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Does climatic change drive mammalian evolution?

Donald R. Prothero, *Department of Geology, Occidental College, Los Angeles, CA 90041, prothero@oxy.edu*

ABSTRACT

Neo-Darwinian evolutionary theory argues that species and faunas are exquisitely adapted to their environment and should respond when their habitat changes. To test this hypothesis, the mammalian response to four of the largest climatic events of the Cenozoic (as documented by the marine record, oxygen isotopes, land plants, and other climatically sensitive organisms) are examined. These events occurred during the global cooling at the end of the middle Eocene (37 Ma), the cooling and drying event in the earliest Oligocene (33 Ma), the spread of C4 grasslands in the late Miocene (7 Ma), and the rapid climatic fluctuations of the Pliocene-Pleistocene (2.5 Ma to present). In each case, there is relatively little short-term response of the mammalian fauna. Typically, there is greater turnover millions of years before and after the time of climatic change than during the climatic event itself. This pattern suggests that the climatic control on mammalian evolution is much more complex than previously supposed, or that intrinsic biotic controls may be more important than extrinsic environmental controls.

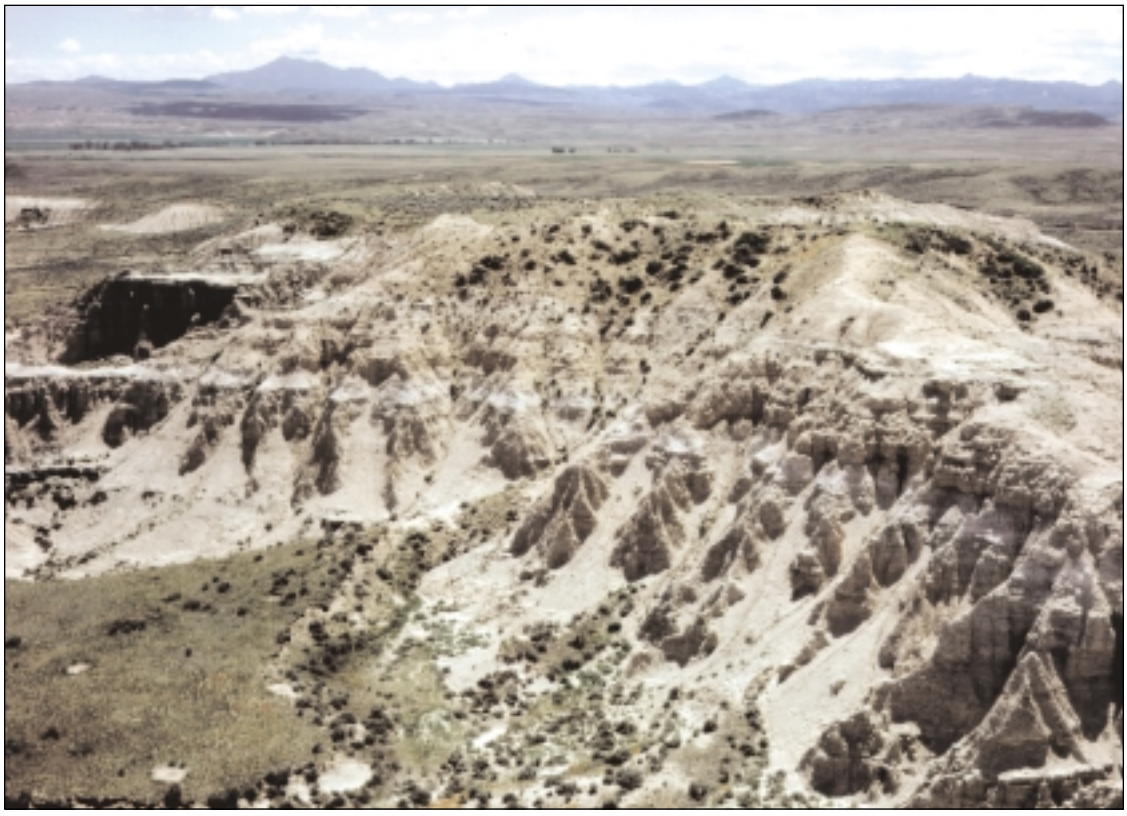

Figure 1. Looking south at exposures of the Eocene-Oligocene White River Group south of Douglas, Wyoming (Laramie Range in the background). The prominent white ash layer in the middle of the cliff (5a tuff of Evanoff et al., 1992) has been $^{40}Ar/^{39}Ar$ dated at 33.9 ± 0.13 Ma (Prothero and Swisher, 1992). Extinction of the brontotheres and most other faunal events at the end of the Chadronian occurred just before and after deposition of this ash. Yet the climatic change (as shown by the sedimentology and land snails—Evanoff et al., 1992) is reflected much higher in this same section.

INTRODUCTION

One of the central tenets of neo-Darwinian evolutionary theory is the idea that organisms are highly responsive to changes in their environment caused by climate, and readily adapt to environmental selection pressures. Evolutionary biologists have documented many elegant (but small-scale and short-term) examples of organisms responding to environmental selection (Weiner, 1994). One explicitly testable hypothesis related to this idea was Vrba's (1985, 1993) "turnover pulse" hypothesis, which suggests that most evolutionary turnover events are correlated with epi sodes of major climatic change. The turnover pulse idea has appeared in many recent books that purport to explain human evolution as a response to climatic change and instability (Stanley, 1996; Potts, 1996; Boaz, 1997).

However, a growing body of data conflicts with the notion that all organisms are highly sensitive to climatic changes, and respond by adaptation to environmental selection pressures. One of the surprising outcomes of the punctuated equilibrium model of Eldredge and Gould (1972) has been recognition of the prevalence of stasis among species through millions of years and many episodes of climatic change (Eldredge, 1995, p. 64). This is not to say that most organisms are insensitive to climate. For some groups of organisms, such as microplankton or land plants, the response to environmental change is well established. However,

Climatic Change *continued on p. 2*

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IN THIS ISSUE

In Memoriam

Thomas F. Bates
State College, Pennsylvania
June 19, 1999

William F. Jenks
Newburyport, Massachusetts
March 18, 1999

Sheldon Judson
Princeton, New Jersey
May 28, 1999

Charles J. Orth
Los Alamos, New Mexico
October 6, 1994

John D. Ridge
Charlottesville, Virginia

Richard C. Thompson
San Francisco, California
June 27, 1999

Robert T. White
Lafayette, Louisiana
July 2, 1999

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Did You Remember To Vote?

The GSA ballots to elect officers for 2000 and councilors for the term 2000–2002 are due September 13, 1999.

Don't forget to vote!

Please note, for the ballot you received, this updated information on Council: Position 3 Nominee Mary P. Anderson. PROF. EXP.: **PROF. HYDROGEOLOGY, UNIV. WISCONSIN–MADISON, 97-.**

Climatic Change *continued from p. 1*

the environmental sensitivity of other organisms (especially marine invertebrates and terrestrial vertebrates) is less obvious.

In recent years, the potential to document and evaluate such patterns with excellent, detailed fossil records of certain organisms has greatly improved. The development of high-resolution chronostratigraphy with integrated biostratigraphy, magnetostratigraphy, and $^{40}Ar/^{39}Ar$ dating has allowed paleontologists to directly date and correlate patterns of faunal response in both the marine and terrestrial realms at a very fine scale. It is now possible to test aspects of the "turnover pulse" hypothesis with a much better data base than was available only a decade ago.

We now can ask whether turnover pulses are typical of the history of mammals. Broad, long-term changes in mammalian faunas (spanning tens of millions of years) apparently correlate with the well-documented climatic changes of the Cenozoic (Webb, 1977; Webb and Opdyke, 1995; Janis, 1989, 1993), but do mammalian faunas respond to rapid, short-term climatic changes, as predicted by the turnover pulse model? Alroy (1995, 1997, 1998) showed that there was a very poor correlation between the turnover patterns of North American Cenozoic mammals and accepted proxies of climatic change, such as the global oxygen isotope record. Hill (1995) and Behrensmeyer et al. (1997) argued that the turnover pulses reported by Vrba (1985) for African Pliocene-Pleistocene mammals are not substantiated by the much larger database of Pliocene mammals from the Tugen Hills and Turkana Basin of Kenya. Thus, even the original data set that led to the turnover pulse hypothesis is under question.

Dialogue

Good communication is stimulating as black coffee, and just as hard to sleep after.

—Anne Morrow Lindbergh

Sara Foland, Executive Director/CEO

As new chief executive officer of GSA, I'm thrilled to have this opportunity each month to talk to the Society's members and friends. As good as it is, however, *GSA Today* is a one-way medium. By itself, it can't give us the open, immediate and interactive communication we need as a scientific society on the verge of a new millennium.

There's Lots to Talk About

GSA's Strategic Plan, approved by Council in 1998, set the stage for sweeping change, while preserving and building on our 111-year heritage. The inspiring vision on which the plan is based reads, "GSA will be a broad unifying scientific society: fostering the human quest for understanding Earth, planets, and life; catalyzing new scientific ways of thinking about natural systems; and applying geoscience knowledge and insight to human needs and aspirations and stewardship of the Earth."

It's my job to lead the headquarters staff in implementing the Strategic Plan on your behalf. But we have a mutual responsibility to discuss and debate the issues that arise from our individual interpretations of the vision. In that spirit, here's a brief overview of what you can expect to see in the months ahead.

GSA's main focus will continue to be the science on which the Society was founded. We'll pursue our mission of advancing the geosciences and the professional growth of our members through our traditional disciplines and Divisions. At the same time, we'll aggressively pursue integrated science that crosses disciplines within our field and with allied sciences.

In the coming months, you'll also see GSA's intrinsic values take their place alongside the science. We'll explore the concept of stewardship and our role as stewards of earth science knowledge and of Earth itself. We'll strive to de-politicize this term, exploring its meaning for both the environmentalists and natural resource professionals among us. If GSA is to grow into its vision of a broad, unifying scientific society, unification must begin here at home. As a Society, we intend to model for others the kind of discourse that makes this possible.

We'll better articulate the role of service at GSA—service to our members, to the geoscience education community, and to society as a whole. We intend to encourage and support geoscientists in offering their services in whatever ways are most rewarding and meaningful to them.

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Photo taken at Dinosaur Ridge near Morrison, Colorado.

You'll also be hearing about the "globalization" of GSA. This may seem like a departure from how we've thought of ourselves in the past, but in fact, it's an acknowledgement of trends already well underway.

Ways to Get in Touch and Stay in Touch

I'm looking forward to lively exchange of ideas on these and other subjects. You can call me at my office here at headquarters (303-447-2020, ext. 139) or send e-mail to ceo@geosociety.org. You can post questions to me on the GSA Web site, www.geosociety.org, by going to "How to Contact Us" and clicking on "Ask Sara Foland."

We're also considering a series of interactive chat room sessions on topics of interest. Watch for details on the Web site and here in *GSA Today*.

I hope to meet as many of you as possible at next month's Annual Meeting in Denver. Watch for notices in *Down to Earth*, the daily meeting newsletter, about locations where you can stop by and say hello. We'll be joined, at various times, by GSA President Gail Ashley, Vice President Mary Lou Zoback, and 1999 Annual Program Committee Chair Sharon Mosher.

I'm excited about working with you all as we move this venerable organization forward. We are GSA. Let's stay in touch. ■

TESTING THE HYPOTHESIS

What is the mammalian response to the major climatic events of the past 50 m.y.? The highly detailed climatic history now available for much of the Cenozoic allows us to pinpoint certain episodes of major environmental change (as recognized in marine faunas, oxygen isotopes, land plants, and other climatically sensitive organisms). With improved dating and correlation, we can examine any mammalian response to each of these global climatic events. If the turnover pulse hypothesis is generally valid for Cenozoic mammals, then there should be similar responses to the other great climatic crises of the Cenozoic. Four major climatic events stand out (see below).This study excludes turnover events such as those at the Paleocene-Eocene boundary, or the Grande Coupure in the European Oligocene, because those episodes include significant immigrational turnover, which complicates the picture of in situ change.

Test 1—Middle Eocene Event

The first major step in the climate change of the Cretaceous through middle Eocene "greenhouse world" was the profound cooling event at the end of the middle Eocene, dated at 37.0 Ma (Berggren and Prothero, 1992; Berggren et al., 1995) (Fig. 1). Oxygen isotope records from benthic foraminifera show that the oceans cooled by about 4–5 °C at this time (Miller et al., 1987). Boersma et al. (1987) argued that there was a major cooling of oceanic bottom waters, which became decoupled from surface waters. In response to this rapid cooling and oceanographic change, there was a major extinction in the warm-water foraminifera (Boersma et al., 1987), a major extinction of many long-lived tropical nannoplankton (Aubry, 1992), and extinctions in the bivalves (84% of species) and gastropods (89% of species) in the Gulf Coastal Plain (Hansen, 1987, 1992). By any standard, the end of the middle Eocene was a dramatic cooling and extinction event, especially in the marine realm.

The terrestrial paleoclimatic record of the middle–late Eocene transition is rather limited, but there are some important clues. Land plants from Alaska to the Gulf Coast indicate a reduction of mean annual temperature of about 14–16 °C (Wolfe, 1978, 1994). Late Duchesnean paleosols from the Big Badlands of South Dakota indicate dense tropical forests with more than 1 m of annual rainfall, while those of the overlying upper Eocene Chadron Formation received between 500 and 1000 mm and were less densely forested (Retallack, 1983).

Climatic Change *continued on p. 4*

Climatic Change *continued from p. 3*

How did land mammals respond to these climatic changes? The middle–late Eocene boundary at 37.0 Ma is now correlated with the boundary between the Duchesnean and Chadronian North American land mammal "ages" (Prothero, 1995; Prothero and Emry, 1996). Most mammalian faunas can be correlated to this interval through a combination of magnetic stratigraphy and $^{40}Ar/^{39}Ar$ dates. In west Texas, the Duchesnean-Chadronian transition can be directly calibrated between $^{40}Ar/^{39}Ar$ dates of 36.7 ± 0.07 and 37.8 ± 0.15 Ma, and by correlation with other faunas, the overall pattern in North America can be determined.

All recent studies of this interval conclude that there was very little change in mammalian faunas between the Duchesnean and Chadronian. Large-scale compilations of species and generic diversity and turnover (Stucky, 1990, 1992; Alroy, 1998) show no significant diversity changes or unusual turnover rates between the late Duchesnean and early Chadronian; there was a stable equilibrium value of between 72 and 84 genera throughout this 5 m.y. (40–35 Ma) interval (Fig. 2). Turnover rates are about average for the late Paleogene. In fact, Emry (1981) and Wilson (1984, 1986) argued that the Duchesnean could be considered a "subage" of the Chadronian, because the differences were so slight. A much greater faunal change (Fig. 2) occurred between the early Duchesnean and the late Duchesnean (Wilson, 1986; Lucas, 1992). This turnover occurred at 39 Ma, 2 m.y. before the climatic change in the oceanic realm (Prothero and Emry, 1996).

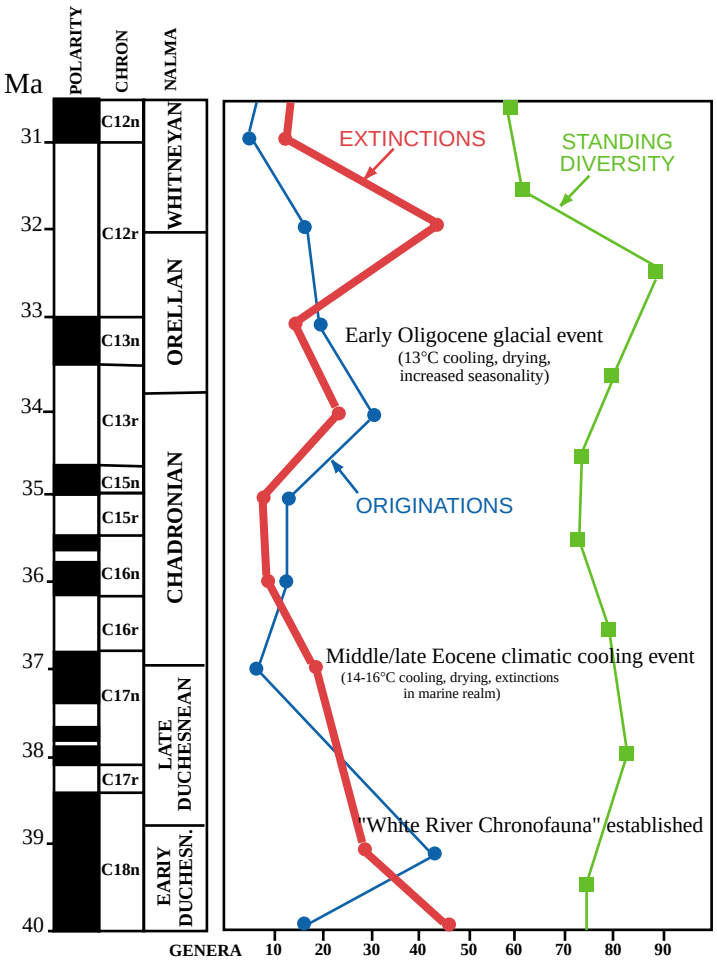

Figure 2. Mammalian diversity and turnover through the late middle Eocene (Duchesnean), late Eocene (Chadronian), and early Oligocene (Orellan and Whitneyan). Diversity data modified from Stucky (1992) for the Duchesnean, and Prothero and Heaton (1996) for the Chadronian through Whitneyan. Total generic diversity (green squares) shown in the middle of 1 m.y. increments; originations (blue circles) shown at the beginning of each 1 m.y. interval, and extinctions (red circles) at the end of each 1 m.y. interval. NALMA = North American land mammal "ages." Time scale after Berggren et al. (1995) and Prothero and Emry (1996).

Test 2—Early Oligocene Event

On the basis of the oxygen isotope curve (Miller et al., 1987) or the land floras (Wolfe, 1978, 1994), the most significant climatic event in the Cenozoic was the global refrigeration that occurred in the earliest Oligocene (about 33.2 Ma). This event was marked by the first significant Antarctic glaciers, and about 5–6 °C of global cooling (Miller et al., 1987; Miller, 1992). The cooling was as drastic as that at the end of the middle Eocene, and extinctions in the marine realm were almost as severe. There were major extinctions in the calcareous nannoplankton (Aubry, 1992), diatoms (Baldauf, 1992), and benthic foraminifera (Gaskell, 1991). Gulf Coast molluscs were decimated again; 97% of gastropod species and 89% of bivalve species disappeared after their late Eocene recovery (Hansen, 1987, 1992). Echinoids dropped 50% in species diversity at this time (McKinney et al., 1992). Planktonic foraminifera underwent a minor extinction; most surviving early Oligocene species were small, low in diversity, and cold adapted (Boersma et al., 1987).

Numerous climatic indicators show that the earliest Oligocene was a time of rapid (less than a few thousand years) change in terrestrial habitats. Land plants from the Gulf Coast to Alaska indicate a decrease of 13 °C in mean annual temperature, a great increase in seasonality (mean annual range of temperatures increased dramatically from about 5 °C to almost 25 °C), and much drier climates (Wolfe, 1978, 1994). Floras indicate that most of North America changed from paratropical forests (like those of tropical Central America) to broad-leaved deciduous forests (like those of New England) in a very short period of time. Paleosols from the Big Badlands of South Dakota show that late Eocene forests, which received more than 1 m of rainfall, were replaced in the early Oligocene by open scrublands with less than 500 mm of annual precipitation (Retallack, 1983, 1992). In Douglas, Wyoming (Fig. 1), flood-plain deposits were replaced by eolian deposits, indicating even greater trends toward aridity (Evanoff et al., 1992). Late Chadronian land snails are large forms adapted to wet, subtropical habitats (like those of modern central Mexico). In the early Orellan they were replaced by smaller taxa with restricted apertures, typical of drier climates, like those of modern Baja California (Evanoff et al., 1992). Late Chadronian reptiles and amphibians were predominantly aquatic taxa, such as crocodilians, pond turtles, and salamanders, but only dry land tortoises are common in the Orellan (Hutchison, 1982, 1992).

How did land mammals respond to this dramatic change in their environment? As Prothero and Heaton (1996) have shown, there was almost no response (Fig. 2). The earliest Oligocene climatic event (middle early Orellan, Chron C13n) was almost ignored by land mammals. Of 70 species known from the earliest Orellan, 62 persisted unchanged into the late Orellan. Most of the modest faunal responses during the Chadronian-Orellan transition had already taken place more than 250 k.y. before the climatic crash of the early Orellan. But even these changes were unimpressive: A few archaic groups from the Chadronian, such as the brontotheres, oromerycid artiodactyls, and cylindrodont rodents disappeared, and the oreodont *Miniochoerus* underwent slight dwarfing, but most mammalian lineages showed no changes worth documenting. Compared to the 177 species now documented for this interval, this is a remarkably mild response to what all the other evidence indicates was a major climatic and floral change. This lack of change cannot be dismissed as an artifact of sampling or preservation, because the White River Group in eastern Wyoming is densely fossiliferous through all of the relevant interval (Prothero and Heaton, 1996; Evanoff et al., 1992).

Test 3—Late Miocene Carbon Isotopes and Grasslands

One of the classic cases of evolutionary response to climate is the well-known story of how some herbivorous mammals acquired high-crowned teeth for eating gritty grasses in the Miocene. This is most often noted in the evolution of horses, but it also occurred in camels, bovids, pronghorns, rhinoceroses, and other groups. Scientists have long pointed to this as a clear example of an evolutionary response to a climatic and vegetational change. There is a major problem with this scenario: the timing is all wrong. Hypsodont horses, camels, rhinos, and bovids all first developed their high-crowned teeth in the middle Miocene (about 15–16 Ma), but geochemical evidence of extensive C4 grasslands (the grasses that now dominate most temperate and tropical latitudes) did not become widespread until the late Miocene (8-7 Ma), at least 7 m.y. later (Quade et al., 1989; Cerling, 1992; Cerling et al., 1997). Retallack (1997) has argued that there must have been an expansion of C3 grasslands in the middle Miocene, but if this is so, we have no modern analogues for such a vegetation (Wang et al., 1994).

Regardless of how one tries to explain this mismatch between teeth and vegetation, the C4 carbon isotope signal, which marks the great expansion of tropical and temperate grasslands and savannas at 8–7 Ma, produces another climatic-evolutionary enigma (Cerling et al., 1997). The carbon isotopic records of several areas (in North America, South America, East Africa, Pakistan) indicate a dramatic and abrupt global isotopic event at 7 Ma. C4 grasslands must have rapidly taken over huge areas in lower and middle latitudes at this time (Fig. 3).

Such a dramatic vegetational change should have led to drastic changes in the mammalian faunas that ate the grasses, especially in their abundance, extinction, and diversification. Yet, a detailed examination of the mammalian record does not support this. In North America, the 7 Ma isotope event falls at the early-late Hemphillian boundary (Woodburne and Swisher, 1995). The change in carbon isotope values at this time was dramatic (Cerling et al., 1997). Before 7 Ma, the values range between –7‰ and –14‰ (all C3 plants), but after 7 Ma, there are numerous values above –7‰ and some as high as +5‰ (mostly C4 plants). At the end of the early Hemphillian, there was some extinction in the horses, browsing camels, and pronghorns (Webb, 1983; Webb et al., 1995), for a total of 9 genera of large ungulates, and 27 genera overall (Stucky, 1990). But only 33 new genera (Stucky, 1990) appeared as the grasslands expanded in the late Hemphillian, and there was no great increase in grazing taxa. No new grazing ungulate genera were added, and the percentage of grazing taxa actually declines from 87% in the late Clarendonian-early Hemphillian to 80% in the late Hemphillian Coffee Ranch Quarry, Texas (Webb, 1983). Janis et al. (1999) found no increases in grazing ungulate taxa in this interval.

In addition, much greater turnover (45 new early Hemphillian genera, 36 Clarendonian genera extinct) marked the beginning of the Hemphillian (9.0 Ma), which was 2 million years before the C4 grasslands appeared. The most significant turnover event (37 new genera, 63 genera extinct) of the entire Miocene occurred 2.5 million years later, at the end of the Hemphillian (4.5 Ma), when most of the savanna fauna of North America (especially among the horses, camels, pronghorns, protoceratids, dromomerycids, rhinoceroses, gomphotheres, and mylagaulids) disappeared (Webb, 1983).

