

GSA TODAY

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MANNA FROM MANN'S

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Director of Development,
GSA Foundation*

GSA, IEE, and the GSA Foundation join in recognizing John and Carol Mann for their continuing and extraordinary investment in the Society. In 1994, the Manns created a charitable remainder unitrust; in 1996, they contributed a major cash gift; last October they pledged another major gift; with an aggregate value exceeding \$2 million, their gifts place the Manns among GSA's most important benefactors.

Since its inception, the Geological Society of America has profited and prospered from the dedication of the membership to the organization's welfare. To describe GSA's success is largely to recite the names of those whose time, talent, and philanthropy first ensured its existence and have since ensured its vigor. Among the philanthropists, one name has long been pre-eminent in GSA's modern history—R.A.F. Penrose, Jr. More recently, the names of Joseph Pardee and John Mann are becoming comparably important to GSA's future.

In the epilogue to his 1982 history of GSA, Edwin B. Eckel posited that the 90 years of the Society's life to that time were almost equally divided into two epochs. The first, extending from the Society's founding in 1888 to 1931, was "marked by gradual growth in maturity, numbers, and prestige, in parallel with significant additions to the body of geologic knowledge." By 1931, Society membership was approximately 600, annual income and expenses were in balance at about \$12,000 augmented by



John and Carol Mann celebrate with GSA Foundation President Bob Fuchs at the 1997 Annual Meeting in Salt Lake City.

an asset portfolio of \$50,000, and the administration (three part-time positions) worked in a room at Columbia University.

Then, on July 31, 1931, Richard Alexander Fullerton Penrose, Jr., died. A man of exceptional intelligence and achievement, he gave to GSA a powerful legacy of leadership and security. In his lifetime, he was both a venturer, developing the Utah Copper Company and selling the thriving enterprise to Kennecott Copper, and a scholar, pursuing as well as supporting field and scientific research and amassing an important library of geological texts. In his lifetime, he served GSA as president and as benefactor, endowing the award now known as the Penrose Medal. At his death, he bequeathed half his considerable fortune and all of his library to GSA, realizing a gift in excess of \$4 million and launching the Society's second epoch.

In the period from 1932 to 1980, virtually every Society activity was affected both by the opportunities arising from the Penrose bequest and by coincident and unprecedented increases in the body of knowledge, the quality of technology, and the number of professionals. By 1980, GSA's membership had reached 12,600, its annual operating budget was \$2 million, and an

administrative staff of 50 had relocated to a headquarters building in Boulder, Colorado.

Speculating about the possible nature of GSA's third epoch, Eckel prophesied that it would require infusion of large amounts of new money to fuel the expansion in activities that gave unique character to the Penrose epoch. Perhaps not accidentally, 1981 saw the birth of the GSA Foundation to support what Eckel termed "the single grandest scheme ever conceived by a scientific society": the proposed Decade of North American Geology project to commemorate GSA's centennial.

Since that beginning, nearly \$14 million in revenue from gifts and grants has supplemented income from operations and the Penrose Endowment. One-third of that total is attributable to the benefactors of the third epoch.

Joseph T. Pardee was a westerner born and bred, and his life was spent in the field as a 32-year employee of the U.S. Geological Survey. In that 32 years, his investigations ranged from glacial deposits to gold deposits, from mine sites to dam sites. Operating almost exclusively in the Northwest and Montana and purposefully avoiding the limelight, he nonetheless contributed

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to site selections of the Grand Coulee and Hungry Horse dams, produced an authoritative compilation of ore deposits in west-central Montana, and provided observations key to resolution of the Channelled Scablands controversy that occupied geological attention throughout four decades. His was a useful if modest career. Yet following the death in 1994 of Pardee's daughter, Mary Kelly, GSA succeeded to their combined estates in the amount of \$2.7 million.

As with the Penrose bequest, the GSA Council elected to treat the "windfall" as an endowment, investing the initial gift and using only the earnings for the intended program support. Even with this far-sighted restriction, the Pardee Fund currently produces over \$150,000 to further geoscientific research, study, and educational advancement. Thus applied to assisting the aspirations of the next generation of geology professionals, the Pardee gift is proving the prescience of Eckel's prophesy.

Most recently we celebrate the generosity of John and Carol Mann. Although as the grandson of one born in Cistern Yard in Colchester, England, John might be thought to have water in his genes, his road to prominence as a hydrogeologist was lengthy and digressive. In fact, he had worked in an investment company, a bank, a bakery, and a cafeteria before finishing college at Colorado School of Mines. Upon graduation, he joined Frontier Refining Company and didn't get to water until the U.S. Navy sent him to the South Pacific in 1944. Surveying the Bikini lagoon proved to be the ticket to a career. The experience, translated to Lake Elsinore in southern California, became a master's thesis and a doctoral dissertation at the University of Southern California (USC).

John stayed on with the USC faculty, advancing to Acting Chairman of his

department, and continuing to teach for 19 years while simultaneously developing a consulting business specializing in ground water. Among his first consulting clients was the United Water Conservation District forming northwest of Los Angeles. The relationship endured for 42 years and generated some truly pioneering work, including the 1959 report "A Plan for Ground Water Management," which may be the first formal application of the concept. John's accumulating expertise, while focused in the Los Angeles region, was recognized and sought as far afield as Spain, Egypt, and in the shadow of his grandfather's English birthplace. His creative understanding of his subject has made a lasting mark on water policy and law.

The Mann gifts synthesize the vision of Penrose and Pardee and reflect John's dual commitment to academic and applied geology, directing the benefit equally to education and outreach. In recognition, GSA is creating the John F. Mann Institute for Applied Geoscience and will conduct several of the GSA Institute for Environmental Education programs under the sponsorship of the Mann Institute.

The activities include the John F. Mann Mentor Program in Applied Hydrogeology, the National Park Service internships, the annual Environmental Forum, the Geology and Environment Public Outreach Program, and the media workshops. Each program has established a secure footing and is ready for further growth. Each has proven potential for meaningful impact, whether on professional development or on public engagement in the geosciences. Together they represent the broad spectrum across which the geoscience community can contribute to public awareness of environmental issues and professional application of specialized knowledge to education and opportunity. ■

Environmental Change, Geoinicators, and the Autonomy of Nature

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ABSTRACT

Geological indicators of rapid environmental change provide a conceptual framework for assessing changes in the abiotic components of landscapes and ecosystems resulting from natural processes or human actions. The application of geoinicators to monitoring of landscape conditions, particularly in state-of-the-environment reporting and long-term ecosystem research, can help earth scientists to contribute more effectively to these interdisciplinary efforts. Geoinicators may also help to remind policymakers and the general public of the reality of natural change and the common difficulty of distinguishing it from human modifications.

ENVIRONMENTAL SUSTAINABILITY: ARE WE GETTING CLOSER?

As the millennium approaches, the most important new development in human thinking may well be embodied in the concept of sustainability, which has at its core the goal of economic, social, and environmental conditions that meet the present and future needs of people everywhere. Despite inevitable overworking, the concept requires an attempt to think and plan for the long term. This is clearly seen in recent international agreements on climate change, atmospheric ozone, forestry, and biodiversity, in which the goals may not be achievable until well into the next century and beyond.

Achieving any kind of sustainability requires a capacity to assess current conditions and trends, so that policies and practices can be tested and revised as needed. Much effort is now being devoted to developing standard economic, social, and environmental indicators with which to assess social and environmental conditions (Hammond et al., 1995; Moldan et al., 1999).

As a key part of this activity, state-of-the-environment reporting has now become commonplace. In the past decade, several hundred such reports have been published for continental regions, nations, states and provinces, and even individual cities. The general aim is to assess and report on what is happening in the environment, the significance of any changes, the reasons for changes (e.g., within the context of global climate change), and the usefulness of societal responses. Are physical, chemical, and biological pressures on the environment increasing or decreasing? If so, in what ways? Are the health and

integrity of ecosystems being maintained, reduced, or enhanced?

A FAILURE OF EARTH SCIENCE

Despite the obvious importance of state-of-the-environment reporting, most published reports appear to ignore key abiotic components of landscapes and ecosystems. For example, neither the 1991 national state-of-the-environment report for Canada (Environment Canada, 1991) nor that for British Columbia (British Columbia Ministry, 1993) mention changes in ice fields and glaciers, changes that have significant implications for hydroelectricity generation, water supplies, fisheries, and outdoor recreation. Neither is there reference to seismicity, notwithstanding much public activity and expenditure on disaster preparedness in the Pacific Northwest. Despite some notable exceptions (e.g., Critical Trends Assessment Project, 1994), few state-of-the-environment reports assess the state of ground-water resources, changes in coastal or fluvial erosion and deposition, the physical condition of soils in areas of extensive ground frost, or the extent of slope instability that could lead to significant landslides and mass wasting.

For example, in the authoritative Guide to the Global Environment, the World Resources Institute (1996), in its review of major problems of rapidly growing urban areas, virtually ignores geohazards (McCall et al., 1996), whether catastrophic (e.g., earthquakes, volcanic eruptions, landslides) or slower and more pervasive (e.g., surface subsidence, ground-water contamination and depletion, sea-level change, erosion). How, for example, could one work sensibly to resolve environment challenges in and around Mexico City, Bangkok, Shanghai, Bogota, or San Francisco without recognizing the importance of seismicity, ground-water pollution, surface subsidence, or slope failure?

The report also estimates that some 34% of the world's coasts are at high risk of degradation, and an additional 17% are at moderate risk; the great majority of European and Asian coasts are in these two categories. The emphasis is on threats from coastal development rather than from natural forces: risks to coastal zones with cities or ports are "automatically" ranked as being high, as are areas where the population, road, or pipeline density is high. Little is said about the background natural processes of erosion, deposition, and subsidence. The question must be

asked, Would delicate ecological niches and coastal habitats along dynamic coastlines, such as the southeastern seaboard of the United States, be stable and their organisms safe from harm if no human development were present? Innumerable studies have shown that coastal changes resulting from wave forces and longshore transport are the norm here, despite human attempts to stabilize shorelines with breakwaters and beach armour (Pilkey and Dixon, 1996). In the United Kingdom too, planners have largely failed to take into account the dynamic nature of the coastal zone (Lee, 1993).

Another direction in assessing environmental health is long-term ecosystem monitoring, usually carried out so as to anticipate change, and to contribute to sustainable management and restore ecosystem function and integrity (Risser, 1991; Leigh and Johnston, 1994). Such programs are becoming more common, both for their important contribution to state-of-the-environment reporting and for more fundamental research reasons, yet many appear to ignore or minimize abiotic components (Hughes, 1995). How can changes in ecosystems be understood without assessing the state of their chemical and physical (landscape) components and without understanding the past trends that have led to current conditions?

Geologists see very well the vagaries of nature and are learning to read its record much more carefully, but it has been an uphill battle to convince others that abiotic processes are an integral part of ecosystem and environmental behavior. This may be the result of our very long time perspective, which tries the patience of those coping with short-term problems, or it may be a question of research focus and language (Moores, 1997). In any case, the gap might be partly bridged with simple tools to assess the condition of the geological environment. How can we assess landscape change on spatial and temporal scales that are meaningful to environmental planners and the general public? What geological processes and phenomena should be monitored?

GEOINDICATORS—AN APPROACH TO LANDSCAPE MONITORING

A response to these questions has been developed by COGEOENVIRONMENT, the International Union of Geological Sciences Commission on Geological Sciences for Environmental Planning

Geoinicators continued on p. 4

TABLE 1. GEOINDICATORS AND SOME ENVIRONMENTAL CHANGES THEY REFLECT

Geoinicator	Change
Coral chemistry and growth patterns	Surface-water temperature, salinity
Desert surface crusts and fissures	Aridity
Dune formation and reactivation	Wind speed and direction, moisture, aridity, sediment availability
Dust storm magnitude, duration, and frequency	Dust transport, aridification, land use
Frozen ground activity	Hydrology, downslope movement, especially in active layer
Glacier fluctuations	Precipitation, insolation, melt runoff
Ground-water chemistry in the unsaturated zone	Weathering, land use
Ground-water level	Abstraction and recharge
Ground-water quality	Industrial, agricultural and urban pollution, rock and soil weathering, land use, acid precipitation, radioactivity
Karst activity	Ground-water chemistry and flow, vegetation cover, fluvial processes
Lake levels and salinity	Land use, streamflow, ground-water flow
Relative sea level	Coastal subsidence and uplift, fluid withdrawal, sedimentation, and compaction
Sediment sequence and composition	Land use, erosion, and deposition
Seismicity	Natural and human-induced release of earth stresses
Shoreline position	Coastal erosion, land use, sea levels, sediment transport, and deposition
Slope failure—landslides	Slope stability, mass movement, land use
Soil and sediment erosion	Surface runoff, wind, land use
Soil quality	Land use, chemical, biological, and physical soil processes
Streamflow	Precipitation, basin discharge, land use
Stream channel morphology	Sediment load, flow rates, climate, land use, surface displacement
Stream sediment storage and load	Sediment transport, flow rates, land use, basin discharge
Subsurface temperature regime	Heat flow, land use, vegetation cover
Surface displacement	Land uplift and subsidence, faulting, fluid extraction
Surface-water quality	Land use, water-soil-rock interactions, flow rates
Volcanic unrest	Near-surface movement of magma, heat flow, magmatic degassing
Wetlands extent, structure, and hydrology	Land use, biological productivity, streamflow
Wind erosion	Land use, vegetation cover

Note: Modified from Berger (1997).

Geoindicators *continued from p. 3*

(Berger and Iams, 1996). This approach is based on standard methods for measuring geochemical, geophysical, and geomorphological processes (e.g., Goudie et al., 1990). It aims to synthesize for any partic-

ular area all the contemporary geological changes that might be significant for environmental assessments. The emphasis is on changes that are naturally induced, with or without human input.

Geoindicators are defined as magnitudes, frequencies, rates, or trends of geo-

logical processes and phenomena that occur at or near Earth's surface and that are significant for assessing environmental change over periods of 100 years or less. Included are both rapid-onset (i.e., catastrophic) and more pervasive, slow-onset events that are generally evident within a human lifespan, whereas important but slower earth processes such as plate tectonics, basin subsidence, and diagenesis are excluded.

There are obviously numerous parameters that could be monitored, but to reduce these to a manageable number, 27 geoindicators have been identified (Table 1) and compiled from standard methods and techniques (Berger and Iams, 1996; complete checklist available on the Internet at www.gcric.org/geo). Together they constitute a kind of landscape metric, a collection of tools for assessing landscape change in any terrestrial or coastal setting. Most can be monitored by inexpensive means, though some geoindicators, such as ground-water, soil, and surface-water quality require complex and costly analyses. Some are quite straightforward, such as shoreline position, presence and condition of desert surface crusts, or ground-water level, but others are composites of many related processes, such as karst and frozen ground activity, and volcanic unrest.

By including measures of past environmental change, such as coral growth rings and sediment sequence and compo-



Figure 1. Western Brook Pond in Gros Morne National Park, Newfoundland, a popular location for boat tours. Frequent rock falls and slides occur along the 650-m-high cliffs. What is the rate of slope failure and mass movement, and how does this affect lake levels and water quality in this oligotrophic pond? Photo courtesy of Parks Canada.



Figure 2. A coastal community where monitoring of geoinicators could assist planning. To what extent are the river channel and its streamflow and sediment load liable to change? The shoreline position has certainly been affected by postglacial adjustments (note the raised terraces). How fixed is it? How stable are the slopes above the settlement and the cliffs along the shore? Photo of Trout River, Newfoundland, by D. R. Grant, 1969.

sition, geoinicators help to emphasize the importance of the geological archive for ecosystem monitoring. This task is easier now that paleoenvironments can be deduced from ice cores, lake sediments, speleothems, and other proxies with the kind of resolution that is useful for assessing short-term changes. As Shen (1996) pointed out, such geoinicators can function as inexpensive automatic field data stations, whose record can be collected from time to time and “played back” to extract information on environmental change.

The geoinicator checklist will certainly need revision and refinement, for there are gaps and inconsistencies (Berger and Iams, 1996, p. 386–389; Berger, 1997). For various reasons, oceanic environments are excluded, as are tree rings and lichens, methane degassing, rock weathering and stresses, and geomagnetics. The checklist excludes parameters relating to nonrenewable mineral and energy resources, since changes in these are unlikely to be naturally induced within the time frame under consideration. An international project on the human contribution to global geomorphological change is currently developing indicators for this purpose (Osterkamp and Morton, 1996). Another avenue for further research concerns ways to combine or aggregate separate measures (Elliott, 1996). Instead of environmental managers having to cope with many unrelated parameters, it would be convenient to have a few simple composite indices that would convey the overall state of geological condition and change.

Figures 1 and 2 illustrate situations where geoinicators could provide guid-

ance in environmental management. Other potential applications include modeling of landscape and terrestrial ecosystem change, assessments of ecosystem health and integrity (e.g., in forest management, wilderness areas, or mining districts), and evaluating the environmental condition of urban or industrial areas. COGEOENVIRONMENT is eager to cooperate with scientists and environmental managers anywhere using geoinicators to assess landscape changes for planning wilderness protection, forest regeneration, urban development, etc. It will, however, take some time to test the concept properly.

The use of geoinicators or, for that matter, any other approach to the assessment of environmental condition, raises the question of the relative importance of natural and human-induced actions or stresses in causing change. Dealing with this question runs directly into “anthropoblamism”—the attitude that natural environments left untouched by humans are stable and unchanging, and that it is only human actions that cause change.

ACKNOWLEDGING NATURAL CHANGE

Natural change was very much a part of the early philosophies. Taoist thought incorporated the notion of a world ever in flux. Plato’s *Timaeus* advanced a philosophy of change through time, based on cycles in which the world is periodically destroyed by catastrophes. With the Enlightenment and the rise of determinism, however, came the idea of a universe amenable to scientific analysis, and the

notion that nature was effectively stable. For example, in his influential work, Marsh (1864, p. 29) stated that where humans were not present, the only geological changes were so slow that they could be regarded “as constant and immutable,” leaving nature with an “almost unchanging permanence of form, outline and proportion.” In “comparatively rare cases of derangement” such as earthquakes and landslides, nature “sets herself at once to repair the superficial damage and to restore, as nearly as practicable, the former aspect of her dominion” (Marsh, 1864, p. 35).

Today, it is anthropogenic stress on the environment that is rightly the central concern, for human actions now affect much of Earth in one way or another (Meyer, 1996). However, so intent is the discussion on the harmful results of human actions on ecosystems and landscapes that natural change and its effects on land and the biosphere tend to be overlooked. The Framework Convention on Climate Change, for example, speaks of protecting the climate system for the benefit of present and future generations, and directs governments to take precautionary measures to anticipate, prevent, or minimize the causes of climate change and mitigate its effects. There is little mention that human-induced changes are superimposed on, and interact with, natural climatic variations that in the past were on occasion much more marked than those currently predicted. Neither does the more recent intergovernmental report on climate change (IPCC, 1996) make much of this obvious fact. The recognition that natural processes continue to set the biophysical context for life, as they have throughout its evolution, also appears to be ignored or downplayed in other recent international agreements. The Convention on Biological Diversity contains no statement recognizing that biodiversity is also affected by natural events and processes beyond our current capacity to predict and control.

The general conviction seems to be that if biodiversity and the biosphere are now in a “perilous state,” this has been “caused by human activity” (Kim and Weaver, 1994, p. 393). From the perspective of deep ecology, “the environment created by nature is perfect as it is and has created no problems” (Drengson, 1989, p. 5). The complete marginalization of nature is neatly exemplified by the title of McKibben’s (1989) popular book, *The End of Nature*, in which he argues that nature unaffected by human actions no longer exists.

Even the efforts of the International Decade for Natural Disaster Reduction and the extensive literature on natural hazards (Burton et al., 1993) do not seem to be

Geoinicators continued on p. 6

reflected in environmental thinking. This may be so in part because labeling as disasters natural changes such as river floods or storm-generated destruction of barrier islands implies that they are not part of the natural background, but rather surprising anomalies. In ancient times, disasters were commonly regarded as punishment by the gods for human transgressions. Now they are aberrations of nature to be compensated for by government emergency funding, insurance payments, or settlements from legal claims against those held to be responsible.

Despite the major efforts of global change research to model natural changes in climate, atmospheric chemistry, and ecosystems, the public seems to believe that if only humans would not interfere, natural change would be slow, benevolent, and predictable, and ecosystems and their organisms would always adapt without significant harm. It is only humans who cause landscape disturbances: ecosystems away from human influence, therefore, remain undisturbed. Human actions control the state of the environment, and what is needed to achieve sustainability is simply a better regard for and management of land, ecosystems, and habitats.

There is a strong ethical dimension to this worldview. "It is genuinely immoral to destroy a species or an ecosystem—a bounded, self-maintaining habitat" (Anderson, 1996, p. 182). Aldo Leopold's dictum turns up time and again: "A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends to do otherwise" (Leopold, 1968, p. 224). This makes sense when we consider human stresses on nature, but rather less when seen from the perspective of natural evolution and change. Is a wilderness landslide that blocks a fish-laden stream "wrong"? Climate warming that melts late-lying snow-beds where rare plants grow? Or a wandering bolide that smashes into Earth, extinguishing species en masse?

A landscape being overrun by desert sands, or a coastal plain drowning by rising sea levels may not be healthy in the sense of functioning well, or sustainable in the sense of lasting, but nature is rarely at rest for long, and is full of surprises and "disvalues," as Rolston (1992) termed them. "Permanence is an illusion; any balance is not only temporary but contingent on what went before" (Dickinson, 1995, p. 3). Botkin (1990) and Watson (1995) have advanced similar arguments from the perspectives of ecology and biology.

Many natural environmental changes are highly beneficial and rejuvenate soils, landscapes, and ecosystems. However, Petit-Maire et al. (1994) have described the widespread desertification of the savannas

TABLE 2. RELATIVE INFLUENCE ON GEOINDICATORS OF HUMAN STRESSES AND NATURAL (NONHUMAN) FORCES

Geoindicator	Natural forces	Human stresses
Coral chemistry and growth patterns	1	1
Desert surface crusts and fissures	1	2
Dune formation and reactivation	1	2
Dust storm magnitude, duration, and frequency	1	2
Frozen ground activity	1	2
Glacier fluctuations	1	3
Ground-water quality	2	1
Ground-water chemistry in the unsaturated zone	1	1
Ground-water level	2	1
Karst activity	1	2
Lake levels and salinity	1	1
Relative sea level	1	2
Sediment sequence and composition	1	1
Seismicity	1	2
Shoreline position	1	1
Slope failure (landslides)	1	1
Soil and sediment erosion	1	1
Soil quality	2	1
Streamflow	1	1
Stream channel morphology	1	1
Stream sediment storage and load	1	1
Subsurface temperature regime	1	2
Surface displacement	1	2
Surface water quality	1	1
Volcanic unrest	1	3
Wetlands extent, structure, and hydrology	1	1
Wind erosion	1	2

Note: 1 = Strongly influenced by; 2 = may be influenced by; 3 = no substantial influence on.

and grasslands of the central Sahara when hit by climate change some 5000 years ago. Issar (1993) traced the effect of natural environmental variations on the history of Middle Eastern societies and religions. These changes may well have been considerably slower than those now being caused by human actions. However, if the recent work on the Greenland ice cores is correct, there were very rapid swings in temperature in the last interglacial that make the predicted global warming look like child's play (Broecker, 1997). Ecosystems of that time are unlikely to have survived unscathed.

