Robert N. Ginsburg, University of Miami, RSMAS, 4600 Rickenbacker, Miami, FL 33149, rginsburg@rsmas.miami.edu.

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## Call for Nominations

# GSA Penrose Medal, Day Medal, and Honorary Fellows



Penrose Medal

The Penrose Medal was established in 1927 by R.A.F. Penrose Jr. to be awarded in recognition of eminent research in pure geology, for outstanding original contributions or achievements that mark a major advance in the science of geology. The award is made

only at the discretion of the GSA Council. Nominees are selected by the Council and may or may not be members of the Society. Penrose's sole objective in making the gift was to encourage original work in purely scientific geology, which is interpreted as applying to all scientific disciplines represented by the Society. Scientific achievements should be considered rather than contributions in teaching, administration, or service. Mid-career scientists who have already made exceptional contributions should be given full consideration for the award.



Day Medal

The Day Medal was established in 1948 by Arthur L. Day to be awarded annually, or less frequently, at the discretion of the Council, for outstanding distinction in contributing to geologic knowledge through the application of physics and chemistry to the solution of geologic problems. Day's intent was to recognize outstanding

achievement and inspire further effort, rather than reward a distinguished career. Scientific achievements should be considered rather than contributions in teaching, administration, or service.

## Honorary Fellows

Each year this honor is bestowed on non-North Americans who live and work outside of North America and have distinguished themselves in geological investigations or in notable service to the Society. Under exceptional circumstances, North Americans have been named Honorary Fellows. This amendment to the bylaws was made in 1969 when the Apollo II astronauts who first walked on the Moon were elected.

The program was established by the GSA Council in 1909, and since then, except during a few war years, one or more Honorary Fellows have been elected annually. Most Honorary Fellows have been elected after many years of outstanding and internationally recognized contributions to the science. At present there are 59 living geologists who have received this honor.

The GSA Council encourages the membership to submit names of qualified candidates for this honor. In preparing a nomination, it is imperative that the original research and scientific advances of the candidate be stressed. All supporting data, especially degrees received, publications, positions, etc., should also be verified by the nominator.

## How to Nominate

To ensure thorough consideration by the respective committees, please submit for each candidate a brief biographical sketch,

such as used in *American Men and Women of Science* and *Who's Who in America*, a summary (200 words or less) of the candidate's scientific contributions to geology that qualify the individual for the award, and a selected bibliography of no more than 20 titles.

A nomination for any one of these three awards *must be supported* by signed letters from each of five (5) GSA Fellows or Members in addition to the person making the nomination. The letters may be attached to the nomination form or may be sent to GSA separately. For Honorary Fellow nominations, please verify degrees received, publications, positions held, etc. The names of unsuccessful candidates proposed to the Council by the respective committees will remain for consideration by those committees for three years. For those still under consideration, it is recommended that an updated letter of renomination be sent to GSA.

The nomination form and instructions are available on the GSA Web site at [www.geosociety.org/aboutus/admin/awards.htm](http://www.geosociety.org/aboutus/admin/awards.htm). A nomination form may also be obtained from the Member Service Center, (303) 447-2020, ext. 774, toll-free at 1-888-443-4472, or [member@geosociety.org](mailto:member@geosociety.org). The deadline for receipt of nominations is February 1, 2001.

## Call for Nominations

# Young Scientist Award (Donath Medal)

The Young Scientist Award was established in 1988 to be awarded to a young scientist (35 or younger during the year in which the award is to be presented) for outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the earth sciences. The award, consisting of a gold medal called the Donath

Medal, and a cash prize of \$20,000 was endowed by Dr. and Mrs. Fred A. Donath.

*For the year 2001, only those candidates born on or after January 1, 1966, are eligible for consideration.* In choosing candidates for the Young Scientist Award, sci-

entific achievement and age will be the sole criteria. Nominations for the 2001 award must include:

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

The nomination form and instructions are available at [www.geosociety.org/aboutus/admin/awards.htm](http://www.geosociety.org/aboutus/admin/awards.htm). A nomination form may also be obtained from the Member Service Center, (303) 447-2020, ext. 774, toll-free at 1-888-443-4472, or [member@geosociety.org](mailto:member@geosociety.org). The deadline for receipt of nominations is February 1, 2001.

## Call for Nominations

# GSA Distinguished Service Award

The GSA Distinguished Service Award was established by Council in 1988 to recognize individuals for their exceptional service to the Society. GSA Members, Fellows, and Associates may be nominated for consideration. Any GSA member or employee may make a nomination for the award. Awardees will be selected by

the Executive Committee, and all selections must be ratified by the Council. Awards may be made annually, or less frequently, at the discretion of Council. This award will be presented during the Annual Meeting of the Society. A letter of nomination, a brief biographical sketch, and a summary (200 words or less) of the candidate's contributions to the Society that qualify the individual for the award should be addressed to Administrative Services Dept., GSA, P.O. Box 9140, Boulder, CO 80301-9140. Deadline for nominations is February 1, 2001.

## Call for Nominations

### GSA Public Service Award

The GSA Public Service Award in honor of Eugene and Carolyn Shoemaker was established by Council in 1998 to be awarded for contributions that have materially enhanced the public's understanding of the earth sciences or significantly served decision makers in the application of scientific and technical information in public affairs and public policy related to the earth sciences. This may be accomplished by individual achievement through:

- Authorship of education materials of high scientific quality that have enjoyed widespread use and acclaim among educators or the general public,
- Acclaimed presentations (books and other publications, mass and electronic media, or public presentations, including lectures) that have expanded public awareness of the earth sciences,
- Authorship of technical publications that have significantly advanced scientific concepts or techniques applicable to the resolution of earth-resource or environmental issues of public concern,
- Other individual accomplishments that have advanced the earth sciences in the public interest.

The award will normally go to a GSA member, with exceptions approved by Council. It may be presented posthumously to a descendant of the awardee.

Nominations must include a cover letter and biographical information that clearly demonstrates applicability to the selection criteria. The deadline for receipt of nominations is February 1, 2001. A letter of nomination, a brief biographical sketch, a summary (200 words or less) of the candidate's contributions that qualify the individual for the award, and a selected bibliography of no more than 10 titles should be addressed to Administrative Services Dept., GSA, P.O. Box 9140, Boulder, CO 80301-9140.



## You Can Help Direct GSA's Future

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). Nominations for 2000 officers and councilors must be received at GSA headquarters no later than February 1, 2001.

Please send nominations and back-up material to Administrative Services Dept., GSA, P.O. Box 9140, Boulder, CO 80301-9140.

## Call for Nominations—National Awards for 2003

Deadline: April 30, 2001

Nominations for the national awards described below are being solicited for 2003. Each year GSA members are invited to participate by recommending possible candidates.

Those who wish to make nominations are urged to do so by sending background information and vitae, and specifying the award for which the candidate is being submitted by April 30, 2001, to the GSA External Awards Committee, P.O. Box 9140, Boulder, CO 80301-9140, (303) 447-2020, fax 303-447-1133. The nomination process is coordinated by the American Geological Institute (AGI) on behalf of its member societies, and a roster of candidates will be finalized by the AGI Member Society Council at its spring 2002 meeting for nomination to the respective offices sponsoring the national awards.

### William T. Pecora Award

The Pecora Award, sponsored jointly by NASA and the Department of the Interior, is presented annually in recognition of outstanding contributions of individuals or groups toward the understanding of Earth by means of remote sensing.

The award recognizes contributions of those in the scientific and technical community as well as those involved in the practical application of remote sensing. Consideration will be given to sustained or single contributions of major importance to the art or science of understanding Earth through observations made from space.

### National Medal of Science

The medal is awarded by the President to individuals "deserving of special recognition by reason of their outstanding contributions to knowledge in the physical, biological, mathematical, engineering, or social and behavioral sciences."

There are now many younger American scientists and engineers who may be reaching a point where their contributions are worthy of recognition. The committee is giving increasing attention to these individuals as well as to those outstanding women and minority scientists who deserve recognition.

### Vannevar Bush Award

The Vannevar Bush Award is presented from time to time to a person who, through public service activities in science and technology, has made an outstanding contribution toward the welfare of mankind and the nation.

The award is given to a senior statesman of science and technology and complements the NSF's Alan T. Waterman Award, which is given to a promising young scientist. The two awards are designed to encourage individuals to seek the highest levels of achievement in science, engineering, and service to humanity.

The nomination should be accompanied by a complete biography and a brief citation summarizing the nominee's scientific or technological contributions to our national welfare in promotion of the progress of science.

### Alan T. Waterman Award

The Waterman Award is presented annually by the National Science Foundation (NSF) and National Science Board to an outstanding young researcher in any field of science or engineering supported by NSF.

Candidates must be U.S. citizens or permanent residents and must be 35 years of age or younger, OR not more than five years beyond receipt of the Ph.D. degree by December 31 of the year in which they are nominated.

Candidates should have completed sufficient scientific or engineering research to have demonstrated, through personal accomplishments, outstanding capability, and exceptional promise for significant future achievement.

Remember: Background information and vitae of nominated candidates should be sent by April 30, 2001, to the GSA External Awards Committee, P.O. Box 9140, Boulder, CO 80301-9140.



## Call for Nominations

# John C. Frye Environmental Geology Award

In cooperation with the Association of American State Geologists (AASG), GSA makes an annual award for the best paper on environmental geology published either by GSA or by one of the state geological surveys. The award is a \$1000 cash prize from the endowment income of the GSA Foundation's John C. Frye Memorial Fund.

### Criteria for Nomination

Nominations can be made by anyone on the basis of the following criteria: (1) paper must be selected from GSA or state geological survey publications, (2) paper must be selected from those published during the preceding three full calendar years, (3) nomination must include a paragraph stating the pertinence of the paper, (4) nominations must be sent to Chief Executive Officer, GSA, P.O. Box 9140, Boulder, CO 80301-9140. Deadline: March 31, 2001.

### Basis for Selection

Each nominated paper will be judged on the uniqueness or significance as a model of its type of work and report and its overall worthiness for the award. In addition, 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).

### 2000 Award Recipient Named

The 2000 award will be presented at the GSA Annual Meeting in Reno, Nevada, to Helen L. Delano and J. Peter Wilshusen for their report, "Landslide susceptibility in the Williamsport 1- by 2-degree quadrangle," Pennsylvania Geological Survey Environmental Geology Report 9, a comprehensive report of the physiographic, geologic, and topographic aspects of natural and manmade slope movements. ■

THE FOLLOWING PEOPLE WILL RECEIVE THE KIRK BRYAN AWARD FROM THE QUATERNARY GEOLOGY AND GEOMORPHOLOGY DIVISION AT THE GSA ANNUAL MEETING IN RENO IN NOVEMBER.

**Brian F. Atwater**

U.S. Geological Survey, Seattle, Washington

**Eileen Hemphill-Haley**

University of Oregon

Eileen Hemphill-Haley's name was inadvertently left off this award when the list was published in the August issue of *GSA Today*. We apologize for the error.

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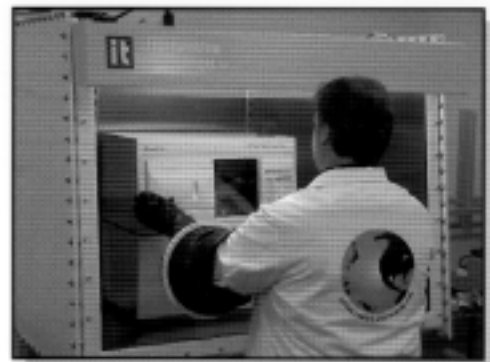
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# GSA DIVISION AND SECTION GRANTS 2000

Leah Carter, Research Grants and Awards Administrator

## DIVISION RESEARCH GRANTS

*Nine of the twelve GSA divisions offer grants for outstanding student research within the fields of the respective divisions. Recipients of these grants for 2000 are listed below. The three divisions that do not currently offer any awards to students are Geoscience Education, History of Geology, and the International Division.*

### Archaeological Geology Division

The Archaeological Geology Division awarded two grants this year. A student paper award was awarded to Carolyn Dillian, University of California—Berkeley, for her abstract entitled “Recent Research at Glass Mountain, Siskiyou County California: The Glass Mountain Archaeological Project.”

The Claude C. Albritton, Jr., Memorial Student Research Award went to Michael R. Hilton, University of California—Los Angeles, for his research proposal “Microstratigraphic Interpretation of Site Formation Processes in the Gulf of Alaska Using Sediment Thin Section Analysis.” The Claude C. Albritton, Jr., Memorial Fund was established at the GSA Foundation in 1991 with contributions from the family and friends of Claude Albritton. The division continues to seek contributions to the fund in memory of Dr. Albritton to provide scholarships for graduate students in the earth sciences and archaeology.

### Coal Geology Division

The Coal Geology Division presented the annual Antoinette Lierman Medlin Research Awards for 2000. The Field Award went to Todd Dallegge, University of Alaska, for his project “Coal Bed Methane Resource Assessment Using High-Resolution Chronostratigraphy, Vitrinite Reflectance and Burial History Modeling, Cook Inlet, Alaska.” The Research Award went to Marcio Kern, Universidade Federal Do Rio Grande Do Sul, Brazil, for his project “The Coalbed Methane Potential of Coal Seams in the Parana Basin, Brazil.”

### Engineering Geology Division

The Engineering Geology Division awarded the Roy J. Shlemon Scholarship Awards for 2000. The recipients are Matthew A. Barner, first place, master's level and Jason M. Taylor, second place, master's level.

### Geophysics Division

The Geophysics Division presented the Allan V. Cox Student Research Award this year for an outstanding student research proposal submitted to the GSA Research Grants Program to Paul Bedrosian, University of Washington, for his project “Self-Potential Mapping of Mount St. Helens.” The Geophysics Division award was presented to Michael D. Rutter, University of Western Ontario, for his project “High Pressure and Temperature Viscosity of Iron-Sulphur Liquid Alloys: Experimental Estimates of Outer Core Viscosity Using Synchrotron Radiation.”

### Hydrogeology Division

Awards for outstanding student research from the Hydrogeology Division were presented this year to six students: Tracey L. Carpenter, Arizona State University, for “A Stable Isotope Evaluation of Non-Equilibrium Condensate from Atmospheric Water Vapor”; Michelle L. Kearney, University of New Mexico, for “Rates and Pathways of Nitrate Attenuation in the Hyporheic Zone of a First-Order Mountain Stream”; Susan E. Kelly, Clemson University, for “Characterizing Spatial and Temporal Variations in Baseflow”; Aaron J. Mango, Florida State University, for “Tidally Induced Pressure Wave Propagation and Attenuation in an Unconfined Coastal Aquifer”; Shaile M. Pfeiffer, University of Wisconsin—Madison, for “Groundwater–Surface Water Interactions in a Floodplain Savanna Wetland”; Heather K. Wood, University of Kansas, for “Strontium Isotopes as Environmental Indicators of Mineral Weathering: A Study of the Interbedded Carbonates and Siliciclastics of the Konza Prairie Long-Term Ecological Research Site, Northeastern Kansas.”