In Asia, isotopic data (Cerling et al., 1997) show an abrupt and dramatic increase in grasslands at 7 Ma (Fig. 3). Before 7 Ma, the δ^{13}C values are between –5 and –14 ‰, but after 7 Ma, the values range from 0 to +5‰. Barry (1995) showed the detailed history of faunal change (mostly bovids and rodents) in the well-studied Siwalik deposits of Pakistan. There was a major turnover event between 9.0 and 8.5 Ma, but none at 7 Ma (Fig. 3). In fact,

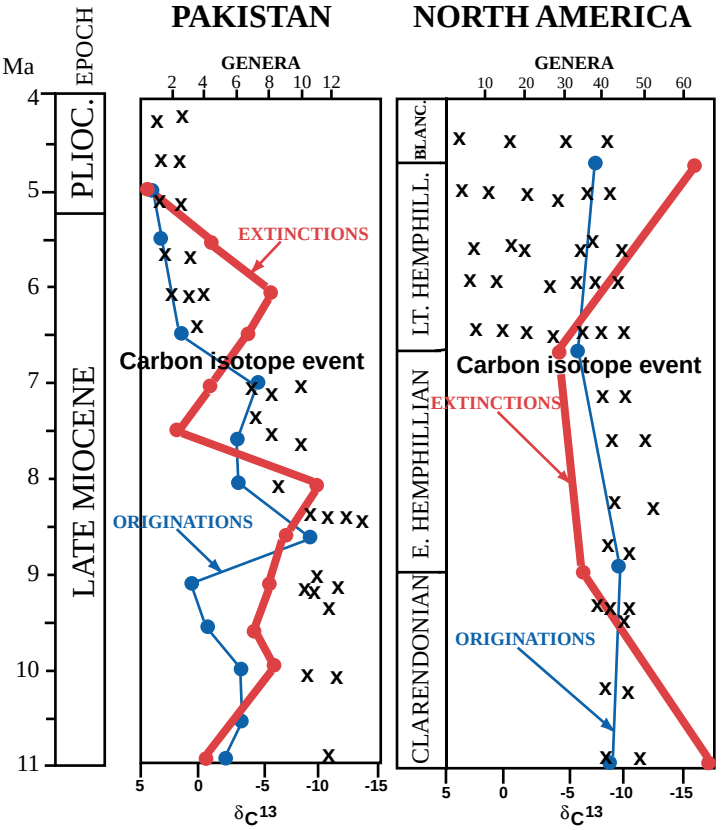

Figure 3. Comparison between carbon isotope values and changes in late Miocene mammalian diversity in Pakistan and North America. Symbols for origination and extinction curves as in Figure 2. Carbon isotopic values (X's) modified from Cerling et al. (1997, Fig. 2). Mammalian diversity statistics for North America after Stucky (1990), and for Pakistan after Barry (1995). Time scale after Woodburne and Swisher (1995) and Barry (1995).

turnover rates (both first and last occurrences) declined dramatically after 8.0 Ma (Barry, 1995). Cerling et al. (1997) suggested that there were some faunal replacement events between 8 and 7 Ma, but this change in dominance is not reflected in the overall taxonomic turnover. In addition, there are many pulses of turnover throughout the Miocene of Pakistan that do not seem to be correlated with any known climatic event. Researchers have argued that these data are evidence of climatically driven turnover, but much of the turnover has no apparent climatic explanation (Barry et al., 1985). Even if higher-resolution studies should show more turnover at 7 Ma, the salient fact remains that turnover was higher before and after the C4 event.

In western Europe, the pattern is similar. Köhler et al. (1998) showed that there were two major faunal turnover events in the Neogene mammals of Spain, one at 10-9 Ma, and the other at 6.5 Ma, but none at 7.0-7.5 Ma. This is consistent with the episodes of maximum turnover in Pakistan. Köhler et al. (1998) suggested that the synchronous turnover across Western Eurasia uncorrelated with the C4 grasslands (which developed in Pakistan but not in Spain) supports a model of protracted faunal change that is caused by more complex forcing factors than a single climatic change.

Isotopic studies from East Africa (Cerling et al., 1997) document a significant carbon isotope event between 9 and 7 Ma. Yet Hill (1987, 1995) argued that the faunas of East Africa show little evidence of grassland dominance until Pliocene-Pleistocene time. Leakey et al. (1996) also found little faunal change in the 9–7 Ma interval. South America also shows the 7 Ma carbon isotope event (MacFadden et al., 1994, 1996; Cerling et al., 1997; Latorre et al.,

Climatic Change *continued on p. 6*

Climatic Change *continued from p. 5*

1997), yet there was no obvious response in turnover or hypsodonty of South American mammals (MacFadden et al., 1994, 1996).

Test 4—Pleistocene Climatic Changes

The most rapid climatic fluctuations of the entire Cenozoic have occurred in the past 2 m.y.a, when climate has been controlled by 120 ka glacial-interglacial cycles. In the classic neo-Darwinian model that postulates species adapting to each climatic change, we would expect that such climatic variability would trigger much adaptation and speciation in Pleistocene mammals. Yet Barnosky (1987, 1994) and Barnosky et al. (1996) have shown that the response is much more complicated than this. Most Pleistocene mammals persist through many climatic cycles. They usually respond to climate change not by evolving new adaptations and producing new species, but simply by migrating north or south as climatic belts shift in latitude. Relatively few evolutionary changes (other than size changes) can be directly attributed to climatic change. The same evolutionary stability has been documented in Pleistocene reptiles and amphibians (Holman, 1995).

CONCLUSIONS

Paleontologists and evolutionary biologists have long sought to explain the excellent fossil record of land mammals, with its many dramatic faunal changes, and examples of adaptations (such as high-crowned teeth or long limbs) in terms of the Cenozoic changes in vegetation and climate. As our understanding of the fossil record of mammals improves, and the dating of the relevant deposits reaches higher levels of resolution and precision, it is possible to test hypotheses of climatic causes for evolutionary changes in much greater detail. In each of these four examples of independently established climatic change (as documented by the marine record, terrestrial isotopes, and terrestrial soils, plants, and climatically sensitive organisms), there are very few instances of direct response of the mammalian fauna to a specific, temporally limited climatic stimulus. Instead, the striking feature of each of these abrupt climatic changes is the *lack* of response of land mammals, even though in each example, it is clear that land plants and other elements of the terrestrial biota are responding. Clearly, the response of mammalian faunas to climatic stimuli is much more complicated than we have previously suspected. As previous studies of species and faunal stasis have shown, many organisms are much more stable in face of environmental change than classic neo-Darwinian models have previously supposed.

In past studies of excellent faunal records through long periods of time, scientists tried to explain each pulse of turnover by a specific external environmental event. Yet as the quality of the dating and of external records of climate improves, the emerging picture is not one of each pulse of turnover having a direct climatic cause. Instead, we are finding that many faunal events occur with no obvious extrinsic trigger, and many other climatic changes seem to cause no mammalian faunal change. On the longer-term scale, this is similar to the conclusions reached by Alroy (1995, 1997, 1998), who found that few of the major global climatic events (as represented by changes in marine oxygen isotopes) were correlated with peaks of mammalian turnover in North America, and vice versa. This noncorrelation seems to reveal an inherent bias toward focusing on possible instances of climatic causation of faunal change, and ignoring all the other unexplained turnover events. Instead, an objective (and statistically valid; Alroy, 1998) view of the mammalian faunal record in the Cenozoic leads to the conclusion that few turnover events can be directly tied to specific climatic changes.

This suggests that scientists should be more skeptical and more rigorous when they wish to suggest a cause-and-effect relationship between short-term climatic and faunal change. Such relationships may exist, but scientists must establish correlation on a very highly resolved chronostratigraphic basis before these hypotheses can be evaluated. To date, when such detailed correlations have been established between global climatic signals and terrestrial faunal change, the response has been contrary to expectations.

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Climatic Change *continued on p. 7*

Tributes Honor Halbouty for 90th Birthday

Internationally known geologist and engineer Michel T. Halbouty is accustomed to accolades—he has received many in his long career. Two events in June were especially meaningful to him, however, as he marked his 90th birthday: a symposium on natural resources and hazards, sponsored by the U.S. Geological Survey, the National Academy of Sciences–-National Research Council, and the Circum-Pacific Council, and a tribute sponsored by the American Association of Petroleum Geologists, Texas A&M's College of Geosciences, and the Houston Geological Society. Halbouty spoke at both events.

Michel Halbouty joined the Geological Society of America in 1958, and it was just a year later that he discovered a gas field in the Kenai Peninsula, Alaska. He was the first independent driller to initiate wildcat wells in Alaska.

Halbouty has received numerous awards and honors, including the GSA Distinguished Service Award (1993). He has lectured all over the world, has served on many government energy-related committees and commissions, and has written or edited hundreds of scientific publications. A fellow of GSA, he was instrumental in the formation of the GSA Foundation and served as a trustee on its first board.

In his response to the tribute in Houston, Halbouty said, "I consider my profession and the science it represents as one of the most vital to the welfare of the world's people.... To me geology is more than a science. It is a vital element—the basic entity which formed my outlook and philosophy of life.... Geology has no rival in the spectrum of science. The story of this earth, the evolution and destruction of continents, the recording of all life since the beginning of time has attracted countless men and women to its realm and continuously records the captivating events of the planet upon which we all live.... When I leave this earth, I trust my contributions to the science will leave it better than the day I became its student."

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Earth Science Week 1999, October 10–16

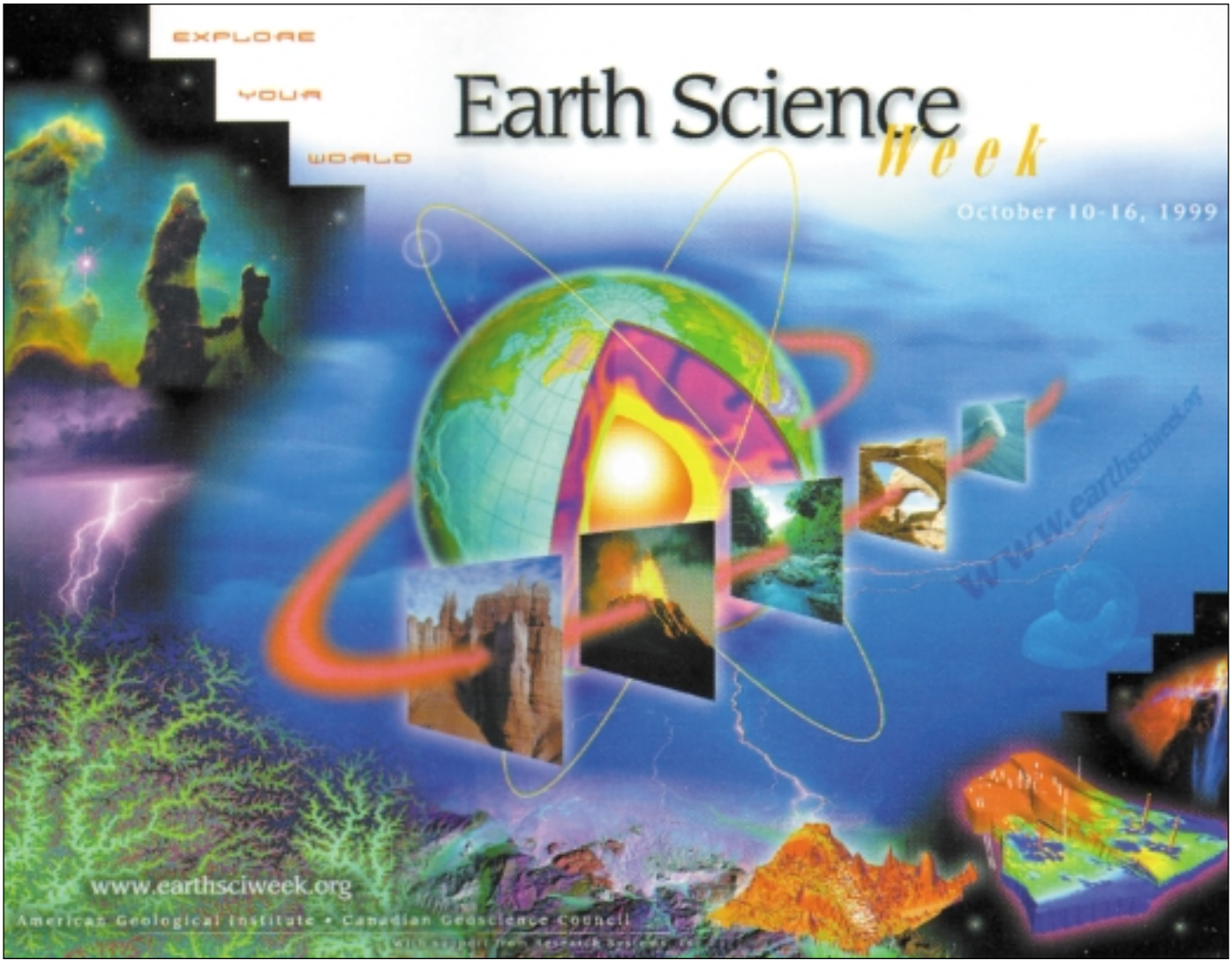
Teach Them to Tell Truth from Trash

Wendy Cunningham, *Program Officer, GSA Science and Outreach*

The resolution to establish Earth Science Week was initiated by the Association of American State Geologists and was read into the Congressional Record in July 1998 by Senator Ron Wyden of Oregon. President Clinton followed this proclamation in October with a message encouraging all Americans to participate in Earth Science Week activities. The promotion of Earth Science Week is one of the 50th anniversary initiatives of the American Geological Institute (of which GSA is a member). GSA member participation in Earth Science Week activities will help implement Goal 3 of GSA's new Strategic Plan (outline in GSA Today, *January 1999; see also www.geosociety.org) to "promote geoscience in the service of society."*

While scientists know that human actions have global implications, recent research has shown that human impact on Earth is considerably more complex than first thought (see, for example, Houghton et al., 1996). Although this knowledge renders public consciousness of geoscience issues increasingly more important, the public has not had sufficient access to scientific facts or thought processes to allow them to make educated decisions on lifestyle and resource allocation. This has led to the creation of a society that often makes short-term, reactive decisions based on little—or, worse, incorrect—scientific data. However, recent public interest in geoscience issues presents each and every geoscientist with an exciting opportunity to participate in creating a discriminating, educated society committed to the responsible use of Earth and its resources. GSA urges each of you to set aside at least one day during Earth Science Week to reach out to your community.

Creating a public that respects and utilizes appropriate scientific research requires a commitment from the scientific community to improve science literacy. GSA members are uniquely equipped to assist in this effort by *using the language of the public* to communicate: (1) critical thinking skills with which the public can effectively separate accurate scientific data from pseudo-scientific propaganda, and (2) factual geoscience information directly related to the quality of human life. Teaching these basic skills and knowledge to the public helps citizens make more informed decisions not only about geoscience issues, but also



about other aspects of their lives. Making better decisions improves the quality of people's lives, which, in turn, benefits each of you as geoscientists, because the public only allocates resources to support projects and skills that it views as valuable to society.

Tips and Resources for Successful Earth Science Week Experiences

There are many ways individual scientists can contribute unique skills, knowledge, and time toward enhancing science literacy. The type of activity you choose to pursue depends on your skills and interests. Some geoscientists prefer to talk to students about geoscience careers, geology in the movies, or the local geologic setting. Others lead local officials on natural hazard field trips, work with policy makers on geoscience legislation, or encourage local bookstores to create a special display of geoscience books during Earth Science Week. No matter what your interest, the following tips and resources can greatly increase the success of your outreach experience:

◆ *Examine how your research relates to the quality of human life.* If you plan to discuss your research with the public, spend some time examining how your research relates to the lives of your audience. This gives both you and your audience a sense of the value of your work, and encourages your audience to view scientists as approachable and interesting.

◆ *Work on your project with a local teacher.* For many geoscientists, language simplification is the greatest barrier to effective communication. According to Partners for Education Program (PEP) member Bill Houston, "There's a big gap between the public and the scientific community. If scientists can learn to convey the simplest science in a way the public can understand, people get a lot more out of it." One effective way to enhance your ability to communicate with the public is to work on your project with a local geoscience teacher. Teachers are masters at translating scientific lingo into language the public understands. One place to find geoscience teacher partners is at your children's school or at the education department of your local museum. Alternatively, consider joining PEP for help connecting with a teacher in your area. PEP provides partnering tips, project ideas, and access to a national database of scientists and educators engaged in outreach. For more information on PEP, visit our Web site at www.geosociety.org/educate/pep.htm.

◆ *If appropriate, involve the media.* Involving the media is an easy way to increase the size of the audience you reach during Earth Science Week. Invite the press if you plan to host an open house at your research institute, lead a public field trip, or assist with a geoscience fair at a local school.

◆ *Utilize existing Earth Science Week resources for project ideas.* Both GSA and AGI provide resources for Earth Science Week projects. GSA offers a list of project ideas, a list of geoscience books recommended by GSA, links to useful Web sites for information and ideas, and a stamp design and directions for those of you who would like to ask your local post office to set up a special cancellation booth during your Earth Science Week activities. These resources are available via GSA's Earth Science Week Web site at www.geosociety.org/educate/earthweek.htm. AGI offers free Earth Science Week kits, which contain project ideas, classroom activities, extensive tips for a successful Earth Science Week experience, posters (one of which you received in the July issue of *GSA Today*), and bookmarks. To order a kit, or to access most of this information on-line, visit AGI's Earth Science Week Web site, at www.earthsciweek.org.

The geoscience community has received a public mandate to participate in the development of a conscientious society that values geoscience research and respects Earth's resources. However, the success of Earth Science Week depends entirely on each individual's contribution to this effort. Start thinking now about how *you* can use Earth Science Week to reach out to your community. This is a mandate we cannot afford to ignore.

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NOTICE OF COUNCIL MEETING

Meetings of the GSA Council are open to Fellows, Members, and Associates of the Society, who may attend as observers, except during executive sessions. Only councilors, officers, and section representatives may speak to agenda items, except by invitation of the chair. Because of space and seating limitations, notification of attendance must be received by the Chief Executive Officer/Executive Director prior to the meeting.

The next meeting of the Council will be Tuesday afternoon, October 26, 1999, at the Annual Meeting in Denver, Colorado.

WASHINGTON REPORT

Bruce F. Molnia, *bmolnia@erols.com*

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

Meet Charles Groat, Director of the U.S. Geological Survey (Part 2)

Last month, *GSA Today* published the first half of an interview with Charles G. Groat, new Director of the U.S. Geological Survey (USGS). This month's Washington Report concludes the interview.

GSA Today: Are there any customer groups that the USGS should deal with that might allow it to come closer to becoming a household word?

Groat: On every street corner, in every house, and in every business, there are people affected by our programs and products. Most of them don't know it. Every effort we make to increase our visibility can strike a resonant chord with almost everybody. Somebody once said to me that when they came out to USGS headquarters and saw all of the interesting things we do, they thought, "The Discovery Channel is right here." People come to our open houses and see all of these things that they are curious about, or find exciting. They identify them with us, and all of a sudden, we are more visible, and people start to think about us.

GSA Today: Several years ago, a DOI Assistant Secretary said that she found Water Supply Papers and many products of the Water Resources Division very useful, but she had yet to see a Geologic Division product that made any sense to her. Is there a need for a much more concerted effort to put the output of the USGS into words that can be understood by the general public?

Groat: We need to use effective means of communication such as the World Wide Web and TV-based approaches. In addition to the general public, there is a whole group of professionals who could apply our products on a big scale, but we don't reach them because we are so traditional. Our practice of writing things for a very technical audience, whether it's a Professional Paper, a Water Supply Paper, or a Bulletin, served us well in communicating with technical people. But if we are targeting decision-makers, policy people in industry, government, or the private sector, we must have products for them. "Decision-support system" is a generic term for what we need to master, a way of getting that technical stuff into an intelligible and rational format that is not "talking down" but that isn't so caught up in jargon. It goes back to the importance of starting out with your customers, your clients, and your partners as you design something. The next step is how we get this information to the customer so they can use it. Almost every science program needs a communications strategy as an integral part of it. With the customers and clients, you tailor the product so they can use it. The nice thing about maps and reports on demand is that you can do that; one format doesn't have to fit all. We can use the flexibility that information technology gives us to meet specific needs.

GSA Today: Some federal agencies have used Madison Avenue–type marketing strategies. About 15 years ago NASA launched its "Mission to Planet Earth" project with well-prepared, broadly distributed graphics and press kits. They spent money to saturate every potential market, especially on Capitol Hill, with an attractive, understandable brochure. The USGS, on the other hand, has relied on its scientific merits and its laurels and has never gone that commercial, outreach route. Is this a necessity in the changing world that we live in?

Groat: NASA has an appealing product and an exciting mission that almost everybody is interested in. The posters, the graphics, the school programs, the Earth system science materials have been very effective. We need to make everybody aware of us, but we can't afford to do it the way NASA does. I don't necessarily think that we would ever come together with NASA, but a close partnership with NASA could be a marriage made in heaven. The danger is that they are so big, so influential, and so PR conscious that they could just gobble you up. On the other hand, they provide a technology that has never been exploited to its potential, because that isn't a part of their mission. But they are recognizing, more and more, that unless they do demonstrate applications, they will have problems with support for their programs. The USGS, an earth science and life science organization that has a multitude of applications for good technology, provides a natural opportunity to work together. If we can ever do it on the basis of mutual benefit it could work well. I think there is a case where we would ride the tail of their great public identity by having our logo next to theirs in some of these things that do reach everyone, from the kids in kindergarten to the people planning giant construction projects and resource management projects. This is a case where, through partnering with people who are already very visible, we can do great science and increase our visibility.

GSA Today: You joined the USGS from an academic background. Do you see stronger cooperative ties developing with academic institutions?

Groat: Being able to partner and colocate with universities gives us reasonably priced facilities and a supply of fresh, young minds, in the form of graduate students and undergraduates, that can help our science. It gives us faculty collaborators who bring compatible interest in science to the table. It's a way of building our capabilities and our support in the least costly and most flexible sort of way, because it can be done on a project basis or a program basis. It's also a way of adding to our capabilities. If there are fields that are important to us and, because of budget and position limitations, we can't plunge into them, we can build that capability through university partners. Whether it's social science or economics, partnering with universities also provides new opportunities for them. Because they have a funding agency on their campus, they have ways to support their graduate students and their faculty

members. It also provides a way for them to meet pressures that they are feeling to make their programs and science more applicable. I think there are clear advantages to both of us to work more closely, whether it's just person-to-person on a program basis or whether it's physically co-locating.

GSA Today: There have been very few new geological positions at the USGS. Do you have any thoughts about how the USGS might acquire some "new blood"?

Groat: Cooperating with universities is one way. Term appointments, details back and forth, and IPAs (Intergovernmental Personnel Act—formal exchanges of staff) are other mechanisms. The tragedy that we must avoid as a bureau is what the 1995 Geologic Division reduction in force (RIF) was, in a microcosm. We must avoid being in a position where the maturity of our scientists and staff consumes our available funding to the point where we don't have any program money and when someone retires we can't replace them because we need their salary to operate. One answer to that is program limitations, cutting back on what we are trying to do, and using that money to support people. The second is budget growth, more than what just covers cost of living increases for existing people and programs. That is part of our push with the Secretary of the Interior right now. The only way we will get the institutional memory we need in our science program is to add new, young people to our core staff at some reasonable rate.

GSA Today: The USGS has been using term appointments with specific focus and duration as an alternative to permanent hiring. Many of these individuals have come, done their work, and left without being renewed or offered a permanent position.

Groat: This solution fits some needs, but not our dominant ones. You can find yourself reduced to where you have a few people managing programs that you give money to other people to do. I can remember when the USGS had more money than it had people and put work out on contract. There are some advantages to doing that. However, if the reason you do that is because you don't have the people to do the programs, then you have lost your identity as a science organization. We can't ever afford to do that. I really see that maintaining our scientific staff and its ability for it to grow as the most overwhelming challenge that we face.

GSA Today: The 1995 Geologic Division RIF resulted in the loss of more than 500 positions. Do you see any future resizing of the USGS needed to meet White House directives?

Groat: I hope that if we do our business well, are serious about meeting our customers' needs, serious about outreach, and serious about identity and raising our profile, no one will have any reason to consider severe cuts to the USGS budget. If we let that happen again, it is our own fault. I don't see anything, other than an extremely conservative President or Administration, in the midst of a major budget crisis, having any reason to force us to do that.

GSA Today: The 1995 RIF coincided with several large buyouts (retirements with a cash incentive). More individuals retired and took buyouts (more than 1,000) than were lost in the RIF (about 530). Do you believe that the USGS has recovered from the buyouts and the downsizing of the past few years?

Groat: I think that there are still some scars and negative feelings about the loss of colleagues and their expertise. Losing senior people through buyouts is a concern in terms of continuity and institutional memory. We have not been able to hire a lot of new young people to replace those lost in the buyouts and in the RIF. We haven't accomplished an objective of building long-term replacements through hiring young people needed to feed the system.

GSA Today: A major interest of President Clinton and Vice-President Gore is "reinventing government," making government do more at less cost. If USGS were asked to do more with less, how would you respond?

Groat: I don't think that we can do more with less, frankly. The expectation that we can just keep heaping unfunded mandates on people and they will produce has reached its limits. This increases the frustrations that come from not being able to get more or new people. People can get excited about things but not feel that they have enough hours left in the day to take on more and more if they are still being expected to continue existing work. We have been accused of never wanting to stop anything, but we *have* ended programs. A lot of stratigraphy and paleontology programs, for example, aren't around anymore, and we aren't doing much orogenesis work. If our planning and our program processes are right, consistent with our strategic plan, we won't be doing things that are irrelevant.

GSA Today: What mix do you want to see between applied (need-driven) research and basic (curiosity-driven) research?