Obviously, efforts to develop a better environmental ethic and more sustainable practices of economic and industrial development must be continued and accelerated, so great is the risk of land degradation. However, defining the latter as due solely to human interference (Johnson and Lewis, 1995, p. 2) ignores the destructive power of nature. Putting all the blame on humans for the repeated deadly coastal flooding in Bangladesh, the submergence of coastal wetlands in the Mississippi delta, or massive landsliding in the mountains of southern Thailand does not seem the path to better environmental policies and attitudes (see also Schumm, 1994; Dickinson, 1995). As Passmore (1980, p. 213) pointed out, "a satisfactory philosophy of nature ... must recognize

that natural processes go on in their own way, in a manner indifferent to human interests and by no means incompatible with man's total disappearance from the face of the earth."

DISTINGUISHING HUMAN FROM NATURAL CAUSES

It is one thing to recognize the reality of natural environmental change, and quite another, particularly after the fact, to distinguish its effects from those due to human agency. Table 2 is an attempt to show the relative importance of natural forces and human-induced stresses in causing geoindicator change (for further details see the full geoindicator checklist in Berger and Iams, 1996). For example, a particular change in the shape and dimensions of stream channels or the capacity of rivers to store and discharge sediments might be a result of dams and reservoirs, irrigation systems, and river diversions, or the consequence of rainfall and flash floods, failure of watershed slopes, or variations in the supply of source sediments. The change could also be a consequence of the internal dynamics of fluvial flow (Schumm, 1994). Ground subsidence, seismicity, and slope failure are all natural processes that can also be triggered directly or indirectly by human action.

The question of causes becomes important in current discussions about assessing environmental and socio-economic sustainability. In developing ways to assess progress, the international Committee on Sustainable Development (1995) and many other national and regional organizations are following a driving force–response–state framework, in which driving forces (stresses, limited to those resulting from human actions) on environments, policy responses, and the resulting environmental condition (state) are recognized (Moldan et al., 1997). This distinction requires that the natural component of any particular environmental change be separated from the human contribution. Interactions between human and nonhuman inputs are oversimplified (Berger and Hodge, 1998).

Parks Canada, like some other national park services, now concentrates its efforts less on management of park visitors and more on maintaining ecosystem integrity. This is “achieved when ecosystem structures and functions remain unimpaired by human-caused stresses and native species are present at viable population levels” (Woodley, 1996, p. 51). The implication seems to be that there is no loss of integrity when natural stresses impair ecosystems or when “alien” species on their own invade new territory and overrun native species. Even if the reality of natural environmental change is accepted, applying this definition in practice again necessitates that natural and human-induced change be clearly distinguished.

The difficulty in distinguishing human from natural environmental change does not make any easier the management of landscapes and urban areas, but ignoring natural forces, in attitude, policy, and practice, would seem to guarantee failure. As Botkin (1990, p. 79) argued, “It is only by understanding how nature works and applying this understanding in our management of nature that we can successfully achieve our goal: people living within nature, neither poisoning it nor destroying its reproductive capabilities.”

CHALLENGING THE MYTH

Earth scientists can help to enhance the way in which environmental managers and the general public understand and accept the reality and complexity of natural landscape change. The geoinicator approach can be a helpful reminder both of the prevalence of natural fluctuations and of the difficulty of separating them from human-induced environmental change. Geoinicators may also prove to be useful tools for enhancing interdisciplinary research and communication, a way to connect with others concerned with environmental issues and problems.

By focusing on important landscape changes, it may be possible to integrate geoscientific knowledge and understanding more fully into ecology, forestry, hydrology, and environmental policy and management. It should also contribute to integrated monitoring and assessment programs and help to ensure their continuation (see the Gros Morne Declaration, *GSA Today*, May 1995).

A fuller recognition of natural change has important implications for sustainable development, environmental ethics, and the way we understand wilderness and nature. It also raises some difficult questions. How can the concept of sustainability and its application be reconciled with a nature that changes—sometimes suddenly—unpredictably and without human input? How can we plan for the unpredictable, the indeterminate? Does ecosystem restoration make sense if, as Dickinson (1995, p. 7) pointed out, “cumulative Holocene environmental changes are largely so irreversible that all hopes to restore the past are vain”? Even more important, how can we acknowledge the autonomy of nature without minimizing the dangers of human-induced change? In recognizing natural environmental change, how can we effectively counter the argument that since we do not know how the world climate would be changing in the absence of human inputs, we might as well continue forcing the atmosphere as it suits us?

We need better ways to assess changes to the landscape, whatever the cause, and to identify and track trends that can at least warn of impending thresholds beyond which new policies must be adopted. Our view of the environment is strongly influenced by our understanding of human stresses, which can be managed, regulated, and legislated (taxation, lawsuits), and natural processes, which by and large cannot. Society must not only reduce unsustainable human activities but must also adjust to natural fluctuations. Continuing to ignore the importance of natural change is bound to lead us farther down the blind alleys of reductionism and determinism, of nature as machine, and of harmful human dominance over the geosphere and the biosphere.

ACKNOWLEDGMENTS

The geoinicator concept is a cooperative effort to which many people have made significant contributions (see list in Berger and Iams, 1996). Discussions with Douglas Freake, Thom Heyd, and Carol Harris have been most useful. I also thank Peter Bobrowsky and Doug VanDine for their comments on earlier versions, and Jack Oliver and Eldridge Moores for reviews.

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GSA Sponsors Summer Internships in the National Parks for Undergraduate Geoscience Majors

GSA Undergraduate Student Associates: Would you like to spend this summer working as a geological interpreter or research assistant in a national park?

GSA is sponsoring five National Park Service undergraduate internships for the summer of 1998. Interns will work with park scientists and staff to develop interpretive programs, provide public education, and conduct research. Internships are available at the following parks: Badlands, Denali, Lake Clark, Petrified Forest, and White Sands.

Each internship carries with it a stipend of \$2500, to cover transportation, food, and incidental expenses. Accommodations in the park will be provided free of charge.

Internships will be awarded on a competitive basis to five junior or senior undergraduates majoring in geoscience. Applicants must be GSA student affiliates. (If you're not an affiliate and you want to apply for the internship, you may join GSA at the same time as you submit your application for the intern program.) Additional qualifications are listed in the individual internship descriptions, below.

Applications for a GSA-National Park Service Internship should include the following:

- One-page letter explaining your interest in and qualifications for the internship. The letter should also include (1) dates that you are available for the internship; (2) your preference (if any) for a national park placement, selected from the list of five parks described in this article; (3) your phone number; (4) your GSA membership number.
- A copy of your academic transcript (unofficial is okay).
- Your resume.
- One letter of reference from a faculty member in your geoscience department. (This letter may be included with your application package in a separate, sealed envelope, with the signature of the reference across the seal, or it can be mailed separately.)

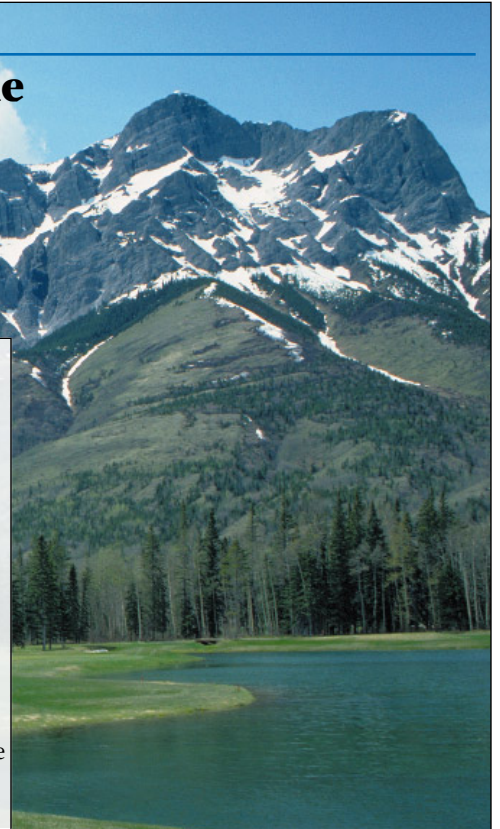
Send applications to: National Parks Internship Program,
Geological Society of America,
3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301

All application materials must be received at GSA headquarters by March 1, 1998.

The five successful applicants will be notified no later than *April 15, 1998*.

For more information, call (303) 447-2020 ext. 195, or e-mail bbrown@geosociety.org

The 1998 GSA-National Park Service Internship Program is supported by generous gifts from John F. Mann, Jr., and the Shell Oil Company Foundation. This program is administered by the John F. Mann, Jr. Institute for Applied Geoscience.



Internship: Badlands National Park, South Dakota

Carved by erosion, this scenic landscape contains fossil remains of mammals, birds, reptiles, and mollusks. Studied since 1847, the White River Badlands area of South Dakota is considered to be the birthplace of the science of vertebrate paleontology. Badlands National Park receives 1.3 million visitors each year, the majority seeking education about fossil and geological resources.

Position Description: The intern will spend 75% of the time in public education work through visitor-center staffing,

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Internships *continued from p. 8*

preparation and presentation of geology walks and paleontology talks, and writing text for exhibits and brochures. The rest of the time will be spent assisting at the Pig Wallow site or other field locations to provide on-site interpretation to park visitors or assist as needed.

Qualifications: Undergraduate junior or senior geoscience major with course work in introductory geology and invertebrate paleontology. It is preferable, but not required, that the individual has completed additional courses in historical geology, stratigraphy, sedimentology, and/or field methods. The intern must be prepared to speak before groups varying in size from 10 to 75, and to work with school-age children. The intern must also be able to translate technical data into material easily understood by the average park visitor.

A personal car is strongly recommended for this internship, but is not required.

Dates: May 24 through August 15, 1998. Availability for these dates is required.

Internship:

Denali National Park, Alaska

Capped by the magnificent Mount McKinley, Denali National Park and Preserve has a rich tectonic history that includes quiet marine environments overridden by multiple thrust sheets of widely diverse origins, veneered in late Tertiary glacial materials. A park-wide database, consisting of more than 1100 cited fossils (mostly marine invertebrates) in 276 localities, was established in 1997.

Position Description: An intern is needed to complete the paleontological database for the park, to determine sample sites for location confirmation, and to field-check those sites and collect reference samples for the park. Data management tasks include input and cross-correlation on the computer database, and recording of site locations on maps and in the park GIS system. Field tasks include field site visits for location confirmation and sample collection, as time and funding permit.

Qualifications: Undergraduate junior or senior geoscience major with course work in introductory geology, historical geology, and invertebrate paleontology. It is preferable, but not necessary, that the individual has completed additional courses in stratigraphy, sedimentology, structure, and field methods and mapping. Experience with database management (Microsoft Access) and GIS is also desirable. *Note:* Field work will be performed in areas of rugged terrain, including snow and ice, and requiring moderate to strenuous physical exertion. Back-country camping in all varieties of weather may also be required.

Dates: Early or mid May to mid- or late September.

Internship: Lake Clark National Park and Preserve, Alaska

This spectacular and remote wilderness park encompasses four million acres in southwestern Alaska, including glacially sculpted volcanoes of the Aleutian Range.

Position Description: The intern will develop a geology pamphlet describing the volcanic and glacial features of the park, using a GIS information database and other pertinent resources. Additional projects will include developing slide programs that explain ongoing glacial recession and volcanic activity, and field work on a glacier monitoring program.

Qualifications: Undergraduate junior or senior geoscience major with background and interest in geomorphology and volcanology, and the ability to research and prepare technical information for the general public. Knowledge of GIS systems is required. Course work in introductory geology, historical geology, geomorphology, and field methods and mapping is desired. *Note:* Lake Clark National Park and Preserve is extremely remote, in very rugged terrain, and with no nearby amenities. This internship is for a student who wants a true wilderness park experience.

Dates: Mid-May to mid-September.

Internship: Petrified Forest National Park, Arizona

A unique and spectacular assemblage of Triassic fossils is the prime attraction at Petrified Forest. Besides the famous displays of petrified wood, fossils include leaves, cones, clams, horseshoe crabs, insects, fish, amphibians, and some of the earliest known dinosaurs.

Position Description: Main duties will be to assist scientists who are conducting active field investigations in the park on a range of topics including Triassic paleoecology and dinosaur evolution, and to help monitor geologic and paleontologic resources in the park. In addition, interns will spend about 25% of their time provid-

ing public education on park resources, including geology walks, paleontology talks, and interpretive programs for children.

Qualifications: Undergraduate junior or senior geoscience major with course work in physical and historical geology, paleontology, sedimentology and/or stratigraphy, and field methods and mapping. This position requires moderate to strenuous hiking through rough terrain, as well as the interest and ability to convey geological concepts to a nontechnical audience.

Dates: May to September.

Internship: White Sands National Monument, New Mexico

White Sands features an unequaled display of gypsum dunes, rising as high as 60 feet, and representing all stages of dune formation and evolution. The monument also features unique plants and animals that have adapted to the harsh conditions within the world's largest gypsum dune field.

Position Description: The internship will focus on public education efforts, including development and presentation of talks about geology and dune ecology, and working at the information desk in the park's visitor center. These activities require the intern to synthesize current geological literature and use this information to explain current understanding of the dunes, as well as future research needs. The intern may also work on development of portable visitor center displays and materials for staff training.

Qualifications: Undergraduate junior or senior geoscience major with excellent oral and written communication skills, an interest in educating the public about geology, and an ability to convey geological concepts to a nontechnical audience. Course work in introductory geology, historical geology, geomorphology and/or sedimentology, and field methods and mapping is desired.

Dates: May 17 to mid- or late August.

What Your Professors Don't Tell You About The Real World (Because They Don't Know!)

Roy Shlemon Mentor Program in Applied Geology

This program bridges the gap between the applied and academic geology communities. Shlemon Mentors present one-day workshops for graduate and senior undergraduate geology students focusing on professional opportunities and challenges in applied geology. The Mentors are well-known practitioners in such fields as Quaternary geology, geomorphology, environmental geology, engineering geology, geoarchaeology, and hydrogeology. They will talk about everything from the technical aspects of their work to the challenges of running a business and testifying in court. Workshops will include extensive opportunity for discussion and may also include field trips, lab visits, and practical exercises.

The Roy Shlemon Mentor Program in Applied Geology will be held at the 1998 Northeastern, Southeastern, Rocky Mountain, and Cordilleran GSA section meetings.

For more information, consult the appropriate section meeting program announcements in *GSA Today*, or contact a member of the program committee for your section.

This program is administered by the John F. Mann, Jr., Institute for Applied Geoscience

WASHINGTON REPORT

Bruce F. Molnia

Washington Report provides the GSA membership with a window on the activities of the federal agencies, Congress and the legislative process, and international interactions that could impact the geoscience community. 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.

Geoscience Education: A Recommended Strategy and a Funding Opportunity

“Even if every new Ph.D. recipient could pursue a career in research, the nation would still want a large number of U.S. citizens to have a high degree of scientific understanding. Thus, strengthening geosciences education is an investment in the future of the nation and indeed the world, as well as in the future of the geosciences themselves.”

—Geoscience Education: A Recommended Strategy

In late 1997, the National Science Foundation (NSF) released a new report, *Geoscience Education: A Recommended Strategy* (NSF 97-171), that presents a series of strategies and recommendations to enhance the future of geoscience education into the next millennium. It enthusiastically embraces NSF’s increased emphasis on education, endorses the principle that research and education should be well integrated, and seeks to provide guidance for developing a strong education program for the geosciences. The report concludes that the geosciences are well suited to lead in this reform, beginning in the pre-college phase, “because the geosciences provide a natural window on the world of science.” It states, “Children display an innate curiosity about the physical world, and everyday events, such as weather forecasts, can be powerful examples of science in action. To be effective, education in science must begin early and take advantage of this curiosity before it is lost. Many young people emerge from the K–12 educational experience largely ignorant of science and frightened by technology. We know that many K–12 teachers lack an adequate background in science in general, and in geosciences in particular.”

The report is the result of the NSF Directorate for Geosciences (GEO) and its Advisory Committee for Geosciences (AC/GEO) concern that geoscience education needed to be addressed more fully within the context of GEO’s long-range planning process. AC/GEO is a group of 18 scientists drawn from academia, industry, and other government agencies. GEO and AC/GEO have made the improvement of geoscience education one of their top priorities. As a result, GEO and AC/GEO established a Geoscience Education Work-

ing Group (GEWG) consisting of representatives of the geoscience research and educational community, including some members of AC/GEO, and NSF staff from GEO and the Directorate for Education and Human Resources. The GEWG was chaired by Richard Somerville, an AC/GEO member from Scripps Institution of

“For too long, research has been such a dominant priority in this community that scientists have neglected the need to communicate with people other than themselves.”

Oceanography. GEWG members were William Bishop (Desert Research Institute and U.S. Department of Energy), Lawrence Braile (Purdue University), Susan Cook (Harbor Branch Oceanographic Institution), Linda Duguay (NSF Division of Ocean Sciences), Judith Hannah (Colorado State University), Ramon Lopez (University of Maryland—College Park), Nancy Marcus (Florida State University), Michael Mayhew (NSF Division of Earth Sciences), Joan Mitchell (NSF Division of Ocean Sciences), David Mogk (Montana State Uni-

versity), Theodore Moore (University of Michigan), Jewel Prendeville (NSF Division of Atmospheric Sciences), Robert Ridky (NSF Division of Undergraduate Education), Robert Ryan (WRC-TV meteorologist, Washington, D.C.), Perry Samson (University of Michigan), John Snow (University of Oklahoma), Denise Stephenson-Hawk (Clark Atlanta University), Pam Stryker (Barton Creek Elementary School, Austin, Texas), Marilyn Suiter (American Geological Institute), and Peter Wilkniss (formerly of NSF Directorate for Geosciences).

The report recognizes that GEO has had a long and successful history of funding our country’s geoscience research efforts. However, many forces are pressuring GEO to change traditional priorities so as to emphasize education, as well as research. Some of these result from the world of policy and politics, such as the need for greater scientific literacy in the general population. Others stem from the demographic realities of the science community itself, such as the overproduction of young Ph.D.s relative to the ability of the traditional research marketplace to absorb them.

The origin of many of the report’s recommendations is a 1996 GEWG workshop. Since that workshop, AC/GEO has reviewed the draft workshop report and GEO staff have evaluated the working group’s recommendations. In early 1997, the working group’s recommendations were integrated into the GEO Science Plan for FY 1998 to FY 2002. Additionally, more specific plans for implementation of geoscience education programs were developed by a GEO Education Team, which consists of staff from all three GEO divisions who have been given special responsibilities with respect to education. Assuming a stable GEO budget in the foreseeable future, the team set priorities for the most effective use of GEO resources. Their recommendations were discussed at the May 1997 meeting of AC/GEO. One direct result of the discussions triggered by the workshop and report has been the development of a special competition for Awards to Facilitate Geoscience Education. Initially, nearly \$1 million will be available. The Announcement of Opportunity for this competition is published as NSF 97-174; it also can be accessed from both the GEO (<http://www.geo.nsf.gov>) and NSF (<http://www.nsf.gov>) Web sites. If you are interested, you must act quickly, as the deadline for proposal submission is January 20.

The report states that the “simple step of proclaiming education a high priority for GEO will send a clear signal to the geosciences community that times have changed.” It further states that GEO’s support for faculty must be more than fund-

Washington Report continued on p. 11

ing research. It must enable faculty to participate in public outreach, in teacher training, and in improving the educational skills of the faculty themselves. It recommends that GEO must “energetically enhance” its partnership with NSF’s Directorate for Education and Human Resources, while recognizing that the directorate is an unknown to most U.S. geoscientists. Also recommended is that GEO “actively promote” the educational aspects of the many university-level consortia it sponsors, and that GEO facilitate the optimal educational use of the institutional networks associated with these consortia. The report recommends that GEO should also make small awards, some in the form of supplements to research grants, to support promising outreach activities of individual scientists. It suggests that GEO and the Directorate for Education and Human Resources could both support research in geoscience education, helping geoscientists to work with colleagues in fields such as education and cognitive psychology, in order to facilitate development of a new generation of geoscience educators. One mentioned mechanism is the cosponsoring of a high-level conference to discuss the present and future of geoscience graduate education and implications for education at all levels. The report emphatically states, “Geoscience education at the graduate and postdoctoral levels is more than supporting research assistants who will be molded in the practices of their advisors. It includes providing a strong foundation in the geosciences for professionals destined for diverse careers including law, business, public policy, and education.”

The report also encourages GEO to continue to strengthen its efforts to correct the underrepresentation of women and minorities in the geosciences by the establishment of fellowship and traineeship programs, undergraduate research experience programs, and computer-based geoscience teaching labs jointly supported by GEO and the Directorate of Education and Human Resources. The report encourages GEO to promote a number of avenues leading to increased geoscience outreach to teachers, students, and the public.

Perhaps the most important statement of the report is the Geoscience Education Working Group’s “deeply held conviction that GEO and the geoscience community it supports must change. The report concludes, “For too long, research has been such a dominant priority in this community that scientists have neglected the need to communicate with people other than themselves. Now it is clear that a better and broader public understanding of the science and its significance is truly essential, and that education is the only route to achieving this goal.” ■

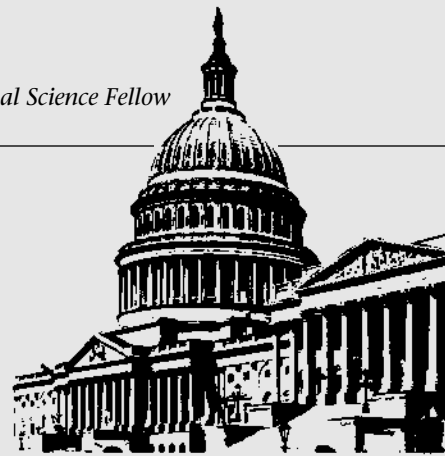
Congress Is Us

David Verardo, 1997–1998 GSA Congressional Science Fellow

FREEDOM IS NOT FREE. These words are inscribed in black granite at the Korean War Veterans Memorial in Washington, D.C. They are strong words that shout a fundamental truth which asserts that privilege and responsibility are inexorably linked. Yet despite a lucid social contract, activism in fundamental governance is often wanting. The question before geoscientists is: Are we doing as much as we can to meet our societal obligations as scientists and ensure that the relevance of our research and professional practice is understood?

Today, involvement of geoscientists in legislative and regulatory matters is critical to a salient and modulated debate on science policy issues. Constructive involvement, however, requires knowledge. Becoming knowledgeable requires effort. Luckily, being well informed about national geoscience issues has never been easier. Through financial support from a consortium of geoscience societies, including GSA, the American Geological Institute maintains a World Wide Web site (<http://www.agiweb.org>) with timely and nonpartisan information on legislative initiatives relevant to geoscientists. Beyond this site, the federal government maintains the THOMAS system at <http://thomas.loc.gov>. Here a user can view Senate and House activities, search for the content and status of legislation, and examine committee activities. So, the knowledge aspect of involvement is easily attainable. This leaves only individual action to achieve.