### Planetary Geology Division

The Planetary Geology Division presents the Stephen E. Dwornik Best Student Paper Awards annually to students who are U.S. citizens and are pursuing advanced degrees in planetary sciences. The awards are presented each year for papers given in March at the Lunar and Planetary Science Conference. Recipients of the 2000 awards are Christopher Cooper, Brown University, for best oral presentation for “Criteria for Remote Sensing Detection of Sulfate Cemented Soils on Mars.” Honorable mentions for oral presentations were awarded to two stu-

dents this year: Joshua Bandfield, Arizona State University, for “Martian Volcanism: A Global Dichotomy of Basaltic and Andesitic Materials,” and Jennifer Anderson, Brown University, for “A New View of Ejecta Curtains During Oblique Impacts Using 3-D Particle Imaging Velocimetry.” The best poster award was presented to Carolyn van der Bogert, Brown University, for “Defining the Petrology of Pseudotachylytes in Ordinary Chondrites: An Experimental and Deductive Approach.” An honorable mention for a poster presentation was awarded to Natasha Johnson, Washington University, for “Temolite Decomposition and Water on Venus.” Recipients of the awards receive a citation and a \$500 cash prize. Honorable mention winners receive a certificate in an awards ceremony held at NASA headquarters in Washington, D.C., early in the summer.

### Quaternary Geology and Geomorphology Division

The Quaternary Geology and Geomorphology Division awarded two J. Hoover Mackin Grants this year. Recipients are Martha Eppes, University of New Mexico, for “Soil Development Control on Geomorphic Processes and Landscape Evolution, San Bernardino Mountains, California,” and Tammy Rittenour, University of Nebraska, for “Late-Pleistocene to Early-Holocene Evolution of the Lower Mississippi River Valley: Response to External Forcing.” The Arthur D. Howard Research Grant was awarded this year to Christopher Moy, Syracuse University, for “Reconstruction of Early to Middle Holocene El Niño/Southern Oscillation Activity in South America: Paradigm for Greenhouse Warming,” and James Sutherland, University of Nevada—Reno, for “Eighteenth-Century Logging and Geomorphic Stability in the Carson Range, Western Nevada: Implications for Lake Tahoe.”

### Sedimentary Geology Division

The Sedimentary Geology Division presented two awards for outstanding student research in 2000 to Tara M. Curtin, University of Arizona, for “Seasonal Climate Signals Preserved in Laminated Lacustrine Rocks in Triassic Lake Ischichuca in the Ischigualasto Basin, Northwest Argentina,” and Margaret E. McMillan, University of Wyoming, for “Late Cenozoic Exhumation of the Central Rocky Mountains.”

## Structural Geology and Tectonics Division

The Structural Geology and Tectonics Division presented its 15th annual awards for outstanding student research this year to Alexander P. Bump, University of Arizona, for "Thermochronologic Constraints on the Late Cretaceous Tectonics of the Colorado Plateau," and Emily H. Onasch, University of California—Santa Barbara, for "The Western Gneiss Region, Norway: A Missing Piece in the Puzzle of Ultrahigh-Pressure Rock Exhumation."

## SECTION RESEARCH GRANTS

*Four of the six GSA regional sections award grants for research to students attending colleges and universities within each section's respective geographical boundaries. The Cordilleran and Rocky Mountain Sections do not currently offer student research grants. Following are grants awarded in 2000 by the other sections.*

## North-Central Section

The North-Central Section awarded grants for undergraduate research projects to students who attend a college or university within the North-Central Section geographic area. Research proposals are submitted and evaluated competitively. Recipients for 2000 are: Emily Gilles, University of Wisconsin—River Falls; Karolyn Knoll, University of Wisconsin—River Falls; William Jacobson, University of Wisconsin—Oshkosh; Matthew Council, Southwest Missouri State University; Amy Stanik, Central Michigan University; and Jennifer Martin, Loras College.

## South-Central Section

The South-Central Section has awarded grants to four graduate students. The 2000 recipients are: Amy K. Gilmer, University of Texas—Austin; Minghua Ren, Baylor University; Chris Amador, Oklahoma State University; and Christine Marie Philips, Texas Christian University.

## Northeastern Section

The Northeastern Section awarded grants to four undergraduate students. The 2000 recipients are: Jennifer Cooper, Southern Connecticut State University; Daniel MacPhee, Yale University; Patrick Kormos, Slippery Rock University; and Naila Moreira, Amherst College.

## Southeastern Section

GSA's Southeastern Section awarded research grants to twelve students this year. They are: Kenneth Robitaille, Jeremy McCartha, Josh Borella, Ricky Schaefer, Livio Tornabene, Daniel Zeitner, Bret Moore, German Bayona, Karen Stockstill, Andrey Bekker, Eric Davis, and Cindy Martin. ■

## GSA Division News

*Divisions will recognize the following individuals at the 2000 Annual Meeting in Reno, Nevada, for their service to the Division and/or contributions to the geological sciences.*

### Hydrogeology Division

E. Scott Bair, 2000 Birdsall-Dreiss Distinguished Lecturer  
Leonard Konikow, Distinguished Service Award

### Engineering Geology Division

Ellis Krinitsky, Distinguished Practice Award  
Erhard Winkler, Meritorious Service Award  
Robert J. Watters, Richard H. Jahns Distinguished Lecturer

### Quaternary Geology and Geomorphology Division

Peter W. Birkeland, Distinguished Career Award  
Stephen G. Wells and Leslie D. McFadden, Farouk El-Baz Award for Desert Research  
Wallace Broecker, Donald J. Easterbrook Distinguished Scientist Award

### Structural Geology and Tectonics Division

S. Warren Carey, Career Contribution Award  
Cees Passchier and Rudolf Trouw, Best Paper Award

For a listing of other award recipients to be honored at the 2000 Annual Meeting, see *GSA Today*, August 2000, page 19, and GSA Division and Section Grants 2000, pages 35 and 36, of this issue.



## Call for Nominations

## Planetary Geoscience Student Paper Award

### The Award

Planetary geologist Stephen E. Dwornik established this award in 1991 to provide encouragement, motivation, and recognition to outstanding future scientists. Two awards are given annually, one for the best oral presentation, the other for the best poster presentation, each winner receiving a citation and \$500. The program is administered through the Planetary Geology Division of the Geological Society of America. The GSA Foundation manages the award fund. For further details, see [www.lpi.usra.edu/meetings/lpsc2001/](http://www.lpi.usra.edu/meetings/lpsc2001/).

### Criteria

The Dwornik Student Paper Award applies to papers presented at the annual Lunar and Planetary Science Conference held each March in Houston. Student applicants must be (1) the senior author of the abstract (the paper may be presented orally or in a poster session); (2) a U.S. citizen; and (3) enrolled in a college or university, at any level of their education, in the field of planetary geosciences. Papers will be judged on the quality of the scientific contributions, including methods and results; clarity of material presented; and methods of delivery, oral or display.

### To Apply

The application form and instructions are found in the Call for Papers for the 32nd Lunar and Planetary Science Conference, to be held March 12–16, 2001, at NASA Johnson Space Center in Houston, Texas. For further information, contact Program Services Division, Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX 77058-1113, (281) 486-2158, [simmons@lpi.usra.edu](mailto:simmons@lpi.usra.edu). Only one abstract per student will be considered.

### Deadline

Hard copy abstracts are due January 3, 2001 by 6:00 p.m. CST; electronic abstracts are due January 10, 2001, by 6:00 p.m. CST. ■



# The Geological Society of America

## 2001 Research Grants Program for Students

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 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, [www.geosociety.org](http://www.geosociety.org). Applications may be downloaded from the Web but may *not* be submitted by facsimile or e-mail. They are also available upon request from the Research Grants Administrator, GSA, P.O. Box 9140, Boulder, CO 80301 or [lcarter@geosociety.org](mailto:lcarter@geosociety.org). Please use only the current 2001 application and appraisal forms.

Confidential evaluations from two faculty members are required from candidates and must accompany applications submitted. PLEASE USE THE "APPRAISAL OF APPLICANT" FORMS, WHICH ACCOMPANY THE 2001 APPLICATION FORMS. APPLICATION FORMS WILL NOT BE ACCEPTED BY FACSIMILE OR E-MAIL.

GSA awarded more than \$400,000 in grants in 2000. The grants went to 245 students doing research for advanced degrees. The average amount awarded was \$1,622. The largest grant was \$3,175, but there is no predetermined maximum amount. Grants supported 41 percent of the applicants. 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 soon after the deadline to evaluate applications and award grants. In late April, GSA's Chief Science Officer will inform all applicants for grants of the committee's actions.

APPLICANTS MUST BE MEMBERS OF GSA TO APPLY.

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## NORTHEASTERN SECTION ANNOUNCES TWO STUDENT GRANT PROGRAMS

### UNDERGRADUATE STUDENT RESEARCH GRANTS FOR 2001

The Northeastern Section's student research grant program for 2001 is competitive and available only to undergraduate students.

To be considered for a research grant:

- ◆ The student must be enrolled at an institution within the Northeastern Section.
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- ◆ Applications must be postmarked no later than **February 12, 2001**.
- ◆ Grants will be awarded following the Northeastern Section Meeting in Burlington, Vermont, in March 2001.

### STUDENT TRAVEL GRANT PROGRAM FOR 2000

The Northeastern Section's student travel grant program is open to graduate and undergraduate students.

To be considered for a travel grant:

- ◆ The student must be the presenter of the paper.
- ◆ The student must be a student associate or member of GSA.
- ◆ Applications must be postmarked no later than **October 10, 2001**.
- ◆ Grants will be awarded approximately 10 days prior to the GSA Annual Meeting in Reno, Nevada, in November 2000.

For further information or a copy of the application form(s) please contact:

Kenneth N. Weaver, Secretary, NEGSA Maryland Geological Survey  
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# GSA FOUNDATION UPDATE

*Donna Russell, Director of Annual Giving*

## Strategic Alliances for the Future

The GSA Foundation has been working on strategic partnerships since its formation in 1980. More than 60 donors have set up funds to underwrite specific programmatic needs of GSA for the betterment of the geosciences.

In 1999, work began on a landmark partnership that would not only assure funding for a portion of annual meeting expenses and enhance member services, but would also provide critical funding for some GSA priority programs. Through an initial contact with GSA's Meetings Department and subsequent intense work by the Foundation and Chief Executive Officer Sara Foland, the strategic partnership with Subaru of America was forged.

Following are the general areas of support made possible by this relationship with Subaru of America.

- Continued funding for the opening reception of the GSA Annual Meeting and other ancillary benefits to attendees. This sponsorship makes Subaru of America the Title Sponsor of the meeting.
- The use of two Subarus at GSA headquarters in Boulder for two years. In addition, GSA will be afforded the use of several new Subarus during the Reno meeting in November.
- Underwriting for two key programs within GSA's Science, Education, and Outreach Department.
  1. The Distinguished High School Earth Science Educator in Residence Program will be underwritten by this partnership. Diana Stordeur, award-winning science

teacher from the Cherry Creek School District in Denver, will work full time for one academic year on the program, meeting a critical need in the K-12 education program for GSA.

2. The Doris Curtis Women in Science Fund was enhanced by the Subaru of America/GSA partnership. An award will be given this year at the GSA Annual Meeting in Reno to an outstanding woman in the geosciences, and additional dollars will be added to the endowment of this fund.
- Members can benefit from this Subaru of America/GSA relationship when purchasing a new car. By contacting Subaru of America within 60 days of purchasing a new Subaru, they will receive a free Added Security Basic Maintenance Plan—a retail value of \$545. In addition, for every car sale recognized under this program, Subaru of America will make a \$150 donation to the GSA Foundation to support the GSA Distinguished Educator Program and the Doris Curtis Women in Science Fund.

The GSA Foundation and GSA are most appreciative of the benefits to the geosciences this new partnership with Subaru of America brings.

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Keith Kvenvolden has been selected as the first Michel T. Halbouty Distinguished Lecturer. Kvenvolden is currently senior scientist at the U.S. Geological Survey, Coastal and Marine Geology Team, in Menlo Park, California, and consulting professor in the Department of Geology at Stanford University. He has received numerous awards and honors, including the Treibs Award (Certificate and Medal) for outstanding contributions in organic geochemistry, and the Distinguished Service Award from the U.S. Department of Interior.

The fund, established by Michel T. Halbouty, provides an honorarium for a Halbouty Distinguished Lecturer at GSA annual meetings. See the September issue of *GSA Today* for more information on Halbouty.

### Digging Up the Past

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# Engaging “My Neighbor” in the Issue of Sustainability

## Part X: What Do We Mean by a Sustainable World?

*E-an Zen, Reston, Virginia*

In earlier articles of this series, we saw that if on our Earth, which is a materially closed system, population and consumption are allowed to grow exponentially, then the basis for a sustainable world of which we are a part will be destroyed (Palmer, 2000a). But what do we mean by a sustainable world?

Sustainability requires humans to learn to live within our means. Major factors, such as human population size, biosphere robustness, resource stock, food supply, and environmental quality must remain in balance, on a global scale. This state of balance must last long enough so that it will not be merely a blip on the curve of unsustainable growth (Zen, 2000a). Even though we might not attain that balance, we must move in that direction if humanity and the ecosystem are to survive.

Because Earth is a closed system, a sustainable world is not compatible with “sustainable growth” (Palmer, 2000b). A closed system might conceivably accommodate “sustainable development,” a term popularized by the World Commission on Environment and Development (1987; the Brundtland Commission), but how that could be done is not obvious (see, however, Daly and Cobb, 1994, Appendix). Another way to look at the issue is to consider the idea of a transition towards sustainability (Board on Sustainable Development, 1999), which, however, needs a complementary discussion of the destination, or end state, of that transition.

Most of us probably accept the proposition that everyone should have access to fair shares of food, water, shelter, and health care. Surely we want to sustain a healthy environment and a robust ecosystem. Certainly we want to promote equity among societies, to reduce disparity between the rich and the poor, to protect human dignity, and to minimize state terrorism. While moving toward that goal, we need to protect the capability of future societies to make real choices for themselves, whatever their social organization or cultural and religious affinity. If these goals seem incompatible with steady growth of population and our present rates of material consumption, then we need to do some careful soul searching about our national obsession for ever-increasing economic throughput.

To take sustainability seriously requires us to reexamine our ideas about growth, social equity, consumption, and standard of living, that putative indicator of social well-being. Sustainability is constrained at both ends of the economic throughput. At the starting point it is constrained by the availability of resources, and at the end point by the accumulation of the products of their use: waste, loss, and pollution. Consumption and systems of material distribution, the processes that link those two ends, go to the heart of the matter. The scale of global consumption, both public and private, depends on population size and on the intensity of resource use.

What are some of the implications of sustainable consumption of resources (Zen, 2000b)? For those living at a subsistence level, to consume is to survive. This is true today for about a third of the world's human population. For them, amenities beyond survival are largely luxury. Such luxury, while arguably marking civilized societies, too easily degenerates into extravagance. One possible approach to sustainable consumption is to support and strengthen the “ecological middle consumers” (Durning, 1992). Globally, the increasing number of people living in abject poverty, combined with the number among the better-off who lapse into ostentatious consumption, threaten to endanger the future existence of the middle consumers. Equity and social justice may well be keys to a durable and sustainable world.