Washington Report *continued on p. 12*

GSA SECTION MEETINGS — 2000

Northeastern Section

March 13–15, 2000,
New Brunswick, New Jersey
Submit completed abstracts to: Kenneth G. Miller, Dept. of Geological Sciences, Wright Lab, Rutgers University, 610 Taylor Rd., Piscataway, NJ 08854-8066, (732) 445-3622, kgm@rci.rutgers.edu.
Abstract deadline: November 29, 1999

Southeastern Section

March 23–24, 2000,
Charleston, South Carolina
Submit completed abstracts to: June E. Mirecki, Dept. of Geology, College of Charleston, Charleston, SC 29424-0001, (803) 953-8278, mireckij@cofc.edu.
Abstract deadline: December 8, 1999

South-Central Section

April 3–4, 2000,
Fayetteville, Arkansas
Submit completed abstracts to: John Van Brahana, Department of Geology, University of Arkansas, Ozark Hall 118, Fayetteville, AR 72701-1201, (501) 575-2570, jbrahana@jungle.uark.edu.
Abstract deadline: December 8, 1999

North-Central Section

April 6–7, 2000,
Indianapolis, Indiana
Submit completed abstracts to: Robert D. Hall, Dept. of Geology, Indiana University–Purdue University, 723 W. Michigan St., Indianapolis, IN 46202-5132, (317) 274-7484, rhall@iupui.edu.
Abstract deadline: December 20, 1999

Rocky Mountain Section

April 17–18, 2000,
Missoula, Montana
Submit completed abstracts to: Marc Hendrix, Dept. of Geology, University of Montana, Missoula, MT 59812-1019, (406) 243-5278, marc@selway.umt.edu.
Abstract deadline: January 15, 2000

Cordilleran Section

April 27–29, 2000,
Vancouver, British Columbia
Submit completed abstracts to: Peter Mustard, Dept. of Earth Sciences, Simon Fraser University, Burnaby, BC, V5A 1S5 Canada, (604) 291-5389, pmustard@sfu.ca.
Abstract deadline: January 10, 2000

GSA DIVISION NEWS

Divisions will recognize the following individuals at the 1999 Annual Meeting in Denver for their service to the Division and/or contributions to the geological sciences.

Engineering Geology Division—
Richard E. Gray, Distinguished Practice Award
Michael W. Hart, Meritorious Service Award

Hydrogeology Division—
Richard R. Parizek, Distinguished Service Award
Warren W. Wood, Distinguished Service Award
E. Scott Bair, 2000 Birdsall-Dreiss Distinguished Lecturer

Quaternary Geology & Geomorphology Division—
Troy L. Péwé, Distinguished Career Award
Mohamed Sultan, Farouk El-Baz Award for Desert Research

For a listing of other award recipients to be honored at the 1999 Annual Meeting, see *GSA Today,* July 1999, page 13.

Washington Report *continued from p. 11*

Groat: If basic means purely curiosity-driven, without any feel for what direction it's headed, there is probably less opportunity for that in this organization than there might have been in the past. If basic means contributing to a field of knowledge that's important, for some application that may be way down the road, then I think that is still important to the USGS. The relevance issue is important for us, but not to the point where we simply apply other peoples' processes to societal problems. That's not where our strengths lie or our role is. We stress the development of scientific understanding for use by others in making decisions about resources and environmental issues. Some people who consider themselves to be basic researchers feel that "applied" automatically means a compromise in quality, effectiveness, and stature. I don't believe there is any stigma or value loss to scientists in having their efforts address real-world needs.

GSA Today: What is your feeling about the role for monitoring long-term earth science observational studies? The USGS is one of the few organizations in the federal government that conducts monitoring. NSF doesn't support monitoring studies. How does monitoring fit into this research mix?

Groat: The great interest today is in processing, displaying, and using information. The greatest appeal of information management systems, GIS, decision-support systems, and Web projects, is, unfortunately, accompanied by a growing lack of appreciation for the need to gather data and for investing in the effort to gather it. One of the most important ways that we gather information is by monitoring. Whether it's a stream-gauging network or the seismic monitoring system or water quality, we are seeing a drop-off in the quality of our systems because we are falling behind technologically. We are not putting in new stations. We are not adding to the networks, and we are not adding to the technical sophistication consistent with the technology that is available. There seems to be an interest in providing funds for this only when there is a major hazard or natural catastrophe. Overall, the government is less willing to invest in technology and the observing systems that we need to gather data. This is occurring at the same time we are talking about adaptive management of natural systems, which depends on monitoring the behavior of those systems as management measures are implemented. Adaptive management without monitoring as a key part is a farce. If we cannot maintain and expand the support for our basic monitoring function, and the technology to do it effectively and efficiently, then our science will be compromised, as will other scientists and managers who depend on our data. Meeting this need is one of the things that we are trying to convince the Secretary of the Interior to support.

GSA Today: The USGS has a long history of international cooperation, involving more than 75 countries. What do you see as its role in international activities under your directorship?

Groat: I was a bit surprised to learn, given the history, that we are at our lowest level of international involvement. This may be the product of a couple of things. In the past, when we were involved in so many countries, there were external (reimbursable) sources of funding, and many of these are no longer available. Also, the role of science as a tool of foreign diplomacy for the United States has declined. I've read a couple of interesting things recently, chastising the federal government for not using U.S. science capabilities more effectively. Unlike the British and others, whose geological surveys are very aggressive and active in other countries, in part as a mechanism for economic influence in the world, the U.S. has not emphasized this approach. There is probably not, particularly with this Congress, a real will for us to use appropriated dollars to do international things. But in the face of the growing globalization of society, if we are truly serious about the frontiers that we can attack as scientists understanding systems that don't honor political boundaries, we need to bring the international dimension. Add to this the fact that geology is an experiential science, and the more experience people get the better scientists they are. We can't get all of our experience in our own backyard. We can assist in capacity building by working in countries that are developing geological surveys. There will be more and more internationalization of scientific cooperation, as there is in the private sector, and in the universities. Given our tradition of international cooperation and capabilities, we are in a better position than almost anybody else to do it. The old fundamental question is, How do you pay for it? International activity depends on building relationships. We may have to wait out current domestic attitudes and use that time to build relationships that have access to funds that are nontraditional to us, such as the World Bank. I hope that sometime soon we can make a serious effort to develop a strategy, because that it is a great opportunity for growth for us.

GSA Today: Several years ago at the International Conference on Geological Surveys, many national surveys reported that in order to maintain the viability of their organizations, they had to contract out their services, either to government or to private industry. Do you see the USGS going this route?

Groat: I can see us contracting our services to other organizations. I don't see any conflict there as long as what we offer is appropriate for a government agency to do. I doubt that we would ever become like the British and provide major services through contracts, with a large part of our business being with the private sector.

GSA Today: Geologic mapping was among the first activities of the original USGS. Considering the Geologic Mapping Act of 1992, which called for closer cooperation with the states but didn't fully appropriate funds to make it happen, what do you see as the future relationship between the state surveys and the USGS?

Groat: When the state surveys generated the Mapping Act, there was the feeling that the USGS really didn't care. In fact, the USGS saw it as a distraction from the scientific direction that it was headed and didn't want to make mapping a priority. Now, the situation is the opposite, and we are very supportive of geologic mapping. The funding level has increased to $27 million. Congress is about to reauthorize the Mapping Act, and the process of preparing for this was a cooperative one.

GSA Today: Where do you think the USGS will fit into the U.S. government of the year 2010 and beyond?

Groat: I see growing limits on what kinds of science the government will actu-

Washington Report *continued on p. 13*

BOOK REVIEWS

Cenozoic Foreland Basins of Western Europe. *Edited by A. Mascle, C. Puijdefàbregas, H. P. Luterbacher, and M.-Fernàndez. Geological Society, London. 1998, 427 p., $59.*

European scientific endeavor is as variable in its approach and methodology as the cultural mosaic from which it has evolved. The European Commission recognized the value of integrating empiricists, theoreticians, and romantics from numerous countries, and targeting broad scientific problems. Thus, from 1992 to 1995, the Integrated Basin Studies Project (IBS), part of which focused on the foreland basins of western Europe, was funded. The intentions of the project were to "study the interplay, at different scales, between tectonics and sedimentation during the construction of an orogen, and also to study how control is exerted on the basin-fill down to the scale of the depositional sequence." This book records the main results of the project.

The book comprises four sections, the first three based on regions and the last devoted to numerical modeling. The basins studied are the Guadalquivir basin, north of the Betic orogen, southern Spain; the Ebro Basin of the southern Pyrenees; and the northern and western foreland basin of the Alps in France, Switzerland, and Germany. Why these basins were chosen above others is an important question that was not addressed. Given the similarity in their paleogeography, do these basins share a commonality of controlling parameters that may differ significantly from other systems worldwide? I believe they do, and that this should be borne in mind when making comparisons.

A common strength in this book is the high quality of data presented, particularly from the Pyrenees and French Alps. Many colored foldouts provide superb images that would be invaluable for field studies. My only disappointment is the level of integration of theory and observation in the regional studies; the variability of scientific approach has remained distinct. Essentially, the regional basis of the book dominates, with too many descriptive papers finishing with unconstrained interpretations of underlying controls. Without a thorough understanding of the possible controlling parameters on a system, it is hard to draw out general implications for other foreland basins of different ages and settings. This aspect should have been improved by a more non-European component to the review panel. Although there are exceptions, notably from the Utrecht research group who generate stimulating predictive models of growth strata associated with fault-bend folding. However, as an example of the lack of integration of researchers, it is curious that these predictive models were not compared to the stunning field examples shown from the Pyrenees earlier in the book.

Overall, the quality and presentation of data in this volume are of a very high standard, and at least 50% of the contributions represent significant modifications in our understanding of the basins discussed. I encourage researchers interested in the complex dynamics of foreland basin systems to take time to increase their knowledge of these important European examples with this worthwhile purchase.

Hugh D. Sinclair,
University of Edinburgh,
Edinburgh EH9 3JW, UK
Hugh.Sinclair@glg.ed.ac.uk

Economics and Policy Issues in Climate Change. *Edited by William D. Nordhaus, Resources for the Future, Washington, D.C., 1998, $45.*

This edited volume provides a review and evaluation of the IPCC's Second Assessment Report on the Economic and Social

Book Reviews *continued on p. 14*

Washington Report *continued from p. 12*

ally conduct. Science in government, in that time frame, will increasingly be science that serves government's direct interests and that meets needs voters can identify with. I think we will be stronger, because the federal government does have a direct vested interest in the lands it owns and the resources it is responsible for, and we are the agency with many of these responsibilities. More broadly, hazards, resources, and environment are appropriate themes for the nation as a whole, not only for this year but for 2010 and 2020.

GSA Today: Is there anything else you want to say?

Groat: For the overall future wellbeing of the USGS, we must find ways to add more young scientists to our permanent staff and make sure our science is broadly appreciated and used. Effective information delivery and outreach are extremely important in the latter. The RIF took a toll, and budget problems and changes are disturbing to people, but if we can just have a positive outlook and really appreciate how good this outfit is, we can do what we have the will to do. With that attitude, and the capabilities that we have, we can build on the accomplishments of the past and do more in the future. ■

THE PALEONTOLOGICAL SOCIETY

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1999-2001

Every year the Paleontological Society selects outstanding scientists whose works are on a wide variety of paleontological topics for The Paleontological Society Distinguished Lecturer Program. Each Distinguished Lecturer has national and international stature in paleontology, has traveled widely, and has published extensively. Each is also known as a superior speaker who can communicate the interest and importance of their research topics. This program is intended to make available lecturers for inclusion in departmental speaker series or other college and university forums.

A list of six Distinguished Lecturers for the 2000-2002 academic year is included below, along with the Distinguished Lecturers from 1999-2001. Additional information is available on The Paleontological Society homepage at PaleoSoc.org. If your department is interested in inviting one or more Distinguished Lecturer to your institution, please contact them directly. Although financial arrangements must be made directly with each speaker, all Distinguished Speakers have agreed to be available on an expenses-only basis.

The Paleontological Society hopes that you take advantage of this opportunity. Paleontology is a dynamic discipline, and these speakers will certainly convey the excitement of our science. If you have any questions regarding this program, please feel free to contact William I. Ausich at ausich.1@osu.edu.

2000- 2002 DISTINGUISHED LECTURERS

Dr. Steven J. Hageman
Appalachian State University
E-Mail: hagemansj@appstate.edu

Dr. David M. Harwood
University of Nebraska, Lincoln
E-mail: dharwood@unl.edu

Dr. Steven M. Holland
University of Georgia
E-mail: stratum@gly.uga.edu

Dr. Claudia C. Johnson
Indiana University
E-mail: claudia@indiana.edu

Dr. David L. Meyer
University of Cincinnati
E-mail: david.meyer@uc.edu

Bruce Runnegar
University of California, Los Angeles
Email: runnegar@ucla.edu

Dr. Charles E. Sarda
Auburn University
E-mail: savrdce@mail.auburn.edu

1999-2001 DISTINGUISHED LECTURERS

Prof. Laurie Anderson, Louisiana State University, E-mail: glande@lsu.edu
Dr. Emily CoBabe, University of Massachusetts, Website: http://www.geo.umass.edu/biogeo/biogeo.html
Dr. Kirk R. Johnson, Denver Museum of Natural History, E-mail: kjohnson@dmnh.org
Dr. David des Marais, NASA Ames Research Center, E-mail: ddesmarais@mail.arc.nasa.gov
Dr. Paul E. Olsen, Lamont Doherty Earth Observatory, E-mail: polsen@ldeo.columbia.edu
Dr. Wylie Poag, Woods Hole, E-mail: wpoag@usgs.gov

Book Reviews *continued from p. 13*

Dimensions of Climate Change. (Intergovernmental Panel on Climate Change, *Climate Change 1995: Economic and Social Dimensions of Climate Change*, Cambridge University Press, Cambridge, UK, 1996). The contributors' views are varied and contrasting, offering interesting insights into the major controversies in the economics of climate change. The IPCC report reflects ambivalence concerning the use and implications of cost-benefit analysis and optimal growth models in the evaluation of climate change response strategies. This ambivalence is a major concern of this set of papers.

One point of view, expressed most forcefully in a chapter by Paul Portney, is that standard economic tools provide a rigorous and necessary framework for rational decision-making. Although uncertainties concerning the costs and benefits of climate change pose problems for empirical analysis, Portney argues that these problems are no worse in the case of climate change than in other policy domains where cost-benefit analysis is routinely employed. Tom Kram and John Weyant offer well-grounded chapters on the costs of abatement of greenhouse gas emissions, while Robert Mendelsohn reviews the more speculative literature on climate change damage assessment. Given the potential for human adaptation to altered climatic conditions, Mendelsohn questions the IPCC's conclusion that a doubling of atmospheric greenhouse gas concentrations would impose costs commensurate to 1.5%–2.0% of world economic output. Climate change, Mendelsohn argues, would likely have benign or perhaps beneficial effects on ecological systems.

Charles Kolstad discusses the literature on so-called "integrated assessment" models, which employ cost-benefit analysis to identify "optimal" climate change policies. Under conventional assumptions, such models suggest that comparatively low rates of abatement of greenhouse gas emissions are justified in the coming decades. In this perspective, it is better to bear the costs of climate change than to impose large short-term costs on the global economy.

Contributions by Granger Morgan, Robert Lind, and Richard Schuler express skepticism regarding the use of standard economic tools in climate change policy analysis. According to Morgan, climate change involves questions of long time horizons and fundamental uncertainty that substantially diminish the power of cost-benefit analysis and related decision-making aids. Lind and Schuler argue that cost-benefit analysis, in which the future costs of climate change are discounted relative to the present to account for the presumed impatience or time preference of decision-makers, is difficult to reconcile with conventional notions of intergenerational equity. More pointedly, they assert that there is no unique approach to identifying "optimal" policy choices for a problem such as climate change that imposes uneven burdens and benefits on generations and world regions. Economic analysis, they argue, should be carefully linked to the ethical and political aspects of climate change policy.

A final chapter by Richard Schmalensee explores the challenges involved in developing the institutional aspects of climate change response strategies. Economists, Schmalensee argues, have stressed the development of global optimization models while underemphasizing the mechanics of policy implementation. He outlines a research strategy for addressing this gap in the literature.

Overall, this volume presents an accessible overview of the IPCC's work on the economics of climate change that is balanced and appropriately critical. For the most part, the authors give the IPCC credit for providing an in-depth description of a truly voluminous literature. Their criticisms reflect the state of the science as opposed to deficiencies in the synthesis report itself.

Viewed in its own terms, the book offers a readable survey that is aimed at a broad, interdisciplinary audience. The contributing authors are of high scholarly distinction. Solicited comments on each chapter provide a sense of the diversity of opinion that prevails in this field.

Richard B. Howarth
Environmental Studies Program
Dartmouth College
Hanover, NH 03755

Lyell in America. *By Leonard G. Wilson. Johns Hopkins University Press, Baltimore, 1998, 429 p., $45.*

Lists have become a popular source of trivial knowledge in the current terminal culture of the millennium. Ranked lists of sports figures, film stars, criminals, and even scientists are abundantly conveyed by books, magazines, and newspapers. On the lists of greatest scientists, far down the enumerated luminaries from physics, chemistry, and biology, perhaps in place 39 or 61, a familiar name inevitably appears: Sir Charles Lyell (1797–1875). The author of *Principles of Geology,* first published in 1830, Lyell is perhaps best known as the advocate of a unifying principle on which to base the entire science of geology. Given the name "uniformitarianism" by his sometimes intellectual adversary, William Whewell, Lyell's principle was magnificently argued in an impressive body of published work. Sir Charles Lyell is rightly celebrated as the outstanding geologist of the millennium.

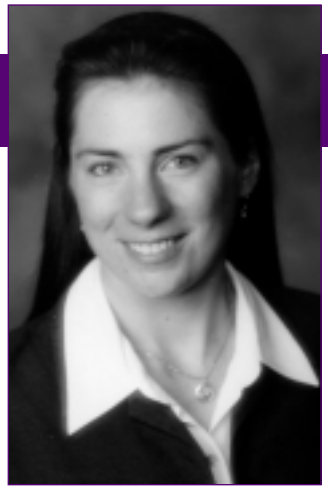
Charles Lyell made four trips to America, two of which (1841–1842, 1845–1846), were quite extensive. These trips, and related events of Lyell's career, are documented in meticulous detail by the eminent historian of science, Leonard G. Wilson. *Lyell in America* covers the years 1841–1853, thus updating Wilson's 1972 book, *Charles Lyell, the Years to 1841: The Revolution in Geology.* The new book conveys much that is of interest in regard to the mid 1800s science of geology in America, relying heavily on Lyell's extensive notes. In addition to the outcrops and fossil localities, *Lyell in America* contains extensive insights on American naturalists, both amateur and professional, and on the social, political, and cultural scene. The latter is wonderfully documented in many letters by Mary Lyell, Charles's wife.

The parallels in Lyell's social and political views to his scientific philosophy are striking. Lyell held to values intermediate between those of the abolitionists and the advocates of slavery. His descriptions of the slow, gradual growth of the Mississippi delta parallel his analysis of the slow, gradual progress of the Negro slave under the more enlightened planters of Georgia. The rash urge to cataclysmic political change by the northern abolitionists was abhorrent to Lyell, just as the improper treatment of slaves in the frontier areas of Mississippi was anathema. That Lyell goes to great length to document circumstances in which slaves were well treated reveals his thorough-going commitment to gradualism.

Charles Lyell was accorded superstar status on his trips to America. Thousands paid the substantial admission fees to attend his many lectures in Boston, New York, and Philadelphia. He met with Daniel Webster, John Quincy Adams, and Presidents Pierce and Tyler. The most prominent American geologists shared their extensive data with him, and he provided a kind of scientific stature to their efforts. In general, his influence was positive in promoting American geology. Back in England, Lyell became so known as an expert on America that he was consulted by William Gladstone and Prince Albert, among others.

This book contains many fascinating insights, including Lyell's thoughts on university educational reform, his contacts with amateur naturalists in remote parts of America, and his efforts to fund science prior to government grants and university science departments. Wilson is such a sympathetic biographer that Lyell's point of view is always championed over those of adversaries. But this is a minor distraction, given the wealth of historical detail provided.

Victor Baker
University of Arizona
Tucson, AZ 85721-0011 ■



GSA Names New Congressional Science Fellow

Melody Brown Burkins, Dartmouth College, is the 1999–2000 GSA Congressional Science Fellow.

Burkins is an adjunct assistant professor of Environmental Studies at Dartmouth, where she teaches environmental science and mentors undergraduates in Dartmouth's Women in Science Project. Her research interests include analysis of community-scale environmental science issues and policies and links among geology, climate, and ecological systems in the dry valleys of Antarctica. As part of her community-focused research, Burkins recently guided students in a pilot environmental indicator project, assessing the long-term environmental issues facing Dartmouth College. In the Antarctic, she continues her doctoral work, using stable isotopes to elucidate the origin, distribution, and cycling of soil organic material in polar deserts. She works collaboratively with the NSF-supported McMurdo Region Long Term Ecological Research (MCM-LTER) program. Burkins has also been involved in ore geochemistry studies in south-central Ireland and central Mexico, glacier studies in southeast Alaska, and marine geochemistry research in the Bering Sea. As a graduate student at Dartmouth, she served as president of the Graduate Student Council and won the Hannah Croasdale Prize for Excellence in Graduate Research and Teaching. Burkins received her B.S. in geology from Yale University. She has been a member of GSA since 1997.

Burkins's broad interests in science and policy include the issues of global climate change, ecosystem health, and standards for air, water, and soil quality. She is keenly interested in the growing communication among scientists, communities, business, and policy-makers surrounding environmental legislation. She is an active advocate for earth and ecosystem science literacy, speaking in community venues such as the Vermont Law School, Dartmouth's Women in Technology program, and local public school classrooms. To further encourage young earth scientists, she spent the fall of 1998 teaching geology and field methods to 10th grade students in Zermatt, Switzerland.

Burkins says she is extremely pleased to have the opportunity to work on science and policy issues in Washington, D.C. She is working with GSA to develop an interactive Web site for the GSA-USGS Congressional Science Fellow, and she will continue the fellows' tradition of publishing perspective articles in *GSA Today*.

Shaping Tomorrow

The Congressional Science Fellowship is a unique opportunity to apply scientific expertise to a wide range of policy issues as a staff member in a congressional or committee office. Fellows can and do directly impact public awareness of earth science and related issues.

Funded by GSA and the U.S. Geological Survey, the fellowship illustrates the value of institutional cooperation toward involving the earth science community in the public policy arena. The program places highly qualified scientists in the offices of individual members of Congress and congressional committees for a one-year to 15-month appointment. Fellows are directly involved in varied legislative, oversight, and investigative activities as sources of expertise. While fellows explicitly do *not* represent special interests, they do play a professional role for GSA during their appointment by bringing issues and perspectives to the attention of headquarters staff and our members and by expanding our network of contacts "inside the beltway." The GSA-USGS fellow, as part of the cohort of appointees from other geoscience societies and along with the AGI Government Affairs Program, are our community's finger on the pulse of national political activities that impact our profession and that provide us opportunities to affect public policy. Following appointment, the GSA-USGS Congressional Science Fellow serves a two-year term on GSA's Geology and Public Policy Committee. In this capacity, fellows continue to provide an invaluable service by lending their one-of- a-kind experience to the work of the committee.

In alignment with GSA's Strategic Plan, the Institute for Earth Science and the Environment (IEE) administers the Congressional Science Fellow program and supports our members' activities and interests in public policy. Please see Science & Society on the GSA Web site for additional information on this program and other science and policy topics. Watch for our new virtual Congressional Science Fellow Hall of Fame. We are proud to recognize the service of current and former GSA-USGS fellows. ■

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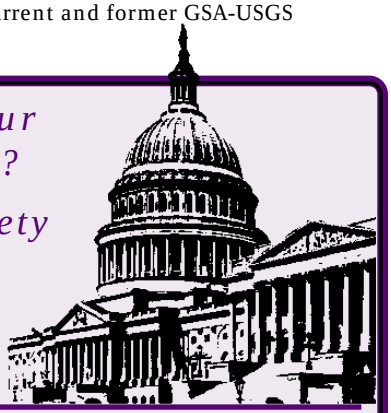

2000–2001 CROSSING DIVIDES: Congressional Science Fellowship

Be the first GSA Congressional Science Fellow of the new millennium! Put your expertise and experience to work helping to shape science and technology policy on Capitol Hill. Work directly with national and international leaders.

The millennial Congressional Science Fellow will be selected from among top competitors early in 2000. If you are an experienced earth scientist with a broad geologic background, experience in applying scientific knowledge to societal challenges, and a passion for helping shape the future of the geoscience profession, GSA invites your application. To learn more about the Fellow experience, contact David Verardo, 1997–1998 GSA Congressional Science Fellow, at (202) 314-2234 or dverardo@usgcrp.gov. For application information on this year's program, watch www.geosociety.org/science/scifello.htm or contact Cathleen May, Director for Science & Outreach, at GSA Headquarters, (303) 447-2020, ext. 195, or cmay@geosociety.org. The deadline for applications is February 1, 2000.

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Pardee Keynote Symposia

The Pardee Keynote Symposia are made possible by a grant from the Joseph T. Pardee Memorial Fund.

Tuesday Morning

K04 Geoscientists in the Legal System: The Challenge for the Next Century

GSA Hydrogeology Division; National Ground Water Association. E. Scott Bair, Ohio State University, Columbus; Steve Wheatcraft, University of Nevada, Reno; David Stephenson, S.S. Papadopulos & Associates, Jackson, Wyoming. ORAL

Keynote speaker Jerry Facher will describe his observations on the effectiveness of the scientific testimony presented at the Woburn toxics trial. A judge, attorneys, and expert geoscience witnesses will present their opinions on the role of science in our legal system and how to be an effective and ethical expert witness. A panel discussion and a question-and-answer period will conclude the session.