Relatively few are drawn to public involvement, even though much of what we do as geoscientists involves the public as both the underwriter and beneficiary of our work. Although many understand this dynamic and discuss its implication with colleagues, few take the next critical step to express their opinions to policymakers. As the political scientist David Greene wrote: “In politics, real intellectual victory is achieved not by transmitting one’s language to supporters but by transmitting it to critics.” Developing this communication skill is essential. Perhaps the perspective offered by Robert Fakundiny, State Geologist of New York, at the GSA Annual Meeting in Salt Lake City is the most realistic point of view. Bob likened his early experiences with legislators to his work as a Peace Corps volunteer. He recounted that working overseas required him to embrace a different culture. The key to success was to remember that different did not equate to less capable and that communication and openness were required to bridge cultural divides. In the context



of working with government, communicating is as easy as writing a short and focused letter to your elected representative regarding an issue or idea. The concept is to communicate clearly and often with legislators as one of their constituents.

Day in and day out, my public policy perspective is limited to an 8-inch-wide America. That is the size of the United States on my desk map. At that scale, it is easy to develop public policy. Only when you travel the land does the narrowness of that perspective seem absurd. America is a land of diverse geology and ideology. It must accommodate, as nearly as possible, the regional perspectives and realities on the ground. This is no easy task. It is important that public policy develop within a flexible framework that includes a variety of perspectives. Only an active citizenry can ensure meaningful debate and realistic policy formulation. Relegating that responsibility to a few hundred members of Congress, without continual citizen input, is folly. Responsibility begins—not ends—with the ballot. As geoscientists, we are sometimes of one mind on an issue. Often, however, we are a diverse group without a single message. Regardless, it is important for all geoscientists to be heard so that all perspectives are recognized. With this in mind, the Geology and Public Policy Committee of GSA will be working on several initiatives this year that require participation in national and local government affairs. To be effective, however, this effort requires the assistance of members from all GSA sections so that regional insights are included and narrow interests are avoided.

In summary, Congress is not THOSE people over there. It is each of us because we elect others as our representatives and expect them to consider our perspective. If this seems naive, consider recent turnabouts in the balance of political power in Congress when voters felt their interests were not represented. As geoscientists we need to change our culture and recognize that involvement in public policy formulation is as important to our professional

Congress continued on p. 12

development as is technical competence. We are comfortable with the concept of change and are patient with the medium in which we pursue our work. We know that *empiricus est taedium*—experience is tedious. Perhaps by integrating public policy scholarship into our repertoire of professional skills, we can aspire to another Latin adage, *semper paratus*, and remain *always ready* to serve our profession. ■

Dave Verardo, 1997–1998 GSA Congressional Science Fellow, serves on the staff of Senator Ron Wyden (D—OR). This one-year fellowship is supported by GSA and by the U.S. Geological Survey, Department of the Interior, under Assistance Award No. 1434-HQ-97-GR-03188. The views and conclusions contained in this article are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. government or GSA. You can contact Verardo by mail at 717 Hart Senate Building, Washington, DC 20510, by phone at (202) 224-3430, or by e-mail at david_verardo@wyden.senate.gov.

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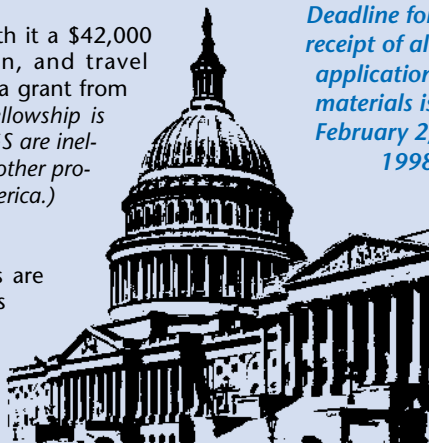
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—Clark E. McHuron



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The primary role of the Research Grants Program is to provide partial support for research in earth science by graduate students at universities in the United States, Canada, Mexico, and Central America. GSA strongly encourages women, minorities, and persons with disabilities to participate fully in this grants program. Eligibility is not restricted to GSA members. New application forms are available each fall in the geology departments of colleges and universities offering graduate degrees in earth sciences. Forms are mailed to GSA Campus Representatives, department secretaries, and chairpersons in the United States, Canada, and Mexico. They are also available upon request from the Research Grants Administrator, Geological Society of America, P.O. Box 9140, Boulder, Colorado 80301. *Please use only the current 1998 application and appraisal forms.*

Confidential evaluations from two faculty members are required from candidates for the M.S. or Ph.D. degree and must accompany applications submitted. PLEASE USE THE "APPRAISAL OF APPLICANT" FORMS, WHICH ACCOMPANY THE 1998 APPLICATION FORMS. Application forms will not be accepted by facsimile or E-mail.

The Geological Society of America awarded over \$300,000 in grants in 1997. The grants went to 188 students doing research for advanced degrees. The average amount awarded was \$1616. The largest grant was \$2500, but there is no predetermined maximum amount. Funding for this program is provided by a number of sources, including GSA's Penrose and Pardee endowments, the National Science Foundation, industry, individual GSA members through the GEOSTAR and Research Grants funds, and numerous dedicated research funds that have been endowed at the GSA Foundation by members and families.

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

**ALL APPLICATIONS MUST BE SUBMITTED ON THE 1998 FORMS
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Please note the new, earlier deadline date which begins in 1998.

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Creationism and Evolution: Still Crazy After All These Years

Eugenie C. Scott, National Center for Science Education, Inc.,
925 Kearney St., El Cerrito, CA 94530-2820, scott@natscienced.org

Yes, Virginia, there is antievolutionism, and it's alive and well. And, yes, it is the end of the 20th century, but nonetheless, outside of science, the ideas that the universe has changed through time and that living things have shared common ancestry are far from being uniformly accepted.

Item: In fall 1996, a principal in Marshall County, Kentucky, recalled the fourth-grade textbooks so that two offending pages on the Big Bang could be glued together. The reason? The textbook's presentation was one-sided: it didn't give equal time to Genesis.

Item: In summer 1997, *U.S. News & World Report* printed a feature article on a geologist in New Mexico who has devised a computer model that, so long as you feed in the "right" physical constants and

maybe change the rates of radioactive decay, will "prove" that Earth's major geological features were established during Noah's Flood.

Item: During fall 1997, the Learning Channel (of all places!) broadcast an antievolutionary program, "The Mysterious Origins of Man," that purported to "prove" through distorted science that humans are not a recent species, but date back 200 million years. I was surprised to learn that there is a conspiracy among scientists to hide important evidence from the public such as items of human manufacture found with Ordovician fossils. Geologists take note: did you know that when glaciers build up at the poles, the weight causes the Earth's crust to spin around? This explains why Atlantis is now under the South Pole.... Lots of other edu-

cational information was provided in this broadcast, such as human and dinosaur footprints together in the Paluxy River of Texas. "The Mysterious Origins of Man" was also shown to hundreds of thousands of viewers on the NBC national network during 1996. A sobering thought: it would be easy to calculate that more people watched the pseudoscience of that program than will ever read all professional scientific publications combined, unless you're Carl Sagan or (maybe) Steve Gould.

These "facts" may seem ridiculous to you, but don't overestimate the public's understanding and acceptance of evolution. To a Gallup poll question, "Man was created pretty much in his current form at one time within the past 10,000 years," 46% of the general public agreed. In contrast, only 5% of scientists (from a sample drawn from the 1995 *American Men and Women of Science*) answered "yes" (Witham, 1997). Surveys during the past 15 years or so have consistently shown that less than half of Americans accept that evolution occurred. In 1996, the National Science Board asked a sample of adult Americans, "Human beings, as we know them today, developed from earlier species of animals, True or False?" Only 44% agreed.

This low public acceptance of evolution is reflected in public school science classes. The National Center for Science Education, Inc., monitors the creation vs. evolution controversy and provides information and advice for those who wish to keep evolution in the classroom. We have found that antievolutionism takes two forms: "equal time" pressure to include religiously based nonscientific views in the curriculum, and pressure to discourage teachers from teaching evolution. The latter is far more common (and more difficult to deal with) than the former, but NCSE receives plenty of calls and letters about "equal time" for creationism.

School districts and individual teachers press for regulations requiring that creation "science" be taught when evolution is taught. (Creation "science" is an effort to support with scientific evidence a more or less literal reading of Genesis: special creation of the universe all at one time, in essentially its present form. The most commonly encountered variety of creation science is "young Earth" creationism, where the universe, Earth, and living things are felt to be no older than 6,000-10,000 years.) And yes, this is happening a full 10 years after the Supreme Court's decision *Edwards v. Aguillard* outlawed such "equal time" legislation.

Usually such efforts can be curtailed by suggesting that the Board of Education consult its legal counsel, as the legal prescriptions against teaching creation science are clear. But if nothing else evolves, creationism does: we now face a series of synonyms for creation science that avoid

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Bob Blodgett 1997 ESSTEP participant



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Applications for 1998 summer workshops are due March 1, 1998.

Funded in part by a grant from the National Science Foundation

using any form of the root “creation,” thus sounding far less religious to a court of law. The two most frequently encountered synonyms are “intelligent-design theory,” and “arguments (evidence) against evolution.”

“Intelligent-design” theory is an evolving view that first came on the scene in 1989 with the publication of a high school biology textbook, *Of Pandas and People*, by Percival Davis and Dean Kenyon. It revives William Paley’s “divine watchmaker” in arguing that structural complexity is evidence that God specially created the present-day world. But whereas Paley used anatomical examples such as the vertebrate eye for structural complexity, modern intelligent-design proponents are more likely to cite biochemical examples such as the structural complexity of DNA or the blood-clotting cascade. The basic argument is the same: such complex structures as the vertebrate eye or DNA couldn’t have occurred “by chance,” so they must have been specially designed. Of course, evolution is not chance. Natural selection is considered by most biologists to be the most important engine of biological change, and it is the antithesis of chance.

In his book *Darwin’s Black Box*, Lehigh biochemist Michael Behe claims that biochemical structures exist that are “irreducibly complex,” that could not function as they do if any component part were lost or changed. Therefore (he claims) they could not have been produced by the incremental process of natural selection. Therefore (he claims) they could not have evolved, and must have been designed by an “intelligence.” These conclusions indicate misunderstanding of an important characteristic of natural selection, in which components of a system may have been (and usually have been) selected for in the context of another structure or function, and then “taken over” for the current function. Jacob’s metaphor of evolution as a tinkerer rather than an engineer more accurately describes the workings of natural selection in evolution than do the presentations of intelligent-design proponents (Jacob, 1977). Extensive scientific and philosophical criticisms of intelligent-design theory are published on the World Wide Web, notably at <http://www.spacelab.net/~catalj/box/behe.htm>.

The theory is attractive to antievolutionists, however, because it may avoid First Amendment challenges by not appearing overtly religious (unless someone asks who the “intelligent designer” is, and then the religious underpinnings of the approach become clear). Another antievolutionist strategy likewise intended to avoid the Establishment Clause is to argue not for equal time for creation science and evolution, but for evolution and the “evidence against evolution.”

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What is the “evidence against evolution?” Why, the same arguments raised in creation science literature! Only without the “c” word. The First Amendment requires public schools to be religiously neutral; hence, to advocate a religious position like creationism is prohibited. By avoiding any word that uses the root “creation,” antievolutionists hope to avoid the challenge that theirs is a religious position. It may work. The First Amendment protects us against establishment of religion, not bad science. By arguing for the presentation of bogus “scientific arguments against evolution” (such as the coexistence of human and dinosaur footprints in the Paluxy River), they may not be violating the First Amendment, but they certainly are not improving the understanding of either the facts and concepts of science, or of science as a way of knowing.

Yes, teachers are pressed to teach creationism or its avatars, but a larger problem looms: teachers who feel too intimidated to teach evolution. Ironically, every Catholic school biology teacher I have spoken to teaches evolution; a far lower percentage of public school teachers do. Many teachers have told me that their principals discourage their teaching of evolution so as to “avoid controversy.” Parental and student complaints also tend to dampen enthusiasm for teaching evolution. A teacher from Massachusetts told me that students tell her “when we get to chapter 21, I’m out of here!” Parents pull students from class when evolution is scheduled. In both Tennessee and Ohio, laws have been proposed and narrowly defeated that would require teachers to teach evolution as “theory, not fact” (here “theory” does not mean “explanation,” but “hunch or guess you don’t have to take seriously”). Several districts and the state of Alabama have pasted disclaimers

in textbooks that single out evolution as a suspect concept students should have reservations about accepting. Such laws and disclaimers have a net effect of intimidating teachers, and decrease the likelihood of evolution being taught.

Scientists who are concerned about these matters can contribute professionally as well as personally. If you are teaching at a college or university, don’t assume that your students will understand, without your making it explicit, that evolution—the theory that the universe has changed through time—is the organizing principle of not just geology, but astronomy and biology as well. These sciences make sense only if phenomena in the universe—the stars, galaxies, solar system, Earth, and the life forms on it—are different today from what they were in the past, only if the universe has had a history. The alternate view is that everything appeared suddenly in its present form—the doctrine of Special Creation, for which there is no scientific evidence. This ahistorical view should not be confused with the broader issue of supernatural creation: many believe that indeed, God created, but brought about the present universe through the process of evolution. The issue in science is not whether God created—explaining Ultimate Cause is outside of our job description—but what happened: was there change through time, or not?

If no change through time took place, then our most fundamental explanations of nature are flawed. Astronomy, geology, and biology all deal with change through time, but depending on their differing subject matter, explain change using different mechanisms and processes. Plate tectonics in geology is quite a different

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process from natural selection in biology. But the big idea is the same for all sciences: the present is different from the past; the universe has had a history, which scientists from various fields are trying to understand. Many times scientists get wrapped up teaching their specific research areas, and they forget the massive forest out there, which students often can't see for the trees. The more specific you are about evolution and its role in science, the more enlightened your students will be.

There are other ways that scientists can contribute to a better public understanding of evolution and science. It is important for all of us to pay attention to what is happening in our local schools. Do the state and/or district science education guidelines (called "standards," "frameworks," or other terms) require teachers to teach evolution? More important, is evolution actually being taught, or are teachers intimidated? What is the evolution content of textbooks used in the schools: is evolution used as an organizing principle or is the subject tucked into a few easily skipped chapters? Scientists need to make sure teachers know they are supported, and this can be done in a variety of ways. Offer to present a seminar in "recent developments in (field X)" to science teachers in your district, or in your state's annual science teacher convention. (It's probably a better use of your time and expertise than appearing as a guest lecturer in a class.)

It's also important to pay attention to who is getting elected to local school boards, and what their positions are on science education and on evolution. Should a problem arise in a school or district, scientists' attendance and willingness to speak out at school board meetings or the willingness of a scientist to meet with a teacher or principal shows teachers they are not being "hung out to dry" by the community. The National Center for Science Education specializes in helping with such controversies; feel free to contact us for advice and information.

The problem of antievolutionism, believe it or not, is a major one in the United States today, as shown by polls as well as by the problems that come to NCSE's attention. The support and active involvement of scientists is the main way that this problem will go away.

References Cited

Jacob, F., 1977, Evolution and tinkering: *Science*, v. 196, p. 1161-1166.

Witham, Larry, 1997, Many scientists see God's hand in evolution: National Center for Science Education, Inc., Report 17(4). ■

Penrose Conference To Examine Ophiolites and Oceanic Crust

Ophiolites have been of particular importance in the reconstruction of ancient plate boundaries ever since recognition of them as on-land fragments of oceanic lithosphere. They are good structural analogues for oceanic crust and provide three-dimensional exposures and age relations to study the nature of extensional tectonics and magmatic construction at oceanic spreading environments. They complement significantly our knowledge of the architecture and generation of oceanic crust that is derived mainly from seismic images and drill holes at mid-ocean ridges. Recent multidisciplinary studies of drilled core samples of modern oceanic crust from the Mid-Atlantic Ridge, Costa Rica Rift, Hess Deep, Southwest Indian Ridge, Lau Basin, Izu-Bonin-Mariana forearc, and Tonga forearc have provided significant information on the mantle heterogeneity, magma chamber processes, melt migration, structural and tectonic processes in deformation of oceanic crust, and geochemical evolution of magma at these modern tectonic settings.

To examine the results of these studies, a Geological Society of America Penrose Conference, "Ophiolites and Oceanic Crust: New Insights from Field Studies and Ocean Drilling Program," will be held September 25-29, 1998, in Marshall, California. The goal of this conference is to bring together a multidisciplinary group of geoscientists from the communities of ophiolite geology and marine geology and geophysics to reevaluate the existing models of ophiolite formation and oceanic crust generation, and to explore the possibility of reaching a new consensus on the nature and significance of ophiolites and oceanic crust for present plate-tectonic processes and for processes in the geological past. The timing of this conference coincides with the 25th

anniversary of the first Penrose Field Conference on ophiolites, during which an ophiolite pseudostratigraphy was formally defined, and gives us a great opportunity to appraise our accumulated knowledge during the past quarter of a century.

The main themes of the conference are: (1) structure and tectonics of ophiolites and ophiolite-ocean-crust analogy; (2) structural and magmatic processes at spreading centers; (3) hydrothermal alteration, serpentinization, and mineralization; (4) petrology and geochemistry of ophiolites and oceanic crust; (5) sedimentation and sedimentary cover of ophiolites and oceanic crust; (6) fracture zone tectonics in ophiolite and ocean-crust geology; (7) ophiolite emplacement, the melange problem, and metamorphic soles; and (8) outstanding problems and future studies in ophiolite-ocean-crust geology, and drilling into oceanic crust in the 21st century. Thematic sessions will include short lectures, poster presentations, and group discussions; poster presentations will be a significant component of the conference to facilitate interactions and group discussions. A one-day field trip to the California Coast Ranges will explore the Late Jurassic Coast Range ophiolite and its sedimentary cover, the Franciscan melange, and the structural relations among the ophiolite, melange, and forearc basin (Great Valley Sequence). The field trip, an integral part of the conference, will serve as a catalyst to discussion of most aspects of the theme sessions by the outcrop.

The current interpretations of a typical ophiolite pseudostratigraphy and oceanic crust-ophiolite analogy deviate significantly from that defined at the first Penrose Conference on ophiolites, and several geological

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GSA Offers Awards in Geomorphology and Micropaleontology

Through the generosity of W. Storrs Cole, two awards for support of research are offered through GSA. The Gladys W. Cole Memorial Research Award provides support for the investigation of the geomorphology of semiarid and arid terrains in the United States and Mexico. It is to be given to a GSA Member or Fellow between 30 and 65 years of age who has published one or more significant papers on geomorphology. Funds cannot be used for work already accomplished, but recipients of a previous award may reapply if additional support is needed to complete their work. The amount of this award in 1998 will be \$11,000.

The second award, the W. Storrs Cole Memorial Research Award, has been established to support research in invertebrate micropaleontology. This award will carry a stipend of \$9,000 in 1998, and will be given to a GSA Member or Fellow between 30 and 65 years of age who has published one or more significant papers on micropaleontology.

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

All applications must be postmarked on or before **February 1, 1998**. Actions taken by the Committee on Research Grants will be reported to each applicant in April. These are two of GSA's most prestigious awards; all qualified researchers are urged to apply.

and geophysical models have been put forward in recent years to explain the deformed and "incomplete" nature of oceanic crust (as opposed to a "layer-cake" model of the late 1970s). An open discussion on these new models and ideas by geologists, geochemists, and geophysicists in the framework of this conference will help in evaluating the models and will provoke new research fields and questions on ophiolite-oceanic crust geology. Furthermore, study of ophiolites and oceanic crust has become increasingly multidisciplinary, because the interplay between tectonic and magmatic activities during seafloor spreading and spatial and temporal relations between deformation and hydrothermal alteration during the evolution of oceanic crust necessitate this sort of collaborative approach between the disciplines in quantitative studies of ophiolites and oceanic crust. We anticipate that this conference will provide an excellent forum for cross-pollination of ideas from investigators working on ophiolites and modern oceanic crust and from diverse approaches of structural geology, petrology-geochemistry, and geophysics.

Participation in the conference will be limited to 80 people. Participants will be selected to include broad representation of different relevant disciplines, particularly from scientists who participated in projects of the Ocean Drilling Program, and researchers from the marine-geology-geophysics and ophiolite geology communities. Graduate students are encouraged to apply; a partial subsidy will be available to some graduate students. The registration fee, which will cover lodging, meals, field trips, and ground transportation during the meeting, is expected to be \$700 or less.

The application deadline is March 16, 1998. Formal invitations to participants will be mailed by May 1, 1998. Potential participants should send a letter of application to Yildirim Dilek at the address below. Applicants should include a brief statement indicating their area of interest, the relevance of their recent work to the themes of the meeting, and the subject of their presentation, if any, at this conference.

Co-conveners of the conference are **Yildirim Dilek**, Dept. of Geology, Miami University, Oxford, OH 45056, (513) 529-2212, fax 513-529-1542, dileky@muohio.edu; **Don Elthon**, Div. of Ocean Sciences, National Science Foundation, Arlington, VA 22230, (703) 306-1586, fax 703-306-0390, delthon@nsf.gov; **Eldridge M. Moores**, Dept. of Geology, University of California, Davis, CA 95616, (530) 752-0352, fax 530-752-0951, moores@geology.ucdavis.edu; **Adolphe Nicolas**, Lab. de Tectonophysique, Université Montpellier II, 34095 Montpellier cedex 05, France, 33-0-467-143602, fax 33-0-467-143603, tectono@dstu.univ-montp2.fr. ■

Final Announcement

**SOUTHEASTERN SECTION, GSA
47th Annual Meeting**

**Charleston, West Virginia
March 30-31, 1998**



The 1998 Southeastern Section meeting of the Geological Society of America will be hosted by the West Virginia Geological and Economic Survey in Charleston, West Virginia. Affiliated organizations meeting concurrently are the Southeastern Section of the Society for Sedimentary Geology (SEPM), the Southeastern Section of the National Association of Geoscience Teachers (NAGT), and the Southeastern Section of the Paleontological Society (PS).

LOCATION AND SETTING

Charleston, the state capital and West Virginia's largest city, is located in the heart of the Appalachian Plateau, a two-hour drive northwest of the Valley and Ridge. Conveniently located at the junction of three interstate highways, (I-64, I-77, and I-79), Charleston is easily accessible by automobile. Charleston's Yeager Airport, located only 3 miles from the center of downtown, is served by U.S. Airways, Mesaba-Northwest Airlinck, United and United Express, and Delta Connection-Atlantic Southeast airlines.

