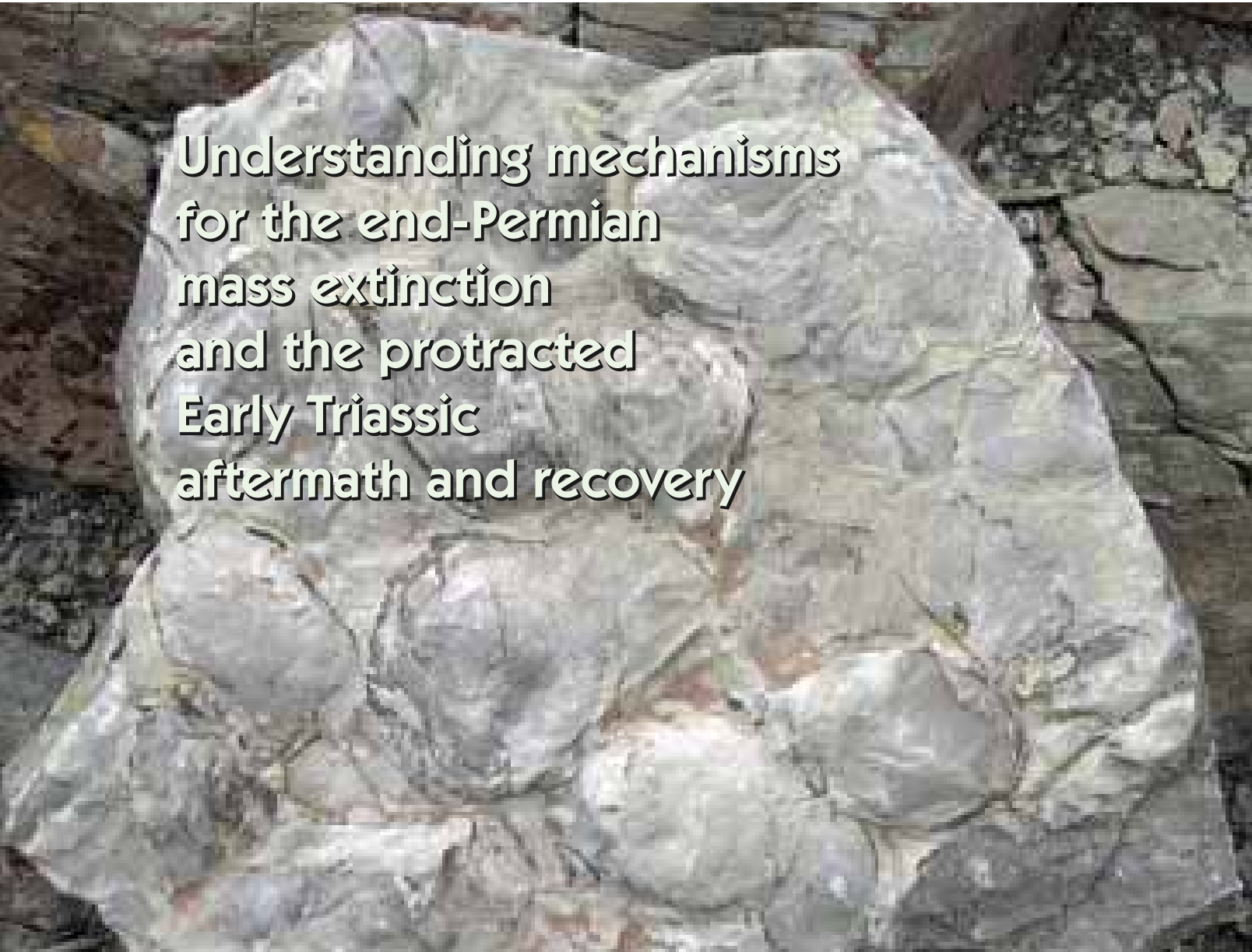


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Understanding mechanisms
for the end-Permian
mass extinction
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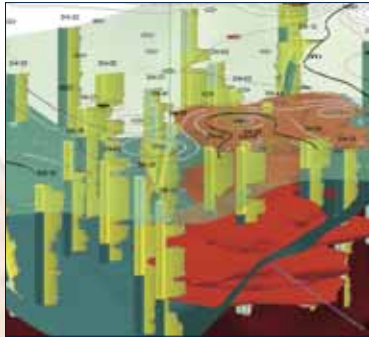
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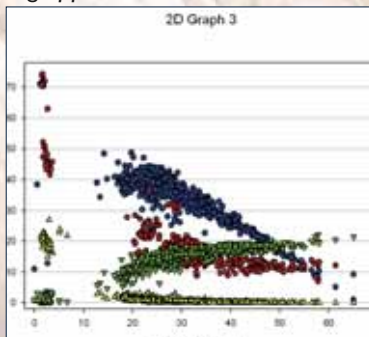
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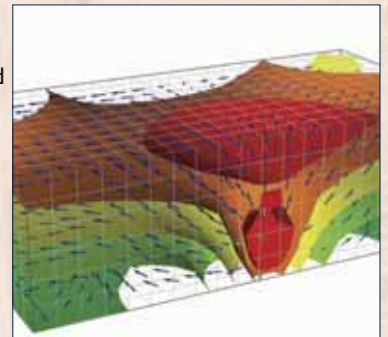
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David J. Bottjer, Matthew E. Clapham, Margaret L. Fraiser, and Catherine M. Powers