Tuesday Afternoon

K01 Impact Events: Environmental Consequences and Their Influence on the Origin and Evolution of Life

GSA Planetary Geology Division; Paleontological Society. David A. Kring, Lunar and Planetary Laboratory, University of Arizona, Tucson. ORAL

Largely because of Cretaceous-Tertiary boundary studies, impact cratering is now widely recognized as an important geologic process. This symposium will explore how this type of geologic process can also affect local and regional environments, global climate, and the biologic evolution of Earth.

Wednesday Morning

K07 The Case for Steady-State Mountain Belts: Observations, Models, and Implications for Global Tectonics

GSA Quaternary Geology and Geomorphology Division. Peter L. Knuepfer, Binghamton University, Binghamton, New York; Frank J. Pazzaglia, University of New Mexico, Albuquerque. ORAL

It has been suggested that the dynamic and demonstrated interaction between tectonics and topography leads to a "steady-state" mountain range, but what defines steady-state conditions and under what circumstances can they truly be attained? This symposium will focus on reconciling field and model-based studies in defining orogenic steady state. We hope to provide insights of diverse tectonic expressions of topography and the role that steady-state processes play in their origin.

Wednesday Afternoon

K05 Low-Latitude Precambrian Glaciation: Geochemical, Climatic, and Biological Effects of the Snowball Earth

Joseph L. Kirschvink, California Institute of Technology, Pasadena; Paul F. Hoffman, Harvard University, Cambridge, Massachusetts. ORAL

Precambrian glacial deposits have long been recognized as peculiar, because of climatic indicators of sea-level ice within the tropics. This symposium will explore geological, geophysical, climatic, and geochemical constraints on these putative low-latitude glaciations, and some of the biological implications of "Snowball Earth" conditions produced when the oceans freeze over completely.

See previous issues of GSA Today *for more detals on the other Pardee Keynote Symposia below.*

Monday

K03 Maintaining a Livable Earth: Conversations Among Concerned Geologists

K06 Globally Warm Climates of the Early Cenozoic: Evidence, Causes, and Biotic Consequences

Thursday

K08 New Insights on Organic Metamorphism in the Earth

K02 Human Transformation of the Physical Landscape

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Colorado Convention Center, Hall A, Sunday, Oct. 24, 5:00 to 7:30 p.m. and Monday, Oct. 25 through Wednesday, Oct. 27, 9:00 a.m. to 5:30 p.m. Enhance your search for the right graduate school by coming to the GSA Annual Meeting in Denver. Meet with representatives from universities across the nation without spending travel time and money to go to each school. The schools participating (as of June 28) are listed below. To receive a complete list of schools, with the contact person and telephone number, contact Tammy White, GSA Exhibits Manager, twhite@geosociety.org.

Institution	Sun	Mon	Tues	Wed
Arizona State University	■	■		
Boston University	■	■	■	■
University of California at Riverside		■	■	
Colorado School of Mines		■		
University of Connecticut		■		
University of Delaware		■		
Duke University			■	
George Washington University		■		
University of Illinois at Chicago		■		
University of Iowa		■		
University of Massachusetts at Amherst			■	
Miami University	■	■		
University of Montana	■	■		
Northwestern University		■		
University of Notre Dame	■	■	■	
University of Oklahoma	■	■	■	■
University of Ottawa	■	■		
Penn State University			■	
South Dakota School of Mines	■			
University of North Carolina, Chapel Hill		■		
University of South Carolina	■	■		
University of Texas at Dallas		■	■	
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University of Utah			■	
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Virginia Tech	■	■	■	
Washington State University		■		
Western Michigan University		■		

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Colorado Scientific Society

Rocky Mountain Association of Geologists

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TECHNICAL SESSION PROGRAM CALENDAR — 1999

Titles and Authors Database: http://www.geosociety.org/meetings/99/config

ALL SESSIONS LOCATED AT THE COLORADO CONVENTION CENTER

Sessions are oral unless poster is indicated. See www.geosociety.org/meetings/99/index for detailed listings and abstracts.
T = Theme Session, K = Keynote Session

SUNDAY, OCTOBER 24, 1999

Session Number	Title	Time	Room
1	T99. Janus I: Impact of Research on Mineral Exploration: A Century-Long Retrospective I *(Society of Economic Geologists)*	8:00 AM–12:00 PM	A207–209
2	T102. Perspectives on Our Ancestors: Old World and New World Human Populations I *(Organic Geochemistry Division of the Geochemical Society)*	8:05 AM–12:00 PM	A101–103
3	T99. Janus I: Impact of Research on Mineral Exploration: A Century-Long Retrospective II *(Society of Economic Geologists)*	1:30 PM–5:30 PM	A207–209
4	T100. The Sustainability Challenge II: Water and Human Sustainability *(Institute for Earth Science and the Environment; GSA Committee on Critical Issues)*	1:30 PM–5:30 PM	A102–104–106
5	T102. Perspectives on Our Ancestors: Old World and New World Human Populations II *(Organic Geochemistry Division of the Geochemical Society)*	1:30 PM–5:30 PM	A101–103

MONDAY, OCTOBER 25, 1999

6	Aqueous Geochemistry I	8:00 AM–12:00 PM	C201
7	Coal Geology I: Energy Mix of the Future	8:00 AM–10:00 AM	C109
8	Economic Geology I: Radiometric Dating, Pb Isotopes, Geochemical Exploration, Metamorphic Au, and PGE in Layered Igneous Complexes	8:00 AM–2:00 PM	A101–103
9	Engineering Geology (Posters)	8:00 AM–12:00 PM	Poster Hall
10	Environmental Geoscience I: Geochemistry of Surfaces, Sediments, and Waters	10:00 AM–12:00 PM	A111
11	Geology Education I	8:00 AM–12:00 PM	A207-209
12	Geoscience Information (Posters)	8:00 AM–12:00 PM	Poster Hall
13	History of Geology (Posters)	8:00 AM–12:00 PM	Poster Hall
14	Metamorphic Petrology I	8:00 AM–12:00 PM	A205
15	Paleontology I: Phylogeny and Functional Morphology	8:00 AM–12:00 PM	A108–110
16	Planetary Geology	8:00 AM– 12:00 PM	C101–103
17	Quaternary Geology (Posters)	8:00 AM– 12:00 PM	Poster Hall
18	Structure I: Deformation Mechanisms, Fabrics, and Strain	8:00 AM– 12:00 PM	C102–104–106
19	**K3. Maintaining a Livable Earth: Conversations Among Concerned Geologists *(GSA Committee on Critical Issues; Institute for Earth Science and the Environment)***	**8:00 AM– 12:00 PM**	**Ballroom 4**
20	T4. Applied Integrated Stratigraphy in Exploration and Development Geology: New Techniques and Perspectives *(Cushman Foundation)*	9:30 AM–11:30 AM	C109
21	T5. Effects of Impact Events in the Sedimentary Record I *(GSA Planetary Geology Division; European Science Foundation [ESF] Impact Program)*	8:00 AM–12:00 PM	C108–110–112
22	T9. Origin of Orogenic Plateaus: Interactions of Plate Convergence, Mantle Processes, and Surficial Processes in Continental Tectonics I *(GSA Structural Geology and Tectonics Division)*	8:00 AM–12:00 PM	C105–107

Session Number	Title	Time	Room
23	T16. Uranium: Minerals, Chemistry, and the Environment I *(Mineralogical Society of America)*	8:00 AM–12:00 PM	C205
24	T18. Application of Advanced Geochemical Modeling to Mining-Related Environmental Issues *(Geochemical Society; Mineralogical Society of America)*	8:00 AM–10:00 AM	A111
25	T43. The Hell Creek Formation and the Cretaceous-Tertiary Boundary in the Northern Great Plains: An Integrated Continental Record of the End of the Cretaceous *(Paleontological Society)*	8:00 AM–12:00 PM	A105–107
26	T50. North Atlantic Crossroads: Terrestrial and Marine Environmental Records of Iceland (Posters)	8:00 AM–12:00 PM	Poster Hall
27	T53. Shallow Subsurface Mapping: Using Geophysics for Geological, Groundwater Resource, and Continuation Studies (Posters) *(GSA Quaternary Geology and Geomorphology Division; GSA Geophysics Division; GSA Hydrogeology Division)*	8:00 AM–12:00 PM	Poster Hall
28	T55. Surficial Three-Dimensional Geologic Mapping: Basic Map Products and Applications (Posters) *(GSA Quaternary Geology and Geomorphology Division; Association of American State Geologists and U.S. Geological Survey National Cooperative Geologic Mapping Program)*	8:00 AM–12:00 PM	Poster Hall
29	T70. Teaching Earth Science with Art	8:00 AM–12:00 PM	A201
30	T78. Calibration, Inversion, and Uncertainty of Groundwater Models *(GSA Hydrogeology Division; International Ground Water Modeling Center, Colorado School of Mines; U.S. Geological Survey, Denver)*	8:00 AM–12:00 PM	C209
31	T87. Measurement Techniques and Modeling of Spatial and Temporal Variability in Groundwater Recharge in Response to Past, Present, and Future Climates I *(GSA Hydrogeology Division)*	8:00 AM–12:00 PM	C207
32	T92. Sediments in Karst Systems: Processes, Mechanisms, Interpretation *(GSA Hydrogeology Division; Karst Waters Institute; GSA Quaternary Geology and Geomorphology Division)*	8:00 AM–12:00 PM	A102–104–106
33	Coal Geology II	4:15 PM–5:30 PM	C207
34	Economic Geology II: Porphyry Cu-Mo-Au, Epithermal and Carlin-type Deposits	1:30 PM–5:30 PM	A101–103
35	Geochemistry I	1:30 PM–5:30 PM	C209
36	Geophysics: Magnetics, Lower Crustal Reflectivity, Seismic Stratigraphy (Posters)	1:30 PM–5:30 PM	Poster Hall
37	Hydrogeology I: Fate and Transport of Contaminants in Groundwater	1:30 PM–5:30 PM	C101–103
38	Metamorphic Petrology II	1:30 PM–5:30 PM	A205
39	Paleontology II: Paleoecology	1:30 PM–5:30 PM	A108–110
40	Precambrian Geology: Proterozoic History of Western Laurentia, plus Precambrian Sedimentology, Tectonics, and Geochronology	1:30 PM–5:30 PM	A105-107
41	Structural Geology (Posters)	1:30 PM–5:30 PM	Poster Hall
42	Tectonics (Posters)	1:30 PM–5:30 PM	Poster Hall
43	**K6. Globally Warm Climates of the Early Cenozoic: Evidence, Causes, and Biotic Consequences *(Paleontological Society)***	**1:30 PM–5:30 PM**	**Ballroom 4**
44	T5. Effects of Impact Events in the Sedimentary Record II	1:30 PM–5:30 PM	C108–110–112
45	T6. Faulting and Folding: Crossing the Divide Between 2-D and 3-D (Posters) *(GSA Structural Geology and Tectonics Division)*	1:30 PM–5:30 PM	Poster Hall
46	T8. Active Faulting and Earthquake Behavior in Complex Orogens: A Multidisciplinary Approach (Posters) *(GSA Structural Geology and Tectonics Division)*	1:30 PM–5:30 PM	Poster Hall
47	T9. Origin of Orogenic Plateaus: Interactions of Plate Convergence, Mantle Processes, and Surficial Processes in Continental Tectonics (Posters)	1:30 PM–5:30 PM	Poster Hall
48	T10. Cenozoic Tectonics of the Southern Rocky Mountains in Colorado and New Mexico: Connections with Global Processes (Posters)	1:30 PM–5:30 PM	Poster Hall
49	T13. Mars, The Next Generation: The Emergent, New Geology of Earth's Neighboring World *(GSA Planetary Geology Division)*	1:30 PM–5:30 PM	C102–104–106
50	T16. Uranium: Minerals, Chemistry, and the Environment II *(Mineralogical Society of America)*	1:30 PM–5:30 PM	C205
51	T32. Geoscience Ethics Guidelines: A Discussion of Their Development, Utility, and Implementation *(American Institute of Professional Geologists)*	1:30 PM–3:30 PM	A111

Session Number	Title	Time	Room
52	T35. Environmental Justice: Geoecological, Social, and Philosophical Perspectives *(GSA Committee on Critical Issues; Institute for Earth Science and the Environment)*	3:30 PM–5:30 PM	A111
53	T45. Beyond Phylogeny Reconstruction: Tree-Based Analyses in Paleontology *(Paleontological Society)*	1:30 PM–5:30 PM	A102–104–106
54	T49. Glaciation and Reorganization of Asia's Network of Drainage: The Effects on Late Quaternary Global Change *(GSA Quaternary Geology and Geomorphology Division; International Geological Correlation Program [IGCP])*	1:30 PM–5:30 PM	A207–209
55	T53. Shallow Subsurface Mapping: Using Geophysics for Geological, Groundwater Resource, and Contamination Studies *(GSA Quaternary Geology and Geomorphology Division; GSA Geophysics Division, GSA Hydrogeology Division)*	1:30 PM–5:30 PM	C109
56	T63. Linking Science Research and Education to Improve Undergraduate Geoscience Programs and K–12 Earth Science Teacher Preparation *(American Geophysical Union; National Earth Science Teachers Association; National Association of Geoscience Teachers; SAGE)*	1:30 PM–5:30 PM	A201
57	T80. Measurement and Description of Flow and Transport in Highly Heterogeneous Aquifers *(GSA Hydrogeology Division)*	1:30 PM–5:30 PM	C105–107
58	T87. Measurement Techniques and Modeling of Spatial and Temporal Variability in Groundwater Recharge in Response to Past, Present, and Future Climates II *(GSA Hydrogeology Division)*	1:30 PM–5:30 PM	C207
59	T92. Sediments in Karst Systems: Processes, Mechanisms, Interpretation (Posters) *(GSA Hydrogeology Division; Karst Waters Institute, GSA Quaternary Geology and Geomorphology Division)*	1:30 PM–5:30 PM	Poster Hall
60	T93. Impacts of Urbanization on Groundwater Quantity and Quality *(GSA Hydrogeology Division)*	1:30 PM–5:30 PM	C201

TUESDAY, OCTOBER 26, 1999

61	Clastic Sedimentology I: Interpreting Environment, Provenance, and Burial History	8:00 AM–12:00 PM	A105–107
62	Economic Geology III: Skarns, Stratiform Cu, Massive Sulfides, and Fluid Flow	8:00 AM–10:00 AM	A102–104–106
64	Experimental Petrology (Posters)	8:00 AM–12:00 PM	Poster Hall
65	Geoscience Information	10:00 AM–12:00 PM	A111
66	Igneous Petrology (Posters)	8:00 AM–12:00 PM	Poster Hall
67	Metamorphic Geology (Posters)	8:00 AM–12:00 PM	Poster Hall
68	Mineralogy (Posters)	8:00 AM–12:00 PM	Poster Hall
69	Paleontology III: Paleobiological Trends	8:00 AM–12:00 PM	A207–20
70	Planetary Geology (Posters)	8:00 AM–12:00 PM	Poster Hall
71	Precambrian Geology (Posters)	8:00 AM–12:00 PM	Poster Hall
72	Volcanology (Posters)	8:00 AM–12:00 PM	Poster Hall
73	**K4. Geoscientists in the Legal System: The Challenge for the Next Century *(GSA Hydrogeology Division; National Ground Water Association)***	**8:00 AM–12:00 PM**	**Ballroom 2 & 3**
74	T3. Alloformations, Synthems, and Sequences *(North American Commission on Stratigraphic Nomenclature)*	8:00 AM–12:00 PM	C105–107
75	T6. Faulting and Folding: Crossing the Divide Between 2-D nd 3-D I *(GSA Structural Geology and Tectonics Division)*	8:00 AM–12:00 PM	C102–104–106
76	T10. Cenozoic Tectonics of the Southern Rocky Mountains in Colorado and New Mexico: Connections with Global Processes I *(GSA Geophysics Division; GSA Structural Geology and Tectonics Division)*	8:00 AM–12:00 PM	C108–110–112
77	T12. The International Space Station: New Opportunities for Earth Science Research and Education *(NASA/Johnson Space Center Office of Earth Sciences; GSA Planetary Geology Division; GSA International Division; GSA Geoscience Education Division; SAGE)*	8:00 AM–12:00 PM	C207
78	T16. Uranium: Minerals, Chemistry, and the Environment (Posters) *(Mineralogical Society of America)*	8:00 AM–12:00 PM	Poster Hall
79	T24. Digital Field Mapping and Data Collection I *(GSA Engineering Geology Division; GSA Structural Geology and Tectonics Division)*	8:00 AM–12:00 PM	C209

Session Number	Title	Time	Room
80	T28. Geologic Hazard Mapping: The State of the Art *(GSA Engineering Geology Division; Association of Engineering Geologists)*	8:00 AM–12:00 PM	C101–103
81	T31. Communication Divides: Perspectives on Supporting Information Bridges in the Geosciences *(Geoscience Information Society)*	8:00 AM–10:00	A111
82	T34. Mission-Driven Geology: Meeting Global Challenges and Society's Needs (Posters) *(GSA International Division; U.S. Geological Survey; Geological Survey of Canada; Association of American State Geologists)*	8:00 AM–12:00 PM	Poster Hall
83	T37. Crossing Disciplinary Boundaries in the Geosciences: Historical Perspectives I *(GSA History of Geology Division; History of the Earth Sciences Society [HESS])*	8:00 AM–12:00 PM	A108
84	T47. Geomorphic and Ecological Responses to Natural and Anthropogenic Disturbances I *(GSA Quaternary Geology and Geomorphology Division)*	8:00 AM–12:00 PM	Ballroom 4
85	T54. Subglacial Processes and the Behavior of Ice Sheets I *(GSA Quaternary Geology and Geomorphology Division)*	8:00 AM–12:00 PM	A205
86	T57. Granite Systems and Proterozoic Lithospheric Processes (Posters) *(International Geological Correlation Program Project #426 [IGCP-426])*	8:00 AM–12:00 PM	Poster Hall
87	T59. Multidisciplinary Studies in Volcanology, Planetary Geology, and Economic Geology: A Tribute to 50 Years of Research by Professor Wolfgang Elston, University of New Mexico (Posters)	8:00 AM–12:00 PM	Poster Hall
88	T60. Building the Quantitative Skills of Non-Majors and Majors in Geoscience Courses *(National Association of Geoscience Teachers)*	8:00 AM–12:00 PM	A101–103
89	T67. Teaching Science By Example: Real Problems, Real Data, All Classes, Every Day *(National Association of Geoscience Teachers)*	8:00 AM–12:00 PM	A201
90	T81. Investigations into the Effect of Measurement Scale on Determining Hydraulic Conductivity: Field and Modeling Studies *(GSA Hydrogeology Division)*	8:00 AM–10:00 AM	C109
91	T91. Low-Recharge Groundwater Systems	10:00 AM–12:00 PM	C109
92	T96. Subsurface Transport, Fate, and Remediation of Nonaqueous Phase Liquid Contaminants in Multicomponent Biogeochemical Systems *(GSA Hydrogeology Division)*	8:00 AM–12:00 PM	C205
93	T98. Sources, Transport, Fate, and Toxicology of Trace Elements in the Environment: A Tribute to Jerome Nriagu *(International Association of Geochemistry and Cosmochemistry)*	8:00 AM–12:00 PM	C201
94	Aqueous Geochemistry II	1:30 PM–5:30 PM	C109
95	Environmental Geoscience II	1:30 PM–5:30 PM	A111
96	Geochemistry II/Ingerson Lecture	1:30 PM–5:30 PM	C101–103
97	Geology Education (Posters)	1:30 PM–5:30 PM	Poster Hall
98	MSA Presidential Address *(Mineralogical Society of America)*	3:30 PM–5:30 PM	C102–104–106
99	Public Policy (Posters)	1:30 PM–5:30 PM	Poster Hall
100	Quaternary Geology I: Quaternary Eolian, Soil-Forming, and Lake- and Sea-Level Events	1:30 PM–5:30 PM	A101–103
101	Stratigraphy I: Magnetic, Chemical, and Biological Chronostratigraphy	1:30 PM–5:30 PM	A201
102	Structure II: Magma, Salt, and Ice—Thrust Belts, Folding, and Faulting	1:30 PM–5:30 PM	C105-107
103	Tectonics I: From the Ancestral Rocky Mountains to the Laramide and Subsequent Rifting	3:30 PM–5:30 PM	C108–110–112
104	**K1. Impact Events: Environmental Consequences and Their Influence on the Origin and Evolution of Life *(GSA Planetary Geology Division; Paleontological Society)***	**1:30 PM–5:30 PM**	**Ballroom 2 & 3**
105	T1. Origins of Carbonate Mounds: Crossing the Divides of Sedimentology, Diagenesis, and Paleontology *(Society for Sedimentary Geology [SEPM])*	1:30 PM–5:30 PM	C207
106	T6. Faulting and Folding: Crossing the Divide between 2-D and 3-D II	1:30 PM–3:30 PM	C102–104–106
107	T10. Cenozoic Tectonics of the Southern Rocky Mountains in Colorado and New Mexico: Connections with Global Processes II *(GSA Geophysics Division; GSA Structural Geology and Tectonics Division)*	1:30 PM–3:30 PM	C108–110–112
108	T12. The International Space Station: New Opportunities for Earth Science Research and Education (Posters) *(NASA/Johnson Space Center Office of Earth Sciences; GSA Planetary Geology Division; GSA International Division; GSA Geoscience Education Division; SAGE)*	1:30 PM–5:30 PM	Poster Hall
109	T24. Digital Field Mapping and Data Collection II	1:30 PM–3:30 PM	C209

Session Number	Title	Time	Room
110	T25. Engineering/Environmental Geology: State Geological Surveys and Academic Communities *(GSA Engineering Geology Division)*	3:30 PM–5:30 PM	C209
111	T37. Crossing Disciplinary Boundaries in the Geosciences: Historical Perspectives II *(GSA History of Geology Division; History of the Earth Sciences Society [HESS])*	1:30 PM–5:30 PM	A108–110
112	T40. The Tropics Compared: Icehouse and Greenhouse States	1:30 PM–5:30 PM	A102–104–106
113	T47. Geomorphic and Ecological Responses to Natural and Anthropogenic Disturbances II *(GSA Quaternary Geology and Geomorphology Division)*	1:30 PM–5:00PM	Ballroom 4
114	T51. Landscape Erosion and Sedimentation Modeling *(U.S. Army Research Office)*	1:30 PM–5:30 PM	A205
115	T54. Subglacial Processes and the Behavior of Ice Sheets II *(GSA Quaternary Geology and Geomorphology Division)*	1:30 PM–5:30 PM	A207–209
116	T57. Granite Systems and Proterozoic Lithospheric Processes *(International Geological Correlation Program, Project #426 [IGCP-426])*	1:30 PM–5:30 PM	A105–107
117	T59. Multi-Disciplinary Studies in Volcanology, Planetary Geology and Economic Geology: A Tribute to 50 Years of Research by Professor Wolfgang Elston at the University of New Mexico	1:30 PM–5:30 PM	C201
118	T60. Building the Quantitative Skills of Non-Majors and Majors in Geoscience Courses (Posters) *(National Association of Geoscience Teachers)*	1:30 PM–5:30 PM	Poster Hall
119	T62. Student Research (Posters) *(Sigma Gamma Epsilon)*	1:30 PM–5:30 PM	Poster Hall
120	T67. Teaching Science by Example: Real Problems, Real Data, All Classes, Every Day (Posters) *(National Association of Geoscience Teachers)*	1:30 PM–5:30 PM	Poster Hall
121	T72. Teaching Geology to the Disabled (Posters) *(National Association of Geoscience Teachers)*	1:30 PM–5:30 PM	Poster Hall
122	T74. Isotopic Records of Microbially Mediated Processes in Natural Environments *(Geochemical Society)*	1:30 PM–5:30 PM	C205

WEDNESDAY, OCTOBER 27, 1999

123	Carbonate Sedimentology: Paleoenvironmental Reconstruction and Diagenesis (Posters)	8:00 AM–12:00 PM	Poster Hall
124	Clastic Sedimentology: Perspectives from Mineralogy, Sedimentology, and Stratigraphy (Posters)	8:00 AM–12:00 PM	Poster Hall
125	Engineering Geology I/Dams, Landslides, and the Richard H. Jahns Distinguished Lecturer	8:00 AM–12:00 PM	C108–110–112
126	Hydrogeology II: Groundwater Modeling and Parameter Estimation	8:00 AM–12:00 PM	C207
127	Stratigraphy (Posters)	8:00 AM–12:00 PM	Poster Hall
128	Tectonics II: North America, from Mexico to Alaska	8:00 AM–12:00 PM	C105–107
129	**K7. The Case for Steady-State Mountain Belts: Observations, Models, and Implications for Global Tectonics *(GSA Quaternary Geology and Geomorphology Division)***	**8:00 AM–12:00 PM**	**Ballroom 2 & 3**
130	T2. Geochemical and Isotopic Tracers Applied to Sedimentary Provenance, Drainage Systems, and Related Tectonics (Posters)	8:00 AM–12:00 PM	Poster Hall
131	T7. Dates of Faults and Rates of Deformation *(GSA Structural Geology and Tectonics Division)*	8:00 AM–12:00 PM	C102–104–106
132	T14. Morphological and Mineralogical Biomarkers for Mars Exploration I *(GSA Planetary Geology Division; Astrobiology Program of National Aeronautics and Space Administration)*	8:00 AM–12:00 PM	Ballroom 4
133	T15. Beryllium: Mineralogy, Petrology, and Geochemistry *(Mineralogical Society of America)*	8:00 AM–12:00 PM	C205
134	T33. Crossing the Greatest Divide: The Earth Sciences, the Humanities, and the Needs of Society *(Institute for Earth Science and the Environment; International Association for Environmental Philosophy [IAEP])*	8:00 AM–12:00 PM	A111
135	T41. From Greenhouse to Icehouse: The Marine Eocene-Oligocene Transition	8:00 AM–12:00 PM	A102–104–106
136	T46. Fire and Geology: Surface Processes and Stratigraphic Records *(GSA Quaternary Geology and Geomorphology Division)*	8:00 AM–12:00 PM	A108–110
137	T50. North Atlantic Crossroads: Terrestrial and Marine Environmental Records of Iceland *(GSA Quaternary Geology and Geomorphology Division)*	8:00 AM–12:00 PM	A101–103