Cabs are available to take you downtown from the airport. Rental cars are available from Avis, Budget, Hertz, National, and Sears at the airport. Charleston is served by Greyhound Bus Lines; limited Amtrak passenger rail service is also available. *Complimentary shuttle service is available from the airport to Embassy Suites, the site of the meeting.*

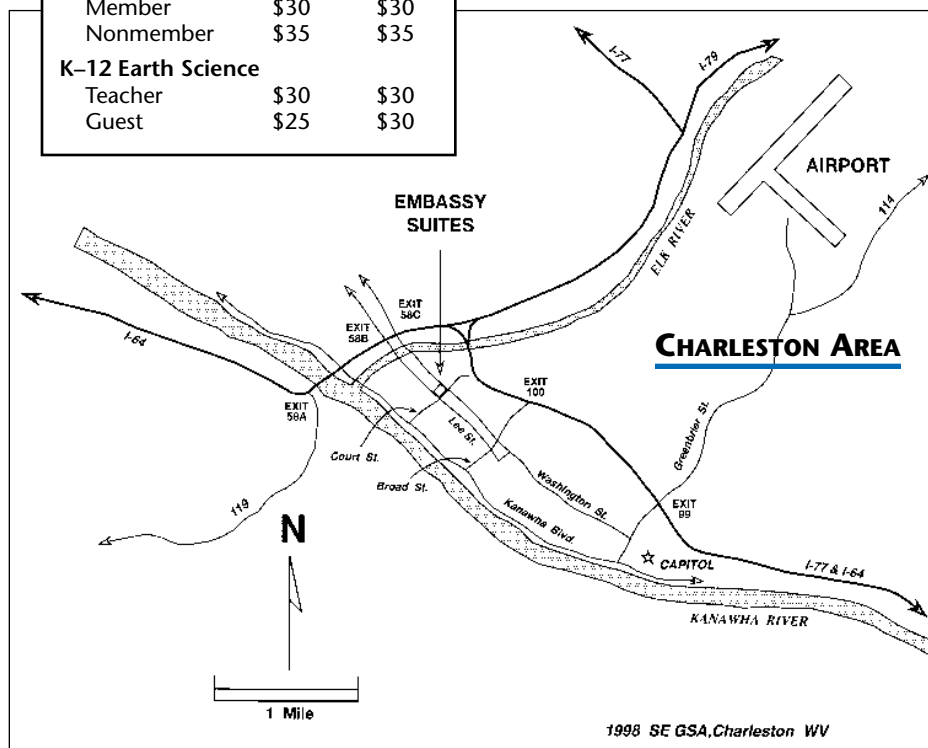
REGISTRATION

**Preregistration deadline:
February 27, 1998**

Advance registration is required for many of the special activities because of participation limits and required guarantees. Use the Preregistration Form provided in this announcement. Save time and money—preregister today!

REGISTRATION FEES		
	Advance	On-Site
Professional		
Member	\$70	\$85
Nonmember	\$80	\$90
Student		
Member	\$30	\$30
Nonmember	\$35	\$35
K-12 Earth Science		
Teacher	\$30	\$30
Guest	\$25	\$30

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Badges must be worn for access to ALL activities, 7 a.m. Monday through 5 p.m. Tuesday, and for the Sunday evening Welcoming Party.

Registration discounts are given to members of GSA and the associated societies listed on the Preregistration Form. Please indicate your affiliation(s) to register using the member rates.

Full payment MUST accompany the completed Preregistration Form. Unpaid purchase orders are NOT accepted as valid registration. Charge cards are accepted as indicated on the Preregistration Form. If using a charge card, please recheck the card number given. Errors will delay your registration. The confirmation card will be your receipt. No other receipt will be sent.

Register one professional or student per form. *Copy the form for your records.*

Guest registration is required for those attending guest activities, technical sessions, or the exhibit hall. Guest registrants MUST be accompanied to the meeting by either a registered professional or a student. A guest is defined as a nongeologist spouse or friend of a professional or student registrant.

Students and K-12 teachers must show a current ID in order to obtain these rates. Students not having a current ID when registering on-site will be required to pay the professional fee.

ALL Preregistration Forms MUST be received by the preregistration deadline of February 27, 1998. All registration forms received after February 27 will be held for on-site processing and charged the on-site rates.

To leave a message for an attendee at the meeting, call (304) 347-8700 or fax 304-347-8737.

Cancellations, Changes, and Refunds

All requests for registration additions, changes, and cancellations must be made in writing and received by March 6, 1998. *No refunds will be made on cancellation notices received after this date.* Refunds will be mailed from GSA after the meeting. Refunds for fees paid by credit card will be credited according to the card number on the Preregistration Form. There will be NO refunds for on-site registration and ticket sales.

On-Site Registration Schedule

Embassy Suites Lobby

Sunday, March 29	3:00 p.m.–7:00 p.m.
Monday, March 30	7:30 a.m.–4:30 p.m.
Tuesday, March 31	7:30 a.m.–11:30 a.m.

Accessibility for Registrants with Special Needs

The GSA Southeastern Section is committed to making the meeting accessible to all people interested in attending. If

you have special requirements, such as an interpreter or wheelchair accessibility, please indicate this by checking the appropriate box on the registration form in the space provided. Please let us know your needs by February 27, 1998.

ACCOMMODATIONS

A block of suites at the newly constructed Charleston Embassy Suites, site of the meeting, has been reserved for attendees. The special suite rate for up to four people includes a two-room suite; a complimentary, cooked-to-order breakfast each morning; a complimentary manager's reception each evening, featuring cocktails, beer, wine, and nonalcoholic beverages; and a daily newspaper. The living room of each suite features a wet bar, microwave oven, refrigerator, and coffee maker. Other amenities include two remote-control televisions, two telephones with Voice Mail, hair dryers, and irons. A health club, sauna, whirlpool, and indoor pool are within the hotel. All of these amenities are included in the special rate of \$112 per night for up to four people. Complimentary airport shuttle service is available. Attendees should make their own room reservations *before March 7, 1998*, by calling (304) 347-8700 or 1-800-EMBASSY (1-800-362-2779). After March 7, reservations will be accepted only on a space- and rate-available basis. To reserve rooms by telephone, state your GSA connection, and request the group rate. The hotel's Web site, at <http://www.embassy-suites.com/embassydocs/properties/CRWEM-1.html>, provides additional information.

Parking. Meeting attendees who stay at the Charleston Embassy Suites may park during the day and overnight in the hotel's parking lot for \$3.50/day (self-service) or \$6/day (valet). Meeting attendees not staying at Embassy Suites may park in the hotel's parking lot for \$1.50/day (self-service) or \$4/day (valet). These rates do NOT include overnight parking. Other parking accommodations are available in the area.

WELCOMING PARTY

The Welcoming Party on Sunday evening, March 29, 6–8 p.m., will be held in the exhibit area at the Charleston Embassy Suites. This will be an excellent opportunity to visit the exhibits, greet old friends, and make new friends while enjoying light food and beverages. All attendees must register before the party.

TECHNICAL PROGRAM

Eleven symposia and seven theme sessions are planned for the meeting. Technical sessions are also planned. Please contact the conveners for more information. All West Virginia Geological and Eco-

logic Survey personnel can be reached at P.O. Box 879, Morgantown, WV 26507-0879, (304) 594-2331, fax 304-594-2575.

Symposia

1. Historical Investigations of Appalachian Geology. Sponsored by GSA History of Geology Division. Peter Lessing, West Virginia Geological and Economic Survey, lessing@geosrv.wvnet.edu; Gregory Good, West Virginia University, (304) 293-2421 ext. 5247, ggood@wvu.edu.

2. Ichnology and Taphonomy. Andrew K. Rindsberg, Geological Survey of Alabama, P.O. Box O, Tuscaloosa, AL 35486-9780, (205) 349-2852, arindsberg@ogb.gsa.tuscaloosa.al.us; Anthony J. Martin, Emory University (404) 727-6491, paleoman@learnlink.emory.edu; Ronald R. McDowell, West Virginia Geological and Economic Survey, mcdowell@geosrv.wvnet.edu.

3. Applied Topics in Coal Geology. James Hower, University of Kentucky, Center for Applied Energy Research, 2540 Research Park Dr., Lexington, KY 40511-8410, (606) 257-0261, hower@alpha.caer.uky.edu; Cortland Eble, Kentucky Geological Survey, (606) 257-5500, eble@kgs.mm.uky.edu.

4. Structure and Tectonics of the Central and Southern Appalachians: Recent Milestones. Mark Evans, Geology and Planetary Science, 321 Old Engineering Hall, University of Pittsburgh, Pittsburgh, PA 15260, (412) 624-8779, mae6+pitt.edu; William Dunne, University of Tennessee, Knoxville, (432) 974-5498, wdunne@utk.edu.

5. GIS Applications to Coal Geology. Craig Neidig, West Virginia Geological and Economic Survey, 1615 Washington St. E., Suite 106, Charleston, WV 25311, (304) 558-4218, neidigcr@wvlc.wvnet.edu; Nick Fedorko, West Virginia Geological and Economic Survey, fedorko@geosrv.wvnet.edu.

6. Activities for Enhancing the Quantitative Skills of Earth Science Students. Glenn Stracher, Dept. of Science and Mathematics, East Georgia College, 131 College Circle, Swainsboro, GA 30401, (912) 237-7831, stracher@mail.ega.peachnet.edu; Mike Hohn, West Virginia Geological and Economic Survey, hohn@geosrv.wvnet.edu.

7. Hydrologic and Hydrochemical Impacts of Surface Mining. Joe Donovan, Dept. of Geology and Geography, P.O. Box 6300, West Virginia University, Morgantown, WV 26506-6300, (304) 293-5603 ext. 4308, donovan@wvugeo.wvnet.edu.

8. Hydrologic and Hydrochemical Impacts of Underground Mining. Henry Rauch, Dept. of Geology and Geography, P.O. Box 6300, West Virginia University, Morgantown, WV 26506-6300, (304) 293-5603 ext. 4318, rauch@wvugeo.wvnet.edu.

9. Hydrogeology and Hydrogeochemistry of Natural Waters. Henry Rauch, Dept. of Geology and Geography, P.O. Box 6300, West Virginia University, Morgantown, WV 26506-6300, (304) 293-5603 ext. 4318, rauch@wvugeo.wvnet.edu; Joe Donovan, West Virginia University, (304) 293-5603 ext. 4308, donovan@wvugeo.wvnet.edu.

10. Watershed Restoration and Management. Paul F. Ziemkiewicz, P.O. Box 6064, 203 NRCCE, West Virginia University, Morgantown, WV 26506-6064, (304) 293-7292, ziemkie@wvu.edu.

11. Landslides and Land Failures. Sponsored by Committee on Geology and Public Policy. John Kiefer, Kentucky Geological Survey, University of Kentucky, 228 Mining and Mineral Resources Bldg., Lexington, KY 40506-0107, (606) 257-5500, kiefer@kgs.mm.uky.edu.

Theme Sessions

1. Undergraduate Research. Sponsored by Sigma Gamma Epsilon. Donald Neal, Dept. of Geology, East Carolina University, Greenville, NC 27858-4353, (919) 328-6360, glneal@ecuvms.cis.ecu.edu.

2. NAGT-GSA K-16 Geoscience Education. John Callahan, Dept. of Geology, Appalachian State University, Boone, NC 28608, (704) 262-3049, callahnje@appstate.edu.

3. Statemap Geological Mapping Poster Session. David Matchen, West Virginia Geological and Economic Survey, matchen@geosrv.wvnet.edu.

4. Undergraduate Research Poster Session. Sponsored by Council for Undergraduate Research. William Ranson, Dept. of Geology, Furman University, Greenville, SC 29613-0440, (803) 294-2052, ranson_bill@furman@furman.edu.

5. Geoscience Programs for K-12 Educators. Thomas Repine, West Virginia Geological and Economic Survey, repine@geosrv.wvnet.edu.

6. Sequence Stratigraphic and Biostratigraphic Applications to the Appalachians. Sponsored by SE SEPM and PS. Steven Holland, Dept. of Geology, University of Georgia, Athens, GA 30602-2501, (706) 542-0424, stratum@gly.uga.edu; Jack Hall, Director of Environmental Studies, University of North Carolina—Wilmington, Wilmington, NC 28403, (910) 962-3488, hall@uncwil.edu.

7. Recent Advances in Cretaceous Geology and Stratigraphy. David King, Dept. of Geology, Auburn University, Auburn, AL 36849-5305, (334) 844-4882, kingdat@mail.auburn.edu.

PROJECTION EQUIPMENT

All slides must be 2" × 2" and fit a standard 35-mm carousel tray. Bring your own loaded carousel trays, or be prepared to rent trays on-site for \$5 per day per tray. Two 35-mm slide projectors and two

screens will be available for each oral technical session. No other projectors will be available. Labeled trays must be handed to the projectionist at least 20 minutes prior to the beginning of the session. A speaker-ready room for previewing slides will be provided in the Embassy Suites Hotel.

POSTER SESSIONS

Four half-day poster sessions are planned. Posters will consist of two horizontally hung 4' × 8' foam boards covered with Velcro loop material. The ONLY way to attach poster materials to these boards is with Velcro hooks. Poster sessions will be set up for four hours, and authors will be available for two hours to discuss their work.

WORKSHOP: ROY SHLEMON MENTORS IN APPLIED GEOLOGY PROGRAM: Dealing with the Transition from the Classroom to the Workplace

Sunday, March 29, 1–5 p.m., Embassy Suites. The Roy Shlemon Mentors in Applied Geology Program, sponsored by the GSA Institute for Environmental Education, presents workshops for upper-level undergraduate and graduate students. For many recent graduates, the transition from geology student to professional geologist has been difficult. Many recent graduates find that they are well prepared academically, but not for the daily routine of performing focused, short-term, applied research; cutting corners; and making money for the company. This workshop, designed to make students more aware of what will be expected of them when they enter the workplace, will be in two parts. Part one will consist of short presentations by representatives of major segments of the geological industry, followed by a brief question-and-answer period. In part two, industry representatives will be available for questions from individuals or small groups. For further information, contact Douglas G. Patchen, West Virginia Geological and Economic Survey, P.O. Box 879, Morgantown, WV 26507-0879, (304) 594-2331, patchen@geosrv.wvnet.edu. Cost: FREE. Limit: 30.

STUDENT RESEARCH PROGRAMS

Sigma Gamma Epsilon will sponsor an oral theme session (Theme Session 1) devoted to student research. The session is designed to showcase student scholarship without restrictions on subject matter, classification, or membership in Sigma Gamma Epsilon. Interested students should contact Donald Neal, Dept. of Geology, East Carolina University, Greenville, NC 27858-4353, (919) 328-6360, glneal@ecuvms.cis.ecu.edu.

The Council for Undergraduate Research will sponsor a student poster ses-

sion (Theme Session 4), to showcase senior theses and other undergraduate research projects. First authors must be undergraduate students and responsible for the bulk of the research, preparation of posters, and presentation of results. For more information, contact Bill Ranson, Dept. of Geology, Furman University, Greenville, SC 29613-0440, (803) 294-2052, ranson_bill@furman@furman.edu.

K-12 WORKSHOP AND FIELD TRIP

For K-12 and college-level introductory geoscience teachers, Theme Session 2 will deal with a variety of educational issues. Contact John Callahan, Dept. of Geology, Appalachian State University, Boone, NC 28608, (704) 262-3049, callahnje@appstate.edu. Theme Session 5 will explore the role of nontraditional geoscience education programs. Contact Thomas Repine, West Virginia Geological and Economic Survey, P.O. Box 879, Morgantown, WV 26507-0879, (304) 594-2331, repine@geosrv.wvnet.edu.

SPECIAL EVENING EVENT

Evening at the West Virginia Cultural Center and Museum, Monday, March 30, 1998, 6–9 p.m. Located in the West Virginia Capitol Complex, the Cultural Center houses the State Museum with permanent and changing exhibits, the State archives, the State theater, and the Cultural Center Shop. The shop features music, literature, arts, crafts, and special food items produced by West Virginians. Excellent hot and cold selections and beer, wine, and soft drinks will be served. Preregistration is required! Order tickets on the Preregistration Form. Cost is \$25 per person. Limit: 125 people.

SPECIAL EVENTS

For room locations, check the program or hotel video monitors.

GSA Southeastern Section Management Board Meeting, Sunday, March 29, 1998, 4:30–6 p.m., Charleston Embassy Suites.

GSA Southeastern Section Campus Liaison Breakfast, Monday, March 30, 1998, 6:30–8 a.m., Charleston Embassy Suites.

SEPM Southeastern Section Business Meeting, Monday, March 30, 1998, 12:00 noon, Charleston Embassy Suites.

GSA Southeastern Section Student Support Committee, Monday, March 30, 1998, 12:00 noon, Charleston Embassy Suites.

GSA Southeastern Section Committee on Geology and Public Policy Meeting, Monday, March 30, 1998, 12:00 noon, Charleston Embassy Suites.

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Paleontological Society Southeastern Section Business Meeting, Monday, March 30, 1998, in session room immediately after Theme Session 6. Lunch will follow at a local restaurant.

GSA Southeastern Section Business Meeting, Monday, March 30, 1998, 5–5:30 p.m., Charleston Embassy Suites.

GSA Second Century Fund Meeting, Monday, March 30, 1998, 5–5:30 p.m., Charleston Embassy Suites.

GSA Southeastern Section Ph.D.-Granting Earth Science Program Chairs Breakfast Meeting, Tuesday, March 31, 1998, 7–8 a.m., Charleston Embassy Suites.

GSA Southeastern Section Education Division and NAGT Officers and State Representatives Combined Breakfast Meeting, Tuesday, March 31, 1998, 7–8 a.m., Charleston Embassy Suites.

EXHIBITS

Exhibits by business, education, and government institutions will be located conveniently near the technical session rooms in the Charleston Embassy Suites. The Sunday evening Welcoming Party will be held in the exhibit area to allow registrants to visit the exhibits without missing any of the technical sessions. The number of booths is limited, so plan to reserve space early. Exhibits will be open Sunday, 6–8 p.m., Monday, 8 a.m.–5 p.m., and Tuesday, 8 a.m.–12:00 noon. For further information and space reservations, contact Kenneth C. Ashton, West Virginia Geological and Economic Survey, P.O. Box 879, Morgantown, WV 26507-0879, (304) 594-2331, ashton@geosrv.wvnet.edu.

FIELD TRIPS

Meeting registration will be waived for field trip participants unable to attend the meeting. If you are not registering for the meeting, please add a \$5 processing fee to the cost of each field trip. Field trip participants who are registering for the meeting should pay the rates listed on the Preregistration Form.

If trips are undersubscribed and canceled, participants will be notified no fewer than 10 days prior to the meeting; all field trip fees will be refunded after the meeting. Plan travel alternatives in advance in case the trip is canceled. There will be no refunds if participants fail to show up on time for reasons other than serious illness or emergency. Sponsoring agencies assume no liability whatsoever for failure of participants to show for a trip; for missed connections; or for injury, loss, or damage during or resulting from transportation on the field trips. Participants are strongly encouraged to bring safety equipment such as hard hats and

safety boots. Participants should have medical insurance in case of injury. *The number of participants is limited, so register early.* Additional information will be sent to trip participants. For general questions concerning field trips, please contact Mitch Blake, field trip coordinator, West Virginia Geological and Economic Survey, P.O. Box 879, Morgantown, WV 26507-0879, (304) 594-2331, blake@geosrv.wvnet.edu. Contact field trip leaders for more information on specific trips.

Premeeting

1. Extensional Structures Along the Allegheny Front in Virginia and West Virginia near the Giles County Seismic Zone. Saturday, March 28 through Sunday, March 29. John M. Dennison, Dept. of Geology, University of North Carolina, Chapel Hill, NC 27599-3315, (919) 962-0686, dennison@email.unc.edu; Jon Filer, Richard Law, Andrew Mehlhop, Jeremy Middleton, Eugene Rader, Kevin Stewart, Robert Whisonant.

A conjugate set of major extensional faults cuts Alleghenian orogeny compressional structures. Nine stops demonstrate possible relations of these younger faults to the Giles County modern earthquake zone. Cost: \$75, includes transportation from Charleston at 4:30 p.m. Saturday; overnight double occupancy at the Ramada Inn in Bluefield, West Virginia; hot lunch on Sunday; guidebook; snacks; and return transportation to Charleston by 6 p.m. Sunday. Trip will originate and end at the Charleston Embassy Suites; participants have the option of arriving separately at Bluefield. Limit: 5 minimum, 25 maximum. Activity level: easy to moderate.

2. Coal Geology, Paleobotany, and Regional Stratigraphy of the Middle Part of the Kanawha Formation, Southern West Virginia. Saturday, March 28 through Sunday, March 29. *Sponsored by the GSA Coal Division.*

Mitch Blake, West Virginia Geological and Economic Survey, P.O. Box 879, Morgantown, WV 26507-0879, (304) 594-2331, blake@geosrv.wvnet.edu; Cortland F. Eble, Kentucky Geological Survey, (606) 257-5500, eble@kgs.mm.uky.edu; William C. Grady, West Virginia Geological and Economic Survey, (304) 594-2331, grady@wvugeo.wvnet.edu; Ronald L. Martino, Marshall University, (304) 696-2717, martinor@marshall.edu.

Large road cuts allow examination of an approximately 200-foot thick coal-bed-and-marine-zone-bearing interval within the Kanawha Formation on a regional scale. Regional petrographic variations within several world-class coal beds will be discussed. Facies found in the marine Dingess Shale Member and the Campbell Creek Shale of I. C. White will be examined as part of an integrated depositional

model for the Kanawha Formation. Additionally, regional correlation busts within the middle Kanawha Formation will be emphasized. The trip will depart both days at 8 a.m. sharp from the Charleston Embassy Suites and return in the evenings. Participants may choose to attend one or both days. Room reservations should be made at the Charleston Embassy Suites, or contact the field trip coordinator for more information. Cost: \$50 per day (\$100 for both days); includes transportation, guidebook, lunch, and en route refreshments. Limit: none; minimum 10. Activity level: easy to moderate.

3. Upper Devonian (Frasnian-Famennian) Extinction Event in the Catskill Delta of Virginia and West Virginia. Sunday, March 29. *Sponsored by the Paleontological Society.* Thomas J. Rossbach, Dept. of Geosciences/NRM, Western Carolina University, Cullowhee, NC 28723, (704) 227-7367, fax 704-227-7647, rossbach@wpoff.wcu.edu; Jack C. Hall, University of North Carolina—Wilmington, (910) 962-3490, fax 910-962-7077, hallj@uncwil.edu.

A tour through the Upper Devonian and Lower Mississippian strata at Elkins and Huttonsville, West Virginia, and Hightown, Virginia. Participants will examine changing environments and faunal assemblages in the Catskill clastic wedge leading up to and across the Frasnian-Famennian stage boundary. The stops are excellent brachiopod- and bivalve-collecting localities. The trip will leave at 8 a.m. sharp from the Elkins Motor Lodge on Harrison Avenue and will return by 5 p.m. For those flying into Charleston, a van will leave the Embassy Suites at 4 p.m. Saturday, March 28 to transport participants to Elkins. Cost: \$35; includes guidebook, transportation, box lunch, and refreshments en route. Motel reservations can be made at the Elkins Motor Lodge (304) 636-1400; the room cost is \$47 for double occupancy. Limit: 20. Activity level: easy to moderate.

Postmeeting

4. Upper Mississippian Paleosols as Indicators of Allocyclic and Autocyclic Events, Southern West Virginia. Wednesday, April 1. Jack B. Beuthin, Dept. of Geology, University of Pittsburgh—Johnstown, Johnstown, PA 15904, (814) 269-2945, beuthin+@pitt.edu; Donald Neal, East Carolina University, (919) 328-4392, neald@mail.ecu.edu. Paleosols at the Mississippian-Pennsylvanian boundary and in the lower Hinton Formation (Upper Mississippian) will be examined, compared, and discussed in relation to sedimentary dynamics of the central Appalachian foreland basin. Cost: \$35; includes transportation departing from and returning to Charleston,

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PREREGISTRATION FORM

GSA Southeastern Section Charleston, West Virginia, March 30-31, 1998

Please print clearly • THIS AREA IS FOR YOUR BADGE

Name as it should appear on your badge (last name first) _____

 Employer/University Affiliation _____

 State or Country _____

City _____

 Mailing Address (use two lines if necessary) _____

 City _____

 State _____

 ZIP Code _____

 Country (if other than USA) _____


Circle member affiliation (to qualify for registration member discount):
 (A) GSA (B) NAGT (C) PS (D) SEPM

GUEST INFORMATION • Please print clearly • This area is for badge

Name as it should appear on your guest's badge _____

 City _____

 State or Country _____

 Please inform us by February 28 of any special considerations that you or your guest require.
 I will need special considerations.