To discuss sustainable consumption, we need to know why people consume beyond their civilized needs. Kates (2000) eloquently explores the intricacies of the issues and gives useful references. Several essays in Crocker and Linden (1998) discuss the motivations behind consumption. Why are commercial ads such a powerful driving force? Is it the attempted fulfillment of daydreams (Campbell, *ibid.*), the emulation of neighbors, or a display of enhanced wealth? If display is the motivating force, then it might help to substitute the assurance of material *capability* for the actual *implementation* (Sen, *ibid.*). For instance, I don't have to stay aloft all the time in order to prove that I can afford all the plane trips I want to take. Such a shift in measuring the standard of living, which

Sen calls a “positive freedom,” might help to bring sustainability closer to reality.

In the end, whether we can attain equitable sustainability depends on the aggregate effects of individual choices; essay XII in this series will discuss this topic. Institutions can provide incentives and even role models, but every one of us must make his or her own decisions. Certain choices may require us to give up things, or even some of our dreams, for the good of others, who include those without voices and those yet unborn (Ashby, 1993). A suggestive metaphor is the choice that is faced in an overcrowded lifeboat (the Titanic; the ecosystem). If taking on one more passenger would swamp the boat, do those already aboard have a right to fend off newcomers? Awful though such choices appear, we in fact face them daily. How we live and how we act affect species extinction, environmental quality, and local and national attitudes toward immigrants and refugees. The scale and complexity of real societies may help to buffer our individual impact, yet among all the living species, humans alone are capable of being guardians for global sustainability buttressed by justice. We must act because we alone can choose to make a difference.

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- Note: This series of essays, with some enhancements for teachers, is now available through a link on GSA's Web site, [www.geosociety.org](http://www.geosociety.org). From either Public Interest or the “Related Links” area of Geoscience Initiatives, click “Sustainability” then “Toward a Stewardship of the Global Commons.”





## LETTERS

Aksu et al. (2000) present a geometric model for the Marmara Sea that features northeast-elongate fault-bounded ridges and basins bound by two east-west branches of the North Anatolian right-lateral transform. They state: (1) "The basins and ridges are rotating counterclockwise..." and (2) "...the entire negative flower structure is in a state of wholesale crustal extension." We are not in a position to evaluate the mapping, but if their fault geometry is correct, we suggest that it is consistent with the clockwise block rotation expected in a right-lateral transform (i.e., like books rotating on a shelf; McKenzie and Jackson, 1986; Lamb, 1994), not counterclockwise as stated in (1). Further, shortening (not extension) is expected across the northeast-striking faults in a right-lateral transform system for the given geometry (for angle  $\phi > 90^\circ$ ; inset to Fig. 1) unless east-west divergence between the rotating blocks is permitted; and extension is expected across the east-west faults. To demonstrate the expected zones of shortening (stippled areas in Fig. 1) and extension (overlap zones of Fig. 1) for the Aksu et al. (2000) geometry, we restore the blocks to their 1 Ma positions, assuming an Anatolia-Eurasia relative velocity as determined by Global Positioning System (GPS) data at GPS station ERDE (Fig. 1; McClusky et al., 2000). Seismic reflection profiles seem to support our dextral kinematic model as Okay et al. (2000) interpret young short-wavelength compressional folding along the southeast flank of the Central Marmara Ridge ( $\delta$  in Fig. 1) and long-wavelength anticlines across  $\alpha$  and  $\delta$  (Fig. 1). These structures resemble anticlines in California above (oblique) thrust-reactivated blind faults (Seeber and Sorlien, 2000). Shortening structures and thrust earthquakes are also associated with clockwise block rotation and termination of strike-slip faults within the pull-apart Salton Trough of California (Armbruster et al., 1998). Thus, the fault geometry proposed by Aksu et al. (2000) is consistent with shortening synchronous with extension within Marmara Sea if it is interpreted as a clockwise rotation system.

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### Acknowledgments

Institute for Crustal Studies contribution 372-102TC. Partial funding for Seeber was from the Southern California Earthquake Center (SCEC), funded by NSF Cooperative Agreement EAR-8920136 and U.S. Geological Survey Cooperative Agreements 14-08-0001-A0899 and 1434-HQ-97AG01718. SCEC contribution 533.

Christopher C. Sorlien  
University of California  
Santa Barbara, CA 93106  
chris@quake.crustal.ucsb.edu

Leonardo Seeber  
Lamont-Doherty Earth Observatory  
Columbia University  
Palisades, NY 10964

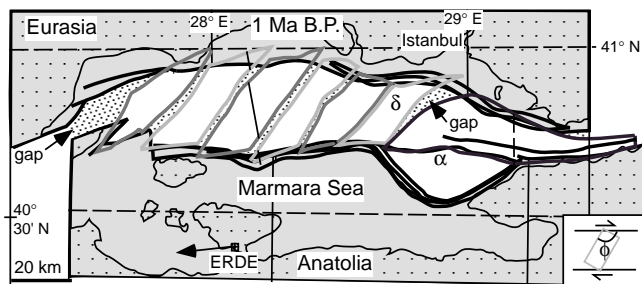


Figure 1. 1 Ma map restoration using Aksu et al. (2000) geometry, displacement at GPS station ERDE, and  $1^\circ$  counterclockwise rotation of Anatolia (McClusky et al., 2000). Dextral shear is interpretatively distributed between 5 km slip (south),  $10^\circ$  clockwise rotation ( $\sim 4$  km), and  $\sim 11$  km slip (north). Gaps (stipple) represent shortening, overlap is extension. Angle  $\phi$  between axis of elongate blocks and the east-west faults that bound them is shown in inset. Distributed extension north of ERDE would reduce overlap at block boundaries. A color version of this figure and a comparison to present geometry can be found at <http://quake.crustal.ucsb.edu/vbmrp> (August 2000).

*Aksu et al. reply:* Sorlien and Seeber raise two issues: (1) rotation sense within the principal deformation zone (the Anatolian transform), and (2) whether the ridges are compressional or extensional. Their restoration assumes dextral shear between two bounding strike-slip faults, leading to clockwise rotation of intervening rigid blocks. Given that  $\phi$  is obtuse in the Anatolian system, these parameters would indeed yield northwest-southeast contraction and northeast-southwest extension in their model, compatible with the kinematics of a releasing bend. However, several lines of evidence refute northwest-southeast contraction anywhere within the principal deformation zone. First, central graben in the basins are oriented east-northeast (Aksu et al., 2000, Fig. 1) and because the bounding faults of the ridges are at less than  $25^\circ$  from the trend of these graben, the ridges must also be under extension. Extension (not contraction) along northeast faults is also confirmed by normal-sense drag on closely spaced faults in the ridges, the strong subsidence of the basins and ridges (to form the Marmara Sea), and the absence of compressional fault-plane solutions in the principal deformation zone.

Why are the modeling results not compatible with our observations? First, the principal deformation zone is totally detached from both the Eurasian and Anatolian plates, riding above a single buried stem fault (unlike the geometry assumed by Sorlien and Seeber and discussed by Lamb, 1994, and Armbruster et al., 1998). In such a detached configuration, individual crustal elements will rotate according to local displacement fields, which can be sufficiently at odds with the regional kinematic framework to allow counterclockwise rotations, especially in a regime of tectonic escape. Second, material in the principal deformation zone is mechanically weak due to pervasive faulting, so cannot be modeled as rotating rigid blocks (e.g., "book-shelf" system). Thus, we maintain that the Marmara-type escape basin (Aksu et al., 2000, Fig. 3C) does not conform with existing models for strike-slip basin formation, particularly the classic pull-aparts that Sorlien and Seeber use as a template.

### References Cited

See listing to the left.

Ali E. Aksu, [aaksu@sparky2.esd.mun.ca](mailto:aaksu@sparky2.esd.mun.ca)  
Tom J. Calon  
Richard N. Hiscott  
Memorial University of Newfoundland  
St. John's, Newfoundland A1B 3X5

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 University of Vermont  
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### SOUTHEASTERN SECTION

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For meeting information:

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 skip\_stoddard@ncsu.edu

### CORDILLERAN SECTION

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 Sheraton Universal Hotel  
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For meeting information:

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### NORTH-CENTRAL SECTION

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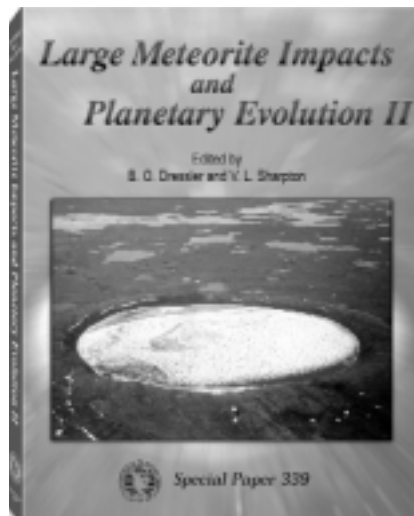
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 Albuquerque, New Mexico

**Abstract Deadline:**

**January 24, 2001**

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edited by **B. O. Dressler and V. L. Sharpton**

Impact specialists, or other scientists interested in the fields of geoscience and planetology, will appreciate the wide range of topics in this 33-chapter volume: impact cratering mechanics; geophysical signatures of impact structures (e.g., Chesapeake Bay, Chicxulub, Mjølnir, Barents Sea, Sudbury, Slate Islands); formation and differentiation of impact melts (e.g., Sudbury); shock metamorphism and shock attenuation (e.g., Slate Islands); terrestrial impact structures under investigation (e.g., Morokweng, Lycksele, Popigai); and the origin of carbon, including diamonds, in impact deposits (e.g., Sudbury, Chicxulub ejecta).

This special volume is the outcome of a second international conference on Large Meteorite Impacts and Planetary Evolution (Sudbury 1997) attended by more than 150 scientists representing approximately 15 countries. Presentations on the Sudbury Structure are introduced by a summary of the understanding of this structure before the 1997 conference and are followed by concluding remarks outlining unresolved problems. This volume contains papers of interest to all geoscientists who investigate the effects of impacts and planetology.

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## Field Forum Scheduled

### Bolide Impacts on Wet Targets

April 22–28, 2001  
Nevada and Utah

#### Conveners:

*John E. Warme, Coordinator, Colorado School of Mines*  
*Christian Koeberl, Geochemistry Institute, University of Vienna*  
*Philippe Claeys, Institute of Mineralogy, Natural History Museum, Berlin*  
*Walter Alvarez, University of California, Berkeley*

Web site: See Field Forum link on Alamo Breccia Research Page, <http://talus.Mines.EDU/students/m/mmorgan/>.

Location: Alamo, Nevada, and the adjacent ranges (five days); Moab, Utah, and nearby Canyonlands and Arches National Parks (two days). Lodging in Alamo will be at the new JFDI (Just Focus and Do It) Executive Retreat Ranch.

#### Significance

This field forum is designed to bring together experts on impact processes and products to generate discussions, exchange ideas, and integrate knowledge of wet impacts by studying and analyzing two field examples and comparing them with impact events on Earth and in space. Asteroid and comet impacts yield different geological products on wet or dry targets. Variable depths of standing water and intervals of saturated bedrock, and surface or subsurface ice, all affect cratering dynamics and the character and distribution of impact debris. The forum themes tie into the ongoing analysis of the Chicxulub crater in Yucatan, into work on many other terrestrial impact events, and into examination of Martian and other extraterrestrial landscapes. Past or present life on Mars is more likely if cratering processes there were influenced by water in some form.

#### Objectives

Using the field venue, we anticipate that the forum will yield new perspectives and syntheses on the geological results of wet impacts. The focus is on physical processes. Results of the forum should help characterize and model wet impact craters, fault systems, melt rocks, shocked minerals, liquefied and fluidized rocks, ejecta blankets, reworked tsunami beds, and associated features. The field examples are the well-exposed Alamo Breccia and the

controversial Upheaval Dome. They will be put into perspective by a mix of international impact specialists who will present case studies and relevant concepts, in poster format, highlighted by invited keynote addresses.

The catastrophic Alamo Breccia was formed by an impact on the Late Devonian shallow-water carbonate platform now exposed in 15 or more mountain ranges in southern Nevada. Its thickness ranges from a central 135 m to a feather edge perimeter 100 km away. The breccia exhibits sedimentary features that are interpreted as a primary ejecta blanket overlain by multiple tsunami beds. It contains shocked quartz, an iridium anomaly, ejecta spherules, and trains of dislodged clasts as much as 500 m long and 90 m high. Of special interest during the forum will be the problem of water depth at the exact time of the Alamo event, identification and interpretation of proximal versus distal impact beds, recognition and origin of fluidization and liquefaction structures, flight history and emplacement of carbonate impact spherules, and timing of primary cratering processes versus early modifications by tsunamis, loading, dewatering, etc. The field area is tectonically complex, and breccia trends have been used to provide paleogeographic solutions for the complex geologic history of the area.

Upheaval Dome is a famous circular structure in the Mesozoic formations of Canyonlands National Park, Utah. Its origin and related deformation is hotly contested: impact crater versus salt diapir. Evidence used to demonstrate impact includes circular geometry, sets of outward directed thrusts and inward directed listric faults, a vertical dike (Robert's Rift) that contains propants from underlying formations, and deformation of the Carmel and Entrada formations at outlying locations in Arches National Park.

#### Itinerary

Sunday, April 22—Morning assembly in Las Vegas, Nevada. Transport by vans to Alamo, with overview stops en route. Lunch at viewpoint. Traverse lower Guilmette Formation and type locality of Alamo Breccia near Hancock Summit. Check-in at JDFI Ranch. Evening lecture and discussion on the Alamo Breccia.

Monday–Wednesday, April 23–25—Field stops, workshops, poster sessions, keynote addresses, discussions, and summaries.

Thursday, April 26—Morning: summary of Alamo Breccia and introduction to Upheaval Dome. Afternoon: transit to Moab; motel overnight.

Friday, April 27—Overview of Upheaval Dome; field workshops on faulted, injected, and deformed marginal beds; discussion; Moab overnight.

Saturday, April 28—Morning: wrap-up discussions and overview of wet impact phenomena. Afternoon: departure for airports in Salt Lake City, Utah, and Grand Junction or Denver, Colorado.

Sunday, April 29 (OPTIONAL, extra cost)—Foot traverse into Upheaval Dome; transfer to airports Sunday night or Monday.

Registration Limit: 40 participants.

Cost: \$925 (\$600 for students), including guidebooks and handouts, meals, lodging (double occupancy), morning and afternoon refreshments, and transportation from starting point in Las Vegas to ending point at airports in Denver or Grand Junction, Colorado, or Salt Lake City, Utah. Optional extension in Moab is extra, with departure from Grand Junction or Denver.

Registration Applications and Information: Students and active researchers on all physical aspects of wet impacts are encouraged to apply. Contact John E. Warme, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401, (303) 273-3816, fax 303-273-3859, [jwarme@mines.edu](mailto:jwarme@mines.edu). ■

#### Field Forums—Call for proposals

Have a great idea for a Penrose Conference that would be much more effective in a field setting? A field trip that captures the essence of new, exciting discoveries or a controversial topic? Submit a proposal for a Field Forum!