Session Number	Title	Time	Room
138	T58. Role of Supercontinents in Earth History: Assembly and Dispersal of the Rodinian Supercontinent (1300–750? Ma), and Impacts on Evolution of the Proterozoic Biosphere, Hydrosphere, and Crust-Mantle System *(GSA Structural Geology and Tectonics Division)*	8:00 AM–12:00 PM	A105–107
139	T61. Undergraduate Research: Strategies for Success I *(National Association of Geoscience Teachers; Council on Undergraduate Research, Keck Geology Consortium)*	8:00 AM–12:00 PM	A205
140	T66. Successes in Creating Multimedia-Assisted Learning Environments: The Sage on the Stage Versus the Guide on the Side—Yet Another Divide to Cross I *(National Association of Geoscience Teachers; American Geological Institute)*	8:00 AM–12:00 PM	A201
141	T75. Geomicrobiology and Biogeochemistry (Posters)	8:00 AM–12:00 PM	Poster Hall
142	T76. Global Biogeochemical Cycles and Climate	8:00 AM–12:00 PM	C209
143	T82. Field Scale Hydrodynamic and Geochemical Interactions at the Interface of Groundwater and Surface Water *(GSA Hydrogeology Division)*	8:00 AM–12:00 PM	C101–103
144	T86. Hydrochemistry of Springs *(GSA Hydrogeology Division)*	8:00 AM–12:00 PM	C201
145	T97. Evolution and Remediation of Acid-Sulfate Groundwater Systems at Reclaimed Mine Sites *(GSA Hydrogeology Division)*	8:00 AM–12:00 PM	C109
146	T103. Biological Diversity in the Phanerozoic I: In Memory of Jack Sepkoski *(Paleontological Society)*	8:00 AM–12:00 PM	A207–209
147	Aqueous Geochemistry (Posters)	1:30 PM–5:30 PM	Poster Hall
148	Archaeological Geology	1:30 PM–3:30 PM	C109
149	Geochemistry (Posters)	1:30 PM–5:30 PM	Poster Hall
150	Hydrogeology (Posters)	1:30 PM–5:30 PM	Poster Hall
151	Igneous Petrology I/Experimental Petrology	1:45 PM–5:30 PM	C207
152	Micropaleontology (Posters)	1:30 PM–5:30 PM	Poster Hall
153	Mineralogy	1:30 PM–5:30 PM	C201
154	Paleoclimatology/Paleoceanography I: Isotopic and High-resolution Analyses	1:30 PM–5:30 PM	A102–104–106
155	Paleontology IV: Early Life on Earth	1:30 PM–5:30 PM	A101-103
156	Paleontology V: Evolution and Ecology of Terrestrial Ecosystems	1:30 PM–5:30 PM	A105-107
157	Quaternary Geology II: Quaternary Glacial Events and Climate Change	1:30 PM–5:30 PM	A108–110
158	Tectonics III: Extensional Regimes; Tectonics of the Western Pacific and Asia	1:30 PM–5:30 PM	C105–107
159	**K5. Low-Latitude Precambrian Glaciation: Geochemical, Climatic, and Biological Effects of the Snowball Earth**	**1:30 PM–5:30 PM**	**Ballroom 2 & 3**
160	T2. Geochemical and Isotopic Tracers Applied to Sedimentary Provenance, Drainage Systems, and Related Tectonics	1:30 PM–5:30 PM	C209
161	T8. Active Faulting and Earthquake Behavior in Complex Orogens: A Multidisciplinary Approach *(GSA Structural Geology and Tectonics Division)*	1:30 PM–5:30 PM	C101–103
162	T14. Morphological and Mineralogical Biomarkers for Mars Exploration II	1:30 PM–5:30 PM	Ballroom 4
163	T17. New Insights into the Giant Butte Hydrothermal Deposit	1:30 PM–5:30 PM	C102–104–106
164	T30. Coastal Geologic Risk: Mapping the Hazards and Influencing Public Policy	1:30 PM–5:30 PM	C205
165	T42. A Multidisciplinary Study of Coalbed Methane in the Ferron Coals, Utah: An Unusual Resource with Potential for Global Environmental Impact *(GSA Coal Geology Division)*	1:30 PM–5:30 PM	A111
166	T61. Undergraduate Research: Strategies for Success II *(National Association of Geoscience Teachers; Council on Undergraduate Research, Keck Geology Consortium)*	1:30 PM–3:30 PM	A205
167	T66. Successes in Creating Multimedia-Assisted Learning Environments: The Sage on the Stage Versus the Guide on the Side—Yet Another Divide to Cross II *(National Association of Geoscience Teachers; American Geological Institute)*	1:30 PM–5:30 PM	A201
168	T71. Teaching Geologic Time: Methods and Relevance *(National Association of Geoscience Teachers)*	3:00 PM–5:30 PM	A205
169	T74. Isotopic Records of Microbially Mediated Processes in Natural Environments (Posters) *(Geochemical Society)*	1:30 PM–5:30 PM	Poster Hall
170	T75. Geomicrobiology and Biogeochemistry I *(Geochemical Society)*	1:30 PM–5:30 PM	C108-110–112

Session Number	Title	Time	Room
171	T85. From Atrazine to Hypoxia to Antibiotics: Occurrence and Fate of Agrichemicals in the Hydrologic System (Posters) *(GSA Hydrogeology Division)*	1:30 PM–5:30 PM	Poster Hall
172	T86. Hydrochemistry of Springs (Posters) *(GSA Hydrogeology Division)*	1:30 PM–5:30 PM	Poster Hall
173	T103. Biological Diversity in the Phanerozoic II: In Memory of Jack Sepkoski *(Paleontological Society)*	1:30 PM–5:30 PM	A207–209

THURSDAY, OCTOBER 28, 1999

174	Archaeology (Posters)	8:00 AM–12:00 PM	Poster Hall
175	Coal Geology (Posters)	8:00 AM–12:00 PM	Poster Hall
176	Economic Geology (Posters)	8:00 AM–12:00 PM	Poster Hall
177	Environmental Geology (Posters)	8:00 AM–12:00 PM	Poster Hall
178	Geology Education II: Successful Assessment in the Geoscience Classroom	10:15 AM–12:00 PM	A201
179	Hydrogeology III: Geological Controls on Groundwater Flow and Biogeochemistry	8:00 AM–12:00 PM	C205
180	Igneous Petrology II	8:00 AM–12:00 PM	C109
181	Paleoclimatology/Paleoceanography II: Causes, Chronologies, and Modeling	8:00 AM–12:00 PM	A102–104–106
182	Paleontology VI: Taphonomy and the Fossil Record	8:00 AM–12:00 PM	A101–103
183	Quaternary Geology III: Fluvial and Coastal Geomorphology	8:00 AM–12:00 PM	A105–107
184	Stratigraphy II: Sequence Stratigraphy and Basin Analysis	8:00 AM–12:00 PM	A205
185	Structure III: Fractures, Faults, and Fluid Flow	8:00 AM–12:00 PM	C102–104–106
186	Tectonics IV: Igneous, Metamorphic, and Geochronologic Perspectives on Continental Assembly and Breakup	8:00 AM–12:00 PM	C101–103
187	**K8. New Insights on Organic Metamorphism in the Earth *(Group Exploring Organic Processes in Geochemistry)***	**8:00 AM–12:00 PM**	**Ballroom 2 & 3**
188	T14. Morphological and Mineralogical Biomarkers for Mars Exploration III	8:00 AM–12:00 PM	Ballroom 4
189	T27. Geologic Input to Public Decision-Making: The Need for Greater Predictive Capability *(GSA Engineering Geology Division; Institute for Earth Science and the Environment)*	8:00 AM–12:00 PM	A108–110
190	T42. A Multidisciplinary Study of Coalbed Methane in the Ferron Coals, Utah: An Unusual Resource with Potential for Global Environmental Impact (Posters) *(GSA Coal Geology Division)*	8:00 AM–12:00 PM	Poster Hall
191	T44. High-Resolution Stratigraphic Approaches in Paleontology *(Paleontological Society)*	8:00 AM–12:00 PM	A207–209
192	T46. Fire and Geology: Surface Processes and Stratigraphic Records (Posters) *(GSA Quaternary Geology and Geomorphology Division)*	8:00 AM–12:00 PM	Poster Hall
193	T48. Integrated Landscapes: The Colorado Front Range *(GSA Quaternary Geology and Geomorphology Division)*	8:00 AM–12:00 PM	A111
194	T52. Geologic and Biologic Evidence for Late Cenozoic Drainage Rearrangements in North America: Implications for Aquatic Biogeography *(GSA Quaternary Geology and Geomorphology Division; Smithsonian Institution)*	8:00 AM–12:00 PM	C105–107
195	T56. The Case for Steady-State Mountain Belts: Observations, Models, and Implications for Global Tectonics (Posters) *(GSA Quaternary Geology and Geomorphology Division)*	8:00 AM–12:00 PM	Poster Hall
196	T65. Evaluation and Assessment of Multimedia Computer-Assisted Geoscience Education: A Hard Look at What Works and Why *(Center for Research and Evaluation for Advanced Technologies in Education)*	8:00 AM–10:00 AM	A201
197	T75. Geomicrobiology and Biogeochemistry II *(Geochemical Society)*	8:00 AM–12:00 PM	C108–110–112
198	T79. Dynamics of Mass Transport in Fractured Rocks and Fine-Grained Sediments: Contributions from Laboratory and Field Analyses to Conceptual and Mathematical Modeling I	8:00 AM–12:00 PM	C209
199	T83. From Atrazine to Antibiotics: The Occurrence and Fate of Agricultural Chemicals in the Hydrologic System *(GSA Hydrogeology Division)*	8:00 AM–12:00 PM	C201
200	T90. Hydrologic Resources of Synorogenic Strata *(Denver Museum of Natural History)*	8:00 AM–12:00 PM	C207
201	Clastic Sedimentology II: Structural and Tectonic Applications/ Carbonate Sedimentology: Deposition and Diagenesis	1:30 PM–5:30 PM	A102–104–106

Session Number	Title	Time	Room
202	Engineering Geology II/Expansive Soils, Road Salts, and General Engineering Geology	1:30 PM–5:30 PM	A108–110
203	Marine Geology (Posters)	1:30 PM–5:30 PM	Poster Hall
204	Paleoclimatology/Paleoceanography (Posters)	1:30 PM–5:30 PM	Poster Hall
205	Paleontology/Paleobotany (Posters)	1:30 PM–5:30 PM	Poster Hall
206	Paleontology VII: Extinctions, Recoveries, and Paleobiogeography	1:30 PM–5:30 PM	A207–209
207	Quaternary Geology IV: Quaternary Tectonics and Weathering	1:45 PM–5:30 PM	A105–107
208	Tectonics V: Laurentian/Gondwanan Correlations and Appalachian Geology	1:30 PM–5:30 PM	C101–103
209	Volcanology	1:30 PM–5:30 PM	A205
210	**K2. Human Transformation of the Physical Landscape *(GSA Archaeological Geology Division)***	**1:30 PM–5:30 PM**	**Ballroom 2 & 3**
211	T11. Making Crustal Souffles: High Mountains and Thin Crust in the Sierra Nevada	1:30 PM–5:30 PM	C105–107
212	T20. Geology: The Bedrock of the Ecosystem; Biological Uses of Geologic Data *(U.S. National Park Service, Geologic Resources Division; U.S. Geological Survey, Biological Resources Division; Institute for Earth Science and the Environment)*	1:30 PM–5:30 PM	C109
213	T39. Proterozoic Glaciations, Cap Carbonates, and Isotopic Excursions: Testing the Snowball Earth Hypothesis (Posters)	1:30 PM–5:30 PM	Poster Hall
214	T75. Geomicrobiology and Biogeochemistry III (Geochemical Society)	1:30 PM–5:30 PM	C108–110–112
215	T79. Dynamics of Mass Transport in Fractured Rocks and Fine-Grained Sediments: Contributions from Laboratory and Field Analyses to Conceptual and Mathematical Modeling II	1:30 PM–5:30 PM	C209
216	T89. Sustainability of Water Resources in the High Plains *(GSA Hydrogeology Division)*	1:30 PM–5:30 PM	C207
217	T95. Wetland Hydrology and Geochemistry: The State of the Science *(GSA Hydrogeology Division)*	1:30 PM–5:30 PM	C205

GSA Short Courses at 1999 Annual Meeting

Registration information and course descriptions were published in the June issue of *GSA Today*. For additional information, contact Edna Collis, GSA headquarters, (303) 447-2020, ext. 134, ecollis@geosociety.org, or see GSA's Web site, www.geosociety.org.

Preregistration deadline: September 17

1. ■ **Practical Methods in Applied C… inant Geochemistry: From Characterization to Re…** …rday, October 23, 8:00 a.m. to 5:00 p.m. Colora… …er. Cosponsored by *GSA Hydrogeology Di…* …ald I. Siegel, Dept. of Earth Sciences, Sy… …ty; Ph.D., University of Minnesota. Limit: 40. Fee: $1… …dents $155; includes course manual and lunch. CEUs: 0.8.

CANCELLED

2. ■ **Applied Inverse Ground Water Modeling: Why Use Anything Less?** Saturday–Sunday, October 23–24, 8:00 a.m. to 5:00 p.m. both days. Colorado Convention Center. Cosponsored by *GSA Hydrogeology Division*. Faculty: Evan R. Anderman, ERA Ground-Water Modeling, LLC, Denver; Ph.D., Colorado School of Mines; James O. Rumbaugh, Environmental Simulations, Denver. Limit: 25. Fee: $385, students $365; includes course manual and lunches. CEUs: 1.6.

3. ■ **Digital Mapping Methods: Accurate Digital Data Capture and Analysis for the Field Geoscientist** Saturday–Sunday, October 23–24, 8:00 a.m. to 5:00 p.m. both days. Colorado Convention Center. 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: 40. Fee: $385, students $365; includes course manual, lunches, and field trip transportation. CEUs: 1.6.

4. ■ **Introduction to Remote Sensing for Geologic Applications.** Saturday–Sunday, October 23–24, 8:00 a.m. to 5:00 p.m. both days. Colorado Convention Center. Cosponsored by *GSA Planetary Geology Division*. Faculty: Andrea Gallagher, Research Systems, Boulder, Colorado; B.S., Colorado School of Mines; Rebecca Dodge, University of Texas at El Paso; Ph.D., Colorado School of Mines; K. Eric Livo, U.S. Geological Survey, Denver; M.S., Colorado School of Mines. Limit: 30. Fee: $325, students $305; includes course manual and lunches. CEUs: 1.6.

5. ■ **Modern Salt Tectonics.** Saturday–Sunday, October 23–24, 8:00 a.m. to 5:00 p.m. both days. Colorado Convention Center. Cosponsored by *GSA Structural Geology and Tectonics Division*. Faculty: Mark G. Rowan, Rowan Structural Consulting, Boulder, Colorado; Ph.D., University of Colorado, Boulder. Limit: 50. Fee: $265, students $245; includes course manual and lunches. CEUs: 1.6.

6. ■ **Three-Dimensional Seismic Interpretation: A Primer for Geologists.** Saturday–Sunday, October 23–24, 8:00 a.m. to 5:00 p.m. both days. Colorado Convention Center. Cosponsored by *GSA Sedimentary Geology Division*. Faculty: Bruce S. Hart, New Mexico Bureau of Mines and Mineral Resources; Ph.D., University of Western Ontario. Limit: 40. Fee: $280, students $260; includes course manual and lunches. CEUs: 1.6.

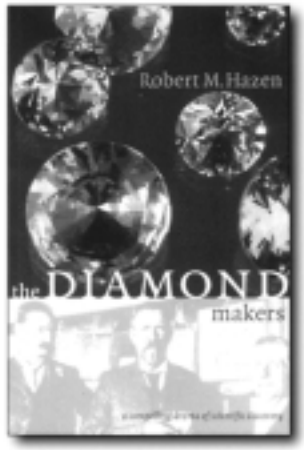
7. ■ **Applications of Environmental Isotopes to Watershed Hydrology and Biogeochemistry.** Sunday, October 24, 8:00 a.m. to 5:00 p.m. Colorado Convention Center. Cosponsored by *GSA Hydrogeology Division*. Faculty: Carol Kendall, Water Resources Division, U.S. Geological Survey, Menlo Park, California; Ph.D., University of Maryland; Thomas D. Bullen, Water Resources Division, U.S. Geological Survey, Menlo Park, California; Ph.D., University of California, Santa Cruz. Limit: 40. Fee: $275, students $255; includes course manual and lunch. CEUs: 0.8.

8. ■ **Teaching Earth System History: A Computer-Assisted Approach.** Sunday, October 24, 8:00 a.m. to 5:00 p.m. Colorado Convention Center. Faculty: Christopher R. Scotese, Dept. of Geology, University of Texas at Arlington; Ph.D., University of Chicago. Limit: 30. Fee: $175, students $155; includes course manual, CD-ROM, software, and lunch. CEUs: 0.8.

NEW AND NOTEWORTHY

The Diamond Makers

Robert M. Hazen



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SOUTH-CENTRAL SECTION, GSA 34th Annual Meeting

Fayetteville, Arkansas
April 3–4, 2000

The Department of Geosciences of the University of Arkansas at Fayetteville in conjunction with the Arkansas Water Resource Center, University of Arkansas at Fayetteville, Department of Earth Science of the University of Arkansas at Little Rock, Department of Physical Science–Geology of Arkansas Tech University, Arkansas Geological Commission, and Fort Smith Geological Society will host the 2000 annual meeting of the South-Central Section of the Geological Society of America. Meeting dates will be Sunday evening, April 2, through Tuesday, April 4, at the Continuing Education Center in Fayetteville, Arkansas. The meeting will be held in association with the Pander Society, the South-Central Section of the Paleontological Society, and the Midcontinent Section of the Society for Sedimentary Geology. A more detailed description of the meeting arrangements is on the GSA Web site at http://www.geosociety.org.

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. Anyone wishing to organize a symposium should contact Doy Zachry, Dept. of Geosciences, University of Arkansas, Fayetteville, AR, 72701, 501-575-2785, fax 501-575-3177, dzachry@comp.uark.edu.

ABSTRACTS

Abstract Deadline:
December 8, 1999

Abstracts for all sessions must be submitted camera-ready on official 2000 GSA section meeting abstract forms. The forms are available from the GSA Abstracts Coordinator, P.O. Box 9140, Boulder, CO 80301, or ncarlson@geosociety.org. A downloadable PDF version will be available on the GSA Web site. Submit completed abstracts to Van Brahana, Dept. of Geosciences, University of Arkansas, Ozark Hall 118, Fayetteville, AR 72701.

SYMPOSIA

1. Alkalic Rocks of North America. Don F. Parker, Dept. of Geology, Baylor University, Waco, TX 76798, don_parker@baylor.edu; Daniel S. Barker, Dept. of Geosciences, University of Texas, Austin, TX 78712, danbarker@ mail.utexas.edu.; J. Michael Howard, Arkansas Geological Commission, 3815 W. Roosevelt Rd., Little Rock, AR 72204, Mike.Howard@mail.state.ar.us.
2. Advances in Structural Geology. John M. Spang, Dept. of Geology and Geophysics, Texas A & M University, College Station, TX 77843-3115, J.Spang@tamu.edu; Jeffrey Connelly, Dept. of Earth Science, University of Arkansas, Little Rock, AR 72204-1099, jbconnelly@ualr.edu.
3. Atokan Series: A Centennial Reexamination. (Sponsored by Paleontological Society South-Central Section.) Walter L. Manger, Dept. of Geosciences, University of Arkansas, Fayetteville, AR 72701, wmanger@comp.uark.edu.
4. Hydrogeology of Mantled Karst. Van Brahana, Dept. of Geosciences, University of Arkansas, Fayetteville, AR 72701, jbrahana@jungle.uark.edu.
5. General Hydrogeology. Ralph K. Davis, Dept. of Geosciences, University of Arkansas, Fayetteville, AR 72701, ralphd @comp.uark.edu.
6. Environmental Hydrogeology: Annual Research Conference. (Sponsored by the Arkansas Water Resource Center.) Kenneth F. Steele, Arkansas Water Resource Center, University of Arkansas, Fayetteville, AR 72701, ksteele@comp.uark.edu.
7. Geological and Geochemical Studies in Southern Lakes. Stephen K. Boss, Dept. of Geosciences, University of Arkansas, Fayetteville, AR 72701, sboss @comp.uark.edu.
8. Pander Society Symposium. James Barrick, Dept. of Geosciences, Texas Tech University, Lubbock, TX 79409-1053, ghjeb@ttu.edu.

FIELD TRIPS

Premeeting

1. Peralkalic Rhyolite of the Davis Mountains. Don F. Parker, Dept. of Geology, Baylor University, Waco, TX 76798, don_parker@baylor.edu; Daniel S. Barker, Dept. of Geosciences, University of Texas, Austin, TX 78712, danbarker@mail.utexas.edu.
2. Hydrogeology of the Savoy Experimental Watershed. Van Brahana, Dept. of Geosciences, University of Arkansas, Fayetteville, AR 72701, jbrahana@jungle.uark.edu.
3. Sequence Stratigraphy of the Atokan Series, Northwest Arkansas. Walter L. Manger and Eddie Valek, Dept. of Geosciences, University of Arkansas, Fayetteville, AR 72701, wmanger@comp.uark.edu.
4. Carboniferous Fossil Localities of Northwestern Arkansas (for teachers). Lynne H. Hehr, Center for Math and Science Education, 105B Ozark Hall, University of Arkansas, Fayetteville, AR 72701, lhehr@comp.uark.edu.

Postmeeting

5. Alkalic Rocks of Central Arkansas. J. Michael Howard, Arkansas Geological Commission, 3815 W. Roosevelt Road, Little Rock, AR 72204, Mike.Howard @mail.state.ar.us.

EXHIBITS

Booths and table space will be available in a ballroom near the poster sessions. Contact Stephen K. Boss, Dept. of Geosciences, University of Arkansas, Fayetteville, AR 72701, (501) 575-7134, sboss @comp.uark.edu for details.

UNDERGRADUATE RESEARCH POSTER SESSION

Sponsored by Geology Division of Council on Undergraduate Research. Designed to showcase senior theses and other undergraduate research projects. For more information, contact Diane Smith, Dept. of Geosciences, Trinity University, (210) 999-7656, dsmith@trinity.edu, or visit the GSA Web site (www.geosociety.org).

REGISTRATION

Preregistration deadline: February 18, 2000. The preregistration form will be available in December 1999.

HOUSING

A block of rooms is reserved at the Hilton Hotel in Fayetteville. The hotel is physically connected to the Center for Continuing Education, where the meetings will be held, and is convenient to restaurants on and around the Fayetteville Square. Rooms for students at a lower cost will be available at a dormitory on the University of Arkansas campus. Buses routinely travel between the dormitories and the Continuing Education Center at convenient intervals and at no cost.

ADDITIONAL DETAILS

Details about social events, business meetings and student travel support and awards will be published in the December 1999 issue of *GSA Today*. See the GSA Web site (www.geosociety.org) for more information. Request a printout of the announcement from GSA Meetings, P.O. Box 9140, Boulder, CO 80301-9140 or (303) 447-2020, ext. 113. ■

NORTHEASTERN SECTION, GSA 35th Annual Meeting

New Brunswick, New Jersey
March 13–15, 2000

REGISTRATION

Preregistration Deadline:
February 4, 2000

The preregistration form will be available in December 1999 *GSA Today*.

ABSTRACTS

Abstract Due:
November 29, 1999

Send one original plus five copies of all abstracts to be considered to: Kenneth G. Miller, Technical Program Chairperson, Dept. of Geological Sciences, Wright Labs, Rutgers University, 610 Taylor Rd., Piscataway, NJ 08854-8066. Request forms from GSA Abstracts Coordinator, P.O. Box 9140, Boulder, CO 80301-9140, or ncarlson@geosociety.org.

SYMPOSIA

Prospective authors should contact the conveners directly. Symposium Co-chairs are Gail M. Ashley and Peter A. Rona, Dept. of Geological Sciences, Wright Labs, Rutgers University, 610 Taylor Rd., Piscataway, NJ 08854-8066, (732) 445-2221 or 6342, gmashley@rci.rutgers.edu or rona@ahab.rutgers.edu.