Preregistration Deadline: February 27
Cancellation Deadline: March 6

MAIL TO:
GSA SOUTHEASTERN SECTION MEETING,
P.O. BOX 9140, BOULDER, CO 80301

Remit in U.S. funds payable to:
1998 GSA Southeastern Section Meeting
(All preregistrations must be prepaid.
Purchase Orders not accepted.)

Payment by (check one):
 Check American Express VISA MasterCard Diners Club

Card Number _____
 Expires _____

PREREGISTRATION FEES

	Full Meeting	Qty.	Amount
Professional Member*	(10) \$70 <input type="checkbox"/>	1	\$ _____
Professional Nonmember	(14) \$80 <input type="checkbox"/>	1	\$ _____
Student Member*	(30) \$30 <input type="checkbox"/>	1	\$ _____
Student Nonmember	(32) \$35 <input type="checkbox"/>	1	\$ _____
K-12 Professional	(60) \$30 <input type="checkbox"/>	1	\$ _____
Guest or Spouse	(90) \$25 <input type="checkbox"/>	1	\$ _____
Field Trip Only Fee	(01) \$ 5 <input type="checkbox"/>	1	\$ _____

*Member fee applies to any current Professional OR Student Member of GSA or Associated Societies listed at left. Discount does not apply to guest registrants.

GUEST EVENT

1. Trip to Tamarack, "Best of West Virginia" ... March 30 (101) \$15 _____ \$ _____

SPECIAL EVENT

1. Evening at West Virginia Cultural Center & Museum March 30 (301) \$25 _____ \$ _____

WORKSHOP

1. Roy Shlemon Mentors Program: Transition from Student to Employee March 29 (601) FREE 1 \$ _____

FIELD TRIPS

1. Allegheny Front Extensional Structures March 28-29 (401) \$ 75 1 \$ _____
 2. Geology of the Kanawha Formation March 28 (402) \$ 50 1 \$ _____
 March 29 (403) \$ 50 1 \$ _____
 Both (404) \$100 1 \$ _____
 3. Upper Devonian Catskill Delta March 29 (405) \$ 35 1 \$ _____
 4. Upper Mississippian Paleosols April 1 (406) \$ 35 1 \$ _____

TOTAL FEES REMITTED \$ _____

Final Announcement

CORDILLERAN SECTION, GSA 94th Annual Meeting

Long Beach, California
April 7-9, 1998



The Department of Geological Sciences at California State University—Long Beach will host the 1998 meeting of the Cordilleran Section of the Geological Society of America. Meetings will be held Tuesday through Thursday, during spring break, on the CSULB campus. Registration, poster sessions, exhibits, and half of the technical sessions will be held in the CSULB Pyramid events center. Additional technical sessions are scheduled for lecture rooms in nearby campus buildings.

SETTING AND ACCESS

The city of Long Beach, population 500,000, shares the largest harbor on the Pacific Coast with the city of Los Angeles. It overlies giant oil fields within the world's most prolific petroleum basin. Development and pumping of these fields required construction of elaborately camouflaged oil islands and resulted in dramatic land subsidence corrected only with development of a network of water injec-

tion wells. The 1933 Long Beach earthquake along the Newport-Inglewood fault caused widespread damage, especially to schools, resulting in the passage and enforcement of strict building codes.

The CSULB campus is in east Long Beach, close to beaches extending south from Los Angeles into Orange County. It is served by exits from the San Diego (I-405) and San Gabriel (I-605) freeways. America West and American Airlines provide regu-

lar service to Long Beach Airport, located near the CSULB campus. Most air travelers will arrive at John Wayne Orange County Airport or Los Angeles International Airport. Shuttle transportation from these airports to conference hotels in east Long Beach costs approximately \$20-\$25 and \$30-\$35, respectively.

Enterprise (562-426-4774), selected as the preferred automobile rental agency for the meeting, offers reduced rates to those identifying themselves as meeting participants (customer number CD9567). All hotels provide free parking. Free parking will be available on campus immediately adjacent to the meeting site. The most direct entrance is off Atherton Street. The parking area (P on the accompanying map) is immediately west of the CSULB Pyramid events center.

The climate during early April is pleasant; temperatures are in the high 70s to low 80s (°F), and it rarely rains. Guest activities have not been arranged because there are many attractions in the area, readily accessible by car. Because of the

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lunch, refreshments, and guidebook. The trip will depart from the Embassy Suites at 8 a.m. sharp. There is an option for participants to caravan to Princeton, West Virginia, and depart for points east and south after the trip. Limit: 15. Activity level: easy to moderate.

PHOTO CONTEST

Submit your best geological photos for a photographic contest. The subject matter must be geological but is not restricted to the southeastern United States. Prints, which can be color or black and white, must be the submitter's original work. The maximum size for photos is 8" by 12". They must be mounted on matte board—no frames, glass, or other modifications. Photos will be mounted on Velcro loop material, so you *must* use Velcro hook material on the back. Along the bottom front of the matte, you may add a title. On the back, you **MUST** include your name, address, and phone number along with a geological description and location. First, second, and third place ribbons will be awarded for each category (color or black and white). You may submit a maximum of three prints in either category, for a total of six. Bring (don't send) your photos to the meeting; you will be responsible for retrieving them. For further informa-

tion, contact Peter Lessing, West Virginia Geological and Economic Survey, P.O. Box 879, Morgantown, WV 26507-0879, (304) 594-2331, lessing@geosrv.wvnet.edu.

GUEST ACTIVITY

Tamarack, "The Best of West Virginia" Arts and Crafts Center. Monday, March 30, 10 a.m.–3 p.m. Take a trip to a unique center showcasing West Virginia's rich cultural heritage. Tamarack features five crafts demonstration studios, "West Virginia Made" shopping, a theater, gallery exhibits, nature trail and gardens, a gourmet shop, and a reasonably priced dining area featuring regional specialty foods catered by the world-famous Greenbrier Resort. Cost of transportation is \$15. Limit: minimum 10, maximum 14. *Guests are strongly encouraged to preregister for this activity, as it will be canceled if there is not sufficient interest.* Fees for canceled trips will be refunded after the meeting. The Hospitality Suite will have information about other local sites of interest that can be visited on your own.

ABSTRACTS WITH PROGRAMS

A limited number of *Abstracts with Programs* for the meeting will be available at the registration desk. Advance-copy purchases made through GSA Membership or Publications Sales require prepayment and

will be mailed approximately three weeks prior to the meeting. Refunds for duplicate orders will not be made.

STUDENT TRAVEL GRANTS

Limited funds for support of travel expenses for students presenting papers at the meeting are available from the GSA Southeastern Section. For information, contact Harold Stowell, Dept. of Geology, University of Alabama, Birmingham, AL 35294, (205) 934-5102, hstowell@wgs.geo.ua.edu. Travel grant applications must be postmarked no later than March 2, 1998.

OTHER INFORMATION

For detailed information concerning the technical program, contact Peter Lessing, West Virginia Geological and Economic Survey, P.O. Box 879, Morgantown, WV 26507-0879, (304) 594-2331, lessing@geosrv.wvnet.edu. For other questions and suggestions, contact Carl Smith, West Virginia Geological and Economic Survey, P.O. Box 879, Morgantown, WV 26507-0879, (304) 594-2331, cjs@geosrv.wvnet.edu. Also, access the West Virginia Geological and Economic Survey Web site at <http://www.wvgs.wvnet.edu> for general information. ■

REGISTRATION FEES

	Preregister	On Site	One Day
Professional—Member	\$85	\$95	\$50
—Nonmember	\$95	\$105	\$55
Student—Member	\$30	\$35	\$20
—Nonmember	\$40	\$45	\$25
K-12 Professional	\$20	\$25	\$10
Guest or Spouse	\$10	\$10	NA

Long Beach Grand Prix auto race on Sunday, April 5, most local hotels will be fully booked for the night of April 4, but there are many other hotels within 15 minutes drive outside of Long Beach proper.

REGISTRATION

Preregistration Deadline: March 6, 1998

Name badges and tickets to special functions will be mailed to those who take advantage of lower registration costs by preregistering before the *March 6, 1998*, deadline. Save yourself time and money—preregister today!

Advance registration is encouraged for many of the field trips because of participation limits. Use the preregistration form provided in this announcement. All registrations received after March 6 will be held for on-site processing and charged the on-site rates.

Badges must be worn for access to all activities, 6:00 p.m. Monday through 5:00 p.m. Thursday.

Registration discounts are given to members of GSA and the associated societies listed on the registration form. Please indicate your affiliation(s) to register using the member rates. Speakers not affiliated with member societies may receive the discount by circling F on the form.

Full payment must accompany registration. Unpaid purchase orders are not accepted as valid registration. Charge cards are accepted as indicated on the preregistration form. Please recheck the card number given, as errors will delay your registration. The confirmation card will be your receipt. No other receipt will be given.

Register one professional or student per form. Copy the form for your records.

Guest registration is required for those attending meeting activities, including technical sessions. Guest registrants must be accompanied to activities by a registered attendee. A guest is defined as a nongeologist spouse or friend of a professional or student registrant.

Students and K-12 professionals must show a current ID on site in order to obtain these rates. Students or K-12 educators not having a current ID when registering on site will be required to pay the professional fee.

On-site registration will be available at the Yellow Entrance on the west side of the CSULB Pyramid from 5:00 p.m. to 7:00 p.m. on Monday, 7:30 a.m. to 4:00 p.m. on Tuesday and Wednesday, and 7:30 a.m. to 12 noon on Thursday.

The *Abstracts with Programs* book may be purchased with your GSA membership renewal, or on site in the registration area.

Cancellations, Changes, and Refunds

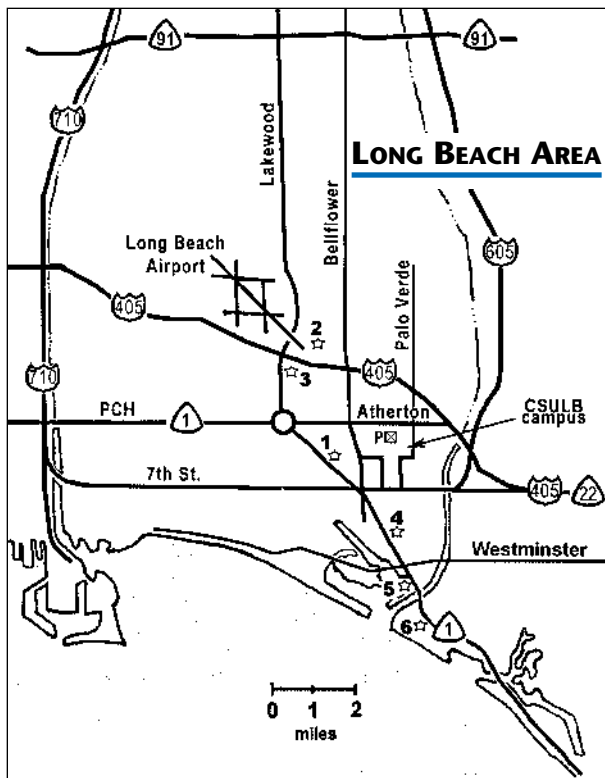
All requests for registration additions, changes, and cancellations must be made in writing and received by March 13, 1998. GSA will refund or credit preregistration fees for cancellations received in writing by that date. No refunds or credits will be made on cancellation notices received after March 13. Refunds will be processed after the meeting. There will be no refunds for on-site registration and ticket sales.

ACCESSIBILITY FOR REGISTRANTS WITH SPECIAL NEEDS

GSA and CSULB are committed to making every event at the 1998 Cordilleran Section meeting accessible to all people interested in attending. All areas of the CSULB campus, including the Pyramid event center, are wheelchair-accessible. Equipment for the hearing-impaired is available. If you have a special requirement, we ask you to indicate it on the registration form. If you have questions, contact Stan Finney, (562) 985-8637, scfinney@csulb.edu. If possible, please let us know by February 7, 1998.

HOUSING

Large blocks of rooms have been reserved at five hotels at distances of one to four miles from the campus. Locations are indicated on the accompanying map by the hotel numbers listed below. Housing registration will be handled by the individual hotels, which the participants must contact directly. Reduced conference rates are available only to those identifying themselves as participants in the



Cordilleran Section GSA meeting and booking their reservation by the individual hotel deadline. Rates listed do not include 12% tax.

- 1. Guesthouse Hotel (Meeting Headquarters)**, 5235 East Pacific Coast Highway, Long Beach, CA 90804; (562) 597-1341; singles \$59, doubles \$69. Closest to CSULB and with regular, but limited, shuttle service to and from the meeting site. *Reservation deadline: February 28, 1998.*
- 2. Long Beach Marriott**, 4700 Airport Plaza Drive, Long Beach, CA 90815; (562) 425-5210; singles and doubles \$109. *Reservation deadline: March 20, 1998.*
- 3. Holiday Inn—Long Beach Airport**, 2640 Lakewood Boulevard, Long Beach, CA 90815; (562) 297-4401; singles and doubles \$69. Very limited shuttle service to CSULB. *Reservation deadline: March 16, 1998.*
- 4. Best Western Golden Sails Hotel**, 6285 East Pacific Coast Highway, Long Beach, CA 90803; (562) 596-1631; singles and doubles \$69. Long walk (2+ miles) to meeting site. *Reservation deadline: March 1, 1998.*
- 5. SeaPort Marina Hotel**, 6400 East Pacific Coast Highway, Long Beach, CA 90803; (562) 596-6480; singles and doubles \$72. Two-mile walk to meeting site. *Reservation deadline: March 10, 1998.*
- 6. Radisson Inn of Seal Beach**, 600 Marina Drive, Long Beach, CA 90740; (562) 493-7501; singles \$91, doubles \$101. *Reservation deadline: March 6, 1998.*

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TECHNICAL PROGRAM

Symposia

S1. Active Tectonics and Seismic Hazards of Metropolitan Southern California. James Dolan, Dept. of Earth Sciences, University of Southern California, Los Angeles, CA 90089-0740, (213) 740-8599, dolan@earth.usc.edu.

S2. Quaternary Mapping and Hazards Mapping of the LA Basin. Poster Session. John Foster, Dept. of Geological Sciences, California State University, Fullerton, CA 92834-9480, (714) 278-7096, jfoster@fullerton.edu.

S3. Southern California Areal Mapping Project (SCAMP). Poster Session. (U.S. Geological Survey and California Division of Mines and Geology) Douglas M. Morton, USGS, Dept. of Earth Sciences, University of California, Riverside, CA 92521, (909) 267-6397, SCAMP@ucrac1.ucr.edu; Michael P. Kennedy.

S4. Neoproterozoic-Cambrian Stratigraphy, Southern Nevada-Eastern California: A Tribute to John H. (Jack) Stewart. Chris Fedo, Dept. of Geology, George Washington University, Washington, DC 20052, (202) 994-6964, cfedo@gwis2.circ.gwu.edu; John D. Cooper.

S5. Current Issues in Paleobiology: Anoxia, Developmental Biology, and Quantitative Issues Involving the Fossil Record (Paleontological Society). David K. Jacobs, Dept. of Biology, University of California, Los Angeles, CA 90095-1606, (310) 206-3987, djacobs@ucla.edu.

S6. Late Cretaceous Denudation of the Peninsular Ranges Batholith. Marty Grove, Dept. of Earth and Space Sciences, University of California, Los Angeles, CA 90095-1567, (310) 825-7975, marty@argon.ess.ucla.edu; David Kimbrough.

S7. Mineral Resource Issues in the West. Russ Miller, (213) 620-5025, and Dinah Shumway, (909) 275-0434, California Division of Mines and Geology, 107 S. Broadway, Room 1065, Los Angeles, CA 90012, fax 213-620-3691.

S8. Geometry, Kinematics, and Mechanics of Gravity-Driven Slide Blocks. Greg Davis, Dept. of Earth Sciences, University of Southern California, Los Angeles, CA 90089-0740, (213) 740-6726, fax 213-740-8801, gdavis@usc.edu; An Yin, (310) 825-8752, fax 310-825-2779, yin@ess.ucla.edu.

Theme Sessions

T1. Active Folding and Buried Reverse Faults. Edward Keller, Dept. of Geological Sciences, University of California, Santa Barbara, CA 93106, (805) 893-4207, keller@magic.geol.ucsb.edu.

T2. Undergraduate Research Poster Session. (Geology Division, Council on

Undergraduate Research), Susan DeBari, Geology Dept., San Jose State University, San Jose, CA 95192-0102, (408) 924-5027, fax 408-924-5053, susan@geosun1.sjsu.edu.

T3. Partnerships for Earth Science Education for Future (Pre-Service) Teachers. Elizabeth L. Ambos, Dept. of Geological Sciences, California State University, Long Beach, CA 90840-3902, (562) 985-4931, fax 562-985-8638, bambos@csulb.edu; Edward Ng, Fred Shair.

T4. Shallow Subsurface Investigations Using Geophysical Methods. Elizabeth L. Ambos, Dept. of Geological Sciences, California State University, Long Beach, CA 90840-3902, (562) 985-4931, fax 562-985-8638, bambos@csulb.edu.

T5. Changing Tectonic Styles in the California Continental Borderland. Robert D. Francis, Dept. of Geological Sciences, California State University, Long Beach, CA 90840-3902, (562) 985-4929, fax 562-985-8638, rfrancis@csulb.edu.

PROJECTION EQUIPMENT

Only **one** 35 mm carousel projector for 2" x 2" slides and one overhead projector for transparencies will be provided in each meeting room. Should it become possible at a later date to equip the rooms with two 35 mm projectors, an announcement will be made on the meetings Web page (see Detailed Information below) when the program is posted to it in late January. Please bring your own loaded carousel tray identified with speaker's name, session, and speaker number to your session room before the start of the session. A speaker-ready room equipped with projectors will be available for review and practice.

POSTER SESSIONS

Students and professionals are encouraged to take advantage of this effective means of presentation and communication. Please indicate Poster Session on the GSA abstract form. Each poster booth will contain two 4' high x 8' wide boards. Poster sessions will be located on the court level of the Pyramid close to exhibits and will be available for viewing for one-half day.

FIELD TRIPS

For details regarding specific field trips, please contact the field trip leader(s). General questions can be addressed to Field Trip Chair Rick Behl, (562) 985-5850, behl@csulb.edu. Preregistration for all field trips is recommended because participants will be accepted on a first-come, first-served basis. Field trip participants must also register for at least one day of the meeting. Trips 2 and 3 are designed to serve K-12 professionals. All other trips are technical in nature and may be physically

demanding for participants. All field trips will begin and end in front of the Gold (west) Entrance to the Pyramid at CSULB.

Premeeing

1. Anatomy of a Craton-Margin: Neoproterozoic-Basal Cambrian Sequence Stratigraphy, Eastern Mojave Desert, California. Friday (afternoon)-Monday, April 3-6, 1998. On this trip to examine critical exposures in a northwest-southeast transect from the inner miogeocline to the craton, the focus will be on the transitional craton-margin hinge zone, where revealing sequence stratigraphic relationships have important implications for nascent Cordilleran continental margin evolution. This succession also has important bearing on the base of the Cambrian and the base of the Sauk Sequence. John Cooper, California State University, Fullerton, (714) 996-1573, fax 714-278-7266, jcooper@fullerton.edu; Chris Fedo, George Washington University. Cost: \$175 (includes meals, snacks, drinks, 2 nights lodging, guidebook, and transportation). Limit: 20.

2. Keeping Ahead of the Bulldozers—Orange County Geology. (Cosponsored by National Association of Geoscience Teachers.) Saturday, April 4, 1998. A day trip designed for K-12 teachers to explore how geology affects life in Orange County, California. Basic geological principles and concepts will be illustrated using Orange County locales, such as igneous processes and faulting in the Orange Hills, structure and stratigraphic relationships in Santiago Canyon, mass wasting in the south county area, and coastal processes at Dana Point. Debra Brooks, Santiago Canyon College, Orange, CA 92869, (714) 564-4788, fax 714-532-4481; Elizabeth Simmons, FREY Environmental, Inc. Cost: \$35 (includes snacks, lunch, drinks, guidebook, and transportation). Limit: 24.

3. San Antonio Canyon: Cultural Geography, Geology, Late Cenozoic Geology, Geomorphology, and Environmental Geology of an Alpine Valley in Southern California. Saturday, April 4, 1998. A synthesis of the relationships among bedrock geology, faults, landslides, water use, flooding, power generation, residential development, and tourism in a beautiful alpine valley on the outskirts of the Los Angeles Basin. Larry Herber, Cal Poly Pomona, (909) 869-3454, fax 909-869-2920, LJHerber@CSUPomona.edu. Cost: \$40 (includes lunch, snacks, drinks, guidebook, and transportation). Limit: 35.

4. Independence Dike Swarm and Mafic Rocks of the Eastern Sierra. Saturday-Monday, April 4-6, 1998. Explore an important regional magmatic feature of California from the Mojave Desert to the eastern Sierra. We present field and magnetic evidence for oblique (sinistral) opening and syndeformational

intrusion which contrasts with an extensional origin for the swarm. We will also visit dated Cretaceous dikes and compare them with Jurassic ones. Cretaceous dikes may have originated from spectacular mafic complexes of the eastern Sierra. Allen Glazner, Dept. of Geology, University of North Carolina, Chapel Hill, NC 27599-3315, (919) 962-0689, fax 919-966-4519, afg@unc.edu; Brian Carl, University of North Carolina, Chapel Hill. Cost: \$150 (includes meals, snacks, drinks, 2 nights lodging, guidebook, and transportation). Limit: 20.

5. High Strains Surrounding a Sinking and Expanding Concordant Pluton, Central White-Inyo Range, Eastern California. Saturday–Monday, April 4–6, 1998. This field trip will examine the synintrusive high strains surrounding the Jurassic Eureka Valley–Joshua Flat–Beer Creek pluton. Early Cambrian strata rotate down into the contact to become concordant from all margins. High strains, dominantly boudinage, indicate that “sinking” was associated with pluton expansion. Sven Morgan, Dept. of Geological Sciences, Virginia Tech, Blacksburg, VA 24061, (540) 231-5765, fax 540-231-3386, morgans@vt.edu; Rick Law, Virginia Tech. Cost: \$130 (includes meals, snacks, drinks, 2 nights lodging, guidebook, and transportation). Limit: 28.

6. Late Miocene–Pleistocene Detachment Faulting in the Northern Gulf of California and Western Salton Trough and Its Role in Evolution of the Pacific–North American Plate Boundary. Saturday–Monday, April 4–6, 1998. A late Miocene–Pleistocene brittle low-angle normal (detachment) fault system, which runs for >200 km along the western Salton Trough, California, and Laguna Salada, Baja California, was instrumental in differentiation of the Gulf extensional province from the Peninsular Ranges. Structural, sedimentological, and thermochronological evidence for this faulting event will be illustrated by key sites in southern California and northeastern Baja California. The relations of this detachment system to formation of the modern transtensional Pacific–North American plate boundary in the Gulf of California rift, to sedimentation in the Salton Trough and Laguna Salada, and to generation of new “transitional” crust in the Salton Trough will be discussed. Gary Axen, UCLA, (310) 825-6928, gaxen@ess.ucla.edu; Arturo Martin-Barajas and John Fletcher, CICESE. Cost: \$250 (includes meals, snacks, drinks, 2 nights lodging, guidebook, and transportation to and within Mexico). Limit: 26.