Field Forums provide an opportunity for exchange of current knowledge and exciting ideas well expressed by the geology of a specific area.

For more information, check our Web site [www.geosociety.org/profdev/f\\_forum.htm](http://www.geosociety.org/profdev/f_forum.htm), or contact [ecollis@geosociety.org](mailto:ecollis@geosociety.org).

## About People

GSA Fellow Kennard B. Bork received the 2000 Neil Miner Award, given to a college-level professor for exceptional contributions to the stimulation of interest in the earth sciences, from the National Association of Geoscience Teachers.

The U.S. Environmental Protection Agency named Fellow Syed E. Hasan, University of Missouri—Kansas City, as its Educator's Environmental Excellence Award recipient from Missouri for the 1999–2000 school year.

Fellow Thomas A. Steven received the 7th Dibblee Medal during an American Association of Petroleum Geologists field trip in June. Tom Dibblee Jr. presented the award on behalf of the Dibblee Geologic Foundation.

Fellow Marilyn J. Suiter, National Science Foundation, was elected to the Executive Board of the Association for Women in Science as a councilor. Suiter will serve through December 2001.

## OCTOBER *Bulletin* and *Geology* Highlights

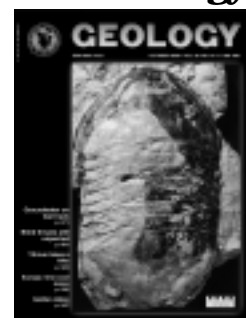
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To learn more about the Fellow experience, contact David Verardo, 1997-1998 GSA Congressional Science Fellow, at (703) 625-6105 or [dverardo@geosociety.org](mailto:dverardo@geosociety.org).

For application information, check our Web site at [www.geosociety.org/science/csf/scifello.htm](http://www.geosociety.org/science/csf/scifello.htm) or contact Karlon Blythe, Program Officer, GSA Headquarters, (303) 447-2020, ext. 136, or [kablythe@geosociety.org](mailto:kablythe@geosociety.org).

## OCTOBER CALENDAR

### 2000 Meetings

#### November

November 14-17, 2000 Petroleum Hydrocarbons Conference and Exposition—Organic Chemicals in Ground Water: Prevention, Detection, and Remediation, Anaheim, California. Information: NGWA Customer Service Center, 1-800-551-7379, [www.ngwa.org](http://www.ngwa.org).

### 2001 Meetings

#### June

June 4-7, Sixth International Symposium on In Situ and On-Site Bioremediation, San Diego, California. Information: Bioremediation Symposium Registrar, The Conference Group, 1989 West Fifth Avenue, Suite 5, Columbus, OH 43212-1912, USA, 1-800-783-6338, (614) 424-5461, fax 614-488-5747, [conferencegroup@compuserve.com](mailto:conferencegroup@compuserve.com).

#### August

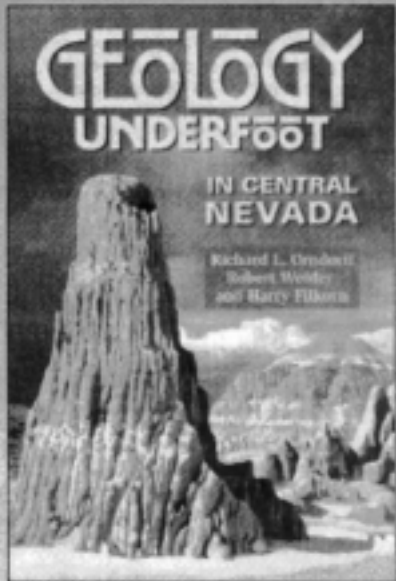
August, dates TBD, First Annual Congress on Petroleum Contaminated Soils, Sediments, and Water, London, United Kingdom. Information: Paul Kostecki, [paul@aehs.com](mailto:paul@aehs.com), or Terri Hwei-ling Greeney, [terri@aehs.com](mailto:terri@aehs.com), Association for Environmental Health and Sciences, [www.aehs.com](http://www.aehs.com). (Abstract deadline: Nov. 17, 2000.)

#### September

September 26-28, 9th Annual International Congress of the Geological Society of Greece, Athens, Greece. Information: Paul G. Marinos, 30-1-7723430, [marinos@central.ntua.gr](mailto:marinos@central.ntua.gr); George K. Tsiambaos, 30-1-7723748, [gktsiamb@central.ntua.gr](mailto:gktsiamb@central.ntua.gr); Jasmine Athanassiou, 30-1-7723490, fax 30-1-7723770.

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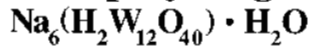
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# A Model Experience in Montana

*Al Fleming, Deerfield High School*

This past year, I was honored to receive the 1999 Outstanding Earth Science Teacher Award for the state of Illinois, presented by the National Association of Geoscience Teachers. As part of this award, GSA, through the John F. Mann Institute for Applied Geoscience, generously sponsored my participation this past summer in "Geology and Ecosystems," a field workshop offered by the National Minerals Training Office and the National Forest Service. We were stationed out of the Judson Meade Geologic Field Station of Indiana University and spent the week working in the Northern Tobacco Root Mountains in southwestern Montana.

The workshop presented me with personal and professional opportunities not readily available to a high school geology teacher, especially a flatlander like me. Hiking in the mountains of Montana is a real treat. At the same time, working at elevations over 8000 feet presented challenges to someone who spends most of his time hanging out at 650 feet above sea level. But the chance to work with surface outcrops was well worth the effort. Teaching in the glaciated terrain of northern Illinois, I must travel more than 60 miles to show my students actual bedrock. (Digging straight down through 400 feet of glacial drift would be a shorter trip, but much more time consuming!) Without a doubt, the most rewarding experience of the week was the opportunity to observe and work with other professional scientists.

As the only teacher among this group of geologists, biologists, and soil scientists, it was exciting to see scientists modeling collaborative scientific investigative techniques consistent with many of the reform efforts taking place in science education. The way science is taught in this country is undergoing significant change. Curricula are being designed to soften the boundaries between biology, chemistry, physics, and the earth sciences, with an emphasis on broad unifying themes. Students bring their individual strengths to small groups, where they investigate real-life problems while constructing their own knowledge. Students' understanding from these experiences is now assessed in a variety of ways, with equal emphasis on what they know and how well they are able to communicate their knowledge. Teachers facilitate these ventures into the natural world, providing guidance (not to mention an audience) and serving as one of many resources available to the students.

The purpose of Geology and Ecosystems was to examine the components of the area's ecosystems, with particular attention to the interaction of these components with respect to their geologic framework. During our group's week in the field, we modeled many of the collaborative approaches to science that I try to teach my students. We looked closely at the interplay between geology, soils, and vegetation. For me, someone who considered soils and plants a nuisance in examining the geology of an area, it was enlightening to have a botanist accurately predict soil and bedrock types based on plant distribution, or to hear a soil scientist explain why certain plants grew in an area based on the bedrock geology. By pooling our shared expertise and experience, we were able to develop a broader, fuller understanding of that particular region of the Rocky Mountains.

The opportunity provided me with not only content knowledge in the natural sciences, but more important, personal experience working with professional scientists. As a result of this experience, my own observations of how science is done in the field will have a lasting impact on my classroom instruction and, consequently, make a real difference in my students' appreciation of science as a valuable human endeavor. ■

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## Positions Open

### IOWA STATE UNIVERSITY

The Department of Geological and Atmospheric Sciences invites applications for four tenure-track positions at the rank of assistant professor to begin in mid-August 2001. The Department is initiating an emphasis in Earth systems science that will complement existing programs in environmental geology, hydrogeology, structural geology/tectonics, geomorphology/glaciology, economic geology, geophysics, petrology, geochemistry, mesoscale weather modeling, regional climate modeling, synoptic meteorology, global climate change, and inquiry-based learning in Earth Sciences. The successful candidates will be encouraged to pursue interactions with faculty in geology and atmospheric sciences and other units on campus such as Agronomy, Botany, Civil and Construction Engineering, Climatology, Environmental Science, Forestry, Soil Science, the Iowa State Water Resources Research Institute, the Leopold Center for Sustainable Agriculture, and the National Soil Tilth Laboratory.

**Environmental Geochemist**—Preference will be given to individuals with a strong background in the application of one or more of the following fields: low-temperature aqueous geochemistry, contaminant hydrogeology, biogeochemistry, organic geochemistry.

**Paleoclimatologist**—The successful candidate should be able to reconstruct patterns of regional or global climate change from the terrestrial, marine, and/or cryospheric record. This position would provide a natural bridge between the Department's geologists and climate modelers interested in both recent and ancient sediments.

**Stable Isotope Geochemist**—Preference will be given to applicants able to provide unique documentation of past and current environmental change and of processes in the Earth's crust. The successful candidate is expected to collaborate widely with existing faculty, many of whom require isotopic analyses for their research, as well as with the environmental geochemist and paleoclimatologist.

**Earth Systems Science Educator**—This position is for a candidate who will develop innovative pedagogical approaches to Earth systems science education. The successful candidate will provide an integrated framework for teaching that spans disciplinary boundaries and is expected to interact with faculty in the Department as well as the College of Education and the University's Center for Teaching Excellence.

The successful candidates will be expected to develop a vigorous research program, supervise graduate students, attract external funding, and participate actively in our graduate (M.S. and Ph.D.) and undergraduate teaching programs.

Letters of application accompanied by curriculum vitae, transcripts, statements of research and teaching interest and philosophy, and three letters of reference should be sent to: Paul G. Spry, Prof. & Chair, Department of Geological and Atmospheric Sciences, 253 Science I, Iowa State University, Ames, IA 50011-3212. Applicants should hold a Ph.D. at the time of appointment. The Department will begin reviewing applications on November 1, 2000 and will continue the search until the positions are filled.

Information about the Department can be found on the World Wide Web at: <http://www.geology.iastate.edu>.

Iowa State University is an Equal Opportunity/Affirmative Action Employer and encourages applications from women, minorities, and other protected groups.

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### ASSISTANT PROFESSOR - STRUCTURAL GEOLOGY, BRYN MAWR COLLEGE

The Department of Geology at Bryn Mawr College invites applications for a full-time, tenure-track position at the rank of Assistant Professor, beginning Semester I, 2001. Areas of preferred expertise are structural geology and/or tectonics. Candidates could also be interested in fields such as neotectonics, geophysics, fluid flow, remote sensing, GIS, and/or modeling, to complement our existing programs in paleontology, petrology/mineralogy, sedimentology and Quaternary geology. The individual is expected to contribute to our interdisciplinary Environmental Sciences Concentration and add depth to our joint graduate program with the University of Pennsylvania. The person will direct undergraduate and graduate research projects and conduct an active research program. Teaching responsibilities will include structural geology and an introductory physical geology course, as well as undergraduate and graduate courses in the candidates field(s) of expertise. Demonstrated teaching ability and a Ph.D. at the time of appointment are required.

Applications should include a curriculum vitae, statement of research and teaching interests, and at least 3 letters of recommendation. Applications should be sent to Structure Search, Maria Luisa Crawford, Department of Geology, Bryn Mawr College, 101 N. Merion Avenue, Bryn Mawr, PA 19010. Preliminary interviews will be conducted at the GSA annual meeting in Reno. Review of applications will begin Dec. 10, 2000.

Bryn Mawr College is a liberal arts college for women with coeducational graduate programs in sciences, some humanities and social work. The College provides a rigorous education in the context of a diverse and pluralistic scholarly community and participates in consortial programs with the University of Pennsylvania, Haverford and Swarthmore Colleges. Bryn Mawr College is an equal-opportunity, affirmative action employer. Members of underrepresented groups are especially encouraged to apply. For more information about the position, the Department and the College, visit [www.brynmawr.edu/Acads/Geo](http://www.brynmawr.edu/Acads/Geo).

### EARTH SURFACE PROCESSES UNIVERSITY OF NORTH DAKOTA

The Department of Geology and Geological Engineering at the University of North Dakota invites applications for a tenure-track faculty position in earth surface processes, at the assistant professor level. We are particularly interested in candidates with strengths in global change, remote sensing, or soil science. A PhD in the geological sciences is required. The successful applicant will be expected to teach undergraduate and graduate courses in his/her area of specialty, and to develop a strong research program. The position is available August 16, 2001. Closing date for applications will be January 15, 2001, or as soon thereafter as a suitable pool of applicants is obtained. We will be interviewing candidates at the Reno GSA meeting.

The successful applicant must have the Ph.D. degree at the time of appointment. Salary will depend on qualifications and experience. Interested applicants should send a letter of application, resume, and the names of three referees to: Richard D. LeFever, Chair, Department of Geology and Geological Engineering, University of North Dakota, Grand Forks, ND 58202-8358. Telephone: (701) 777-2811. Fax: (701) 777-4449. For further information about the Department, please visit our web site at <http://www.und.nodak.edu/dept/geology/>.

The University of North Dakota is an Equal Opportunity/Affirmative Action Employer.

### GEOPHYSICS-GEODYNAMICS UNIVERSITY OF FLORIDA

The Department of Geological Sciences invites applications for a tenure-track assistant professor appointment to be made for the 01-02 academic year in the area of geophysics-geodynamics. Applications should include a statement of interests and career goals in teaching and research, CV, and the names and addresses of at least three referees. We seek a quantitative, process oriented scientist capable of establishing a strong, independent research program that will complement existing programs in geochemistry, paleoclimatology, and tectonics (see [web.geology.ufl.edu](http://web.geology.ufl.edu)).

Applications should be addressed to Professor David A. Foster, ([dfoster@geology.ufl.edu](mailto:dfoster@geology.ufl.edu)) University of Florida, Department of Geological Sciences, 241 Williamson Hall, P.O. Box 112120, Gainesville FL 32611-2120; 352-392-2231/FAX:352-392-9294.

The University of Florida is an equal opportunity employer; qualified women and minorities are especially encouraged to apply.

### HYDROGEOLOGIST, WISCONSIN GEOLOGICAL & NATURAL HISTORY SURVEY

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Additional information is available at [www1.uwex.edu/ces/personnel/](http://www1.uwex.edu/ces/personnel/).

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### PETROLOGIST UNIVERSITY OF WISCONSIN-MILWAUKEE

The Department of Geosciences at the University of Wisconsin-Milwaukee seeks to hire a petrologist at the tenure-track Assistant Professor level. Applicants must hold a Ph.D. in geology, and have demonstrated field and research experience in petrology. Post-doctoral experience is desirable. The successful candidate is expected to conduct an active research program, and teach undergraduate and graduate courses in igneous/metamorphic petrology, geochemistry, mineralogy (on an occasional or team-taught basis) and related subject areas. Information is available on-line regarding the Department at <http://www.uwm.edu/Dept/Geosciences/>.

Candidates must mail a curriculum vitae with a research plan, a statement of teaching philosophy, and the names of three references to Mark Harris, Chair, Department of Geosciences, University of Wisconsin-Milwaukee, P. O. Box 413, Milwaukee, WI 53201 (FAX: 414-229-5452; e-mail: [mtharris@uwm.edu](mailto:mtharris@uwm.edu)), and postmarked by December 1, 2000. The University of Wisconsin-Milwaukee is an Equal Opportunity/Affirmative Action Employer.