1. Holocene Climate Change in Northeast U.S. and Adjacent Oceans. David A. Robinson, Dept. of Geography, Rutgers University, 54 Joyce Kilmer Ave., Piscataway, NJ 08854-8054, (732) 445-4741, drobins@rci.rutgers.edu; James D. Wright, (732) 445-3622, jdwright@rci.rutgers.edu.
2. Radium, Radon, and Short-Lived Radionuclides: Occurrence and Human Exposure. Zolton Szabo, U.S. Geological Survey, 810 Bear Tavern Rd., Suite 206, West Trenton, NJ 08628, (609) 771-3929, zszabo@usgs.gov.
3. Influence of Urbanization on River Form and Process. Jim Pizzuto, Dept. of Geology, University of Delaware, Newark, DE 19716, (302) 831-2710, pizzuto@udel.edu; W. Cully Hession, (610) 566-5414, hession@acnatsci.org.
4. Lacustrine Geology and Holocene Climatology of N.E. North America Holocene. Henry T. Mullins, Dept. of Earth Sciences, Syracuse University, Syracuse, NY 13244, (315) 443-4706; William P. Patterson, (315) 443-3869. Poster
5. Coastal Hazards and Management in the Mid-Atlantic Bight. Susan Halsey, New Jersey Dept. of Environmental Protection, Trenton, NJ 08625, (609) 292-9762, shalsey@dep.state.nj.us; Nicholas Coch, (212) 642-2202.
6. Evidence for the Assembly and Breakup of Rodinia in the Appalachians. Alec E. Gates, Dept. of Geological Sciences, Rutgers University, 195 University Ave., Room 411, Newark, NJ 07102, (973) 353-5034, agates@andromeda.rutgers.edu; Richard Volkert, (609) 292-2576, richv@njgs.dep.state.uj.us.
7. Effectiveness of K–16 Collaboration in Geoscience Education. (Sponsored by NAGT.) Richard F. Yuretich, Dept. of Geosciences, University of Massachusetts, Amherst, MA 01003, (413) 545-0538, yuretich@geo.umass.edu; Richard D. Little, (413) 757-1445, little@gcc.mass.edu.
8. Appalachian Basin Stratigraphy: Sequences in an Active Tectonic Basin. (Sponsored by Northeastern Section of SEPM.) Chuck Mitchell, Dept. of Geology, SUNY Buffalo, Buffalo, NY 14260-3050, (716) 645-6800, ext. 3991, cem@nsm.buffalo.edu; Robert Jacobi, (716) 645-6800, rdjacobi@acsu.buffalo.edu.
9. Environmental Geophysics (Poster). Samuel Peavy, Dept. of Geological Sciences, Boyden Hall, Rutgers University, Newark, NJ 07102, (973) 353-1851, peavy@andromeda.rutgers.edu.

THEMES

Theme session papers are volunteered. Prospective authors should contact the conveners directly. For general information, contact Gail M. Ashley or Peter Rona (see Symposia).

1. Holocene Sea Level: Magnitudes and Frequency of Events. Norbert Psuty, Dept. of Marine and Coastal Sciences, Rutgers University, New Brunswick, NJ 08903, (732) 932-6555 ext. 506/500, psuty@imcs.rutgers.edu; Joseph Kelley, (207) 581-2152, jtkelley@maine.maine.edu.
2. Late Cretaceous to Cenozoic Sea Level, Sequences, and the U.S. Atlantic Margin. Gregory S. Mountain, Lamont-Doherty Earth Observatory, Palisades, NY 10964, (914) 365-8540, mountain@ldeo.columbia.edu; Kenneth G. Miller, (732) 445-3374, kgm@rci.rutgers.edu.
3. East Coast Rift Basins and Late Triassic–Early Jurassic Paleoclimatology. Dennis V. Kent, Dept. of Geological Sciences, Wright Labs, Rutgers University, 610 Taylor Rd., Piscataway, NJ 08854-8066, (732) 445-6974, dvk@rci.rutgers.edu; Paul E. Olsen, (914) 365-849, polsen@ldeo.columbia.edu.
4. Filling the Rift: Modern and Ancient Sedimentary Systems in Rift Valleys. (Sponsored by SEPM Northeastern Section.) Craig S. Feibel, Dept. of Anthropology, Rutgers University, 131 George St., New Brunswick, NJ 08901-1414, (732) 932-8853, feibel@rci.rutgers.edu; Gail M. Ashley, (732) 445-2221, gmashley@rci.rutgers.edu.
5. Fracture Populations, Scaling Laws, and the Mechanics of Fracturing. Roy W. Schlische, Dept. of Geological Sciences, Wright Labs, Rutgers University, 610 Taylor Rd., Piscataway, NJ 08854-8066, (732) 445-3142, schlisch@rci.rutgers.edu.
6. Sedimentary Processes and Their Impacts across the Mid-Atlantic U.S. Continental Margin. Lincoln F. Pratson, Earth and Ocean Sciences, 103 Old Chemistry Bldg., Duke University, Durham, NC 27708-0230, (919) 681-8077, pratson@eos.duke.edu.
7. Value of Geologic Research in Public Lands. Jack B. Epstein, U.S. Geological Survey, MS926A, National Center, Reston, VA 20192, (703) 648-6944, jepstein@usgs.gov; Donald Monteverde, (609) 984-7929, donm@njgs.dep.state.nj.us.
8. Taphonomy: Case Studies in the History of Fossils From Death Until Discovery. (Sponsored by Paleontological Society.) Cindy Fisher, Dept. of Geology and Astronomy, West Chester University, West Chester, PA 19383, (610) 436-2108, cfisher@wcupa.edu; Christopher McRoberts, (607) 753-2925, mcroberts@cortland.edu.
9. Linking Terrestrial and Marine Records of Glaciations in U.S. Northeast. Scott Stanford, New Jersey Geological Survey, CN427, Trenton, NJ 08625, (609) 292-2576, scotts@njgs.dep.state.nj.us.
10. Appalachian Basin Stratigraphy; Sequences in an Active Tectonic Basin. (Sponsored by SEPM Northeastern Section.) Chuck Mitchell, Dept. of Geology, SUNY Buffalo, Buffalo, NY 14260-3050, (716) 645-6800, ext. 3991, cem@nsm.buffalo.edu; Robert Jacobi, (716) 645-6800, rdjacobi@acsu.buffalo.edu.
11. Undergraduate Research. (Sponsored by the Council on Undergraduate Research Geology Division.) David G. Bailey, Dept. of Geology, Hamilton College, Clinton, NY 13323 (315) 859-4142, dbailey@hamilton.edu. Poster only.

SHORT COURSE

Mechanics of Sediment Transport. (Sponsored by SEPM Northeastern Section.) John Southard, Dept. of Earth, Atmospheric, and Planetary Science,

Northeastern *continued on p. 29*

Preliminary Announcement and Call for Papers

SOUTHEASTERN SECTION, GSA 49th Annual Meeting

Charleston, South Carolina
March 22–24, 2000

Please see the full announcement of this meeting at the following Web sites:
http://www.geosociety.org/
http://www.cofc.edu/~geology/SEGSA/
http://www.geo.ua.edu/segsa/

REGISTRATION

Meeting Preregistration and Hotel Accommodation Deadline:
February 11, 2000

Please preregister to qualify for lower registration fees, and to assist the local committee in planning. Field trip participants must preregister for the meeting. Preregistration by mail will be handled by the GSA Registration Coordinator, P.O. Box 9140, Boulder, CO 80301-9140. Preregistration forms will be available in December 1999 *GSA Today*. The local committee encourages preregistration because accommodations are scarce in Charleston during the spring months.

ACCOMMODATIONS

The conference will be held at the Westin Francis Marion Hotel, 387 King St., Charleston, SC 29403, (800) 937-8461. Rooms there will range from from $99 to $129. Other accommodations are available; see www.geosociety.org.

ABSTRACTS

Abstract Deadline:
December 8, 1999

Abstracts for all sessions must be submitted camera-ready on official 2000 GSA Section meeting abstract forms. These forms are available from the Abstracts Coordinator, GSA, P.O. Box 9140, Boulder, CO 80301, (303) 447-2020, ext. 161, ncarlson@geosociety.org, or the Technical Committee Co-Chair, June Mirecki, College of Charleston, mireckij@cofc.edu. A downloadable PDF version will be available on the GSA Web site. An original and five copies of all abstracts should be sent to June Mirecki, Dept. of Geology, College of Charleston, Charleston, SC 29424. Late abstract submissions will be returned. Abstracts sent by e-mail or fax will not be accepted.

FIELD TRIPS

For general questions concerning field trips please contact Christopher Abate, field trip coordinator, abatec@cofc.edu, (843) 953-1802.

Field Trips—Tentative

1. Paleoliquefaction Effects of the 1886 Charleston Earthquake. Pradeep Talwani, University of South Carolina, Columbia, talwani@prithvi.seis.sc.edu, (803) 777-6449.
2. Charleston Earthquake Damage Walking Tour. (Sponsored by NAGT Southeastern Section.) William A. Smith, Earthquake Education Center, Charleston Southern University, wsmith@csuniv.edu, (843) 863-8085.
3. Neotectonic Features of the Lower Coastal Plain of Georgia and South Carolina. Jerry Bartholomew, ESRI, University of South Carolina, Columbia, jbarth@esri.sc.edu, (803) 777-7693; Fredrick Rich, frich@gasou.edu, (912) 681-0849.
4. Newberry Eclogite: Structural Setting and Style of Occurrence. Allen J. Dennis, University of South Carolina, Aiken, dennis@sc.edu, or (803) 641-3396; John Shervais; Don Secor.
5. Folly Beach: Tomorrow's Coastal Problems, Today. Gered Lennon, College of Charleston, lennong@cofc.edu, (843) 953-3193.
6. U.S. Geological Survey Aquifer Storage Recovery Project, Charleston. Bruce Campbell, U.S. Geological Survey—Water Resources Division, Columbia, bcampbel@usgs.gov, (803) 750-6100.
7. Depositional History and Coastal Processes at Cape Romain. Walter J. (Jerry) Sexton, Athena Technologies, Inc., Columbia, athena@netside.com, (803) 790-4483; Tim Kana, twkana@aol.com, (803) 799-8949.
8. Paleontology and Biostratigraphy of the Coastal Plain. David Campbell, University of North Carolina, Chapel Hill, bivalve@mailserv0.isis.unc.edu, (919) 966-4516.
9. Sapelo Island Coastal Geology and Paleontology. Susan J. Goldstein sgoldst@gly.uga.edu, (706) 542-2397; John Garbisch, jgarbisch@peachnet.campuscw.net.

SYMPOSIA

If you have a suggestion for an additional symposium, please contact June Mirecki, College of Charleston, Charleston, South Carolina, mireckij@cofc.edu, (843) 953-8278.

1. Role of Geology in Coastal Restoration. Richard A. (Skip) Davis, Jr., University of South Florida, Tampa, rdavis@chuma.cas.usf.edu, (813) 974-2773; Orrin H. Pilkey, pilkey@geo.duke.edu, (919) 684-5847. Oral and poster.
2. The Bald Head Island Conferences on Coastal Plain Geology Revisited; A Memorial to Victor A. Zullo. W. Burleigh (Bill) Harris, harrisw@uncwil.edu, (910) 962-3492, University of North Carolina, Wilmington; Tricia Kelley, kelleyp@uncwil.edu, (910) 962-3490; Richard A. Laws, laws@uncwil.edu, (910) 962-3490. Oral and Poster.

Southeastern *continued on p. 30*

Northeastern *continued from p. 28*

Massachusetts Institute of Technology, Cambridge, MA 02139, (617) 253-2127, Southard@MIT. edu.

FIELD TRIPS

The field trip coordinator is Roy Mueller, Environmental Studies, Stockton College, Pomona, NJ 08240, (609) 652-4209, Ray.Mueller@stockton.edu.

1. Mineralogy and Geochemistry of the Watchung Flood Basalt Flows of Northern New Jersey. John H. Puffer, Dept. of Geological Sciences, Rutgers University, 195 University Ave., Newark, NJ 07102, (973) 353-5238, jpuffer@andromeda.rutgers.edu.
2. Ultra-Metamorphism of Preexisting Sedimentary Rocks and the Thermal Aureoles of the Palisade Intrusion, from Staten Island to Nyack. Alan Benimoff, Applied Science Dept.—Geology Division, College of Staten Island, 2800 Victory Blvd., Staten Island, NY 10314, (718) 982-2835, benimoff@postbox.csi.cuny.edu.

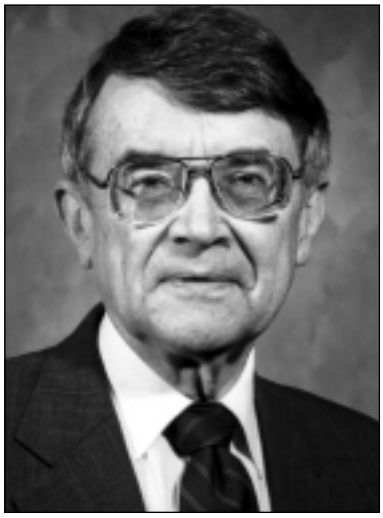
DETAILED INFORMATION

For more information, contact the general chair, Robert E. Sheridan, Dept. of Geological Sciences, Rutgers University, 610 Taylor Rd., Piscataway, NJ 08854-8066, (732) 445-2015, rsheridn@rci.rutgers.edu, or see the GSA Web site, www.geosociety.org. Request a printout of the announcement from GSA Meetings, P.O. Box 9140, Boulder, CO 80301-9140 or (303) 447-2020, ext. 113. ■

GSAF UPDATE

Donna L. Russell, *Director of Annual Giving*

Foundation Appoints Eaton as Trustee



The GSA Foundation Board of Trustees is pleased to announce the appointment of Gordon P. Eaton as a Foundation Trustee. He will complete the term of Hugo Dummett, who has resigned. Eaton is also a current member of the Foundation's Board Development Committee.

Eaton, who lives in Coupeville, Washington, brings a wide variety of experience and leadership to the Board.

He graduated from Wesleyan University with high honors and a B.A. in geology. He received an MS in geology as well as a Ph.D. in geology and geophysics from the California Institute of Technology. In 1994, he became the 12th Director of the U.S. Geological Survey. Eaton held a variety of positions with the U.S. Geological Survey during his career there, including Associate Chief Geologist in Reston, Virginia; Scientist-in-Charge at the Hawaiian Volcano Observatory in Hawaii; Project Chief of Geothermal Geophysics and Project Chief of the Southwestern Geophysics Project both in Denver, Colorado; and Deputy Chief of the Office of Geochemistry and Geophysics in Washington, D.C. and Reston, Virginia.

He also served as the Director of Lamont-Doherty Earth Observatory of Columbia University in Palisades, New York for four years, and was President of Iowa State University in Ames, Iowa for four years. Earlier, Eaton was Dean of the College of Geosciences, then Vice President for Academic Affairs at Texas A&M University.

Eaton has received many honors during his career, including the American Geological Institute's Ian Campbell Medal in 1995, as well as the California Institute of Technology Distinguished Alumnus Award in 1995. He is currently a member of the Earth Sciences Advisory Board at Stanford University and the External Advisory Board of the Geoscience and Environment Center at Sandia National Laboratories. Morris "Brud" Leighton, Chair of the GSA Foundation Board commented, "I am very pleased that Gordon has accepted a position as Trustee on the Board. Gordon brings many talents to our Board and is well known among the geologic community."

El-Baz Award Fund Growing

The recent announcement by GSA and Boston University that the Farouk El-Baz Award for Desert Research will be naming its first recipient at the GSA Annual Meeting in Denver has generated a plethora of contributions to the Foundation. In June alone, over $71,000 was received for the El-Baz award fund, bringing the endowment balance to $91,945.

El-Baz, research professor and director of the Center for Remote Sensing at Boston University, intends for this award to encourage young scientists to strive for excellence in desert research. According to El-Baz, deserts have not received as much attention by geologists as other types of landforms, and that is why we need to encourage and reward arid-land studies. The El-Baz award will be managed by the Quaternary Geology & Geomorphology Division of GSA.

El-Baz is well known for his work on the Apollo missions and the use of remote sensing techniques in nondestructive archaeology and exploration for groundwater in arid lands. He is currently working on a project for the Sultanate of Oman. El-Baz's scientific contributions have made a remarkable legacy for future generations.

Bryce Hand Award for 2000

To honor the retirement of Bryce Hand from 30 years of service at the University of Syracuse, several friends and associates made contributions to the GSA Foundation's Research Grants Fund. Hand, whose specialty is in sedimentation, joined the geology department at Syracuse as an associate professor in 1969.

All donations received in honor of Bryce Hand will be given to the GSA Committee on Research Grants in the spring of 2000 for a one-time Bryce Hand Award. ■

Southeastern *continued from p. 29*

3. New Strategies for Interpreting the Coastal Plain of South Carolina; A Memorial to Donald J. Colquhoun. David C. Prowell, U.S. Geological Survey, Atlanta, dprowell@usgs.gov, (770) 903-9100; Karen E. Waters, waters@water.dnr.state.sc.us, (803) 737-0800; Joseph A. Gellici, gellici@water.dnr.state.sc.us. Oral and poster.
4. A Century of Progress in Southern Appalachian Tectonics. William A. (Bill) Thomas, University of Kentucky, Lexington, geowat@pop.uky.edu, (606) 257-6222. Oral.
5. Planetary Geology in the Southeastern Section. Harry A. (Hap) McSween, University of Tennessee, Knoxville, mcsween@utk.edu, (423) 974-9805. Oral.
6. Geoarchaeology—Blackbeard's Flagship *Queen Anne's Revenge* Returns to Charleston. John E. Callahan, Appalachian State University, Boone, North Carolina, callahnJE@Appstate.edu, (828) 262-2746; Mark Wilde-Ramsing, mramsing@ncsl.dcr.state.nc.us, (901) 458-9042. Oral.
7. Structure and Tectonics Symposium in Honor of Donald T. Secor, Jr. Allen J. Dennis, University of South Carolina, Aiken, dennis@sc.edu, (803) 641-3396; John W. Shervais, shervais@sc.edu, (803) 777-2669. Oral.
8. Structural Geology, Metamorphism, and Geochronology Along the Eastern-Western Blue Ridge Contact. Charles H. Trupe, Georgia Southern University, Statesboro, chtrupe@gsaix2.cc.gasou.edu, (912) 681-0337; Kevin G. Stewart, kgstewar@email.unc.edu, (919) 966-4519. Oral.
9. Shoreline and Shoreface Geology of the Carolinas: Recent Advances. William J. Cleary, University of North Carolina at Wilmington, Clearyw@uncwil.edu, (910) 256-3721, ext. 251; Stanley R. Riggs,riggss@mail.ecu.edu, (252) 328-6379.

THEME SESSIONS

If you have a suggestion for a theme session, please contact June Mirecki, mireckij@cofc.edu, (843) 953-8278.
1. Hydrology at the Land's Edge: Sea-Water Intrusion, Submarine Discharges, and Groundwater Geochemical Fluxes. W. Berry Lyons, University of Alabama, Tuscaloosa,

Donors to the Foundation, June 1999

Birdsall Award
Philip C. Bennett
George H. Davis

John T. Dillon Alaska Scholarship Award
Catherine L. Hanks

Shirley Dreiss Memorial
Maryellen Cameron*

Engineering Geology Award
Phyllis Wormington

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Samira Omar*◆
Cordula Robinson◆
Barbara Ross◆
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Qaboos bin Said Sultan of Oman*◆
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Howard R. & Marilyn B. Gould*◆

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Michele L. Aldrich*

Institute for Earth Sciences & the Environment
National Science Foundation*◆
E-an Zen◆

J. Hoover Mackin Award
Bruce H. Bryant

Antoinette Lierman Medlin Scholarship Award
Richard F. Meyer
John F. Murphy

Meetings Support
M. Lee Allison

Minority Fund
R. Ernest Anderson

Northeastern Section Endowment
Robert W. Metsger◆

Penrose Conferences
R. Ernest Anderson
Oregon Department of Geology & Mineral Industries*

Research Grants
Jean M. Bahr
Charles E. Bartberger *in honor of Bryce Hand*
Marion E. Bickford, Jr.* *in honor of Bryce Hand*
Deborah A. Bondi-Ellison *in honor of Bryce Hand*
James C. Brower *in honor of Bryce Hand*
Carol Cavalluzzi *in honor of Bryce Hand*
John L. Davis *in honor of Bryce Hand*
Vita Demarchi *in honor of Bryce Hand*
Susan M. Dugolinsky *in honor of Bryce Hand*
Christine Gilmore *in honor of Bryce Hand*
Jane A. Gilotti
Daniel Howe *in honor of Bryce Hand*
Linda C. Ivany* *in honor of Bryce Hand*
George C. Kelley *in honor of Bryce Hand*
Ruth H. Major *in honor of Bryce Hand*
Leslie D. McFadden
Annie Merriam *in honor of Bryce Hand*
David Lachlan Meyer◆
Helen M. Michaels *in honor of Bryce Hand*
Ernest H. Muller *in honor of Bryce Hand*
Henry T. Mullins *in honor of Bryce Hand*
National Science Foundation*◆
Stephen Norwick
Beverly H. O'Brien *in honor of Bryce Hand*
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Kenneth B. Ranlet *in honor of Bryce Hand*
Joanne L. Ranz *in honor of Bryce Hand*
Joseph E. Robinson *in honor of Bryce Hand*
John L. Rosenfeld*
Christopher A. Scholz *in honor of Bryce Hand*

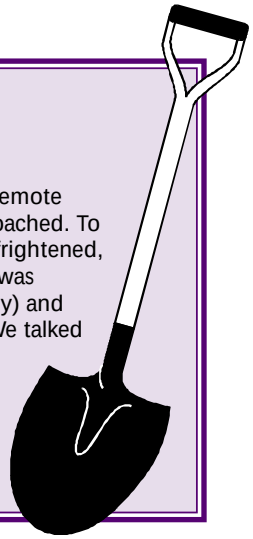
Donors *continued on p. 32*

Digging Up the Past

Most memorable early geologic experience:

"In 1951, I was a neophyte mapping alone in remote Navajo country; an Indian carrying a rifle approached. To my east-coast eyes he looked mean. I became frightened, especially when he demanded to know what I was doing on his land. I told him (with some anxiety) and invited him to share my lunch, which he did. We talked about geology and the land, and I learned that we had many interests in common, despite our different cultures."

—Arthur Mirsky



blyons@wgs.geo.ua.edu, (205) 348-0583; Anne E. Carey, acarey@coe.eng.ua.edu, (205) 348-4008. Oral.

2. From the Mountains to the Sea: The Biogeochemistry of Surface Waters in the Southeast. C. Brannon Andersen, Furman University, Greenville, brannon.andersen@furman.edu, (864) 294-3366; William B. (Brian) Hughes, U.S. Geological Survey—Water Resources Division, wbhughes@usgs.gov, (803) 750-6106. Oral.

3. Innovative Applications of GIS Technology to Geological Research. (Sponsored by Sigma Gamma Epsilon.) Douglas W. Haywick, University of South Alabama, Mobile, dhaywick@jaguar1.usouthal.edu, (334) 460-6381, David T. Allison, dallison@jaguar1.usouthal.edu. Poster and oral.

4. The Geologist as Informant: Assessing Geohazard Risks and Raising Public Awareness. (Sponsored by the GSA Committee for Geology and Public Policy.) Peter J. Lemiszki, Tennessee Division of Geology, Knoxville , plemiszki @mail.state.tn.us, (423) 594-5598; Earl A. Shapiro, earl_shapiro@mail.dnr.state.ga.us, (404) 656-2833. Oral.

5. Geology and Military History. (Sponsored by the Southeastern Sections GSA Education Committee and NAGT.) Robert C. Whisonant, Radford University, Virginia, rwhisona@runet.edu, (540) 831-5224; Roger J. Cuffey, cuffey@ems.psu.edu, (814) 865-1293. Oral.

6. Petrographic and Chemical Methods in the Analysis and Interpretation of Historic Artifacts. Michael S. Smith, University of North Carolina, Wilmington, smithms@uncwil.edu, (910) 962-3496. Poster and oral.

7. A Century of Progress in Southern Appalachian Tectonics. William A. (Bill) Thomas, University of Kentucky, Lexington, geowat@pop.uky.edu, (606) 257-6222; Robert D. (Bob) Hatcher, Jr., bobmap@utk.edu, (423) 974-6565. Oral.

8. Undergraduate Research. (Sponsored by the Council for Undergraduate Research.) C. Brannon Andersen, Furman University, Greenville, brannon.andersen@ furman.edu, (864) 294-3366; Joel B.Thompson, thompsjb@eckerd.edu, (813) 864-8991. Poster.

Request a printout of the announcement from GSA Meetings, P.O. Box 9140, Boulder, CO 80301-9140 or (303) 447-2020, ext. 113. ■

GSA's 1999 Research Grant Awards

Leah Carter, Research Grants Administrator

The GSA Committee on Research Grants met in Boulder, Colorado, on April 16–17, 1999, and awarded $395,235 to 212 graduate student applicants, and $20,000 for the Gladys W. Cole and W. Storrs Cole Awards to two postdoctoral applicants. Committee members for 1999 are Paul M. Myrow (Chair), James N. Connelly, Duncan M. FitzGerald, James G. Schmitt, Allen F. Glazner, Brian G. Katz, Jim E. O'Connor, Russell C. Kelz (National Science Foundation Conferee).