7. Geology and Marine Geophysics of Catalina Island and the California Continental Borderland. Saturday–Monday, April 4–6, 1998. This excursion includes both ocean cruise and land-based components. At sea, we will image the

Palos Verdes fault, using marine seismic reflection methods, and discuss active tectonic processes. On Catalina Island, we will discuss the geology and evolution of the California Continental Borderland and will investigate all metamorphic facies within the Catalina Schist. R. Dan Francis, Dept. of Geological Sciences, California State University, Long Beach, CA 90840, (562) 985-4929, fax 562-8638, rfrancis@csulb.edu. Cost: \$220 (includes snacks, meals, drinks, guidebook, ocean and land transportation, and 2 nights lodging on Catalina Island). Limit: 25.

8. Old Oil Fields and a New Life: A Visit to the Los Angeles Basin. Sunday, April 5, 1998. An investigation of the depositional environments, stratigraphic setting, petroleum production, and rehabilitation of several giant oil fields of the Los Angeles Basin. The trip will visit Miocene turbiditic sequences in San Clemente, as well as the Wilmington, Huntington Beach, and Newport Beach oil fields. Don Clarke, Dept. of Oil Properties, City of Long Beach, (562) 570-3915, fax 562-570-3922, colbdop@ix.netcom.com; George Otott, Thums Long Beach Company; Chris Phillips, Tidelands Oil Production Company. Cost: \$50 (includes continental breakfast, lunch, snacks, drinks, guidebook, and transportation). Limit: 40.

9. St. Francis Dam Story: No Place for Poor Geology—Not by a Dam Site! Sunday, April 5, 1998. The St. Francis Dam site in San Francisquito Canyon north of Los Angeles is a classic study area for the application of engineering geology to dam construction. The dam failed catastrophically on March 12, 1928, and more than 400 people died. We will examine geological evidence that the failure should be ascribed to the weakness of the Sespe Formation sandstone near the northwest abutment and unfavorable foliation orientation of the Pelona Schist at the southeast abutment of the dam. Jack Green, Dept. of Geological Sciences, California State University, Long Beach, CA 90840, (562) 985-4198, fax 562-965-8638, jgreen3@csulb.edu. Cost: \$40 (includes snacks, lunch, drinks, guidebook, and transportation). Limit: 38.

10. Igneous and Tectonic Response of the Eastern San Gabriel Mountains to Neogene Extension and Rotation of the Transverse Ranges. Sunday, April 5, 1998. Prior to northwest translation along the San Andreas fault, the eastern San Gabriel Mountains basement was intruded by late Oligocene felsic magma and mid-Miocene intermediate-mafic magma. This trip will visit resulting flows and intrusions exposed between the Pomona Valley and the shoulder of Mount Baldy and will explore their relationships to synmagmatic and postmagmatic faults. Great views and precipitous canyon/waterfall outcrops reveal processes of extension, intrusion, rotation, and displacement

associated with an evolving dextral transform plate boundary. Jon Nourse, Cal Poly Pomona, (909) 869-3460, fax 909-869-2920, JANourse@aol.com; Peter Weigand, CSU Northridge; Garrett Hazelton, UCLA. Cost: \$35 (includes lunch, snacks, drinks, guidebook, and transportation). Limit: 30.

11. Active Tectonics and Earthquake Hazard, Santa Barbara Fold Belt: Anticlinal Uplift and Reverse Faulting of Wave-cut Platforms. Sunday–Monday, April 5–6, 1998. The Santa Barbara fold belt contains spectacular exposures of very young active folds and buried reverse faults. The rapid westward propagation of a very young fold and subsequent defeat of Mission Creek is illustrated at the historic Santa Barbara Mission. Several other sites demonstrating very young deformation will also be visited, including the prominent La Mesa and Hope Ranch anticlines. Ed Keller, Dept. of Geological Sciences, University of California, Santa Barbara, CA 93106, (805) 893-4207, fax 805-893-2314, keller@magic.geol.ucsb.edu; Larry Gurrola, Molly Trecker, Ross Hartleb, UCSB. Cost: \$140 (includes lunches, snacks, drinks, 1 night lodging, guidebook, and transportation). Limit: 40.

During Meeting

12A and 12B. THUMS Oil Islands and Oil Tour of Historical Long Beach. Two separate 4-hour trips, Wednesday morning (A) and afternoon (B), April 8, 1998. Visit the giant Long Beach (Signal Hill) and Wilmington oil fields to discuss the history and development of the oil business in the Long Beach area. Then, take a boat trip out to the THUMS oil islands to examine the innovative drilling and production facilities. George Otott, THUMS Long Beach Company, Long Beach, CA 90802, (562) 624-3234, fax 562-624-3296, gotott@mail.arco.com. Cost: \$20 (includes guidebook and transportation). Limit: 20/trip.

Postmeeting

13. Late Cretaceous Denudation History of the Peninsular Ranges as Recorded in Upper Cretaceous–Paleocene Sedimentary Rocks, Northern Santa Ana Mountains. Friday, April 10, 1998. The secluded canyons in the northern Santa Ana Mountains exhibit classic Upper Cretaceous–Paleocene strata and fossils. These strata preserve a record of the progressive denudation of the adjacent Peninsular Ranges. New insights on pluton emplacement, uplift and erosion rates, and depositional ages are provided via analyses of detrital K-feldspar grains by total fusion Ar/Ar ages modeled by using a newly created computer program. New insights have been gained through U/Pb analyses of conglomerate clasts and mag-

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netic susceptibility measurements of clasts and sandstone beds. Pat Abbott, Dept. of Geological Sciences, San Diego State University, San Diego, CA 92182-1020, (619) 594-5591, fax 619-594-4372, pabbott@geology.sdsu.edu; Dave Kimbrough, SDSU; Marty Grove, UCLA; Chuck Herzig, SDSU. Cost: \$40 (includes breakfast, lunch, snacks, drinks, guidebook, and transportation). Limit: 100.

WORKSHOPS

1. Roy Shlemon Mentors in Applied Geology Program: Workshop for Students. (Sponsored by GSA Institute for Environmental Education.) Monday, April 6, 8:30 a.m.–5:00 p.m., Department of Geological Sciences, CSULB. Stephen Testa, president, Testa Environmental Corporation. This workshop, designed for upper-level undergraduate and graduate students, will address practical aspects of engineering geology. There is no charge to students for this workshop, but space is limited to 20. Students wishing to attend should write a short note expressing their interest in the workshop by March 1, 1998, to Jack Green, Dept. of Geological Sciences, California State University, Long Beach, CA 90840. The selected applicants will be notified by March 15, 1998.

2. Analysis of Aquifer Test Data. Monday, April 6, 8:30 a.m.–3:30 p.m., Department of Geological Sciences, CSULB. Isam Amin, CSULB. This workshop reviews methods of determining aquifer parameters using manual techniques and computer programs. Cost: \$25 for students; \$60 for professionals.

3. Applying Earth Science Standards in the 21st Century. (Sponsored by NAGT—Far Western Section.) Tuesday, April 7, 6:00 to 9:00 p.m., CSULB. Dorothy Stout, Cypress College, (714) 826-2220, ext. 153, gaea@deltanet.com; Richard Lozinsky, Fullerton College, (714) 992-7207, rick_lozinsky@fullcoll.edu. Emplacement of the National Science Education Standards requires major changes in the very way science is taught in today's classroom. This workshop will focus on applying new standards in the classroom. Speakers from K–12 schools and colleges and universities will discuss successful methods they have employed. Cost: free.

4. "Four Easy Pieces": A Workshop in Geophysical Instrumentation. Thursday, April 9, 9:00 a.m. to 4:00 p.m., Department of Geological Sciences, CSULB. Elizabeth Ambos, (562) 985-4931, bambos@csulb.edu; Roswitha Grannell, CSULB. Participants will learn the basics of operation of four primary means of geophysical measurement: the 24-channel seismic system, cesium vapor and proton precession magnetometers, gravimeters, and ground-penetrating radar. Particularly

recommended for those with little background in geophysics and for K–12 educators. Cost: \$10 for students and K–12 educators; \$20 for professional.

STUDENT SUPPORT

The GSA Cordilleran Section has funds available for partial support of GSA Student Associates of the Section who are presenting papers at the meeting. Apply to Cordilleran Section Secretary Bruce A. Blackerby, Dept. of Geology, California State University, Fresno, CA 93740, (209) 278-2955, bruceb@csufresno.edu. Applications should include certification that the student is presenting a paper and is a GSA Student Associate of the Cordilleran Section. All letters must be received by *January 15, 1998.*

The local committee has funds available for partial support of students who will assist with the audio-visual equipment at the meeting. Apply to General Chair Stan Finney, (562) 985-8637, scfinney@csulb.edu. Applications should state the student's interest in attending the meeting. All letters must be received by *February 15, 1998.*

STUDENT PAPER AWARDS

For the first time, the Cordilleran Section will honor the best student papers. There will be separate awards for oral and poster presentations—a single best paper award of \$250 and two honorable mention awards of \$100 in each category. The principal author and presenter must be a graduate or undergraduate student and must be a Student Associate of the Cordilleran Section of GSA.

Volunteers are needed to judge presentations for student paper awards. Help ensure the successful inauguration of this important program. To volunteer, contact Gary Girty, Student Paper Awards Chair, Dept. of Geological Sciences, San Diego State University, San Diego, CA 92182, (610) 594-2552, ggirty@geology.sdsu.edu.

The Council on Undergraduate Research is sponsoring a student poster session to showcase results of undergraduate research. There will be a "best poster" award given to the most outstanding undergraduate presentation.

CHILD CARE

Child care facilities for children three and older will be available on site. Arrangements, still being completed, will be posted on the Web site (see Detailed Information below) in late January.

SPECIAL EVENTS

All breakfasts and luncheons are scheduled in banquet rooms in the University Dining Plaza on campus at CSULB (see map in *Abstracts with Programs*).

Welcoming Reception, Monday, April 6, 6:00–8:00 p.m., CSULB Pyramid, Concourse level. Exhibits will be open. Cash bar.

GSA Geology & Public Policy Committee Business Meeting and Breakfast, Wednesday, April 8, 7:00–8:30 a.m. Cost: \$10.

GSA Education Committee Meeting and Breakfast, Wednesday, April 8, 7:00–8:30 a.m. Cost: \$10.

GSA Cordilleran Section Management Board Meeting and Luncheon, Wednesday, April 8, 12:00–1:00 p.m. Cost: \$15.

Paleontological Society, Cordilleran Section Luncheon, Wednesday, April 8, 12:00–1:00 p.m. Cost: \$15.

Annual Cordilleran Section Banquet, Hawaiian Luau Buffet, Wednesday, April 8, 5:30–7:00 p.m. Cost: \$20. Cash bar.

1998 Cordilleran Section Meeting Keynote Address, Wednesday, April 8, 7:00–8:30 p.m. Matthew Golembek, Jet Propulsion Lab, Pasadena, "Mars Pathfinder Science Results," Carpenter Performing Arts Center. Free.

NAGT—Far Western Section Breakfast, Thursday, April 9, 7:00–8:30 p.m. Cost: \$10.

Association for Women Geoscientists, Luncheon and Business Meeting, Thursday, April 9, 12:00–1:30 a.m. Cost: \$15.

GSA Cordilleran Section Business Meeting and Luncheon, Thursday, April 9, 12:00–2:00 p.m. Cost: \$15.

EXHIBITS

Exhibits will be located along with poster sessions and primary food concessions on the concourse and court levels of the CSULB Pyramid events center. The exhibit area, site of the welcoming reception, is open 6:00–8:00 p.m. Monday evening, 8:00 a.m.–5:00 p.m. Tuesday and Wednesday, and 8:00 a.m.–noon Thursday. Applications for exhibit space are available from Exhibits Chair Barbara Grubb, (909) 482-5238, bgrubb@webb.org, or General Chair Stan Finney.

DETAILED INFORMATION

Further information on meeting activities, schedule, and locations will be in the *Abstracts with Programs* for the Cordilleran Section meeting. Direct general questions to General Chair Stan Finney, (562) 985-8637, scfinney@csulb.edu. Additional important information, updated regularly, will be posted on the home page of the Department of Geological Sciences at CSULB at <http://seis.natsci.csulb.edu>. In late January 1998, the program with all sessions, speakers, titles, and room locations will be added to the home page. ■

PREREGISTRATION FORM

GSA Cordilleran Section

Long Beach, California, April 7-9, 1998

Please print clearly • THIS AREA IS FOR YOUR BADGE

Name as it should appear on your badge (last name first) _____

 Employer/University Affiliation _____

City _____ State or Country _____

Mailing Address (use two lines if necessary) _____

City _____ State _____

ZIP Code _____ Country (if other than USA) _____

Circle member affiliation (to qualify for registration member discount):

- (A) GSA (B) NAGT (C) PS (D) SEPM (E) Speaker

GUEST INFORMATION • Please print clearly • This area is for badge

Name as it should appear on your guest's badge _____

 City _____ State or Country _____



Please inform us by February 7 of any special considerations that you or your guest require.

I will need special considerations.

Preregistration Deadline: March 6
Cancellation Deadline: March 13

MAIL TO:
GSA CORDILLERAN SECTION MEETING,
P.O. BOX 9140, BOULDER, CO 80301

Remit in U.S. funds payable to:
1998 GSA Cordilleran Section Meeting
(All preregistrations must be prepaid.
Purchase Orders not accepted.)

Payment by (check one):

- Check American Express VISA MasterCard

Card Number _____

Signature _____

Expires _____

PREREGISTRATION FEES

Professional Member*	Full Meeting	One Day	Qty.	Amount
Professional Member*	(10) \$85	(11) \$50	1	\$
Student Member*	(14) \$95	(15) \$55	1	\$
Student Nonmember	(30) \$30	(31) \$25	1	\$
K-12 Professional	(32) \$40	(33) \$25	1	\$
Guest or Spouse	(60) \$20	(61) \$10	1	\$
	(90) \$10	NA	1	\$

*Member fee applies to any current Professional OR Student Member of GSA or Associated Societies listed at left. Discount does not apply to guest registrants.

SPECIAL EVENTS

1. GSA G&PP Comm. Business Mtg. & Breakfast	April 8	(301) \$ 10	1	\$
2. GSA Education Comm. Mtg. & Breakfast	April 8	(302) \$ 10	1	\$
3. Cordilleran Section Mgmt. Board Business Luncheon	April 8	(303) \$ 15	1	\$
4. Paleontological Society Luncheon	April 8	(304) \$ 15	1	\$
5. Annual Banquet	April 8	(305) \$ 20	1	\$
6. NAGT Breakfast	April 9	(306) \$ 10	1	\$
7. AWG Luncheon	April 9	(307) \$ 15	1	\$
8. Cordilleran Section Business Luncheon	April 9	(308) \$ 15	1	\$

WORKSHOP

1. Roy Shlemon Mentors Program	April 6	(601) FREE	1	\$
2. Analysis of Aquifer Test Data	April 6	(602) \$ 60	1	\$
	Professional Student	(602) \$ 25	1	\$
3. Applying Earth Science Standards	April 7	(603) FREE	1	\$
4. Four Easy Pieces: Workshop in Geophysical Inst.	April 9	(604) \$ 20	1	\$
	Professional Student	(604) \$ 10	1	\$
	K-12	(604) \$ 10	1	\$

FIELD TRIPS

1. Anatomy of a Craton-Margin	April 3-6	(401) \$175	1	\$
2. Keeping Ahead of the Bulldozers: Orange City Geology	April 4	(402) \$ 35	1	\$
3. San Antonio Canyon	April 4	(403) \$ 40	1	\$
4. Independence Dike Swarm & Mafic Rocks, E. Sierra	April 4-6	(404) \$150	1	\$
5. High Strains, Sinking/Expanding Concordant Pluton	April 4-6	(405) \$130	1	\$
6. Late Miocene-Pleistocene Detachment Faulting	April 4-6	(406) \$250	1	\$
7. Geology & Marine Geophysics, Catalina Island	April 4-6	(407) \$220	1	\$
8. Old Oil Fields: Los Angeles Basin	April 5	(408) \$ 50	1	\$
9. Saint Francis Dam Story	April 5	(409) \$ 40	1	\$
10. Igneous & Tectonic Response, E. San Gabriel Mtns.	April 5	(410) \$ 35	1	\$
11. Active Tectonics & Earthquake Hazard	April 5-6	(411) \$140	1	\$
12. THUMS Oil Islands & Oil Tour, Historical Long Beach	April 8 (A) AM (B) PM	(412) \$ 20	1	\$
	(413) \$ 20	(413) \$ 20	1	\$
13. Late Cretaceous Denudation, N. Santa Ana Mtns	April 10	(414) \$ 40	1	\$

TOTAL FEES REMITTED \$ _____

NEW SERIES

Monographs in Mineral Resource Science
published by the Center for Mineral Resources
(University of Arizona-U.S. Geological Survey)
Tucson, Arizona

This Monograph series will help fill the need for extended original studies of scientific and societal aspects of mineral resources. Regional-resource studies will be included, but the scope is international. These Monographs will be timely, affordable, and high quality -- acid-free paper, sturdy side-stitched binding, full CIP data.

MONOGRAPH 1 (1997)

"Geology and Mineral Resources of the
Santa Catalina Mountains, SE Arizona:
a cross-sectional approach"
by Eric R. Force and others

135 pages with 117 figs. and 15 tables, 1 full-color 36" x 44" geologic map at 1:48,000 + 3 b/w maps at 1:12,000, includes self-leading field-trip guide, 8.5" x 11" format, soft cover, ISBN 0-9961233-1-X. PRICE \$49.50 + shipping; 25% discount to GSA, SEG, AGS members (mention this ad).

MONOGRAPH 2 (planned for 1998)

"Geology of pluton-related gold mineralization at Battle Mountain, Nevada" by T. G. Theodore and others

Distributed by University of Arizona Press, 1230 N. Park Ave., Tucson, AZ 85719, email: orders@uapress.arizona.edu, credit-card orders 1-800-426-3797. For submissions, contact Mark Barton (520) 621-8529.

Northeastern Section Announces Student Grant Programs

Undergraduate Student Research Grants. The GSA Northeastern Section student research grant program for 1998 is competitive and available only to undergraduate students. To be considered for a research grant, the student must be enrolled at an institution within the Northeastern Section, the student must be a student associate or member of GSA, and applications must be postmarked no later than **February 16, 1998**.

Grants will be awarded following the Northeastern Section Meeting in Portland, Maine, in March 1998.

Student Travel Grant Program. The Northeastern Section's student travel grant program is open to both graduate and undergraduate students. To be considered for a travel grant, the student must be the presenter of the paper, the student must be enrolled at an institution within the Northeastern Section, the student must be a student associate or member of GSA, and applications must be postmarked no later than **February 16, 1998**.

Grants will be awarded approximately 10 days prior to the Northeastern Section Meeting in Portland, Maine, in March 1998.

For further information or a copy of the application form(s), contact Kenneth N. Weaver, Secretary NEGSA, Maryland Geological Survey, 2300 St. Paul St., Baltimore, MD 21218, (410) 554-5532, fax 410-554-5502, kweaver438@aol.com.

Bulletin Update

John Geissman and Lynn Walter, GSA Bulletin Editors

Greetings for 1998 from the two of us and our capable editorial office assistants, Vicki Lawrence and Cathy Ratcliff. December 1997 marked the end of our first three-year term as science editors of the *Bulletin*, and it seemed like an appropriate time to explore evolutionary trends in *Bulletin* manuscript topics. Contributions in the following broad topical areas were compared for 1990 and 1997: paleoceanography, hydrogeology, paleontology, geophysics, marine geology, Quaternary geology and geomorphology, igneous and metamorphic petrology, sedimentology and stratigraphy, and structure and tectonics. Although this classification scheme could be refined to be more all-encompassing, this exercise did reveal, very clearly, that the breadth and topic range of *GSA Bulletin* articles have increased dramatically. More large-scale, integrative, and interdisciplinary studies are being published in the *Bulletin*. One reason is that many workers are expanding their research outside of traditional disciplinary boundaries. Another, we hope, is that the geoscience community perceives the *Bulletin* as an appropriate place to showcase studies of this type. We believe that both of these factors play a part. Certainly the past six years have seen tremendous shifts in earth science research and its role in larger political and social arenas. The role of the solid-earth sciences in our understanding of the impact of climate and environmental change has increased dramatically.

As editors, we are very encouraged by these trends, and we are especially gratified to see authors willingly, even enthusiastically, placing their large databases and extensive observational material in the GSA Data Repository, which is now available directly through the GSA home page (<http://www.geosociety.org/pubs/drprint/htm>).

How much insight do three years of experience as editors give us? We think enough to believe that the *Bulletin* occupies a unique and important niche in providing a highly visible outlet for the increasingly complex, integrative, and data-rich studies in the earth sciences. The response to the new Overview articles has been very positive, and we intend to maintain this thought-provoking feature in the *Bulletin*. When people question us about the future of the "generalist" journal, we have good reason to report that it is surprisingly rosy!

Lynn has decided to make 1998 her last year as editor, partly to initiate staggered terms for the *Bulletin* editor teams. This plan will provide greater continuity in the expertise of handling the *Bulletin* and will also smooth the transitions in working with authors of manuscripts in review or in different stages of production.

Finally, we heartily thank all of our Associate Editors for their expertise and sound input in shaping our editorial decisions. The following Associate Editors have completed their terms, and we especially thank them for their service to the *Bulletin*:

Hans G. Avé Lallemand
Edward C. Beutner
Robert G. Bohannon
Joanne Bourgeois
Laura Crossey

Kip V. Hodges
Samuel B. Mukasa
Frank V. Perry
Thomas K. Rockwell
James F. Tull

New GSA Fellows

The following 6 Members were advanced to Fellowship in October 1997.

Elizabeth Y. Anthony
Barbara M. Bekken
Judith A. Hannah

Michel Hermelin
Alain Tremblay
Ellen E. Wohl

January BULLETIN and GEOLOGY Contents



The Geological Society of America
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Alternates Receive 1997 Student Research Grants

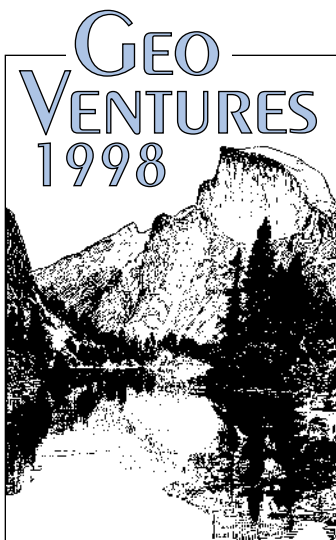
Each year when the Committee on Research Grants selects student grant recipients they also select an alternate group of recipients in the event that some of the grantees return part or all of their funds because they have received funding elsewhere or have changed their research plans. As the returned funds become available, they are re-awarded by the Research Grants Administrator to the alternates named by the committee.