### GEOLOGIST

(Scientist I), Position #00428, Location: Abingdon, VA, Salary Range \$36,962 - 57,706. The Division of Mineral Resources is seeking a research geologist to perform and publish geological studies of the Appalachian Plateaus and Valley and Ridge mapping provinces. TO QUALIFY: Ability to work independently and as part of a multi-disciplinary team to complete geological projects that support environmentally sound development of Virginia gas and coal resources. Experience in sequence-stratigraphy, field mapping, subsurface geology, digital databases and digital mapping required. Ability to synthesize complex data sets, communicate effectively and provide information to a wide range of customer requests from industry, the public and other government agencies. Ability to stoop, crawl, bend and walk for long distances over rough terrain required. Experience in: contouring; gas or coal geology; coal-bed methane; hydrogeology; and/or web page creation is desirable. TO APPLY: Send State of Virginia Application for Employment (Form #10-12) to: Department of Mines, Minerals and Energy, Human Resources Office, 202 North 9th Street, 8th Floor Richmond, VA, 23219.

Classifieds *continued on p. 48*

## Classifieds *continued from p. 47*

Telephone:(804) 692-3215; TTY/TDD (800) 828-1120; FAX: (804) 692-3237 ALL APPLICATIONS MUST BE RECEIVED BY 5:00 P.M.Tuesday, October 31st, 2000.

### POST-DOCTORAL POSITION, VOLCANIC STRATIGRAPHER, IDAHO STATE UNIVERSITY

The Geology Department at Idaho State University seeks a post-doctoral research scientist to fill a two-year position studying the volcanic stratigraphy of the eastern Snake River Plain. Research duties will focus on the correlation of subsurface basalt flows, especially a critical appraisal of published correlations and the viability of correlation techniques. The critiqued correlations will be used to interpret volcanic and deformational processes that operate on the Plain as well as groundwater flow parameters. Experience in basalt petrography and borehole geophysics is required, while experience in geochemistry, paleomagnetism, geochronology, and GIS analysis is desirable. See [www.isu.edu/departments/geology](http://www.isu.edu/departments/geology) for additional information. Send CV, statement of research interests, and names of 3 referees to Dr. David Rodgers, Department of Geology, Idaho State University, Pocatello, ID 83209-8072. Applications will be reviewed beginning October 23, 2000. ISU is an EO/AA Employer. ISU Geology Department — Phone: 208-282-3365, Fax: 208-282-4414, email: [geology@isu.edu](mailto:geology@isu.edu).

### HYDROGEOLOGY/GEOPHYSICS PORTLAND STATE UNIVERSITY

The Geology Department of Portland State University seeks to fill a tenure track Assistant Professor position in the area of Hydrogeology/Geophysics to begin Fall, 2001. The successful candidate is expected to teach undergraduate and graduate courses and conduct a vigorous externally funded research program, including supervision of master's students in Geology and master's and Ph.D. students in Environmental Sciences and Resources. Primary interest is in numerical modeling of earth science systems, with emphasis in Hydrogeology and Geophysics. Candidates should also be interested in applying their knowledge and skills to the general education of undergraduate students. Secondary areas of interest could include laboratory simulations, analogue modeling of earth systems, geographical information systems or secondary education. The new faculty should interface with ongoing studies in geomicrobiology, igneous petrology, soils, glaciology, contaminant modeling, beach, lacustrine and estuarine processes. The Ph.D. is required by the date of hire. A detailed resume including two letters of professional references and a statement of research and teaching interests must be received by December 15, 2000. Applications should be sent to: Hydrogeology/Geophysics Search Committee; Geology Department; Portland State University; Portland, Oregon 97207-0751. Fax: (503) 725-3025. E-Mail: [streckm@pdx.edu](mailto:streckm@pdx.edu). The Geology Department home page is <http://www.geol.pdx.edu>. Portland State University is an equal opportunity/affirmative action institution.

### MARYLAND GEOLOGICAL SURVEY

The Maryland Geological Survey, an agency of the Maryland Department of Natural Resources, invites applications for a full-time, permanent position, for a Geologist III, General Option, in its Environmental and Mineral Resources Program. The purpose of the position is to serve as the coordinator and supervisor of educational outreach activities in the Earth Science Information Center, in support of the Survey's mission of promoting public awareness of geology.

Responsibilities will include giving lectures on various geologic topics, leading field trips, integrating education and technology on the Survey's website and developing a course for teachers to comply with the State of Maryland's CEU (Continuing Education Units) requirement. Additionally, the position has responsibility for conducting geologic research of the state's mineral resources and geology.

The salary range is \$32,274 to \$48,169 plus an attractive benefits package.

Minimum qualifications: The position requires a Master's degree from an accredited college or university in the field of geology or related field of earth science and two years of experience as a practicing geologist or earth scientist, preferably in the fields relating to natural resources programs; or a Bachelor's degree from an accredited college in geology or a related field of earth science and four years of experience as a practicing geologist or earth scientist, at least two years of which must have been in work directly applicable to natural resources programs.

Selective qualifications: One year of experience in teaching and/or educational outreach activities.

To be considered for this position, a Maryland State Employment Application (MS-100) must be received at the address below by the closing date, November 1, 2000. The MS-100 application form may be obtained from:

Maryland Department of Natural Resources, Human Resources Service, Tawes State Office Bldg C-3, Annapolis, MD, 21401, Attention: Beth Cottman-Brown - Fax: (410) 260-8099, TTY:(410) 260-8835.

The State of Maryland is an Equal Opportunity Employer.

### GLACIAL GEOLOGIST/GEOMORPHOLOGIST NORTH DAKOTA GEOLOGICAL SURVEY

The North Dakota Geological Survey announces a permanent position opening for a geologist. Successful applicant will be responsible for generating surficial geologic maps at a scale of 1:24,000 as well as creating, supervising, and publishing reports on projects dealing with various environmental and economic issues and with other topics relating to the geology and mineral resources of North Dakota.

Applicants should have a minimum of a masters degree in geology as well as geologic mapping experience above and beyond the traditional summer field course. Emphasis should be on glacial geology, but training in the field or classroom in glacial geology, geomorphology, Tertiary stratigraphy, and sedimentology are all desirable. Experience in aerial photographic interpretation and mapping experience at the 1:24,000 scale are desirable. Applicants should have strong writing and public communication skills and knowledge of GIS. Preference will be given to applicants with demonstrated experience in communicating geologic knowledge to a lay audience both through writing and oral communications.

Starting annual salary will be between \$32,400 and \$34,000 plus benefits for this permanent position. Please apply by letter stating qualifications to Ms. Karen Gutenkunst, North Dakota Geological Survey, 600 East Boulevard Ave., Bismarck, ND 58505. Include a resume and the names and addresses of three or more references. Phone (701) 328-8000 for more information.

Preliminary interviews for this position will be conducted at the GSA meeting in Reno (November, 2000). Deadline for applications is December 31, 2000 but position will remain open until it is filled.

For more information about the North Dakota Geological Survey, see <http://www.state.nd.us/ngds/>.

The North Dakota Geological Survey is an Equal Opportunity Employer.

### TENURE-TRACK FACULTY POSITION IN STABLE ISOTOPE GEOCHEMISTRY UNIVERSITY OF KENTUCKY

The Department of Geological Sciences at the University of Kentucky invites applications for a tenure-track position at the Assistant Professor level in the field of stable isotope geochemistry beginning Fall 2001. The successful applicant will be expected to establish a state-of-the-art stable isotope analytical facility with a research emphasis on low-temperature environmental systems and processes such as (but not limited to) ground and surface water contamination, biogeochemistry, sedimentary geochemistry, organic geochemistry, and paleoclimatology. The candidate should be able to collaborate with faculty engaged in research in high-temperature stable isotope geochemistry (metamorphic processes, fluid-rock interaction, igneous petrogenesis, deformation processes), organic petrology (dispersed organics and coal macerals), and hydrogeology (contaminant fate and transport). Applicants should possess the Ph.D. and have a proven publication and funding record. The successful applicant will be expected to establish a funded, productive research program, including supervision of graduate student research. In addition to current faculty within the Department, opportunities exist for collaboration with scientists from the Kentucky Geological Survey, Center for Applied Energy Research, Department of Chemistry, Kentucky Water Resources Research Institute, College of Agriculture, and Medical Center. Teaching responsibilities include geochemistry courses at the graduate and undergraduate level.

Interested applicants should send a cover letter, curriculum vitae, a brief statement of research and teaching interests, copies of relevant research publications, and the names, addresses, and e-mail addresses of at least three references to: Dr. David P. Moecher, Stable Isotope Search Committee Chair, University of Kentucky, Department of Geological Sciences, Lexington KY 40506-0053.

The committee will begin reviewing applications on Nov. 1, 2000. For additional details of the position see [www.uky.edu/AS/Geology/isotopes](http://www.uky.edu/AS/Geology/isotopes). The University of Kentucky is an Affirmative Action employer, and applications from minority and female applicants are encouraged.

### TENURE-TRACK FACULTY POSITION IN APPLIED SEISMOLOGY, UNIVERSITY OF KENTUCKY

The Department of Geological Sciences at the University of Kentucky invites applications for a tenure-track faculty position at the Assistant Professor level in the area of

applied seismology beginning Fall 2001. The successful candidate will be expected to build upon an existing program in earthquake seismology, engineering, and hazard reduction. Ability to obtain funding for earthquake research from state and federal sources is essential. Existing facilities include a regional strong-motion and seismic monitoring network (comprised of 15 short/intermediate period seismometers and 10 strong-motion accelerometers), which is concentrated on the New Madrid Seismic Zone. A wide range of supporting field equipment is also available, and the successful candidate will be given start-up funding with which to purchase additional equipment. This position offers a broad range of opportunities for cooperation with other departments and agencies (e.g., Kentucky Geological Survey, Department of Civil Engineering at UK, Kentucky Transportation Center, and Central United States Earthquake Consortium). In addition to assuring continuity of our earthquake research program, our new colleague will be expected to enhance geophysical research within the department. Departmental programs currently emphasize tectonics, applied geosciences including engineering geology and hydrogeology, and energy resources. In addition to developing a vigorous research program, the new faculty member will be expected to develop and teach challenging courses at both the undergraduate and graduate levels.

Interested applicants should submit a cover letter including a brief statement of research and teaching interests, curriculum vitae, copies of relevant research publications, and the names, addresses and e-mail addresses of at least three referees to: Dr. Sue M. Rimmer, Geophysics Search Committee Chair, Department of Geological Sciences, University of Kentucky, Lexington, KY 40506-0053. Applicants will be expected to show a proven record of publication and funding, and experience beyond the Ph.D. is desirable. The committee will begin to review the applications on November 1, 2000. The University of Kentucky is an Affirmative Action employer, and applications from minority and female applicants are encouraged.

### IGNEOUS PETROLOGIST, OHIO UNIVERSITY

The Department of Geological Sciences at Ohio University invites applications for a tenure-track appointment at the assistant professor level in field-oriented igneous petrology to begin in September 2001. We are seeking an individual who is committed to both research and teaching, and is qualified to teach courses in hard-rock petrology (such as hand-specimen petrology, earth materials, optical mineralogy, igneous/metamorphic petrography, igneous petrology, and field geology). Excellence in teaching at both the undergraduate and graduate level and supervision of M.S. student research must be complemented by the development of a strong field-based research program in igneous petrology supported by external funding. The successful applicant will possess a Ph.D. in geology and must show demonstrated potential for excellence in teaching and research.

Ohio University is a state-assisted residential campus with an enrollment of approximately 20,000 students (including approximately 2,500 graduate students). The Department of Geological Sciences has twelve faculty and currently enrolls approximately 50 undergraduates and 20 MS degree graduate students. Applicants should send a vita, a description of research interests, a statement of teaching philosophy, and the names and addresses of three referees to: Search Committee Chair, Department of Geological Sciences, 316 Clipping Laboratories, Ohio University, Athens, Ohio 45701-2979. Applications should be received before January 1, 2001, but will be considered until the position is filled. Ohio University is an affirmative action/equal opportunity employer. Women and minorities are especially encouraged to apply. For further information concerning the department and its faculty, visit the Ohio University web site at [www.ohiou.edu](http://www.ohiou.edu).

### MARINE SEDIMENT GEOCHEMIST (COASTAL OCEAN EMPHASIS)

UNIVERSITY OF CALIFORNIA, AT SANTA BARBARA  
The Department of Geological Sciences invites applications for a tenure track position in marine sediment geochemistry with a coastal ocean emphasis, available July 1, 2001. The position is to be filled at the assistant professor level. Applicants should have broad geoscience backgrounds with primary research interests centered on the geochemistry of marine sediments of the continental margins and their global interactions. The ability to take advantage of UCSB's unique setting adjacent to the California Borderland is especially desirable. The successful applicant will be expected to build a strong research program and interact with the marine science graduate program at UCSB, which has strengths in marine geology, paleoceanography and climatology and biological

Classifieds *continued on p. 50*



### **Cenozoic Tectonics and Volcanism of Mexico**

edited by Hugo Delgado-Granados, Gerardo J. Aguirre-Diaz, Joann M. Stock, 2000

#### Cenozoic Tectonics and Volcanism of Mexico



Edited by:  
Hugo Delgado-Granados  
Gerardo J. Aguirre-Diaz  
Joann M. Stock

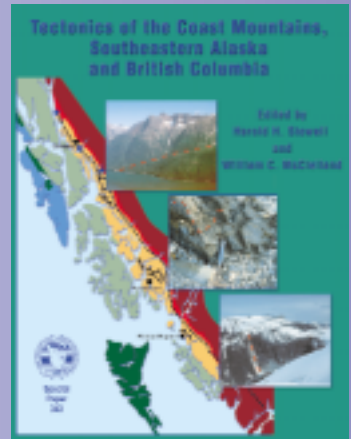


More than a dozen authors explore the Cenozoic evolution of Mexico, providing a key perspective on recent advances in the understanding of the tectonics and volcanic history of the country. Many of the papers focus on the relationship between the observed geology and the inferred plate motions. Attention is given to studies in and around the Rivera plate and the Jalisco region, recognizing that an understanding of this area could hold the key to the relationship between changes in plate tectonics at a trench and the effect on the geology of the overriding plate. A must-have volume for those interested in the continuing study of the geology of Mexico.

SPE334, ISBN 0-8137-2334-5, 282 p., indexed, 2 plates  
\$64.00, Member Price \$51.20

### **Tectonics of the Coast Mountains, Southeastern Alaska and British Columbia**

edited by Harold H. Stowell and William C. McClelland, 2000



The geology of southeastern Alaska and coastal British Columbia has played a pivotal role in the recognition of terranes and the growth of the terrane concept, and the Coast Mountains in particular include some important and controversial terrane boundaries.