COLE AWARDS FOR POSTDOCTORAL RESEARCH

Grant A. Meyer, Middlebury College, Vermont, was awarded the Gladys W. Cole Memorial Research Award for 1999 to support his project "Postglacial Climate and Alluvial System Processes in the Arid Bighorn Basin, Wyoming: Insights through Comparison to Adjacent High-Elevation Systems." This award is restricted to support research for the investigation of the geomorphology of semi-arid and arid terrains in the United States and Mexico.

The W. Storrs Cole Memorial Research Award, which is restricted to support research in invertebrate micropaleontology, was presented this year to T. Markham Puckett, University of Alabama, for his project "The Use of Ostracodes in Sequence Stratigraphy."

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

STUDENT AWARDS

This year, proposals were received from 468 students, of which 212 (45%) were awarded grants. Of these recipients, 92 are master's candidates, and 120 are doctoral candidates. Proposal requests totaled $952,603 for an average of $2,035. The average award was $1,865.

Twenty alternate candidates were selected by the committee in the event that some of the grantees return all or part of their grant funds due to their having changed their research project or receiving funds from another source.

The Committee's budget included $170,000 from the Penrose Endowment and the Pardee Memorial, $130,000 from the National Science Foundation, $8,500 from the Harold T. Stearns Award Fund, the Geophysics Division, the Sedimentary Geology Division, and the Structural Geology and Tectonics Division, and $3,814 from funds returned too late in 1998 and early in 1999 to be re-awarded. The budget also included $83,600 from the GSA Foundation which included $27,000 from the Research Fund (including $2,000 from Mobil Oil), $46,785 from GEOSTAR and Unrestricted funds, $1,000 from the Second Century Fund (donations by the Lipman Research Fund), and $2,100 from the Engineering Geology and Hydrogeology Divisions.

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

OUTSTANDING MENTION

The Committee on Research Grants specially recognized 32 of the proposals as being of exceptionally high merit in conception and presentation:

Wade Lee Aubin, Washington State University, "Magma Mingling in Ignimbrites of the Deschutes Formation, North-Central Oregon: Implications for Magma Genesis in the High Cascades."

Mengesha Assefa Beyene, University of Nevada—Las Vegas, "Timing and Kinematics of Pinto Shear Zone, New York Mountains, Northeastern Mojave Desert, California."

Donors *continued from p. 31*

Bette S. Siegel *in honor of Bryce Hand*
C. Brian Trask *in honor of Bryce Hand*
Craig A. Webb *in honor of Bryce Hand*

Rocky Mountain Section Endowment
Robert M. Weidman◆

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Shoeaker Memorial Fund for Crater Studies
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Edmund G. Wermund, Jr.
Manfred P. Wolff
Phyllis Wormington

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

◆Second Century Fund.

Peter A. Buscemi, University of Massachusetts, "The Petrologic and Tectonic Significance of Proterozoic Ultramafic Rocks in the Upper Granite Gorge, Grand Canyon, Arizona."

Donna D. Carlson, University of Cincinnati, "Bivalve Epibiont Armor: The Evolution of an Anti-Predatory Strategy."

Amy Carter, University of Nebraska-Lincoln, "Mid–Late Holocene Sea Level Change—Optically Stimulated Luminescence Dating of Coastal Sands from the Texas Gulf Coastal Plain."

Zhensheng Chen, University of Tennessee, "$^{40}Ar/^{39}Ar$ Dating of Authigenic Potassium Feldspar of the Mt. Simon Sandstone in the Illinois Basin."

Mark Clementz, University of California—Santa Cruz, "Stable Isotopes as Indicators of Dietary Preferences and Niche Partitioning within Sirenians."

Luke Copland, University of Alberta, "Relationship Between Short-Term Velocity Patterns and Subglacial Hydrology on a Polythermal Glacier."

Catherine Duke, University of New Mexico, "Aqueous Alteration of Carbonaceous Chondrites: Experimental Low-Temperature Hydrothermal Alteration of Allende."

Rebecca Marie Flowers, University of Utah, "Structural and Geochronological Investigation of a Mid-Crustal Discontinuity Exposed in the Vredefort Impact Structure, South Africa."

Duane G. Froese, University of Calgary, "Ground Penetrating Radar and Resistivity Imaging of Valley-Fill Geometry: A New Method to Quantify Grade and Neotectonic Effects on Rivers."

Rebecca R. Ghent, Southern Methodist University, "Numerical Modeling of Folds and Ribbons in Venusian Crustal Plateaus."

Galen Pippa Halverson, Harvard University, "Dating Cap Dolomites in Svalbard: An Attempt to Constrain the Number of Neoproterozoic Glaciations."

Ulrike Maria Huber, University of Colorado, "Linkages between Past Climate, Vegetation and Fire Regimes in Southernmost Patagonia and Tierra del Fuego."

Marcia L. Jensen, University of New Mexico, "Evaluating Dinosaur Metabolism Using Stable Isotope Geochemistry."

Ganqing Jiang, Columbia University, "Integrated Sequence and Chemostratigraphy of the Neoproterozoic Yangtze Platform of South China."

Jade Star Lackey, University of Wisconsin—Madison, "Modification of Oxygen Isotope Ratios in Detrital Quartz during Infiltration-Driven Contact Metamorphism of Sandstone in the Mount Morrison Roof Pendant, CA: Implications for Changing Permeability."

Nancy E. Leawood, Memorial University of Newfoundland, "Distribution and Transport of Toxic Heavy Metals in a Heavily Polluted Estuarine Harbour."

Kevin M. Middleton, Brown University, "Morphological and Functional Evolution of the Hallux (Digit I) in Mesozoic Birds."

Christopher M. Moy, Syracuse University, "Holocene El Niño Events Preserved in Lacustrine Sediment Cores from the Southern Ecuadorian Andes."

Radu Popa, University of Cincinnati, "Biogenic Origin of Framboidal Pyrite Via an Energy-Yielding $Fe^{2+}/S_2O_3^{2}$."

Joshua H. Ring, Stanford University, "Geochronology and Petrology at Mammoth Mountain in the Western Moat of Long Valley Caldera, California: Recurrence Intervals and Possible Eruption Triggers at a Potentially Active Volcano."

Meredith S. Robertson, University of Southern California, "Paleoseismologic Investigations of the San Andreas and Garlock Faults, Southern California: Implications for Fault Interactions."

Jennifer C. Russel, Dalhousie University, "Taphonomy and Microevolution of the Cape Phillips Formation Graptolite Fauna, Cornwallis Island, Arctic Canada."

Jennifer Rebecca Smith, University of Pennsylvania, "A History of Quaternary Climate Change and Human Occupation in the Western Desert, Egypt."

Laryn Micaela Smith, University of Colorado, "Holocene Paleoceanography of the East Greenland and Northwest Iceland Continental Margins of the Denmark Strait."

Kristin Polizzotto Teusch, Cornell University, "Evidence of Environmental Effects on the Fossil Gastropods *Turritella cooperi* and *T. jewetti:* Marks of Predation and Stable Isotope Analysis."

Douglas Keith Tinkham, University of Alabama, "High-Temperature Tectonothermal History Across the Wenatchee Block, Cascades Crystalline Core, Washington: Metamorphic Phase Equilibria and Garnet Sm-Nd Chronology."

Asuka Tsuru, University of Alberta, "Chemical Weathering in Glacial Environments: Establishing Links between Weathering of the Himalayan Mountains, CO_2 Levels and Sr Isotopic Oceanography."

Jorge A. Vazquez, University of California—Los Angeles, "Chronology of Magma Chamber Processes in the Yellowstone Caldera System using Ion Microprobe Analysis."

Dorothy J. Vesper, Pennsylvania State University, "Mechanisms and Timing of Trace Metal Transport in a Karst Flow System: Impacts on Spring Water Quality."

John A. Vines, Virginia Tech, "Lineation Development and Strain Path within the Santa Rita Shear System, East-Central California."

STUDENT RECIPIENTS OF SPECIAL AWARDS IN 1999

Gretchen L. Blechschmidt Research Award. This award supports research for women interested in achieving a Ph.D. in the geological sciences and a career in academic research. This year's recipient is Laryn Micaela Smith, University of Colorado, for her project "Holocene Paleoceanography of the East Greenland and Northwest Iceland Continental Margins of the Denmark Strait."

John T. Dillon Alaska Research Award. John T. Dillon was noted for his radiometric dating work in the Brooks Range, the results of which have had a major impact on the geologic understanding of this mountain range. The recipient of this award is Jeffrey David Manuszak, Purdue University, for "Development of a Sedimentologic and Structural Model for Collisional Basins: A Case Study of the Nutzotin Basin, Alaska."

Robert K. Fahnestock Award. This award honors the memory of Ken Fahnestock, who was a member of the Committee on Research Grants. It is awarded to the applicant with the best proposal in sediment transport or related aspects of fluvial geomorphology. The 1999 recipient is Simon Brocklehurst, Massachusetts Institute of Technology, for "Effects of Glacial Erosion on Relief in the Eastern Sierra Nevada."

Lipman Research Award. The Lipman Research Fund is supported by gifts from the Howard and Jean Lipman Foundation to promote and support student research grants in volcanology and petrology. Peter W. Lipman, president of the Lipman Foundation, was the recipient of a GSA research grant in 1965. The 1999 Lipman Award recipient is Jorge A. Vazquez, University of California—Los Angeles, for "Chronology of Magma Chamber Processes in the Yellowstone Caldera System using Ion Microprobe Analysis."

Bruce L. "Biff" Reed Scholarship Award. The Bruce L. "Biff" Reed Scholarship Award was established in Reed's memory to provide grants to graduate students pursuing studies in the tectonic and magmatic evolution of Alaska primarily, and also can fund other geologic work in Alaska. This year's recipient is Rebecca Marie Flowers, University of Utah, for "Structural and Geochronological Investigation of a Mid-Crustal Discontinuity Exposed in the Vredefort Impact Structure, South Africa."

Alexander Sisson Research Award. Family members of Alexander Sisson established a fund in his memory to promote and support research for students pursuing studies in Alaska and the Caribbean. The recipient of the award this year is Jonathan G. Wynn, University of Oregon, for "Neogene Paleosols of the Middle Tanana Basin, South-Central Alaska."

Research Grants *continued on p. 34*

Research Grants *continued from p. 33*

Harold T. Stearns Fellowship Award. Harold Stearns established the Harold T. Stearns Fellowship Award in 1973 for student research on aspects of the geology of the Pacific Islands and the circum-pacific region. The 1999 recipients are: Ulrike Maria Huber, University of Colorado, for "Linkages Between Past Climate, Vegetation and Fire Regimes in Southernmost Patagonia and Tierra del Fuego," Matthew Lachniet, Syracuse University, for "Late Quaternary Glaciation and Climate of Costa Rica," and Christopher M. Moy, Syracuse University, for "Holocene El Niño Events Preserved in Lacustrine Sediment Cores from the Southern Ecuadorian Andes."

Industrial Donations and Awards. Industrial donations this year amounted to $2,000 from Mobil Oil Corporation. The 1999 recipients are: Matthew Hackworth, Louisiana State University, for "Effects of Gas Hydrates on Authigenic Carbonate Precipitation in Hydrocarbon Seep Sediments: Louisiana Continental Slope, Deepwater Gulf of Mexico," and Kaveh Khorzad, University of Texas at Austin, for "Land Subsidence Along the Texas Gulf Coast Due to Oil and Gas Withdrawal." ■

OTHER SUCCESSFUL APPLICANTS

Other applicants recommended for funding are the following:

Nancy K. Adams
Lee Amoroso
C. Fred T. Andrus
Katherine Ault
Ellen Avery
David L. Barbeau, Jr.
Susan L. Barbour
April Ann Barnes
Scott Barnes
Mona L. Becker
Michael Begbie
Matthias Bernet
Anand Erik Boice
Steve D. Bowman
Alexander P. Bump
William Matthew Burns
Robert A. Burrows
Illya V. Buynevich
Eric Cannon
Colin D. Card
Brian R. Cellura
Ryan D. Christensen
Julia Allison Clarke
Monika Cogoini
Sean R. Cornell
Samuel J. Coyner
William Crump
Kristina A. Curry
Dyanna Czeck
Julia F. Daly
Patricia Allison Dean
Carol Merritt Dehler
Rhawn F. Denniston
Arie Jan Doets
André Ellis
Rachel Ellisor
Michael Emilio
Annette Summers Engel
Gregory M. Etter
Matthew J. Evans
Cassandra R. Fenton
Eric J. Fermann
Patricia A. Foglesong
Margaret Fraiser
JingFang Fu
Lisa S. Gardiner
Geoffrey Garrison
Jennifer M. Garrison
Carmala N. Garzione
David Scott Gerwe
D. A. Grau
Lea Greenwood
Michael Guidry
Paula Gural
Britta Gustavson
Laura B. Hagan
Yoshie Hagiwara
Jenney M. Hall
Brian Hampton
Eric V. Hargrave
Garret L. Hart
Ross David Hartleb
Carolyn L. Hartwick
Nicholas W. Hayman
Elizabeth A. Haynes
Jason S. Herrin
Mark A. Hespenheide
Matthew D. Hildreth
Barbara M. Hill
Glenn S. Jaecks
Elizabeth R. James
Christopher L. Johnson
James V. Jones III
Pedro J. Jugo
Thomas J. Kalakay
Sharon L. Kanfoush
Stuart Knoop
Michele N. Koppes
Matthew Kosnik
Joseph R. Krieg
Lori Krikorian
Thomas R. Kulp
Suman Kumar De
Melissa Lafreniere
Toti Larson
Peter B. Lask
Wendy Faye Lawdermilk
Timothy J. Lee
Amy E. Lesen
Cynthia M. Liutkus
Caroline M. Loop
Christina M. Luke
Kari Anne Lundeen
Eugene W. MacDonald
Julie Annette Malburg
Cindy Michelle Martin
Christopher R.M. McFarlane
Margaret E. McMillan
Nadine McQuarrie
Liz McVay
Sean P. Metivier
Brian A. Michaels
Heather A. Moffat
Jessica D. Moore
Amy Elanor Myrbo
Anne I. Nelson
Catherine M. O'Reilly
German Y. Ojeda
Ann E. Olesen
Alyssa Olson
Nathan Washburn Onderdonk
Mutlu Ozdogan
Heather L. Petcovic
Eric W. Peterson
William T. Phelps
Preston Lee Phillips, Jr.
Geoffrey S. Pignotta
Christopher J. Pluhar
Michael Patrick Poland
Julie Ann Pollard
Vera Pospelova
Michael E. Potter
John A. Rayburn
Mark Elliott Reinhold
Michael W. Ressel
James R. Richardson
Jemuel Lothrop Ripley
Delores M. Robinson
Hilary Sanders
Ivan Savov
Maija Elizabeth Schellpeper
Kristin A. Schultheis
Ross Secord
Naseer Ahmed Shafique
Colin A. Shaw
Caiming Shen
Christian V. Shorey
Robert R. Sickler
Dirk-Jan H.A.E. Simon
Derek J. Sjostrom
Joshua B. Smith
Sara C. Smith
Glen T. Snyder
Michael Sperling
Scott D. Stanford
Jan Marie Strickland
Andrew Strike
Aviva Joy Sussman
Kierstin Swanson
Dylan Taylor
Michael H. Taylor
Stephen Thompson
Trista L. Thornberry
Neil Ernest Tibert
Blair Ryan Tormey
David R. Tretbar
Aradhna Tripati
Allan Tucker
Joseph Turak
David Frank Ufnar
Jennifer C. Villinski
Laura M. Wallace
Amy Leigh Weislogel
Jennifer M. Wenner
Paul H. Wetmore
Eric P. White
Timothy Michael White
Eugene K. Whitehead
James M. Wise
Trudy Wohlleben
Raphael Wust
Kevin M. Yeager
Christopher Zahm
Matthew K. Zimmerman ■

August *BULLETIN* and *GEOLOGY* Contents

GEOLOGICAL SOCIETY OF AMERICA
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GEOLOGY

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SEPTEMBER 1999

CALENDAR

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

1999 Meetings

October

October 18–21, 15th Annual International Conference on Contaminated Soils and Water, Amherst, Massachusetts. Information: Denise Leonard, (413) 545-1239, dleonard @schoolph.umass.edu.

2000 Meetings

January

January 20–23, International Conference on Environmental Modeling and Simulation, San Diego, California. Information: Jin-Yi Yu, Department of Atmospheric Sciences, University of California, 405 Hilgard Ave., Los Angeles, CA 90095-1565, (310) 206-3743, fax 310-206-5219, yu@atmos.ucla.edu, www.atmos.ucla.edu/~yu.

February

February 6–11, 9th International Conference on Fission Track Dating and Thermochronology, Lorne, Australia. Information: FT2000 Conference, School of Earth Sciences, University of Melbourne, Parkville, 3052, Australia, phone 61-3-9344-7675, fax 61-3-9344-7761, ft2000@unimelb.edu.au, http://ft2000.unimelb.edu.au.

February 23–24, Petroleum Systems of Sedimentary Basins in the Southern Midcontinent, Norman, Oklahoma. Information: Kenneth Johnson, Oklahoma Geological Survey, University of Oklahoma, 100 E. Boyd St. Room N-131, Norman, OK 73019, (405) 325-3031 or (800) 330-3996, fax 405-325-7079.

September

September 12–14, Fifth International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe, Prague, Czech Republic. Information: Prague 2000, Florida State University, 2035 E. Paul Dirac Dr., 226 HMB, Tallahassee, FL 32310-3700, (850) 644-7211, fax 850-574-6704, www.prague2000.fsu.edu.

CLASSIFIED ADVERTISING

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Positions Open

DARTMOUTH COLLEGE
LOW TEMPERATURE GEOCHEMIST

The Department of Earth Sciences expects to fill a tenure-track position in low temperature geochemistry at the assistant professor level. The successful candidate will be expected to demonstrate excellence in both teaching and research, develop a vigorous externally funded research program, advise student research at both undergraduate and graduate levels in earth sciences. The Earth Sciences department has a VG Sector Mass Spectrometer, High Resolution ICP-MS, and a clean laboratory. Candidates with expertise in radiogenic isotope geochemistry are particularly encouraged to apply.

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

Evaluation of applications will begin November 1, 1999. The appointment will be effective July 1, 2000.

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

THREE TENURE-TRACK FACULTY POSITIONS
DEPARTMENT OF GEOLOGY
BUCKNELL UNIVERSITY

The Department of Geology at Bucknell University invites applications for three assistant professor positions in Hydrogeology, Mineralogy/Petrology, and Sedimentology to be filled at the entry level beginning Fall semester, 2000. A Ph.D. with some prior teaching experience is strongly preferred; ABD considered. Two of these positions arise due to retirements; the third position results from an expansion of our program. The Department of Geology anticipates that it will be housed in a new building to be occupied by Fall of 2001.

Bucknell is a selective liberal arts university with an engineering program. The Department of Geology offers BA and BS degrees in both Geology and Environmental Geology. Department members value teaching and research in both fundamental and applied geology. For all three positions, we seek broadly trained teacher-scholars who are equally comfortable in the field and in the laboratory and who complement the strengths of our continuing faculty (aqueous geochemistry, geomorphology, and structural geology). Given our exceptional location, we expect candidates to incorporate fieldwork into some aspects of most courses. Opportunities exist for teaching and research collaboration with other departments on campus. In addition to upper-level courses listed below, each candidate will teach introductory courses which contribute to Bucknell's general education program and introductory laboratory courses, which may include engineering, environmental, historical, and/or physical geology, and oceanography. Candidates may also prepare introductory- and senior-level seminar courses or writing-intensive courses. The standard teaching load is two courses with labs per semester. Ability to teach upper-level courses in geophysics or economic geology will strengthen an application for any position.

Candidates are expected to conduct and disseminate independent research in their area of expertise and to supervise undergraduate research. Faculty are encouraged to seek external funds to support research.

Mineralogist/Petrologist. The candidate will teach upper-level courses in mineralogy and hard rock petrology with laboratory sections. The ability to contribute to departmental and university environmental programs will strengthen an application.

Sedimentologist. The candidate will teach upper-level courses in sedimentology and paleontology with laboratory sections. The ability to contribute to departmental and university environmental programs will strengthen an application.

Hydrogeology/GIS. The candidate will teach upper-level courses in hydrogeology and geographic information systems (GIS) with laboratory sections. The person filling this position is expected to contribute to both departmental and university environmental programs. Consulting experience is preferred. The ability to integrate field studies with ground water flow modeling at a level appropriate to undergraduate students is expected.

Applicants should send a statement of teaching and research interests and experience, resume, and at least three letters of reference to: {appropriate position} Search Committee, Department of Geology, Bucknell University, Lewisburg, PA 17837. Review of applications will begin September 1, 1999, and will continue until the positions are filled. Candidates are encouraged to visit our web site at www.departments.bucknell.edu/geology. Bucknell University encourages applications from women and members of minority groups (EEO/AA).

GLOBAL SEDIMENTARY SYSTEMS
UNIVERSITY OF CALIFORNIA, RIVERSIDE

The Department of Earth Sciences, University of California, Riverside, invites applications for a tenure-track position at Assistant Professor rank. The applicant must hold a Ph.D. and have a strong commitment to excellence in both research and teaching. We seek an individual with primary research interests in the sedimentology of marine rocks, linking global ecological and paleoenvironmental change through study of the stratigraphic record. A strong field-based research orientation is essential. The successful candidate will be expected to foster interaction with ongoing research in paleoecology, specimen-based paleobiology, stratigraphy, biogeography, geochemistry, paleoclimatology, and geomorphology. Teaching responsibilities will include undergraduate offerings in sedimentology and Earth Systems History as well as graduate courses in the area of specialty.

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 November 1, 1999, to: Dr. Mary Droser, Chair, Global Sedimentary Systems Search, Department of Earth Sciences, University of California, Riverside, California 92521. E-mail contact: mary.droser@ucr.edu. The University of California is an equal opportunity employer.

SEDIMENTARY GEOLOGIST
UNIVERSITY OF CHICAGO

Applications are sought for a one-year research associate position (with the possibility of renewal for a second year) in sedimentology/stratigraphy beginning January, 2000, in the Department of the Geophysical Sciences. Applicants should have a Ph.D. and a record of independent scholarship. We hope to appoint a person who will complement and broaden our research programs in paleogeography, Earth history, stratigraphy, taphonomy, paleobiology, and macroevolution. Demonstrated ability and willingness to teach are desired. Please send curriculum vitae, a statement of interests, and the names, addresses (standard and electronic), and phone and fax numbers of at least three scholars who can supply letters. Review of applications will begin October 1, 1999. Address applications to: Susan Kidwell, Department of the Geophysical Sciences, University of Chicago, 5734 South Ellis Avenue, Chicago, IL 60637. The University of Chicago is an Equal Opportunity/Affirmative Action Employer.

FACULTY POSITIONS IN ATMOSPHERE, OCEAN, CLIMATE DYNAMICS AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University announces a search for several ladder faculty positions in the general area of atmosphere, ocean, and climate dynamics. We seek both junior and senior applicants with records of creative research in subject areas that improve understanding of modern atmospheric and oceanic processes and/or the evolution of the earth's climate on geologic time scales. Areas of special interest include atmosphere/ocean modeling; climate-system modeling; coupled air-sea interaction; dynamical meteorology and oceanography; glaciology; hydrology; remote sensing; and the physics, dynamics, and chemistry of clouds. New appointments at Yale in these areas will contribute to a broad emphasis in the Department on paleoclimatology, paleoenvironments, and global change. Additional appointments in the Department will be made in areas of

active tectonics and geomorphology, geochemistry, paleontology, and solid-earth geophysics. Closing date for applications is September 30, 1999.

We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of professional goals, and the names and addresses of three or more referees to:

AOCD Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

FACULTY POSITIONS IN GEOCHEMISTRY AT YALE UNIVERISTY

The Department of Geology and Geophysics at Yale University is starting a new multidisciplinary hiring initiative in earth science, which will include several ladder faculty appointments in the general area of geochemistry, starting as early as January 2000. We invite applications from both junior- and senior-level candidates who will develop internationally recognized research programs in collaboration with present and future Yale geoscientists. The positions will include teaching at both the undergraduate and graduate levels. All subfields will be considered, including, but not limited to: biogeochemistry, earth surface chemical processes, experimental geochemistry, mantle geochemistry, organic geochemistry, radiogenic and stable isotopes, and theoretical geochemistry. Closing date for applications is September 30, 1999.

We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of professional goals, and the names and addresses of three or more referees to:

Geochemistry Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

FACULTY POSITION IN SOLID-EARTH GEOPHYSICS AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University is starting a new multidisciplinary hiring initiative in earth science, which includes a major expansion in solid-earth geophysics. To this end, we intend to fill several ladder faculty positions in solid-earth geophysics, either at the junior or senior level, starting as early as January 2000. We invite applicants who will develop internationally recognized research programs in collaboration with present and future Yale geoscientists. The positions will include teaching at both the graduate and undergraduate levels. All subfields of solid-earth geophysics will be considered, including, but not limited to: geodesy, geodynamics, geomagnetism, mineral physics, rock and earthquake mechanics, and seismology. Closing date for applications is September 30, 1999.