In 1997 six alternates received funding following the initial awarding of grants. They are: Brian K. Alers, Colorado School of Mines; Andrey Bekker, Virginia Polytechnic Institute and State University; Carl Matthew Schafer, University of Montana; Caroline S. Whitehill, Vanderbilt University; Simmy Yau, Pennsylvania State University, University Park; and Christopher K. Zahm, University of Texas, Austin.

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Comment: Lawrence A. Hardie • Reply: Heinrich D. Holland, Heide Zimmermann
- 93 Global mafic magmatism at 2.5 Ga: Remnants of an ancient large igneous province?
Comment: Eric S. Cheney • Comment: Henry C. Halls • Reply: Larry M. Heaman
- 96 Correction: Flysch to molasse transition in peripheral foreland basins: The role of the passive margin versus slab breakoff



Field Trips with a Difference for GSA MEMBERS AND FRIENDS

CALL TODAY! HOLD A SPOT FOR YOURSELF AND FRIENDS

1998 GeoVentures Fee Schedule

	Grand Canyon	Durango	Tetons
Dates	April 10-18	June 27-July 2	July 18-23
No. of Days	9	6	6
Member Fee	\$1745	\$660	\$675
Nonmember Fee	\$1845	\$710	\$725
Deposit	\$200	\$100	\$100
Balance Due	January 12	April 30	May 29
100% Deposit refund date (less processing fee)	January 12 (\$50)	April 30 (\$20)	May 29 (\$20)

GEOTrip: FROM THE BIRTH OF A CONTINENT TO GLEN CANYON DAM: A GRAND CANYON VOYAGE

April 10-18, 1998 • 9 days, 8 nights

Scientific Leaders

Brad Ilg, Cerro Alto Geological Consultants, Inc., Glorieta, New Mexico
 Jeff Bennett, Northern Arizona University, Flagstaff
 Mike Timmons, University of New Mexico, Albuquerque
 Joel Pederson, University of New Mexico, Albuquerque

Join in on this adventure floating down the Colorado River in the Grand Canyon with several Grand Canyon geologists.

Fee and Payment (register by January 12)

GSA Member: \$1745 Nonmember: \$1845

Based on 25 people (the trip may be more if there are fewer registrants). A \$200 deposit, due with your reservation, is refundable through January 12, 1998, less \$50 processing fee. Total balance due: January 12, 1998. Minimum age: 21.

Please refer to December 1997 GSA Today for more detailed information on this trip, or contact Edna Collis, GSA Meetings Department, 1-800-472-1988, ext. 134 or (303) 447-2020, ecollis@geosociety.org.

SPACE still AVAILABLE.
Call Now!



Photo by Adam Read.

REGISTER TODAY!

Send a deposit to hold your reservation; please pay by check or credit card. You will receive further information and a confirmation of your registration within two weeks after your reservation is received.

Name _____
 Institution/Employer _____
 Mailing Address _____
 City/State/Country/ZIP _____
 Phone (business/home) _____
 Guest Name _____
 GSA Member # _____

CALL TODAY FOR MORE INFORMATION:

1-800-472-1988, x134, or (303) 447-2020, e-mail: ecollis@geosociety.org, check for updates: <http://www.geosociety.org>

	DEPOSIT PER PERSON	NO. OF PERSONS	TOTAL PAID DEPOSIT
GT981—Grand Canyon	\$200	___	\$ _____
GH982—Durango	\$100	___	\$ _____
GH983—Tetons	\$100	___	\$ _____
TOTAL DEPOSIT			\$ _____

I've enclosed no deposit, but I'm interested. Please send information.

VISA MasterCard American Express

Credit Card # _____ Exp. Date _____

Signature _____

FAX OR MAIL REGISTRATION FORM AND CHECK OR CREDIT CARD INFORMATION TO:

1998 GSA GeoVentures
 GSA Meetings Department
 P.O. Box 9140, Boulder, CO 80301
 Fax 303-447-0648

MAKE CHECKS PAYABLE TO: GSA 1998 GeoVentures

GeoHostel

Geology of THE GRAND TETON—YELLOWSTONE COUNTRY

**Teton Village, Jackson, Wyoming, 6 days, 6 nights
July 18–23, 1998**

Scientific Leaders: *Rob Thomas and Sheila Roberts, Western Montana College–UM, Dillon, Montana*

Rob Thomas is an associate professor and chair of the Department of Environmental Sciences at Western Montana College–UM, in Dillon, Montana. Rob developed an interest in the geology of the Grand Teton–Yellowstone country while working on Cambrian mass extinctions for his dissertation at the University of Washington. Since then, his research has broadened to include the study of the dynamics of carbonate platform development and destruction, the origin and timing of extensional tectonism in southwestern Montana, interdisciplinary geosciences program development, and geoscience teacher-education reform.

Sheila Roberts is an assistant professor of geology in the Department of Environmental Sciences at Western Montana College–UM, in Dillon, Montana. Having lived and worked much of her life in Montana and Wyoming, she has a deep passion for educating people about the geology of her home area. She has extensive experience with the geology of Wyoming as a result of her tenure as geoscience editor at the Wyoming Geological Survey in

Photo by Sheila Roberts.

Laramie. Her doctoral research at the University of Calgary focused on Pleistocene paleoclimates recorded in saline lacustrine sediments of Death Valley, California.

Description

The geology of the Grand Teton–Yellowstone country is some of the most spectacular in North America. From Archean metamorphic rocks to Quaternary glacial deposits, the Grand Teton–Yellowstone region has geology that promotes dynamic discussion and debate. The GeoHostel will include trips to look at Archean through Holocene geology of the Grand Tetons, the glacial and tectonic history of Jackson Hole, the eruptive history of the Yellowstone caldera in Yellowstone National Park, mafic volcanics of the Snake River Plain country, and extensional tectonics of the “wake zone” of the Yellowstone hot spot in the Quake Lake region of southwestern Montana. The trips are both full day and half-day, and some leisure time will be available to enjoy sightseeing in Jackson and the spectacular scenery of the Grand Teton–Yellowstone country.

Lodging, Meals, and Ground Transportation

The group will be lodged at The Hostel[®] in Teton Village. All lodging is based on single occupancy, or doubles for couples. Meals will include plentiful hors d’oeuvres at the Welcoming Reception–Orientation on Saturday evening, daily breakfasts and sack lunches, and a hearty farewell dinner on Thursday evening. Field trip transportation will be provided in air-conditioned, 15-passenger vans.

Fee and Payment

\$675 for GSA Members \$725 for Nonmembers

\$100 deposit is due with your reservation and is refundable through May 29, less \$20 processing fee.

Total balance due: May 29.

Included: Classroom programs and materials; field trip transportation; lodging for 6 nights (single-occupancy, or double for couples); breakfast and lunch daily, welcoming and farewell events.

Not included: Transportation to and from Jackson, Wyoming; transportation during hours outside field trips; and other expenses not specifically included.

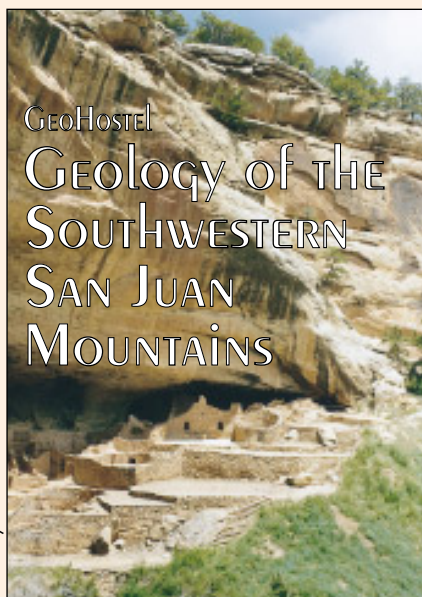


Photo by Ken Kolm.

**Fort Lewis College,
Durango, Colorado
June 27–July 2, 1998
6 days, 6 nights**

Scientific Leaders
*Gregory Holden and
Kenneth Kolm,
Colorado School of Mines,
Golden, Colorado*

Greg Holden and Ken Kolm are experienced GeoHostel leaders and ran a Durango GeoHostel in 1992. Both are associate professors at the Colorado School of Mines and know the Durango area well. You will find them informed, informing, and enthusiastic.

Description

Durango, Colorado, was founded more than a century ago as the supply center for the mining camps of the San Juan Mountains. Located at the boundary of the Colorado Plateau and the Colorado Rockies, the town today is the recreational center for some of the most scenic, historic, and geologically diverse country in the west. The Durango townsite was the terminus to the Ice Age Animas River glacier, largest to drain

the San Juan icefield. Fort Lewis College is 300 feet above the town, on the remnant of an outwash terrace. Erosion during Neogene uplift has exposed Precambrian basement rocks, a complete Paleozoic and Mesozoic sedimentary section, and Tertiary caldera-related pyroclastic rocks and associated mineralization. The area is home to the historic Durango & Silverton Narrow Gauge Railroad, Anasazi Indian ruins, ghost towns, and spectacular mountain wildflowers and scenery.

Lodging, Meals, and Ground Transportation

The group will be lodged at Fort Lewis College, West Hall. All lodging is based on single occupancy, or doubles for couples. Meals will include plentiful hors d’oeuvres at the Welcoming Reception–Orientation on Saturday evening, daily breakfasts and sack lunches, and a hearty farewell dinner on Thursday evening. Field trip transportation will be provided in air-conditioned, 15-passenger vans.

Fee and Payment

\$660 for GSA Members \$710 for Nonmembers

\$100 deposit is due with your reservation and is refundable through April 30, less \$20 processing fee.

Total balance due: April 30.

Included: Classroom programs and materials; field trip transportation; lodging for 6 nights (single-occupancy, or double for couples); breakfast and lunch daily, train ride on the Durango & Silverton Narrow Gauge Railroad, welcoming and farewell events.

Not included: Transportation to and from Durango, Colorado; transportation during hours outside field trips; and other expenses not specifically included.

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>.

1998 Penrose Conferences

May

May 14–18, **Linking Spatial and Temporal Scales in Paleoecology and Ecology**, Solomons, Maryland. Information: Andrew S. Cohen, Dept. of Geosciences, University of Arizona, Tucson, AZ 85721, (520) 621-4691, fax 520-621-2672, acohen@geo.arizona.edu.

June

June 4–12, **Evolution of Ocean Island Volcanoes**, Galápagos Islands, Ecuador. Information: Dennis Geist, Dept. of Geology, University of Idaho, Moscow, ID 83844, (208) 885-6491, fax 208-885-5724, dgeist@uidaho.edu.

July

July 4–11, **Processes of Crustal Differentiation: Crust-Mantle Interactions, Melting, and Granite Migration Through the Crust**, Verbania, Italy. Information: Tracy Rushmer, Dept.

of Geology, University of Vermont, Burlington, VT 05405, (802) 656-8136, fax 802-656-0045, trushmer@zoo.uvm.edu.

September

September 13–17, **Ophiolites and Oceanic Crust: New Insights from Field Studies and Ocean Drilling Program**, Marshall, California. Information: Yildirim Dilek, Dept. of Geology, Miami University, Oxford, OH 45056, (513) 529-2212, fax 513-529-1542, dileky@muohio.edu.

1998 Meetings

February

February 9–12, **Global Paleoenvironmental Data**, Boulder, Colorado. Information: David M. Anderson, NOAA Paleoclimatology Program, 325 Broadway, Code E/GC, Boulder, CO, 80303-3328, (303) 497-6237, fax 303-497-6513, danderson@ngdc.noaa.gov, or Robin Webb, rwebb@ngdc.noaa.gov.

March

March 22–26, **Symposium on the Application of Geophysics to Engineering and Environmental Problems**, Chicago, Illinois. Information: SAGEEP, (303) 771-2000, <http://www.sageep.com>.

May

May 11–15, **International Workshop on the Geology and Geophysics of Tenerife**, Tenerife, Canary Islands. Information: Joan Marti, Institute of Earth Sciences "Jaume Almera" (CSIC), Lluís Sole Sabaris s/n, 08028 Barcelona, Spain, joan.marti@ija.csic.es, phone 34-3-330 27 16, fax: 34-3-411 00 12.

May 16–22, **Natural and Anthropogenically Induced Hazards: Frequency-Magnitude Relationships in Earthquake and Fault Populations: Implications for Seismic Hazard**, Acquafredda di Maratea, Italy. Information: J. Hendekovic, European Science Foundation, 1 Quai Lezay-Marnesia, 67080 Strasbourg Cedex, France, euresco@esf.org, <http://www.esf.org/euresco>.

May 17–22, **American Society for Surface Mining and Reclamation 15th National Meeting**, St. Louis, Missouri. Information: John Mead, Southern Illinois University, Carbondale, IL 62901-4623, (618) 536-5521, fax 618-453-7346.

May 20–21, **Response of the Earth's Lithosphere to Extension**, London, UK. Information:

R. B. Whitmarsh, Southampton Oceanography Ctr., European Way, Southampton SO14 3ZH, UK, phone 44-1703-596564, fax 44-1703-596554, Bob.Whitmarsh@soc.soton.ac.uk. (Poster proposals due: March 31, 1998.)

May 22–27, **Geochemistry of Crustal Fluids: Characterization of Reactive Transport in Natural Systems**, Aghia Pelaghia, Crete. Information: J. Hendekovic, European Science Foundation, 1 Quai Lezay-Marnesia, 67080 Strasbourg Cedex, France, euresco@esf.org, <http://www.esf.org/euresco>.

May 26–29, **American Geophysical Union Spring Meeting**, Boston, Massachusetts. Information: AGU Meetings Dept., 1998 Spring Meeting, 2000 Florida Ave., NW, Washington, DC 20009, (202) 462-6900 (outside North America), 800-966-2481 (in North America), fax 202-328-0566, meetinginfo@kosmos.agu.org, <http://www.agu.org>.

June

June 6–11, **Clay Minerals Society 35th Annual Meeting**, Cleveland, Ohio. Information: Patricia Jo Eberl, Clay Minerals Society, P.O. Box 4416, Boulder, CO 80306, (303) 444-6405, fax 303-444-2260, peberl@clays.org.

June 28–July 4, **Gondwana 10, Event Stratigraphy of Gondwana**, Cape Town, South Africa. Information: Congress coordinator, fax 27-21-4486263, deborah@medicine.uct.ac.za, <http://www.uct.ac.za/dept/cigc/Gondwana10>.

July

July 12–16, **Tropical Hydrology and Caribbean Islands Water Resources**, San Juan, Puerto Rico. Information: AWRA, Tropical Hydrology and Caribbean Water Resources Symposium, 950 Herndon Pkwy., Ste. 300, Herndon, VA 20170-5531, (703) 904-1225, fax 703-904-1228.

July 26–30, **Society for Organic Petrology 15th Annual Meeting**, Halifax, Nova Scotia. Information: P. K. Mukhopadhyay, Global Geoenergy Res., Box 9469, Station A, Halifax, NS B3K 5S3, Canada, (902) 453-0061, avery@agc.bio.ns.ca, <http://agc.bio.ns.ca/tsophalifax98>. (Abstract deadline: April 1, 1998.)

August–September

August 30–September 2, **International Commission on the History of Geological Sciences (INHIGEO) Congress: Advancing Geological Knowledge of the Carpathian-Balkan Region in the Nineteenth and Twentieth Centuries**, Vienna, Austria. Information: Endre Dudich, Geological Institute of Hungary, P.O. Box 106, H-1142, Budapest, Hungary, phone 36-1-2510109, fax 36-1-2510703, geo@mafi.hu.

September 7–14, **International Commission on the History of Geological Sciences (INHIGEO) Congress: From Folds to Nappes to Plates, and History of Ideas about Glaciation**, Neuchâtel, Switzerland. Information: Jean-Paul Schaer, Université de Neuchâtel, Institut de Géologie, Emile Argand 11, 2007 Neuchâtel, Switzerland, phone 41-38-718-2663 or 41-38-718-2600, fax 41-38-718-2601, sabine.robert@geol.unine.ch.

September 20–24, **Fluid Flow in Carbonates: Interdisciplinary Approaches**, Door County, Wisconsin. Information: Judy Tarpley, SEPM, 1731 E. 71st St., Tulsa, OK 74136-5108, (918) 493-3361, ext. 22 (outside North America), 800-865-9765, ext. 22 (in North America), fax 918-493-2093, cemeet@galstar.com.

Calendar continued on p. 35

KARST HYDROLOGY

June 22-27, 1998

This is the 19th year for this successful, "hands-on" course/workshop offered in Bowling Green, KY. It deals with groundwater monitoring techniques, tracers, and the movement of contaminants through karst aquifers. Other topics include methods for preventing or treating sinkhole flooding and collapse, qualitative and quantitative dye trace tests, geophysical techniques such as microgravity, color down-hole video cameras, and cave radio techniques for locating monitoring wells in karst aquifers. A primary objective of this course is to provide "state-of-the-art" information and experience for dealing with groundwater problems of karst regions.

Instructors:
William White, Ph.D., Pennsylvania State Univ.
Nick Crawford, Ph.D., Western Kentucky Univ.

KARST HYDROLOGY

of the

EDWARDS AQUIFER

June 8-13, 1998

The Edwards Aquifer of south-central Texas is among the world's most complex and politically embroiled groundwater systems. The karstic nature of the aquifer adds significantly to its complexity. This six day field course will be based in San Antonio, TX, the largest city in the U.S. relying solely on an aquifer for its water. The course will focus on teaching the principles of karst hydrogeology, with an emphasis on interpretation of the types of karst features most common and important to the understanding and management of the Edwards.

Instructor: George Veni, Ph.D.

for more information contact:
Dr. Nicholas C. Crawford, Director
Center for Cave and Karst Studies
Department of Geography and Geology
Western Kentucky University
Bowling Green, KY 42101-3576
(502) 745-3252
cave.karststudies@wku.edu

Karst Field Studies

at

Mammoth Cave

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Karst Geomorphology

June 21-27
Speleology
Cave Ecology

June 22-27
Karst Hydrology

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cave.karststudies@wku.edu

GSA ANNUAL MEETINGS

■ 1998

TORONTO
1998 Annual Meeting

October 26–29

Metro Toronto Convention Centre
Sheraton Centre Toronto Hotel
www.geosociety.org/meetings/98

General Chairs: *Jeffrey J. Fawcett, University of Toronto,
Peter von Bitter, Royal Ontario Museum*

Technical Program Chairs:

*Denis M. Shaw, Dept. of Geology, McMaster University, Hamilton,
Ontario L8S 4M1, Canada, hawden@mcmill.cis.mcmaster.ca*

*Andrew Miall, Dept. of Geology, University of Toronto, 22 Russell St.,
Toronto, Ontario M5S 3B1, Canada, miall@quartz.geology.utoronto.ca*
Symposia and theme proposals were due to GSA January 2, 1998.

Call for Field Trip Proposals

Field Trip Chairs:

*Pierre Robin, Dept. of Geology, University of Toronto, Erindale
Campus, Mississauga, Ontario L5L 1C6, Canada,
(905) 828-5419, probin@erin.utoronto.ca*

*Henry Halls, Dept. of Geology, University of Toronto, Erindale
Campus, Mississauga, Ontario L5L 1C6, Canada,
(905) 828-5363, hhalls@erin.utoronto.ca*

Or call Edna Collis at GSA, (303) 447-2020, x134
See November GSA *Today* for a preliminary list of trips.

All proposals are due **January 15, 1998.**

GSA SECTION MEETINGS—1998

NORTHEASTERN SECTION, March 19–21, Holiday Inn by the Bay, Portland, Maine. Information: Stephen G. Pollock, Dept. of Geosciences, University of Southern Maine, Gorham, ME 04038, (207) 780-5350, fax 207-780-5167, pollock@usm.maine.edu. *Preregistration deadline: February 13, 1998.*

NORTH-CENTRAL SECTION, March 19–20, Ohio State University, Columbus, Ohio. Information: William I. Ausich, Geological Sciences, Ohio State University, 275 Mendenhall, 125 S. Oval Mall, Columbus, OH 43210, (614) 292-0069, fax 614-292-7688, ausich.1@osu.edu. *Preregistration Deadline: February 13, 1998.*

SOUTH-CENTRAL SECTION, March 23–24, OU Continuing Education Center, Norman, Oklahoma. Information: M. Charles Gilbert, School of Geology and Geophysics, University of Oklahoma, 100 E. Boyd St., Suite 810, Norman, OK 73019-0628, (405) 3254424, fax 405-325-3140, mcgilbert@ou.edu. *Preregistration Deadline: February 6, 1998.*

SOUTHEASTERN SECTION, March 30–31, Embassy Suites, Charleston, West Virginia. Information: Larry D. Woodfork, West Virginia Geological and Economic Survey, P.O. Box 879, Morgantown, WV 26507-0879, (304) 594-2331, fax 304-594-2575, woodfork@geosrv.wvnet.edu. *Preregistration Deadline: February 27, 1998.*

CORDILLERAN SECTION, April 7–9, California State University, Long Beach, California. Information: Stan Finney, Dept. of Geological Sciences, California State University, Long Beach, CA 90840, (562) 985-8637, scfinney@csulb.edu. *Preregistration Deadline: March 6, 1998.*

ROCKY MOUNTAIN SECTION, May 25–26, Northern Arizona University, Flagstaff, Arizona. Submit abstracts to: Wendell Duffield, U.S. Geological Survey, 2255 Gemini Road, Flagstaff, AZ 86001, (520) 556-7205, wduffield@iflag2.wr.usgs.gov. *Abstracts Deadline: January 8, 1998.*

CALL FOR NOMINATIONS REMINDERS

Calendar continued from p. 34

October

October 4–8, **The Geologic Record of Natural Disasters**, Portland, Oregon. Information: Judy Tarpley, SEPM, 1731 E. 71st St., Tulsa, OK 74136-5108, (918) 493-3361, ext. 22 (outside North America), 800-865-9765, ext. 22 (in North America), fax 918-493-2093, cemeet@galstar.com.

October 5–7, **Fifth International Conference on Remote Sensing for Marine and Coastal Environments**, San Diego, California. Information: ERIM Marine Conferences, Box 134001, Ann Arbor, MI 48113-4001, (313) 994-1200, ext. 3234, fax 313-994-5123, wallman@erim.org.

October 13–17, **Water China '98**, Beijing, China. Information: Rebecca Chan, Unit 1223, 12/F, 1 Trademart Dr., Kowloon Bay, Hong Kong, phone 852-2865-2633, fax 852-2866-1770.

October 19–23, **Precambrian-Paleozoic Interactions Between Laurentia and Gondwana**, Oaxaca, Mexico. Information: J. D. Keppie, Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Delegación Coyoacán, 04510 México D.F., México, phone 52-5-622-4303, fax 52-5-622-4289, duncan@servidor.dgsca.unam.mx.

November

November 15–19, **American Water Resources Annual Conference, Point Clear, Alabama**. Information: AWRA, 1998 Annual Conference & Symposia, 950 Herndon Pkwy., Ste. 300, Herndon, VA 20170-5531, (703) 904-1225, fax 703-904-1228.

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

PENROSE AND DAY MEDALS, AND HONORARY FELLOWSHIP

Nominations for 1998 Penrose and Day Medals and for Honorary Fellowship in the Society are due by **FEBRUARY 2, 1998.**

YOUNG SCIENTIST AWARD (DONATH MEDAL)

For the year 1998, only those candidates born on or after January 1, 1963, are eligible for consideration for the Young Scientist Award. In choosing candidates, scientific achievement and age will be the sole criteria. Nominations for the 1998 award must include biographical information, a summary of the candidate's scientific contributions to geology (200 words or less), a selected bibliography (no more than 10 titles), supporting letters from five scientists in addition to the person making the nomination.