This volume provides an overview of the accretionary and post-accretionary processes that occurred along these terrane boundaries in the western Coast Mountains between Skagway, Alaska, and Bella Coola, British Columbia. The authors use lithologic, geochemical, and isotopic data to correlate tectonostratigraphic packages separated by faults; use structural relations and ages of intrusions to suggest the timing of terrane accretion and the displacement history for shear zones and sutures; and use pressure-temperature-time data and modeling to constrain explanations for metamorphism. By emphasizing geochronologic, structural, stratigraphic, and petrologic data and interpretations, this volume delivers a comprehensive look at the Coast Mountains orogen.

SPE343, ISBN 0-8137-2343-4, 289 p., indexed (in press)

### **Volcanic Hazards and Disasters in Human Antiquity**



Edited by  
Floyd W. McCoy  
and Grant Heiken

Special Paper 210

### **Volcanic Hazards and Disasters in Human Antiquity**

edited by Floyd W. McCoy and Grant Heiken, 2000

Huge volcanic eruptions ravage civilizations by destroying cities and burying landscapes. The records of such disasters are preserved within and beneath tephra, as are the consequent alterations to human history by such cataclysmic events. These records also preserve the responses to such disasters—too often, a reoccupation of the same landscape, ignoring the hazards inherent in volcanism. This eight-chapter volume brings together geologists and archaeologists (in the evolving scientific subdiscipline of archaeological geology, or geoarchaeology) to discuss the impacts of volcanic hazards and disasters on prehistoric and historic cultures at regional and local scales. Areas discussed range from Africa and Central America to Indonesia, England, Hawaii, and Greece. The result is a fascinating book for scientists of all disciplines.

SPE345, ISBN 0-8137-2345-0, 105 p.  
\$42.00, Member Price \$33.60

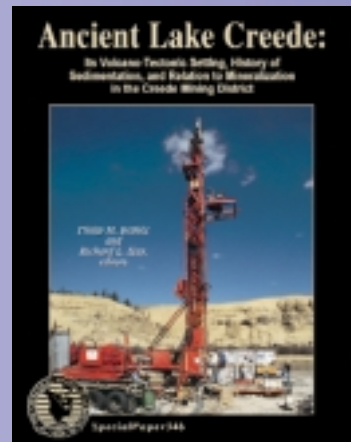
### **Ancient Lake Creede**

edited by Philip M. Bethke and Richard L. Hay, 2000

Lake Creede was a late Oligocene closed-basin lake that existed in the moat of the Creede caldera in the central San Juan Mountains, Colorado. The lake evolved to moderate salinity, hosted brine shrimp, and precipitated ikaite ( $\text{CaCO}_3 \cdot 6\text{H}_2\text{O}$ ) on tufa mounds on the lake margins. Lake sediments comprise locally-derived volcanic ash and volcanoclastic material and contain varve-like beds of alternating siliciclastic and carbonate material. Authigenic pyrite is nearly ubiquitous. This book provides a comprehensive major update on the volcanic and geomorphic evolution of the central San Juans, examines the sedimentation and diagenetic history of the volcanoclastic and carbonate lake sediments, traces the stable isotopic evolution of the lake and formation waters, and examines the relationship between the lake and the well-studied epithermal silver and base-metal mineralization in the Creede mining district.

evolution of the central San Juans, examines the sedimentation and diagenetic history of the volcanoclastic and carbonate lake sediments, traces the stable isotopic evolution of the lake and formation waters, and examines the relationship between the lake and the well-studied epithermal silver and base-metal mineralization in the Creede mining district.

SPE346, ISBN 0-8137-2346-9, 340 p., indexed  
\$55.00, Member Price \$44.00



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oceanography. The successful applicant will also fulfill graduate and undergraduate teaching needs in introductory and chemical oceanography, geochemistry, sedimentology and/or other areas of the candidate's specialization. A Ph.D. is required at the time of appointment.

Submit resume, statement of research and teaching interests, and names and addresses of three references before December 1, 2000 to: Dr. David Lea, Chair, Search Committee, Department of Geological Sciences, University of California, Santa Barbara, CA 93106-9630. UCSB is an EEO/AA employer.

### FACULTY POSITION IN GEOBIOLOGY GEORGE WASHINGTON UNIVERSITY

The Department of Earth & Environmental Sciences at The George Washington University invites applications for a full-time tenure-track position in the interdisciplinary field of Geobiology. The ideal candidate will have a strong background in carbonate systems. Specifically, we are interested in someone whose research is focused on the relationship between the microbial world and chemical sedimentation. This includes the study of simple/early life (unicellular or metazoan) on Earth, terrestrial CO<sub>2</sub> sinks, biogeochemical cycles, climate change/orbital forcing, and geomicrobiology. Preference will be given to candidates whose expertise would lead to interactions with other faculty members with strength in sedimentology, geochemistry, mineralogy, and structural geology. The appointment will be made at the Assistant Professor level with salary commensurate with qualifications and experience. The successful candidate will begin duties at the beginning of the academic year 2001.

We seek a candidate with an established publication and research record and a high potential to obtain external research funding. The successful candidate is expected to develop a vigorous research program and supervise undergraduate and graduate student research. The incumbent will be required to teach undergraduate courses in historical geology and invertebrate paleontology, as well as graduate courses in his/her area of expertise.

Applicants must possess a Ph.D. at the time of appointment, and post-doctoral experience is strongly valued. All applicants should submit a curriculum vita, concise statements describing their teaching and research interests, and arrange for four letters of recommendation to be sent directly to the search committee. Review of applicants will begin October 16, 2000 and continue until the position is filled.

The George Washington University is located in downtown Washington, D.C., where there are opportunities for cooperative research with scientists from other nearby organizations, including Smithsonian Institution, USGS, NASA, EPA, DOE and Carnegie Institution of Washington. Additional information about the department can be found at our web site (<http://www.gwu.edu/~geology>). Applications should be addressed to the Chair, Search Committee, Department of Earth & Environmental Sciences, 2029 G Street NW #101, Washington, D.C. 20052.

The George Washington University is an affirmative action/equal opportunity employer.

### UNIVERSITY OF DENVER DEPARTMENT OF GEOGRAPHY ASSISTANT PROFESSOR ENVIRONMENTAL OR QUATERNARY GEOLOGY

The Geography Department at the University of Denver seeks an environmental or quaternary geologist for an entry level, tenure-track assistant professor position. The successful candidate will be expected to teach basic undergraduate courses in introductory geology, rock and mineral identification, sedimentology and stratigraphy, and more advanced (upper level) undergraduate and graduate courses in other specialized areas (such as fluvial geomorphology, glacial processes, soils, geologic applications of GIS and/or remote sensing technology, historical geology, etc.) Preference will be given to applicants with demonstrated skill in the use of geographic information systems and/or remote sensing technology and their ability to incorporate technology in their course offerings. The successful candidate will be expected to solicit extramural funding, maintain an active research program, and supervise graduate student research projects. PhD required by September 1, 2001. Salary competitive.

The Geography Department at the University of Denver includes a strong physical geography program with emphases in hillslope processes, Quaternary studies, climate change, and applied geomorphology. The department consists of nine faculty members and offers the PhD in physical and human geography, the MS in GIS, the MA and BA degrees in geography, the BA and BS degrees in environmental science, and a geology minor. In addition,

unique curricular opportunities include a strong field research component in upper level classes and an extended 10-week field quarter during the academic year. Facilities include fully equipped soils, sedimentology, and palynology laboratories, three computer laboratories with a variety of GIS and remote sensing software, and access to the University's Mt. Evans research field station. Denver is the western regional headquarters for most federal agencies, including the U.S. Geological Survey, U.S. Forest Service, and the Environmental Protection Agency, which offers unique opportunities for research collaboration. Additional information about the department is available on the web at <http://www.du.edu/geography>.

Applicants should submit letter of application, statement of research interests, curriculum vitae, official transcripts, teaching evaluations or other evidence of teaching quality, and arrange to have three letters of recommendation forwarded to: Dr. Michael J. Keables, Search Committee Chair, Department of Geography, University of Denver, Denver, CO 80208. Screening of completed applications begins January 15, 2001 and will continue until the position is filled.

The University of Denver (Colorado Seminary) is an Equal Opportunity institution. It is the policy of the University not to discriminate in the admission of students, in the provision of services, or in employment, on the basis of race, color, religion, sex, national origin, age, marital or veteran status, sexual orientation, or physical or mental disability.

### THE AUSTRALIAN NATIONAL UNIVERSITY INSTITUTE OF ADVANCED STUDIES RESEARCH SCHOOL OF EARTH SCIENCES POSTDOCTORAL FELLOW/RESEARCH FELLOW (LEVEL A/LEVEL B - FIXED TERM)

REF: ES16.8.1

The Research School of Earth Sciences seeks to appoint research scientists in the following areas:

**Stable Isotope Geochemist, Ore Genesis:** The appointee will contribute to the application of stable isotope geochemistry to the understanding of the genesis of metalliferous ore deposit. She/he will operate and maintain a conventional and excimer laser ablation stable isotope laboratory. The successful applicant will also have access to SHRIMP II and be expected to work in collaboration with the SHRIMP and Ore Genesis Groups to develop micro-analytical techniques for analyses of stable isotopes by laser ablation and ion micro-probe. Enquiries: Dr Ian Campbell, email: [Ian.Campbell@anu.edu.au](mailto:Ian.Campbell@anu.edu.au), tel: +61 2 6249 4366.

**Experimental Rock Deformation, Petrophysics:** The appointee will use high pressure, high temperature gas-medium rock deformation facilities and microstructural techniques to investigate (1) coupling between deformation processes and fluid transport properties in rocks at conditions relevant to deformation/fluid regimes at mid-crustal to upper mantle depths, and/or (2) effects of metamorphic devolatilisation and hydration reactions on the evolution of permeability, strength and deformation processes in rock materials at elevated pressures and temperatures. Enquiries: Professor Stephen Cox, email: [sfcx@geology.anu.edu.au](mailto:sfcx@geology.anu.edu.au), fax: +61 2 6279 8253.

Appointment: Postdoctoral Fellow (Level A) - up to 3 years. Research Fellow (Level B) - up to 5 years.

Contact: Before applying further particulars and selection criteria must be obtained from the Assistant Executive Officer, RSES, tel: +61 2 6249 5176; fax: +61 2 6249 0738 or email: [Administration.rses@anu.edu.au](mailto:Administration.rses@anu.edu.au) This information is also available at website address: <http://www.rses.anu.edu.au>.

Closing date: 15 October 2000.

Information on how to apply may be obtained from the ANU web page - <http://www.anu.edu.au/hr/jobs> or by telephoning/emailing the contact. All applications should be addressed to the Staffing Recruitment Officer, Building 10A, The Australian National University, Canberra ACT 0200. Applications from suitably qualified women are particularly welcome.

### TENURE-TRACK POSITION IN HYDROGEOLOGY UNIVERSITY OF IOWA

The Department of Geoscience at the University of Iowa invites applications for a tenure-track Assistant Professor with a specialty in hydrogeology. The appointment will begin in August 2001. We seek an outstanding researcher and teacher who is a field-oriented hydrogeologist and whose research is in groundwater contamination and remediation. He/she is expected to develop an active, externally-funded program of research and to work with other faculty in our department to improve our graduate program in hydrogeology and undergraduate program in environmental sciences. Teaching responsibilities will involve three courses per academic year and may include a rotation in Introduction to Environmental Science, team-

participation in Introduction to Hydrogeology, and/or an upper-level undergraduate/graduate course in contaminant hydrogeology or engineering geology. Applicants should have a Ph.D. in hand by August 10, 2001. Women and minorities are especially encouraged to apply. Applicants should send a complete resume (including a bibliography and statement of teaching and research interests) and have at least three letters of recommendation sent to: Dr. You-Kuan Zhang, Search Committee Chair, Department of Geoscience, University of Iowa, Iowa City, IA 52242 (Phone: 319/335-1806; Fax: 319/335-1821; e-mail: [you-kuan-zhang@uiowa.edu](mailto:you-kuan-zhang@uiowa.edu)). Screening begins January 1, 2001. The University of Iowa is an affirmative action/equal opportunity employer.

### GEORGIA STATE UNIVERSITY, DEPARTMENT OF GEOLOGY TENURE TRACK FACULTY POSITION IN SEDIMENTOLOGY-STRATIGRAPHY

The Department of Geology at Georgia State University seeks to fill a tenure-track faculty position at the rank of assistant professor in the area of Sedimentology-Stratigraphy beginning August 15, 2001. Georgia State's Geology Department (see [www.gsu.edu/geology](http://www.gsu.edu/geology)), located in downtown Atlanta, has eight tenure-track and tenured faculty, approximately 50 undergraduate majors, and 15 resident graduate students.

The successful candidate will teach an upper division undergraduate course in sedimentology-stratigraphy, introductory courses, and a course in his/her research specialty. The area of research is open within the broad area of sedimentology and stratigraphy. We expect the successful candidate to be an excellent instructor, to develop a productive externally funded research program, and to direct graduate research. A Ph.D. degree is required. Post-doctoral experience and prior college-level instructional experience are desirable.

To ensure full consideration, please send your curriculum vitae (resume), statement of teaching and research interests, and the names and contact information of four references to: Prof. W. Crawford Elliott, Chair of the Search Committee, Department of Geology, Georgia State University, Atlanta, GA 30303. Initial consideration of applications will begin on December 15, 2000, and applications will continue to be accepted until the position is filled. GSU, a unit of the University System of Georgia, is an equal opportunity employer. Applications from under-represented groups are particularly welcomed.

### GEOPHYSICS/NEOTECTONICS PURDUE UNIVERSITY

The Department of Earth and Atmospheric Sciences, Purdue University seeks to fill two tenure-track positions as part of a focused effort to continue building in the area of dynamic interactions between deep-Earth, crustal and surface processes. The positions are offered at the level of Assistant Professor, but exceptionally qualified candidates at the Associate Professor level will be considered. We encourage applications from scientists interested in collaborative research on tectonic processes such as the growth and decay of orogenic belts, orogenic controls on climate, and fault movements in areas of active tectonics.

Areas of research specialization may include, but are not limited to, geophysics applied to tectonic problems; mapping crustal and/or upper mantle with seismic methods; geodetic measurements of surface deformation and crustal strain using Global Positioning Systems, Synthetic Aperture Radar, and other techniques; tectonic geomorphology; and neotectonics.

The EAS Department is a growing multi-disciplinary department that consists of 27 faculty with a broad range of interests in the earth sciences. We are committed to sustaining a vital and innovative research and teaching program that unifies all areas of earth science research and teaching. We welcome applicants that will contribute to and strengthen on-going programs in atmospheres, oceans, and climate; solid earth geophysics; geochemistry, and tectonics. Examples of these and other programs can be found on our web page at [www.eas.purdue.edu](http://www.eas.purdue.edu).

Candidates should possess a Ph.D. degree in some area of the earth sciences. The successful applicant will establish a vigorous externally funded research program, and teach traditional and specialized courses in earth science, at both the undergraduate and graduate levels. Applicants should submit their curriculum vitae, statement of research and teaching interests, and the names of at least three references to:

Chair, Geophysics/Neotectonics Search Cmt.  
Dept. of Earth & Atmospheric Sciences  
1397 Civil Engineering Building, Purdue University  
West Lafayette, IN 47907-1397 USA

Consideration of applications will begin December 15, 2000 and the search will continue until the positions are filled.