We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of professional goals, and the names and addresses of three or more referees to:

Solid-Earth Geophysics Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

FACULTY POSITION IN ACTIVE TECTONICS AND GEOMORPHOLOGY AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University announces a ladder faculty position, at either the junior or senior level, in the general area of active tectonics and geomorphology, starting as early as January 2000. This position is part of a broad multidisciplinary hiring initiative in earth sciences at Yale, including the areas of the dynamics of the oceans, atmospheres, and climate; geochemistry; solid-earth geophysics; and paleontology. For the active tectonics and geomorphology search, we are particularly interested in finding candidates who relate the evolution of landforms to the forcing caused by tectonic and climate processes. We also welcome applications from related fields, including but not limited to: geodynamics of landscape evolution, paleoseismology, structural geology, and tectonics. The successful candidate is expected to develop an internationally recognized research program and teach at both the graduate and undergraduate levels.

The closing date is September 30, 1999. We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of professional goals, and the names and addresses of three or more referees to:

Geomorphology Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

FACULTY POSITION IN PALEONTOLOGY AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University is starting a new multidisciplinary hiring initiative in earth science, which includes strengthening of its program in paleontology. To this end, we intend to fill a ladder faculty position in paleontology, at either the junior or senior level, starting September 2000. We invite applicants who will develop an internationally recognized research program in collaboration with present and future Yale geoscientists and bioscientists. The position will include teaching

Classifieds *continued on p. 38*

Classifieds *continued from p. 37*

at both the graduate and undergraduate levels. All subfields of paleontology will be considered, including, but not limited to: biogeochemistry, biosratigraphy, event stratigraphy, evolutionary processes, functional morphology, macroevolution, origin of major groups/body plans, marine paleoecology, mass extinctions, paleobiogeography, paleoenvironmental analysis, systematics, or taphonomy. Closing date for applications is January 15, 2000.

We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of professional goals, and the names and addresses of three or more referees to:

Paleontology Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

VISITING FACULTY POSITIONS IN EARTH SCIENCES AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University announces the opening of several visiting faculty positions, starting as early as September 1, 1999. Applicants from all areas of earth science and all career levels are welcome to apply. The visiting positions are part of a major hiring initiative in earth sciences at Yale focused on rebuilding the size and strength of the department. We are looking for individuals who would enjoy contributing and interacting in a broad multiplidisciplinary department that includes active programs in atmospheres, oceans and climate; geochemistry; petrology; solid-earth geophysics; paleontology and evolutionary theory; and tectonics. The successful applicant would be expected to conduct an active research program, to interact with students and faculty, and to teach one course or seminar per semester with the topic to be negotiated. The duration and scope of the visit are negotiable as well. Applications will be considered as they arrive.

We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of objectives for the visit, and the names and addresses of three referees to:

Visiting Faculty Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

DIRECTOR BUREAU OF ECONOMIC GEOLOGY THE UNIVERSITY OF TEXAS AT AUSTIN

The University of Texas at Austin seeks a Director of its Bureau of Economic Geology, one of the largest research units of the university and which also serves as the State Geological Survey. Required is a doctorate in the geological sciences, a record of substantial research, and upper-level management and leadership experience. The applicant must have experience working in a university setting, working with policy issues at the state and national level, and obtaining financial support for major research programs. The successful candidate will have credentials suitable for appointment as a full professor in geological sciences.

The Bureau of Economic Geology is a prominent research and service institution with a long history and a reputation for research excellence and scientific leadership. It is a major publisher of geological reports, especially in the fields of energy and the environment. The bureau operates yearly on an appropriated budget of $1.2 million, plus $12 to $15 million in grants and contracts from state and federal agencies, industry, and private foundations. Further details of bureau programs and organizations can be obtained by visiting the website http://www.utexas.edu/research/beg or by requesting a copy of the bureau's annual report.

Application, including a resume, letter of interest, and names and addresses of at least three references, should be submitted to Prof. William L. Fisher, Chair of the Director Search Committee, Bureau of Economic Geology, University Station, Box X, Austin, TX 78713-8924. Additional position information can be found at www.utexas.edu/admin/ohr/emp/. Refer to Job Number 99-06-21-10-0382. The position is open until filled, with review of applications beginning in early fall of 1999. Anticipated starting date is January 1, 2000. Salary is negotiable. The University of Texas at Austin is an Equal Opportunity/Affirmative Action employer.

STATE UNIVERSITY OF NEW YORK COLLEGE AT ONEONTA — LECTURER

The Department of Earth Sciences at the State University of New York College at Oneonta invites applications for a one-year Lecturer position beginning Fall 1999 pending budgetary approval. This is a full-time position in Surficial Geology/Hydrology. Required qualifications: Ph.D. or ABD; extensive knowledge and experience in environmental applications; emphasis on quality classroom instruction, student mentoring, and the application of instructional technology. Duties include teaching courses in support of undergraduate curricula in Geology, Water Resources, and Environmental Science. To apply: send curriculum vita, statement of interest and qualification for this position, and three current letters of recommendation to: Dr. Jerome Blechman, Search Committee Chair, Earth Sciences Department, Box G, SUNY Oneonta, Oneonta, NY 13820. Review of applications will begin immediately and will continue until the position is filled. SUNY Oneonta is an EEO/AA employer. Women and minorities are encouraged to apply.

THE EARTH SYSTEM SCIENCE INTERDISCIPLINARY CENTER UNIVERSITY OF MARYLAND SEARCH FOR DIRECTOR REOPENED

Applications are invited for the position of Director of the Earth System Science Interdisciplinary Center (ESSIC) at the University of Maryland. ESSIC was recently established by a collaborative agreement between NASA's Goddard Space Flight Center (GSFC) and the University of Maryland to carry out preeminent research and teaching programs in Earth system science (http://www.essic.umd.edu). The research goal of ESSIC is to expand scientific knowledge of Earth, including its land surface, atmosphere and oceans, particularly by using satellite-based remote sensing data. Participating units at the university include the Departments of Geography, Geology and Meteorology.

The Director will provide scientific leadership for the center, including participation in the appointment of two additional faculty, and will manage its day-to-day operations. The appointment will be made at the rank of professor with tenure in one of the participating departments. The Director will provide leadership in developing the research and teaching programs of the center and will encourage collaboration among the participating departments and between the university and GSFC. The appointee will be an eminent physical scientist experienced in leading an interdisciplinary research group, with an established international reputation in some facet of Earth system science, experience with satellite-based remote sensing, and a substantial record of external research funding.

The University of Maryland is an Affirmative Action/Equal Employment Opportunity employer. For best consideration applications should be submitted by October 15 to: Chair of the ESSIC Search Committee, Earth System Science Interdisciplinary Center, University of Maryland, Computer and Space Sciences Building, College Park, MD 20742-2465. Applicants should provide a statement describing their vision for ESSIC and how their experience and research and teaching interests contribute to this vision. Applicants should also provide a signed curriculum vitae and the names and addresses of four references.

PALEOECOLOGY–ECOSYSTEM PROCESSES–BIOGEOCHEMISTRY

The University of Pennsylvania seeks an earth scientist with research interests in the interface between the terrestrial biosphere and geosphere. The candidate will fill a tenure-track position in the Department of Earth and Environmental Science. Possible areas of focus may include but are not limited to paleoecology, ecosystem dynamics, and biogeochemical processes. Preference will be given to candidates who have a strong, established research program that (ideally) addresses both modern and ancient ecosystems. We are also particularly interested in candidates who use the modern tools of geochemistry in their work and who can interact with related departmental interests in forest ecosystems, Quaternary geology and paleoclimatology, paleontology, paleobotany and isotope geochemistry. A competitive start-up package will be made available as part of this appointment. Applicants should send a curriculum vitae, reprints, statements of research and teaching interests, and a list of at least three references with addresses, e-mail address, and phone and fax numbers to Arthur H. Johnson, Geobiology Search Committee, Department of Earth and Environmental Science, University of Pennsylvania, Philadelphia, PA 19104-6316. E-mail: ahj@sas.upenn.edu. The search will continue until the position is filled. The University of Pennsylvania is an equal opportunity employer. Women and minorities are encouraged to apply.

DEPARTMENT CHAIRMAN, GEOGRAPHY AND PHYSICS, UNIVERSITY OF TENNESSEE AT MARTIN

The Department of Geology, Geography and Physics invites applications for a tenure-track position at the rank of Associate or Full Professor to serve as Chair of the department beginning July 1, 2000. The department is a multi-discipline unit with ten faculty members supporting service courses and a geosciences major with concentrations leading to degrees in Geology, in Geography, and in Travel/Tourism (approximately 40 majors). The department also offers a minor in physics. The department invites candidates for the position of Department Chair from any of the disciplines represented in the department. The Department Chair will be expected to teach half-time. A background to teach introductory geology courses and upper division courses of mineralogy and igneous/ metamorphic petrology is preferred (other courses will depend on expertise and demand). The successful candidate will be expected to provide evidence of teaching and administrative experience with a strong commitment to undergraduate education. Administrative duties include: budget development and oversight, personnel evaluation for faculty and staff, curriculum management and communicating administration policies and decisions. Other expectations associated with the university mission include assignments such as: research (involving undergraduate students where possible), advising departmental majors and pre-professional students, serving on committees and public service. The Search Committee will begin review of applications on December 3, 1999, and the search will continue until the position is filled. Applications should include a letter of application, curriculum vita, copies of transcripts and a list of references. Mail application to: Professor W. T. McCutchen, Chair of Search Committee, Department of Geology, Geography, and Physics, University of Tennessee at Martin, Martin, TN 38238 (E-mail: tmccutchen@utm.edu, telephone 901-587-7437). UTM is an EEO/AA/Title VI/ Title IX/ Section 504/ADA/ADEA Employer. We are particularly interested in receiving nominations from women and minority candidates.

The Swiss Federal Institute of Technology (ETH) and the University of Zurich invite applications for the position of a

PROFESSORSHIP IN PHYSICAL SEDIMENTARY GEOLOGY

We are looking for an outstanding candidate who pursues an internationally competitive research program in physical aspects of erosion and processes of clastic sediment production, transport, and deposition. A strong interest in modeling such processes in surficial systems (aquatic, glacial, eolian) and in investigating their variability with respect to tectonic and climatic processes is expected. Involvement in multidisciplinary research that interfaces with geotechnical (e.g. slope stability and mass movements) and hydrogeological engineering questions is desirable.

The professorship (with its staff) will contribute to a joint earth science teaching program involving ETH and the University of Zurich. We expect dedication to excellence in teaching sedimentology, stratigraphy, basin analysis, alpine geology, mapping, and in the supervision of thesis-related field work.

Applicants should submit a detailed curriculum vitae, a statement of research interests, a list of publications, and the names of three potential referees to the President of ETH Zurich, Prof. Dr. O. Kübler, ETH Zentrum, CH-8092 Zurich no later than November 15, 1999. Our schools specifically encourage female candidates to apply with a view towards increasing the proportion of female professors.

TENURE TRACK FACULTY POSITIONS INDIANA UNIVERSITY–PURDUE UNIVERSITY INDIANAPOLIS (IUPUI)

The Department of Geology at IUPUI invites applications for two tenure-track assistant professor positions, beginning in Fall 2000. We seek individuals interested in developing a strong, externally funded research program in a collaborative environment who are also committed to high quality teaching. A Ph.D. in geology is required.

Mineralogy—Applicants will have demonstrated potential in mineralogy applied to geologic and/or environmental problems. Collaboration with ongoing research programs in geochemistry and sedimentology will be highly desirable.

Geomorphology—Applicants will have demonstrated potential in glacial, fluvial, and/or soil geomorphology. Collaboration with ongoing research programs in sedimentology and hydrology will be highly desirable.

IUPUI is the third largest university in Indiana, with 28,000 students. The Department of Geology has 8 full-time and 7 adjunct faculty, and offers B.A., B.S., and M.S. degrees. Instrumentation in the department or on campus includes XRD, SEM/EPMA, ICP-AES, Leica Total Stations, and an ARC/INFO and ERDAS GIS laboratory.

Interested individuals should send a resume, statements of research and teaching interests, and the names of three referees by December 1, 1999 to: Dr. Andrew Barth, Search and Screen Committee, Department of Geology, IUPUI, 723 W. Michigan Street, Indianapolis IN 46202-5132. E-mail address: nfribley@iupui.edu. Web site: www.geology.iupui.edu.

IUPUI is an equal-opportunity, affirmative-action employer.

EASTERN MICHIGAN UNIVERSITY
HYDROGEOLOGIST/ENVIRONMENTAL GEOLOGIST

The Department of Geography and Geology announces a tenure-track assistant professor position in Hydrogeology or Environmental Geology, available Fall 2000. The successful applicant will participate in the department's Urban Water Resources Center and/or Center for Environmental Information Technology and Applications and will teach introductory earth science or geology courses and advanced courses in the area of expertise. Qualifications include: Ph.D. by time of appointment; expertise in hydrogeology, environmental geology, or fluvial processes; commitment to achieving excellence in teaching; strong computer skills. Additional desired qualities include substantial knowledge in geographic information systems and a record of research, publications, and/or external funding. To apply, please submit detailed curriculum vitae; letter detailing how you satisfy position qualifications; statement of relevant course work and your teaching philosophy; list of courses you are/can be prepared to teach; statement of research plans and goals; names, addresses, phone numbers, and e-mail addresses of at least three references familiar with your teaching and research accomplishments and potential. Review of applications will begin November 1 and continue until position is filled. Reply to Position F0003, 202 Bowen, Eastern Michigan University, Ypsilanti, MI 48197. For information about the department and university visit http://www.emich.edu/public/geo/welcome.html. EMU is an affirmative action/equal opportunity employer.

FACULTY POSITION
CALIFORNIA STATE UNIVERSITY, HAYWARD

The Department of Geological Sciences at California State University, Hayward, seeks a dynamic faculty member with strengths in applied geophysics, engineering geology or sedimentology. Pending administrative approval, a tenure-track position at the assistant professor level will be offered beginning September, 2000. The individual hired will be expected to have talents in undergraduate and graduate teaching for a diverse student population, and become part of the research program in geology or environmental science. Expertise in GIS and spatial analysis is highly desirable, as is significant field experience. The department offers BA, BS and MS degrees in geology, and plays a major role in the university's environmental science and teacher credential programs. The university and its San Francisco Bay setting offer a rich combination of cultural amenities, renowned geology and nearly limitless research opportunities. Applicants who will possess the PhD by September, 2000, should mail a curriculum vitae and three letters of recommendation to Dr. Nancy Fegan, Search Committee Chair, Department of Geological Sciences, California State University, Hayward, 25800 Carlos Bee Boulevard, Hayward, CA, 94542-3088.

THE OHIO STATE UNIVERSITY
ENVIRONMENTAL ISOTOPE GEOCHEMISTRY

The Department of Geological Sciences invites applications for one tenure track position at the assistant professor level, or higher, to begin as early as September, 2000. A Ph.D. in geological sciences or a related field is required. Candidates should have a strong record of funded research, refereed publications, a commitment to teaching, and collaboration with colleagues in other areas of specialization.

The successful candidate will be expected to develop an independent research program in paleoclimatic reconstruction, work closely with the Ohio State ice-core paleoclimate research program and participate broadly with the department's research programs. Expertise in stable isotopes of oxygen, hydrogen, and/or carbon is desirable. Teaching will involve courses at the introductory and advanced levels. The successful candidate will be expected to maintain strong research ties with the Byrd Polar Research Center and faculty in geological sciences and other departments and disciplines (e.g., Department of Chemistry and Department of Geography). The successful candidate will also be expected to generally participate in the Ohio State University Environmental Sciences initiative.

The Department of Geological Sciences has 24 full-time faculty and approximately 70 graduate students. The department is well equipped with laboratory and computing equipment and is occupying newly renovated laboratory, classroom and office space. To apply, send a curriculum vitae, statement of research and teaching interests, and names of three referees to Search Committee Chair: Professor Lonnie G. Thompson, Department of Geological Sciences, 155 South Oval Mall, Columbus, OH 43210. The search committee will begin reviewing applications on January 1, 2000, and will continue until a suitable candidate is hired.

The Ohio State University is an equal opportunity/affirmative action employer. Women, minorities, Vietnam-era veterans, disabled veterans, and individuals with disabilities are encouraged to apply.

THE OHIO STATE UNIVERSITY
GENETIC STRATIGRAPHER

The Department of Geological Sciences at The Ohio State University invites applications for a tenure-track position in genetic stratigraphy. The position is at the assistant professor level, although a position at a higher rank will be considered and may begin as early as September 2000. Candidates with interests and demonstrated skills in interpreting the depositional architecture of sedimentary fill in basins are encouraged to apply. Particularly suitable areas of research interest include outcrop and/or subsurface-based sequence stratigraphy, chemostratigraphy, and computer modeling of stratigraphic sequences. A Ph.D. in geological sciences or a related field is required. Candidates should have a strong potential for funded research, have refereed publications, and have a commitment to teaching. The successful candidate can expect to interact closely with existing programs in sedimentology, biostratigraphy, paleobiology, Quaternary geology and global change, geophysics, and hydrogeology.

The successful candidate will be expected to maintain an active funded research program, advise graduate students, and contribute to the teaching mission of the department at both the undergraduate and graduate levels.

The Department of Geological Sciences is a comprehensive earth sciences department, with 24 regular faculty that maintain close ties with inter-disciplinary research centers on campus, including the Byrd Polar Research Center and the Center for Mapping.

To apply, send a curriculum vitae, statements of research and teaching interests, and names of three referees to Search Committee Chair, Department of Geological Sciences, 155 South Oval Mall, Columbus, OH 43210, USA. The search committee will begin reviewing applications on January 5, 2000, and will continue until a suitable candidate is hired. The Ohio State University is an equal opportunity/affirmative action employer. Women, minorities, Vietnam-era veterans, disabled veterans, and individuals with disabilities are encouraged to apply.

GRAND VALLEY STATE UNIVERSITY
GLOBAL CLIMATE CHANGE, GLOBAL SYSTEMS, AND CYCLES

Tenure-track assistant professor of geology position beginning fall 2000. Ph.D. in Geosciences required. Expertise desired in global climate change with an emphasis on atmosphere-hydroshpere-lithosphere interactions. Preference will be given to candidates with secondary expertise in meteorology, planetary geology, GIS, remote sensing, or surficial geology. A strong commitment to teaching and doing research with undergraduate students is essential. Preference will be given to candidates with teaching experience and interest in contributing to an environmental emphasis in the geology major. The successful candidate will teach introductory geology courses and courses in her/his specialty. Candidates should also have an expressed interest in developing and teaching courses for a proposed Master of Education program with an emphasis in earth science.

The department currently is composed of eight faculty members, a lab supervisor, and 70+ majors, divided between geology and earth science or group science education. Of the geology majors, approximately half go to graduate school and half obtain position in the environmental field.

Send letter of application, a vita, a succinct statement of teaching philosophy, and the names, addresses, e-mail addresses, and phone numbers of three references to: William Neal (nealw@gvsu.edu), Chair, Department of Geology, Grand Valley State University, Allendale, MI 49401. Applications must be postmarked by November 8.

GVSU is an Affirmative Action/ADA and Equal Opportunity Employer.

ENVIRONMENTAL GEOLOGY
DEPAUW UNIVERSITY

The Department of Geology and Geography at DePauw University invites applications for a three-year term position in Environmental Geology at the rank of Assistant Professor (Instructor for ABD) beginning August 15, 2000. We desire a person who is broadly trained in the geosciences with expertise in geochemistry/hydrogeology. 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. 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. Review of applications will begin October 15 and will continue until the position is filled. We plan to conduct interviews of selected applicants at the 1999 GSA meeting in Denver. DePauw University is an affirmative action, equal opportunity employer. Women and minorities are especially encouraged to apply.

Consultants

Global Geological Services is experienced with geological consulting to domestic and foreign Engineering, Geotechnical, and Environmental projects. For information on services, contact by e-mail: globgeosrv@aol.com or fax: 909-735-9908.

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For Sale: J. Petrology, V. 1-37, plus Spec. Vols. 1988 & 1991. US$3000 + shipping f.o.b. Ottawa, Canada. Contact thfrisch@nrcan.gc.ca.

Books: Geology and 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. E-mail: pldaniel @horizon.hit.net. Web site: www.hit.net/~pldaniel

Opportunities for Students

Graduate Student Opportunities in Earth Sciences, Lehigh University. The Department of Earth and Environmental Sciences of Lehigh University has Graduate Student Fellowships for highly qualified individuals. The department has active research programs in tectonic studies (geochronology, stable isotope geochemistry, low temperature geochemistry, seismology, high resolution geophysics, structural geology, paleomagnetism) and surficial processes (low temperature geochemistry, fluvial and tectonic geomorphology, glacial geology, hydrology, and limnology). Please contact Prof. D. Morris, Dept. of Earth and Environmental Sciences (dpm2@lehigh.edu) or see our Web page for more details (http://www.ees.lehigh.edu).

Department of Geosciences, University of Arizona, announces the availability of Sloan Scholarships for minority Ph.D. students in the geosciences. The Alfred P. Sloan Foundation and the Department of Geosciences are committed to increasing the number of African-Americans, Hispanic-Americans, and Native Americans receiving Ph.D.s in the geosciences. Sloan scholars receive fellowship support, three summers of research support, a research allowance, and peer and faculty mentoring. Additional support through other fellowships and teaching or research assistantships are also available. Inquiries and requests for applications to: Graduate Program, Department of Geosciences, The University of Arizona, Tucson, AZ 85721. Or gradapps@ geo.arizona.edu and http://www.geo.arizona.edu. ■

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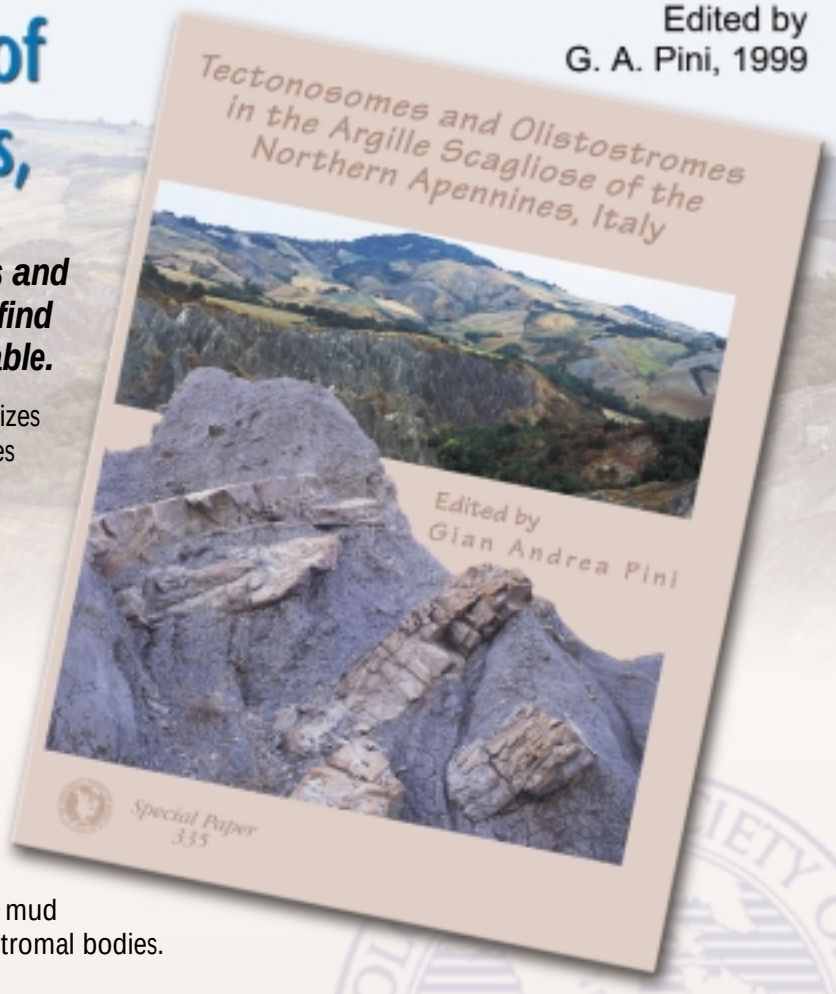
Tectonosomes and Olistostromes in the Argille Scagliose of the Northern Apennines, Italy

Edited by
G. A. Pini, 1999



Every geologist interested in melanges and in the evolution of orogenic belts will find this profusely illustrated volume valuable.

A summary of the geology of the northern Apennines familiarizes the reader with this classic orogen. Field and laboratory studies reveal new information on the origin of the *argille scagliose* — scaly clays — in their type area in the northern Apennines of Italy. These stratally disrupted rocks, with prevailing block-in-matrix fabric, have been regarded for more than a century as gravitationally induced, chaotic assemblages.

This 73-page volume includes a discussion of criteria for subdividing the *argille scagliose*, at both map and outcrop scales, into either strongly deformed stratigraphic units—tectonosomes, or sedimentary bodies emplaced by mass flow—olistostromes.

Evidence shows that olistostromes mostly were derived from the tectonosomes. Debris flows and avalanches and, possibly, mud diapirism have contributed to the final character of the olistostromal bodies.

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