Deadline for nominations for 1998 is **FEBRUARY 2, 1998.**

OFFICERS AND COUNCILORS

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

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

DISTINGUISHED SERVICE AWARD

The GSA Distinguished Service Award recognizes individuals for their exceptional service to the Society. GSA Members, Fellows, Associates, or, in exceptional circumstances, GSA employees may be nominated for consideration. Any GSA member or employee may make a nomination for the award. Awardees will be selected by the Executive Committee, and all selections must be ratified by the Council. Awards may be made annually, or less frequently, at the discretion of Council. This award will be presented during the annual meeting of the Society. Deadline for nominations for 1998 is **MARCH 2, 1998.**

Materials and supporting information for any of the nominations may be sent to GSA Executive Director, Geological Society of America, P.O. Box 9140, Boulder, CO 80301. For more detailed information about the nomination procedures, see the November 1997 issue of *GSA Today*, or the Web (www.geosociety.org/admin/awards.htm), or call headquarters at (303) 447-2020, extension 140.

GSA in Salt Lake City 1997



1997 GSA Annual Meeting Statistics

Technical Program

Abstracts submitted	2649
Abstracts presented	2590
Abstracts rejected or withdrawn	59
Percentage of abstracts accepted	97%
Poster presentations (including theme posters)	677
Oral presentations	1930
Oral presentations, discipline sessions	720
Oral presentations, theme sessions	829
Oral presentations, symposia	312
Total number of sessions (including posters)	188
Theme sessions in poster format	9
Theme sessions in oral format	73

Registration

Professional	3188
Student	1410
Exhibitor	593
Guest	195
Total attendance	5570

Short Courses

Number of GSA-sponsored courses	7
Participants	143

Field Trips

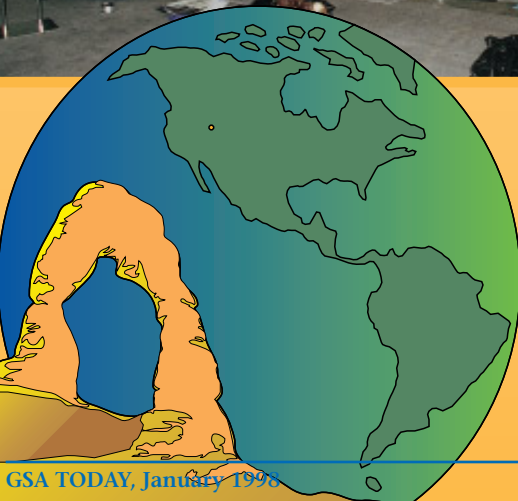
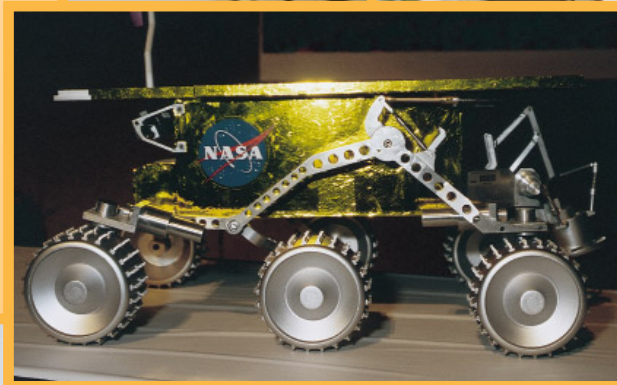
Number of trips	26
Participants	768
Number of participants in one-day trips	271

Exhibits

Number of booths	231
Number of exhibiting companies	174

Employment Service

Applicants	211
Employers	38
Interviews	504
Positions available	112



CLASSIFIED ADVERTISING

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

Classification	Per Line for 1st month	Per line for each add'l month (same ad)
Situations Wanted	\$1.75	\$1.40
Positions Open	\$6.50	\$5.50
Consultants	\$6.50	\$5.50
Services & Supplies	\$6.50	\$5.50
Opportunities for Students		
first 25 lines	\$0.00	\$2.35
additional lines	\$1.35	\$2.35
Code number: \$2.75 extra		

Agencies and organizations may submit purchase order or payment with copy. Individuals must send prepayment with copy. To estimate cost, count 54 characters per line, including all punctuation and blank spaces. Actual cost may differ if you use capitals, centered copy, or special characters.

To answer coded ads, use this address: Code # ----, GSA Advertising Dept., P.O. Box 9140, Boulder, CO 80301-9140. All coded mail will be forwarded within 24 hours of arrival at GSA Today office.

Positions Open

CASE WESTERN RESERVE UNIVERSITY

The Department of Geological Sciences invites applications for a tenure-track opening at the Assistant Professor level, to begin in August 1998. We seek applicants with research interests and expertise in areas related to processes at or near the surface of the earth that will complement existing programs in geomorphology, hydrology, and geochemistry. Examples include, but are not limited to, sedimentology and sediment transport, soil genesis, geochemical cycles, applications of isotope systematics to surficial processes, and geomicrobiology.

The successful candidate will be expected to pursue a vigorous research program, teach selected undergraduate courses, provide opportunities for undergraduates to participate in field and/or lab-oriented research, and develop graduate courses and supervise dissertation research in his/her area(s) of specialization. An important consideration will be the ability to teach courses in sedimentology and in field geology for undergraduate majors. A Ph.D. is required at the time of appointment.

The search will remain open until the position is filled. To apply send a complete resume, a statement of teaching and research interests, and names and addresses of three references to Philip Banks, Chair, Department of Geological Sciences, Case Western Reserve University, Cleveland, OH 44106-7216. Our web site is <http://www.cwru.edu/CWRU/Dept/Artsci/geol/geol.html>. CWRU is an AA/EEO employer. Applications from women and minorities are strongly encouraged.

PART-TIME MICROSCOPE SALES / SCIENTISTS

Manufacturer of a new, high-resolution optical 3D microscope seeks microscopists with discretionary time interested in supplementing income through equipment sales and application development. Ideal candidate will continue to perform research in a discipline benefiting from 3D analysis. Compensation based on ability to develop and publish new applications for technology and to assist in sales of microscopes to other scientists. Send resume to: InGen Corporation, 235 Montgomery Street, Suite 300, San Francisco, CA 94104.

DEPARTMENT OF PHYSICS AND GEOLOGY NORTHERN KENTUCKY UNIVERSITY

LECTURER IN PHYSICS, continuing non-tenure track academic year appointment, beginning August, 1998. M.S. in physics or related discipline required. Appointee will share with other faculty the responsibilities for the department's science and non-science majors' courses. Applicants should have collegiate teaching experience related to both lectures and laboratories at the introductory level in physics and experience in the use of instructional technologies in classrooms and laboratories. Teaching experience in astronomy and/or geology as well as physics is strongly preferred. Applicants should submit a resume, a separate statement of teaching philosophy, and a list of three references (names, addresses, phone numbers and e-mail) to: Dr. John Filaseta, Search Committee Chair, Department of Physics and Geology, Highland Heights, KY 41099-1900. Screening of applications will begin Feb. 16, 1998 and continue until the position is filled. NKU is an AA/EEO.

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ENGINEERING / SURFICIAL PROCESSES

CALIFORNIA STATE UNIVERSITY, SACRAMENTO

The Geology Department at California State University, Sacramento seeks to fill one tenure-track position in Engineering Geology and/or Surficial Processes at the assistant professor level. Review of applications begins February 1, 1998; position open until filled.

Submit resume, letter of application, and three letters of reference to: Dr. Brian Hausback, Geology Department, California State University, Sacramento, 6000 J Street, Sacramento, CA 95819-6043. AA/EEO

Further details can be found at: <http://www.csus.edu/nsm/index.html>

HYDROLOGIST

Indiana University-Purdue University at Indianapolis (IUPUI) Applications are solicited for a tenure-track, assistant-professor position in hydrology or hydrogeology. We seek an individual who will develop a rigorous research program and is committed to high-quality teaching. A Ph.D. in geology or a related field is required. Numerous opportunities are available for professional interactions with colleagues in the Schools of Medicine, Public and Environmental Affairs, Liberal Arts, and Engineering. Research specialty should complement existing strengths in the environmental field of: 1) the department (geochemistry, glacial geology, sedimentology, soils), 2) other academic units of the University (engineering, environmental science, geography, environmental toxicology), and 3) cooperating environmental scientists in the central Indiana area.

Indianapolis is the twelfth largest city in the United States. The city uniquely combines the cultural amenities of urban life with the residential qualities of smaller communities. IUPUI is the third largest university in Indiana, with about 28,000 students. It includes one of the nation's leading medical centers. The Geology Department is part of the School of Science, and offers B.S., B.A., and M.S. degrees in geology. There are currently 9 full-time and 7 adjunct faculty, with about 60 undergraduate and 15 graduate majors.

The initial appointment will begin August, 1998. Interested candidates should send a resume, statements of research and teaching interests, and the names of at least three referees. Deadline for receipt of applications: February 15, 1998. Applications and correspondence should be addressed to: Chair, Search and Screen Committee, Department of Geology, Indiana University-Purdue University at Indianapolis, 723 W. Michigan Street, Indianapolis, IN 46202-5132. E-mail address: nfribley@iupui.edu. Website: www.geology.iupui.edu.

IUPUI is an equal-opportunity, affirmative action employer.

SEDIMENTARY GEOLOGY AT DUKE UNIVERSITY

The Division of Earth & Ocean Sciences (EOS) of the Nicholas School of the Environment at Duke University invites applications for an anticipated tenure-track position in the general area of sedimentary geology to be filled at the assistant professor level. The starting date will be open, but we hope to fill the position by Fall 1998.

EOS at Duke includes 14 full-time faculty, 3 faculty with secondary appointments from other units, and 3 research scientists. Research and educational programs of EOS cover a broad spectrum of subdisciplines in geology, marine geology, hydrology, and oceanography. Supporting facilities at Duke include a wide range of computer hardware and software, analytical equipment, laboratories, and research vessels. We look forward to receiving applications from qualified applicants who will enhance the existing strengths of EOS and NSOE in these areas. Please see our web site at <http://www.geo.duke.edu> for additional information.

The successful candidate will hold a Ph.D. degree and will be expected to develop a vigorous research program in his or her specialty as well as being committed to both undergraduate and graduate teaching, including B.S., M.S., and Ph.D. level geology degree candidates. The

position is broadly defined in terms of specialty and could include outstanding individuals with innovative approaches to stratigraphy, sedimentation, sedimentary petrography, basin analysis, etc. We especially encourage applications from candidates who use the sedimentary record in investigations of global change and tectonics. Send vitae and names of 3 references to: Chair of the Search Committee, Division of Earth & Ocean Sciences, Box 90230, Duke University, Durham, NC 27708-0230. All applications received by March 1, 1998, will be guaranteed consideration. Duke University is an Equal Opportunity/ Affirmative Action Employer.

SEDIMENTARY PROCESSES

SYRACUSE UNIVERSITY

Syracuse University invites applications for a tenure-track Assistant or Associate Professorship in Earth Sciences. We seek an individual with scholarly interests in the stratigraphic record of environmental change, and whose research addresses large-scale questions in Earth history using approaches that are paleoclimatological, paleoecological, organic geochemical, or sedimentological. Priority will be given to candidates with postdoctoral experience, a record of research funding, a record of high-caliber scholarly publications, and university teaching experience. The successful candidate will teach a majors course in Sedimentology or Stratigraphy/Sedimentology, an introductory course in History of Earth and Life, and a graduate course in his/her specialty area. Applications will be reviewed beginning January 20, 1998, and should be directed to: Professor Cathryn Newton, Department Chair, Department of Earth Sciences, Heroy Geology Laboratory, Syracuse University, Syracuse, NY 13244-1070. AA/EEO

GEOLOGY

The Department of Applied Sciences of the College of Staten Island, a senior college of The City University of New York, seeks candidates for an anticipated tenure-track position as assistant professor of Geology, beginning September 1998. CSI is located on a new 204-acre campus equipped with first-rank teaching and research facilities. Required: Ph.D. in Geology with postdoctoral experience preferred, demonstrated commitment to research and publication, and excellence in undergraduate teaching. Qualified candidates may be appointed to the doctoral faculty of CUNY. The successful candidate will be expected to teach undergraduate geology courses to liberal arts students, establish a vigorous and productive research program, advise students, and develop curricula in the applied sciences. Salary range: \$37,172-\$52,213, commensurate with qualifications. Review of applications will begin on February 1, 1998 and continue until the position is filled. Send letter of application that describes teaching experience and research interests, a curriculum vitae, and the names, address, and telephone numbers of at least three references to Professor A. Ohan, Chair, Geology Search Committee, Department of Applied Sciences, College of Staten Island/CUNY, 2800 Victory Blvd., Staten Island, NY 10314. EEO/AA/ADA employer.

WASHINGTON AND LEE UNIVERSITY

DEPARTMENT OF GEOLOGY

The Department of Geology at W&L (4 full-time faculty, a secretary, and departmental technician) occupies well-equipped quarters in a new \$23 million Science Center, receives generous independent funding, belongs to the Keck Geology Consortium, and is beautifully situated in the Shenandoah Valley of Virginia. Our student body is national and highly selective.

We seek a colleague to fill a tenure-track position at the beginning Asst. Professor level effective at the commencement of the 1998-99 academic year. Teaching contact averages 12 hours/week (split evenly between labs and classes). The successful candidate will have a comprehensive background in the earth sciences with broad specialization in Earth materials. He or she will teach introductory geology and courses that includes mineralogy, petrology, and global systems geochemistry. We expect the successful applicant to maintain a program of sustained original research and actively collaborate with students and colleagues in geology and the other sciences.

Candidates should submit a letter of application outlining their approach to teaching and research in a liberal arts setting, vitae, graduate academic transcripts, and 3 or 4 letters of recommendation that specifically address the candidates ability as a teacher-scholar. All application materials must arrive by February 15, 1998 and be

addressed to Earth Materials Position, Department of Geology, Washington and Lee University, Lexington, VA 24450. Interviews will be held on campus in March and early April.

We also have a second, temporary, one-year sabbatical replacement position open. Teaching responsibilities for this second position include introductory geology, geomorphology, hydrology, and other upper class major or general education classes. Application materials for this second position (including 3 to 4 letters of recommendation) should be addressed to Geomorphology Position, Department of Geology, Washington and Lee University, Lexington, VA 24450 and must be received by February 15.

Washington and Lee University is an equal opportunity employer.

PRINCETON UNIVERSITY DEPARTMENT OF GEOSCIENCES FACULTY POSITION

The Department is seeking applicants for a junior, tenure-track faculty appointment. The search will concentrate on the following areas, but we also encourage outstanding applicants in other areas of the earth sciences.

Surface and Tectonic Processes — including erosion and deposition, geomorphology, structural geology, continental dynamics, interface between petrology and tectonophysics, and links to climate and geochemistry. Paleoclimates -- including observational and modeling studies of past as well as present climate. Environmental Mineralogy and Biogeochemistry — chemical and biological processes, particularly with interests in mineralogy and/or microbiology.

Applicants may strengthen, and benefit from, three related programs at Princeton. The Program in Atmospheric and Oceanic Sciences and the NOAA Geophysical Fluid Dynamics Laboratory support numerical modeling of atmospheric and oceanic processes and of present and past climate. The Princeton Environmental Institute is involved in research at the interface of biology, engineering, chemistry, and the geosciences. The Princeton Materials Institute facilitates interdisciplinary research in Materials Sciences.

Send resume, statement of teaching and research interests, and the names, addresses, and phone numbers of at least three references to Professor George H. Philander, Chairman, Department of Geosciences, Princeton University, Princeton, NJ 08544-1003, (609) 258-4100, FAX 609 258-5275. Applications received by January 31, 1998 will receive formal consideration. Princeton University is an Affirmative Action Equal Opportunity Employer; women and members of minority groups are encouraged to apply.

TENURE-TRACK FACULTY POSITION SOUTHWEST TEXAS STATE UNIVERSITY

The Department of Physics at Southwest Texas State University (SWT) invites applications for a tenure-track, assistant professor of geology position to begin September 1, 1998. Geology faculty is housed administratively within the Department of Physics and offer a minor in geology. The successful applicant must have a Ph.D. in geology with a strong commitment to excellence in teaching and scholarship. The courses that must be taught are Physical and Historical Geology, Mineralogy, Hydrogeology, Sedimentation and Stratigraphy, Applied Geology, and a Field Course in Geology. Send curriculum vitae with publications list, a list of three references with addresses and telephone numbers, and a brief statement of research interest and teaching philosophy to Dr. James R. Crawford, Department of Physics, Southwest Texas State University, San Marcos, TX 78666-4616. Completed applications will be reviewed starting January 15, 1998. SWT has an enrollment of over 20,000 and is located on the edge of the Hill Country in central Texas between Austin and San Antonio. Southwest Texas State University is an Affirmative Action/Equal Employment Opportunity employer and encourages applications from qualified minority and women applicants.

DEPARTMENT OF GEOLOGICAL SCIENCES INDIANA UNIVERSITY

The Geological Sciences faculty at Indiana University, Bloomington seeks an outstanding research scientist to serve as a departmental Chair. The recruitment of an external Chair is undertaken in response to the unexpected recent loss of several senior faculty. The newly appointed Chair will guide significant faculty expansion. Additional benefits come from an on-going expansion of

analytical and computational infrastructure and a new \$5 million endowment. Preference will be given to mid-career candidates with international recognition and scientific interests that complement and enhance departmental strengths. This tenured appointment will be at the level of Full Professor beginning in January 1999 or sooner. Salary and start-up funding will be commensurate with the record of scholarly activity, commitment to continued research productivity, and previous administrative responsibilities.

All applications received by March 1, 1998 will receive full consideration but the search will continue until the position is filled. Letters of application or nomination including a curriculum vitae, a statement of research and teaching activities, a description of administrative positions and philosophy, and the names of five potential references should be sent directly to Professor Lisa M. Pratt, Chair Search Committee, 1005 East 10th Street, Department of Geological Sciences, Indiana University, Bloomington, IN 47405.

Indiana University is an equal-opportunity/affirmative-action employer.

WATERSHED HYDROLOGIST UNIVERSITY OF CALIFORNIA, DAVIS

The Hydrology Program of the Department of Land, Air, and Water Resources seeks applicants for an academic year (9-month), tenure-track position (fiscal year, 11-month, term employment offered and continued based on academic personnel review), at the Assistant Professor level. The appointee is expected to develop a quantitative field-experimental research program in Watershed Hydrology emphasizing processes that may include precipitation and runoff, surface water and groundwater interaction, surface water detention, wetland hydrology, snow hydrology, sediment transport, and chemical cycling in watersheds. The appointee is expected to have a foundation in physical sciences and mathematics and be able to analyze and quantitatively interpret the acquired data. Research topics might include impacts of range management, forestry, or urban development on watershed function, water yield and surface water quality, infiltration, surface runoff and erosion, stream flow, riparian and wetland restoration, groundwater recharge and chemical transport. The appointee is expected to lead a team-taught field course in hydrology, an undergraduate course in watershed hydrology and a graduate-level course in experimental watershed hydrology. Supervision of graduate students, student advising, and participation in outreach programs is expected. The position is available September 1, 1998. Applicants should submit resume with their e-mail address, transcripts, research and teaching statements with background in each, copies of relevant publications and manuscripts, and the names including address, telephone number, FAX and e-mail address of at least four references to: Professor Jan W. Hopmans, Watershed Hydrology Search Committee Chair, Hydrology Program, Department of Land, Air and Water Resources, University of California, Davis, CA 95616, telephone (530) 752-3060/1130, e-mail: jwhopmans@ucdavis.edu. Open until filled. To ensure consideration applications should be postmarked by 3/27/98. A more detailed job description can be obtained from the above address. Information on the Department, Hydrology Program, and its faculty, can be found on <http://lawr.ucdavis.edu>.

The University of California, Davis, is an equal opportunity/affirmative action employer.

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Opportunities for Students

Graduate Student Research Opportunities in Contaminant Hydrogeology and Residual Soils, Department of Geological Sciences, University of Tennessee, Knoxville. Applications are invited for M.S. and Ph.D. candidates interested in hydrogeology of residual soils. Research topics include: origin, distribution and aperture/diameter of fractures/microprobes; mineralogy/geochemistry of fracture coatings; DNAPL entry, pres-

sure-saturation, and degradation; transport of dissolved and colloidal contaminants. Research projects are related to contamination of weathered and fractured shales at nearby Oak Ridge National Lab (ORNL) and typically involve collaboration with ORNL staff. Students are supported through teaching and research assistantships, with opportunities for summer research employment. The program is supported by UT and the U.S. Dept. of Energy.

For more information and application forms, contact Dr. Larry McKay, Dept. of Geol. Sci., Univ. of Tennessee, Knoxville, TN 37996-1410, ph (423) 974-0821, <http://geoweb.gg.utk.edu>, email: lmckayu@utk.edu. The University of Tennessee is an equal opportunity/affirmative action employer.

Graduate assistantship in applied micropaleontology. Applications are invited for students wishing to pursue an M.S. or Ph.D. in micropaleontology, Dept. Geol.Sci., Univ. Nevada, Reno. M.S. position is currently available, starting July 1998, involving the integration of siliceous microfossils, geochemistry, & sedimentology in the Silurian of the Canadian Arctic. Successful applicant must be available for July, 1998 fieldwork, should be prepared for Arctic camping, and have prior experience with measuring section. Applicants should have coursework in paleontology, sedimentology, and must enjoy microscope work. Previous experience with microfossils & computer graphics desirable. A 2-year RA will be awarded for the Arctic project, contingent on project funding. E-mail Dr. P.J. Noble for further information. noblepj@unr.edu.

Fossil Butte National Monument Paleontological Internship, June 1–August 30, 1998. The two primary activities will be fossil collection and preparation.

Fossil Butte National Monument is currently involved in the active collection of fossils at two localities: one within Monument boundaries provides data for evaluating a near-shore paleoenvironment and the changes within it over time; the other locality is in deeper-water sediments and represents different flora and fauna, as well as the opportunity to investigate a larger area stratigraphically.

Sufficient volume of fossil material is collected from these localities to require a dedicated effort towards their preparation in order to collect additional data not readily evident in field examination. Fossil preparation requires diligence, patience, and attention to detail along with the mastery of air scribe and abrasive equipment.

This position is funded by the Geologic Resources Division through the Student Conservation Association. Call SCA at (603) 543-1700 for applications. For more information contact Peter Ambrose, Park Paleontologist, Fossil Butte National Monument (307) 877-4455, e-mail: peter_ambrose@nps.gov.

Jonathan O. Davis Scholarship, administered by the Quaternary Sciences Center, Desert Research Institute. The family and friends of Jonathan O. Davis, a prominent geologist and geochronologist, have established an endowment which provides an annual scholarship of \$1,000. Jonathan was tragically killed in an automobile accident in December, 1990. It is the wish of his family and friends to support graduate students working on the Quaternary geology of the Great Basin and surrounding areas.

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

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

Applications must be postmarked by February 1, 1998. Applications should be addressed to: Executive Director, Quaternary Sciences Center, Desert Research Institute, 7010 Dandini Blvd., Reno, NV 89512. Contact: Emily Nelson, (702) 673-7303; or e-mail emily@dri.edu.

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