Purdue University is an equal opportunity/ affirmative action employer and has a policy of being responsive to the needs of dual career couples.

**HYDROLOGIST  
NEW MEXICO INSTITUTE OF MINING  
AND TECHNOLOGY**

New Mexico Institute of Mining and Technology invites applications for a tenure-track research position in hydrology with the New Mexico Bureau of Mines and Mineral Resources (NMBMMR). The Bureau, a research and service division of New Mexico Tech, functions as the state geological survey with a staff of 38 earth science professionals.

Applicants should have a Ph.D. or M.S. in hydrology, geology, geological engineering or a closely related field, and a demonstrated record of innovative and original research emphasizing quantitative ground-water or surface-water hydrology. Applicants with skills and interest in numerical, analytical, and/or statistical analysis and interpretation of hydrologic data will be given preference. Desirable qualifications include a strong geological background, experience in the collection and interpretation of hydrologic data at a regional or sedimentary-basin scale, and experience or knowledge relevant to New Mexico geology and hydrogeology. The successful candidate will work closely with geologists and hydrogeologists at NMBMMR integrating geological information into quantitative models, and will also have the opportunity to interact with New Mexico Tech's nationally recognized hydrology program. The position will require collection and innovative analysis of field hydrologic, geologic, geophysical, and/or hydrogeochemical data to delineate and characterize aquifers, and quantify ground-water recharge and ground-water surface-water interactions.

Interested applicants should submit a cover letter that specifically addresses academic background and experience with regard to the required and desirable qualifications, a full resume, transcripts, and three professional references, to New Mexico Institute of Mining and Technology, 801 Leroy Pl., Human Resources Wells Hall Box 99B, Socorro, NM 87801. Incomplete applications will not be considered. For full consideration application deadline is October 15, 2000, but will remain open until the position is filled. Visit Tech's web page at <http://www.nmt.edu/>. E-mail applications NOT accepted. EO/AA

**ST. CLOUD STATE UNIVERSITY  
DEPARTMENT OF EARTH SCIENCES**

St. Cloud State University seeks applications for an Assistant Professor in the Department of Earth Sciences to begin August 2001. Salary commensurate with qualifications and experience.

Responsibilities: Teach undergraduate physical geology for majors and general-education earth science courses. Additional teaching to include one or more of the following upper division courses for majors: earth materials (mineralogy and petrology), field geology, structural geology and tectonics, or geophysics. Additional responsibilities include participation in undergraduate research program, appropriate scholarly activity, continued professional development, advising and university/community service.

Qualifications: Ph.D. in geology required; minimum one year experience in solid earth and field geology and university level teaching experience preferred. Demonstrated classroom expertise and commitment to excellence in teaching. Evidence of ability to establish a research program involving undergraduates. Ability to teach and work with persons from diverse backgrounds desired.

Apply to: Garry Anderson, Search Committee Chair, Department of Earth Sciences, St. Cloud State University, 720 4th Avenue South, St. Cloud, MN 56301-4498

A completed application must include a letter of application, vitae, transcripts (copies acceptable for initial screening), and three to five recent letters of references. Application deadline date is November 3, 2000. Position will remain open until a suitable candidate is found.

SCSU is committed to excellence and actively supports cultural diversity. To promote this endeavor, we invite individuals who contribute to such diversity to apply, including minorities, women, GLBT and persons with disabilities.

**GEOLOGY DEPARTMENT AT THE  
UNIVERSITY OF WISCONSIN-PARKSIDE  
ASSISTANT PROFESSOR, SEDIMENTOLOGY**

The Geology Department at the University of Wisconsin-Parkside has a tenure track opening for an Assistant Professor of Sedimentology for Fall, 2001. Candidates must have a Ph.D. in geology, with an interest in environmental applications of geosciences. We are seeking an individual with a high level of enthusiasm for teaching undergraduates and for involving undergraduate students in his/her research. For a complete position announcement, visit the University of Wisconsin-Parkside at <http://www.uwp.edu/>

[admin/academic.affairs/geologyap.html](http://admin/academic.affairs/geologyap.html) or contact Dr. Christine V. Evans, Chair, Geology Department, University of Wisconsin-Parkside, Box 2000, 900 Wood Road, Kenosha, WI 53141-2000, [evansc@uwp.edu](mailto:evansc@uwp.edu).

Faculty of UW-Parkside Geology will also conduct on-site interviews at GSA meetings in Reno, NV.

**ASSISTANT PROFESSOR  
UNIVERSITY OF CALIFORNIA, SANTA BARBARA**

University of California, Santa Barbara, Department of Geography, invites applications for a tenure-track position at the Assistant Professor level in Terrestrial Biophysical Processes. A Ph.D. is required by the date of appointment. The successful applicant will have research and teaching interests in the interaction between biological and physical processes at local to regional spatial scales, and in quantitative spatial modeling. Relevant areas include atmosphere-biosphere interactions, regional vegetation dynamics, and biogeochemical cycles. The Department has strengths in three systematic areas: (1) modeling, measurement, and computation; (2) human-environment relations; and (3) earth system science. This position is most strongly associated with earth system science, but interests in one or both of the other systematic areas are also expected. The Department has a strong commitment to multidisciplinary research and teaching and provides opportunities for interactions with many other departments and research units on the campus. The application deadline is November 15, 2000, and the starting date is July 1, 2001. Qualified applicants should mail a complete curriculum vitae, a statement of research and teaching interests, and the names of at least three referees to: Frank Davis, Search Committee Chair, Department of Geography, University of California, Santa Barbara, CA 93106-4060; phone (805) 893-3438; FAX (805) 893-3146; email [fd@geog.ucsb.edu](mailto:fd@geog.ucsb.edu). To learn more about the department, visit our website at [www.geog.ucsb.edu](http://www.geog.ucsb.edu). University of California is an Equal Opportunity/Affirmative Action Employer.

**UNIVERSITY OF CALIFORNIA, RIVERSIDE  
ASSISTANT PROFESSOR OF  
SOIL-LANDSCAPE RELATIONS**

POSITION: Assistant Professor of Soil-Landscape Relations. DATE AVAILABLE: July 1, 2001. RESPONSIBILITIES: Applications are invited for a tenure track faculty position directed at studying soil resources at landscape to regional scales. The successful candidate is expected to develop an independent research program in which the spatial distributions of soil properties are quantitatively analyzed to address issues related to the use and conservation of land, water, air, and biological resources. The appointee will emphasize a broad scale approach within a strong, dynamic, and growing soil and water science program. S/he will also have the opportunity to bring a soils perspective into collaborations with other scientists addressing landscape and regional issues such as plant and wildlife habitats, agricultural sustainability, urban and rural interfaces, mediation of non-point source pollution, and water and watershed management.

The appointee will be expected to teach a 1-quarter undergraduate course in soil resources beginning the first year and additional undergraduate and graduate course(s) related to his/her area of specialization in subsequent years. The appointee will direct graduate students in the Soil & Water Sciences and Environmental Sciences graduate programs.

QUALIFICATIONS: Candidates must have a Ph.D. with strong training in soil science, particularly soil-landscape relations, soil morphology, and soil conservation/land use. S/he should have interest in, and experience with, methodologies applicable to landscape and regional scale studies, such as the use of soil survey databases, GIS, remote sensing, and geostatistical analysis. Candidates must possess a strong commitment to teaching excellence at both the undergraduate and graduate levels. Prior teaching experience is highly desirable.

APPLICATION PROCEDURES: Candidates for this position are requested to submit a curriculum vitae, a statement of teaching/research interests, transcripts, the names and addresses of at least three references, and any other supporting documentation to Dr. Marylynn Yates, Chair, Department of Environmental Sciences, University of California, Riverside, CA 92521. The closing date for applications is December 11, 2000.

More information regarding the Department of Environmental Sciences can be found at: <http://envisci.ucr.edu/>. The University of California is an equal opportunity-affirmative action employer.

**BIOGEOCHEMIST OF ANCIENT ENVIRONMENTS  
UNIVERSITY OF CALIFORNIA, RIVERSIDE**

The Department of Earth Sciences invites applications for a tenure track position at Assistant Professor rank in the biogeochemistry or organic geochemistry of sedimentary

rocks. We seek an individual to expand our core research program in paleoecology, which includes faculty research in field and specimen-based paleobiology, paleoenvironmental analysis, stratigraphy, biogeography, and paleoclimatology. The individual should have research interests that link global ecological and paleoenvironmental change through the study of the geochemical record. Specialties may include the development of, or changes in, the biosphere, biomarkers, isotopes, or geochemical proxies of oceanographic processes. Teaching responsibilities will include undergraduate and graduate courses in the area of specialty. The applicant must hold a Ph.D. and have a strong commitment to excellence in both research and teaching.

Information about Earth Sciences at UCR is available on the Web at <http://cnas.ucr.edu/~earth/es.html>. Applications, including a vita, statement of research and teaching interests, and full contact information of three referees should be sent by January 5th 2001, to: Dr. Mary Droser, Chair - Biogeochemist Search, Department of Earth Sciences, University of California, Riverside, California 92521. E-mail contact: [mary.droser@ucr.edu](mailto:mary.droser@ucr.edu). The University of California is an Affirmative Action/Equal Opportunity employer.

**UNIVERSITY OF FLORIDA**

**ASSISTANT PROFESSOR ORGANIC GEOCHEMISTRY**

The Department of Geological Sciences invites applications for a tenure-track assistant professor position in the general area of organic geochemistry for the 2000-2001 academic year. Preference will be given to quantitative, process-oriented scientists who will develop strong and innovative research programs, and exhibit a strong commitment to teaching undergraduate and graduate students. We are particularly interested in scientists whose research investigates fundamental earth processes in a quantitative way. More information on this position, the Department, and its research programs is available at [web.geology.ufl.edu](http://web.geology.ufl.edu). Qualified candidates should send a letter of interest, including a statement of research and teaching goals, a curriculum vitae, and the names and addresses of three references by January 15, 2000 to: Dr. Paul A. Mueller, Department of Geology, Box 112120, 241 Williamson Hall, University of Florida, Gainesville, FL 32611; Ph. (352) 392-2231 / FAX (352)-392-9294.

The University of Florida is an equal opportunity employer; qualified women and minorities are especially encouraged to apply.

Possible specialties include: sedimentology; sedimentary geochemistry, including biogeochemistry; environmental geology; seismic stratigraphy; basin evolution, etc. In addition, consideration will be given to those whose research complements existing research strengths of the Department, e.g., paleoclimatology/ paleoceanography, crustal evolution/chemical geodynamics, paleomagnetism/tectonophysics, environmental geology/ hydrogeology, and isotope geology.

**PHILIPS ELECTRONICS  
APPLICATION SPECIALIST XRD**

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Application Specialist XRD: Philips Analytical has an immediate opening for an application specialist in X-ray diffraction (XRD) in our Boston area office in Natick, MA. Qualified candidates will have a BS, MS or Ph.D in geology, mineralogy or ceramic engineering and three years of experience with X-ray diffraction equipment and analysis. Experience with quantitative clay mineral analysis preferred. Duties will include analyzing a wide range of materials for feasibility studies, software and hardware sales demonstrations, on-site customer training and providing technical support to the sales staff. Effective written and verbal communication skills are essential and prior teaching or training experience is strongly preferred. This position requires travel.

Interested candidates should forward their resume and salary requirements to: Philips Analytical Inc., 12 Michigan Drive, Natick, MA 01760, fax (508)647-1113, email: [joanne.perloff@philips.com](mailto:joanne.perloff@philips.com). EOE

**ASSISTANT PROFESSOR OF GEOLOGY  
CALIFORNIA STATE UNIVERSITY, FULLERTON**

The Department of Geological Sciences, California State University, Fullerton, invites applications for a tenure-track position that will be filled at the rank of Assistant Professor, starting August 2001. We are looking for applicants whose primary interests are in teaching general education

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*The Geological Society of America*

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courses, and secondarily in developing a research program that includes undergraduate and graduate students. The successful applicant will have the following credentials and capabilities:

Ph.D. in Geology with an interest in teaching geology to non-majors AND in coordinating the teaching activities of part-time faculty and graduate students;

Research in an area of geology that supports senior and graduate theses.

We are looking for a versatile person who will commit himself or herself to the success of our General Education program and who will add to our research programs. The new faculty member will oversee the department's general education course offerings and will supervise the graduate teaching assistants and part-time faculty. Teaching responsibilities may include physical geology, historical geology, and topics in geology such as geological hazards or environmental geology and upper division or graduate courses in the new faculty member's area of expertise. Research activities must result in publications in refereed journals.

CSU Fullerton is a large urban university dedicated to the preeminence of learning. Located 22 miles southeast of metropolitan Los Angeles, Fullerton is a full-service city renowned for its unique mix of residential, commercial and industrial, educational, and cultural environments that provide residents with an outstanding quality of life. The Department has nine full-time faculty with expertise in traditional and applied areas of geology. The nearby geological provinces provide abundant opportunities for field-based research, which the department emphasizes in its curriculum. We have about 50 undergraduate majors and have implemented a new masters degree program this year. Other information is available through our web page at <http://geology.fullerton.edu/geology/>.

To apply, please send the following: (1) a detailed curriculum vita; (2) a letter of application that explains how you meet the qualifications outlined above; (3) a statement about teaching that includes a discussion of relevant course work and/or experience in preparation for teaching, a list of courses you would feel comfortable teaching, and a statement of your teaching philosophy; (4) a statement of your future research plans and goals; and (5) the names, addresses, phone numbers, and email addresses of at least three references familiar with your teaching and research potential.

Send application to: Dr John Foster, Chair, Department of Geological Sciences, California State University, PO Box 6850, Fullerton, California 92834-6850. Applications will be accepted until November 15, 2000. Applications received after this date will be reviewed only if the position is not filled from the original pool of applicants.

California State University, Fullerton is an Affirmative Action/Equal Opportunity Employer. All personnel policies conform to the requirements of Executive Order 11246, the Americans with Disabilities Act (ADA) of 1990, Title IX of the Higher Education Amendments of 1972 and other federal regulations regarding nondiscrimination.

**ASSISTANT MUSEUM DIRECTOR  
(OUTREACH SPECIALIST)  
UNIVERSITY OF WISCONSIN-MADISON**

The Department of Geology and Geophysics is inviting applications to fill the newly established position of Assistant Museum Director (Outreach Specialist). This is a full-time fixed-renewable position with guaranteed funding for three years. Continuation of the position is dependent on the receipt of additional funding. We anticipate that the position will begin in January of 2001. M.S. in a natural science or science education is required; Ph.D. in a natural science is preferred.

Other required qualifications include two to three years in science-based education. Basic computer skills (word processing, spreadsheets) are essential. Experience with grant writing is desirable. Applicants must be enthusiastic about the earth sciences, and about communicating their knowledge to a broad spectrum of audiences, mainly K-12 students and their teachers.

Additional information about the Department, the Museum, and the position may be found at [www.geology.wisc.edu](http://www.geology.wisc.edu).

Interested applicants should submit a cover letter, resume and the names/addresses of three references to Dr. Toni Simo, Department of Geology & Geophysics, 1215 W. Dayton Street, Madison WI 53706. Applications must be received by November 1, 2000.

The University of Wisconsin-Madison is an equal opportunity/affirmative action employer. Women and minority candidates are encouraged to apply. Unless confidentiality is requested in writing, information regarding the applicants must be released upon request. Finalists cannot be guaranteed confidentiality.

# GEOCHEMIST

The Westinghouse Savannah River Company, whose professional environment broadens your career horizons using state-of-the-art technology, operates the Savannah River Site for the United States Department of Energy. SRS missions include defense programs, non-proliferation, environmental clean-up and restoration, waste management, research and development, and technology transfer. We are currently seeking a Geochemist to support our Environmental Restoration Technology Group at the Savannah River Technology Center.

**The successful candidate must have a broad interdisciplinary in the geosciences with strong emphasis in geochemical processes. The Geochemist will participate as a team member in the acquisition and interpretation of groundwater and soil geochemical data. Focus areas include the integration of geochemistry into fate and transport (soil and groundwater) modeling, technology deployments, remediation projects and general research and development. Specific duties would include conducting laboratory and field investigations of new or emerging technologies, support for waste site characterization and remediation, preparation of technical reports, regulatory documents, journal publications, proposals and oral presentations.**

**Positions requires a PhD or MS Degree with 2 years experience with emphasis in Geochemistry. A strong technical background in Geology and Hydrogeology is preferred. Good written, oral communication and collaboration skills are essential.**

**U.S. CITIZENSHIP AND ABILITY TO OBTAIN  
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**MALCOLM & SYLVIA BOYCE PROFESSORSHIP  
IN GEOLOGICAL SCIENCES, INDIANA UNIVERSITY**

The Department of Geological Sciences at Indiana University invites applications and nominations for the newly created Malcolm & Sylvia Boyce Professorship of Geological Sciences in the field of HYDROGEOLOGY. As a named professorship in Geological Sciences, the position is expected to be filled at the full-professor level. However, under exceptional circumstances, the position may be filled at a tenured, associate-professor level. The Malcolm and Sylvia Boyce Professor should have research interests that complement existing programs in chemical and physical aspects of surface and shallow-subsurface hydrology. We are especially interested in an established scholar with a research focus on water and solute transport (including modeling) at the basin scale, although other areas of expertise will be considered. The successful candidate will provide a link between hydrogeology and sedimentary geology as part of an initiative aimed at developing an interdisciplinary program in the geology of sedimentary basins.

Excellent laboratories exist in the Department for chemical and stable-isotope analyses. The current hydrogeology faculty has strong interactions with a complementary program (Water Resources) at Indiana University in the School of Public and Environmental Affairs (SPEA), and with the Center for Geospatial Data Analysis at the Indiana Geological Survey. Many opportunities exist for collaboration with other on-campus researchers in the Department of Chemistry as well as the Indiana Geological Survey. A Ph.D. or equivalent degree is required. Applications should include a personal statement of vision for the future of research, a narrative of important research, teaching, and service accomplishments, a detailed curriculum vitae, and names and addresses (including e-mail) of five referees.

The application deadline has been extended to October 30, 2000, but the position will remain open until filled. Applications or nominations should be sent to: Boyce Professorship Search Committee, Department of Geological

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Sciences, Indiana University, 1001 E. 10th Street, Bloomington, IN 47405 USA.

This position is one of two newly endowed professorships in the Department of Geological Sciences at Indiana University. Further information about these positions and the Department can be found at: <http://www.indiana.edu/~geosci/>.

Indiana University as an Equal Opportunity/Affirmative Action Employer encourages the candidacies of women and minorities.

### HASSELMANN ENDOWED CHAIR IN GEOLOGICAL ENGINEERING AT THE UNIVERSITY OF MISSOURI

The Department of Geological and Petroleum Engineering at the University of Missouri-Rolla seeks applications for the Fred Hasselmann Chair in Geological Engineering. This Chair has been established through a gift from an endowment fund for the purpose of ensuring faculty excellence in Geological Engineering. Candidates thus should have a well established reputation of academic and/or industrial experience and possess the communication and management skills necessary to provide leadership within the department. Rank will depend upon qualifications and previous experience in an area considered critical to the mission of the program. A Ph.D. in Geological Engineering or a related field is required and registration as a professional engineer or the qualifications to become registered is strongly desired. The successful candidate should possess a strong commitment to undergraduate and graduate level teaching and should have a demonstrated research record including the successful pursuit of external funding and publication. Preferred areas of expertise include ground water hydrology and contaminant transport, applied geomorphology, engineering geology and geotechnics, and geographic information systems.

The department is a part of the school of Mines and Metallurgy and currently has seven faculty members, approximately 100 undergraduates and 15 graduate students. The 10 year old McNutt Hall of Mineral Engineering houses the department along with four other mineral and materials engineering programs and a geology and geophysics program. All departments grant degrees through the Ph.D. and all undergraduate engineering programs are ABET accredited. The University of Missouri-Rolla also grants degrees in seven traditional engineering programs in the School of Engineering as well as science and mathematics and liberal arts degrees through the College of Arts and Sciences.

Interested candidates should submit a resume, a statement of teaching and research accomplishments and goals, transcripts of all college work, and the names and addresses of three individuals from whom letters of reference may be solicited. The deadline for receipt of application materials is November 3, 2000, although the selection process will begin immediately upon receipt of applications. Please visit our website at <http://www.umar.edu/~geef/>. Applications materials should be directed to Human Resources Services, Reference Number :R51861, University of Missouri-Rolla, 1202 North Bishop, 1870 Miner Circle, Rolla, MO 65409-1050. The University of Missouri-Rolla as an equal opportunity and affirmative action institution, welcomes applications from qualified women, minorities, and persons with disabilities.

### GEOMORPHOLOGY / NEOTECTONICS / ENGINEERING GEOLOGY / MINERALOGY CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

The Geological Sciences Department seeks to fill a tenure-track faculty position at the Assist. Prof. level, to begin Sep. 2001. An earned Ph.D. in Geology with expertise in one or more of the following disciplines: Geomorphology / Neotectonics / Eng. Geology / Mineralogy is required by the time of appointment. Responsibilities will vary depending on specialty but broadly include teaching and developing undergrad. core courses, e.g., Applied Geomorph / Engineering Geology / Applied Geophysics / Optical Min. / GIS apps. in Geology, Env. Policy and Regs. and Gen. Ed. or Sci. Ed. or support courses; directing undergraduates in field-oriented research concentrating on geologic problems in southern Calif.; co-coordinating and integrating GIS into an undergrad. curriculum; student advising; committee assignments. Preference will be given to applicants with documented effective undergraduate teaching, breadth of teaching abilities and an active research, publication, successful grant funding record. Send resume, statement of teaching and research interests, three current letters of reference, unofficial transcripts and completed app. form (supplied by Dept.) to: Dr. John A. Klasik, Chair, Geological Sci. Dept., Cal Poly Pomona, 3801 W. Temple Ave., Pomona, CA, 91768. (Email: [jaklasik@csupomona.edu](mailto:jaklasik@csupomona.edu)) Position open until

filled. Initial review of apps, Jan. 2, 2001. Official transcripts required of all finalists. EO/AA employer.

### ASSISTANT PROFESSOR SOUTHERN METHODIST UNIVERSITY

The Department of Geological Sciences at Southern Methodist University invites applications for a tenure-track faculty position in the broad areas of surficial processes or geodynamics. We seek creative applicants with an excellent understanding of fundamental physical principles and processes, and a demonstrated ability to apply that understanding in a quantitative manner to important problems in the Earth sciences. The department seeks an individual who will complement existing strengths in one or more of the following areas: geochemistry, petrology/tectonics, geophysics, planetary dynamics, terrestrial paleoecology. We anticipate making the appointment at the assistant professor level with the appointment to begin no later than Fall, 2001. Applicants are required to have a PhD by the beginning of the Fall 2001 semester. The successful candidate will be expected to teach at the undergraduate and graduate levels, supervise graduate research, and establish an externally funded research program in his or her field of expertise. The committee will begin its review of the applications on or about November 1, 2000. To ensure full consideration, the application should be postmarked by November 1, 2000. Candidates should submit their curriculum vitae, names and addresses of three references, and a written statement of teaching and research interests to: Dr. Lee McAlester, Chair, Department of Geological Sciences, P.O. Box 0395, Southern Methodist University, Dallas, Texas 75275-0395. Email: [geol@mail.smu.edu](mailto:geol@mail.smu.edu) and website: <http://www.geology.smu.edu>. SMU is an Affirmative Action/Equal Opportunity/Title IX Employer.

### ENVIRONMENTAL GEOLOGY, DEPAUW UNIVERSITY

The Department of Geology and Geography at DePauw University invites applications for a tenure-track position in Environmental Geology at the rank of Assistant (Instructor for ABD) or Associate Professor to begin August 15, 2001. We desire a person who is broadly trained in the geosciences with expertise in hydrogeology and/or geochemistry. The successful applicant will teach a variety of courses for undergraduate students including Physical Geology, Physical Geography, Geochemistry, and Applied Hydrogeology; will develop research projects for undergraduate students; and will possess excellent field and/or computational skills. DePauw University is a nationally ranked, selective liberal arts University. We offer nationally competitive faculty salaries, an excellent faculty development program to support teaching and research initiatives, and a pre-tenure sabbatical leave program. Rank and salary will be commensurate with experience. Screening of applications will begin November 1 and we will conduct preliminary interviews at the Geological Society of America Meeting in Reno, NV. Applicants should send a letter describing their teaching pedagogy and research interests, vita, transcripts of all academic work, and three letters of recommendation to Dr. Frederick M. Soster, Chair, Department of Geology and Geography, DePauw University, Greencastle, IN 46135. Closing date for applications is December 15, 2000. DePauw University is an affirmative action, equal opportunity employer. Women and minorities are especially encouraged to apply.

## Services & Supplies

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**BOOKS:** Geology, Paleontology, History of Geology. Used, out-of-print, and rare. Free Catalog. Patricia L. Daniel, BS, MS, Geology, 618 W. Maple, Independence, KS 67301 ph: (316) 331-0725, fax: (316) 331-0785. email: [pldaniel@horizon.hit.net](mailto:pldaniel@horizon.hit.net) website: <http://users.hit.net/~pldaniel>.

## Opportunities for Students

**Graduate Research Assistantship in Structural Geology/Glaciology - Department of Geosciences, University of Colorado, Boulder.** Research assistantship available for qualified candidate for M.S. or Ph. D. to work on

NSF-funded project: "Anisotropic flow, depth-age relationships and stratigraphic disturbances in polar ice sheets." Theoretical study of flow instability and shear banding in anisotropic ice-like fluids; field study and mechanical interpretation of rock analogs in high-strain shear zones. Work supports effort to interpret paleoclimates, but will also contribute to our understanding of processes in shear zones and other highly deformed rock terrains. Contact Prof. Ray Fletcher ([fletcher@spot.colorado.edu](mailto:fletcher@spot.colorado.edu)) for more details.

**Ph.D. Student Fellowships in Contaminant Hydrogeology, Colorado School of Mines.** Colorado School of Mines (CSM) has been awarded a grant from the Department of Education's GAANN program that provides graduate fellowships. We seek applicants who wish to pursue PhD degrees in the general area of computational subsurface contaminant transport processes starting Spring 2001 or Fall 2001. Specific research topics are highly flexible. Fellows are encouraged to combine mathematical modeling with laboratory or field research. Fellowships are available through the following programs: Geological Engineering, Geology, Civil Engineering, Environmental Science and Engineering, and Geochemistry. Fellows will be affiliated with the International Ground Water Modeling Center (<http://www.mines.edu/igwmc/>). Fellowships include payment of tuition and fees and a stipend of \$15,000 per year. CSM is located in Golden, Colorado in the foothills of the Rocky Mountains. For more information, contact Dr. John McCray, 303-384-2181, [jmccray@mines.edu](mailto:jmccray@mines.edu), <http://www.mines.edu/~jmccray/>. Applicants who have completed a Master's degree, and members of groups that are underrepresented in computational earth sciences and engineering, are especially encouraged to apply. Applicants must be U. S. citizens.

**Ph.D. Opportunity/Sea-Level Research/University of Illinois at Chicago.** The NSF-funded project "Rates of Holocene relative sea-level rise and differential crustal movements in the Mississippi Delta" provides a 3-year research assistantship for a Ph.D. candidate, to begin in January 2001. This project is part of the multidisciplinary Environmental Dynamics research program at UIC. The study is field-based, and aims at obtaining a large data set of high-resolution sea-level data from different parts of the Mississippi Delta, and to assess Holocene sea-level history in the context of differential subsidence rates and isostatic responses, climate change, and coastal wetland dynamics. An M.S. or equivalent degree in the geosciences is required, preferably with one or more relevant specialties (e.g., Quaternary geology, sedimentology, paleoecology).

Send an application letter outlining research interests, along with a curriculum vitae, transcripts (copies are acceptable), and the names and addresses of three referees by October 15, 2000, to Dr. Torbjörn E. Törnqvist, Department of Earth and Environmental Sciences, University of Illinois at Chicago, 845 West Taylor Street, Chicago, IL 60607-7059, USA. More information can be obtained from our website (<http://www.uic.edu/depts/geos/>) or directly by E-mail ([tor@uic.edu](mailto:tor@uic.edu)).

**Graduate Student Opportunities/Earth & Environmental Sciences/Univ. of Illinois at Chicago.** Graduate research and teaching assistantships are available for highly qualified individuals seeking Msc and PhD in the Earth and Environmental Sciences. Competitive stipends are available for two years for Msc and up to four years for PhD degrees. The department has strengths in hydrology, Quaternary studies, geochemistry, mineralogy, and paleoenvironmental reconstructions, which is part of a growing environmental research emphasis at UIC. Specific areas of research include polar limnology and hydrology, Holocene sea level fluctuations, complex response of fluvial systems, structural mineralogy (clays), x-ray and TEM analysis, mineral surface and organic-clay reactions, experimental petrology, stable and radiogenic isotope geochemistry and chronology, lithosphere evolution, plate tectonics, thermal evolution of oceanic lithosphere, solid earth geodynamics, sediment biomarkers and paleoceanographic conditions, Arctic glacier/paleoglacier dynamics and land-sea interactions, eolian depositional systems, luminescence and cosmogenic geochronology, and climate and ecosystem modeling. Numerous opportunities exist for laboratory- and/or field-based research.

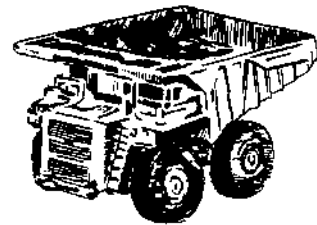
UIC is an ambitious Carnegie Research 1 University and the largest public university in the Chicago area. State-of-the-art analytical facilities exist in the department and there are many opportunities for collaborative research with nearby national laboratories, museums and other institutions. More information at <http://www.uic.edu/depts/geos/> or contact Steve Forman, Graduate Director, Dept of Earth and Environmental Sciences, 845 W. Taylor, Chicago, IL 60607-7059 or at [SLF@uic.edu](mailto:SLF@uic.edu).

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