Cover: After the end-Permian mass extinction, huge numbers of benthic molluscs, in particular four cosmopolitan genera of bivalves, proliferated wildly on Early Triassic seafloors. This produced fossil assemblages like that seen on this bedding surface from the Virgin Limestone Member (Moenkopi Formation), east of Ute (Nevada, USA) in the Muddy Mountains, composed predominantly of the bivalves *Promyalina* and *Eumorphotis*. See "Understanding mechanisms for the end-Permian mass extinction and the protracted Early Triassic aftermath and recovery" by D.J. Bottjer et al., p. 4–10.



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Understanding mechanisms for the end-Permian mass extinction and the protracted Early Triassic aftermath and recovery

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ABSTRACT

Modern study of the end-Permian mass extinction in the marine realm has involved intensive documentation of the fossil content, sedimentology, and chemostratigraphy of individual stratigraphic sections where the mass extinction interval is well preserved. These studies, coupled with innovative modeling of environmental conditions, have produced specific hypotheses for the mechanisms that caused the mass extinction and associated environmental stress. New paleobiological studies on the environmental distribution and ecological importance of brachiopods, benthic molluscs, and bryozoans support the hypothesis that stressful ocean conditions—primarily elevated H₂S levels (euxinia) but also heightened CO₂ concentrations—were the prime causes of the end-Permian mass extinction. These studies also further demonstrate that both the Late Permian interval preceding this mass extinction and the Early Triassic interval that followed were times of similar elevated environmental stress. In the low-diversity Early Triassic biosphere, huge numbers of benthic molluscs, in particular four cosmopolitan genera of bivalves, typically covered the seafloor. That a few marine genera thrived during this time indicates a greater than usual tolerance to some combination of marine anoxia, as well as elevated CO₂ and/or increased H₂S concentrations. Research focusing on experiments with modern organisms similar to those that died, as well as those that thrived, in microcosms where levels of O₂, CO₂, and H₂S can be experimentally manipulated will enable an even more detailed understanding of the nature of this greatest Phanerozoic biotic crisis.

INTRODUCTION

A major drop in global biodiversity defines mass extinctions, as revealed by compilations of taxonomic richness (Sepkoski, 1981). The end-Permian mass extinction (ca. 252 Ma) has long been recognized as the most severe biodiversity crisis in the Phanerozoic (Erwin, 2006), and its associated faunal shift from

the brachiopod-rich Paleozoic Fauna to the mollusc-rich Modern Fauna (Gould and Calloway, 1980; Sepkoski, 1981) represents a fundamental change in the taxonomic structure as well as the ecological architecture of marine animal ecosystems. A range of mechanisms from oceanographic to climatic to extraterrestrial has been proposed to explain the end-Permian mass extinction (e.g., Renne et al., 1995; Knoll et al., 1996; Wignall and Twitchett, 1996; Isozaki, 1997; Krull and Retallack, 2000; Becker et al., 2001; Grice et al., 2005). Similarly, a variety of evidence shows that environmental stress lingered through the Early Triassic, strongly affecting recovery processes (e.g., Schubert and Bottjer, 1992; Woods et al., 1999; Payne et al., 2004; Pruss et al., 2006).

We focus here on paleobiological approaches that incorporate ecological, environmental, and biogeographic analyses during the time leading up to the end-Permian mass extinction as well as the subsequent Early Triassic aftermath and recovery to test the variety of mechanisms hypothesized for this interval of biotic crisis. These new analyses provide the foundation for future experiments in which environmental conditions can be manipulated in microcosms, thus allowing a more comprehensive understanding of the largest biotic crisis of the Phanerozoic.

ANALYTICAL APPROACHES

Recent paleobiological studies have adopted a more quantitative approach to document hierarchical changes, from local to global scales, in the marine biosphere during the Late Permian extinctions and the Early Triassic recovery. The combination of paleoecological analysis, based on counts of fossil assemblages and shell accumulations, with assessment of the changing habitat preferences and geographic distribution of environmentally sensitive animal groups provides a clearer picture of the ecological processes operating at a variety of scales during the Permo-Triassic extinction and recovery interval. These paleoecological analyses build upon results from modern ecology, indicating that (1) abundant species typically play a crucial role in controlling the ecological functioning of their communities (Power et al., 1996), and (2) the correspondence between a taxon's abundance in marine life and death assemblages is relatively faithful (Kidwell, 2001, 2002). As such, fossil accumulations, known as shell beds, provide a rich source of paleoecological data. Shell beds have been used to estimate the identity of ecologically dominant groups in the fossil record (e.g., Clapham et al., 2006) and as proxies for numerical dominance of skeletonized benthic marine invertebrates during important biological transitions, such as the Ordovician Radiation (e.g., Li and Droser, 1999). Both quantitative accounts of

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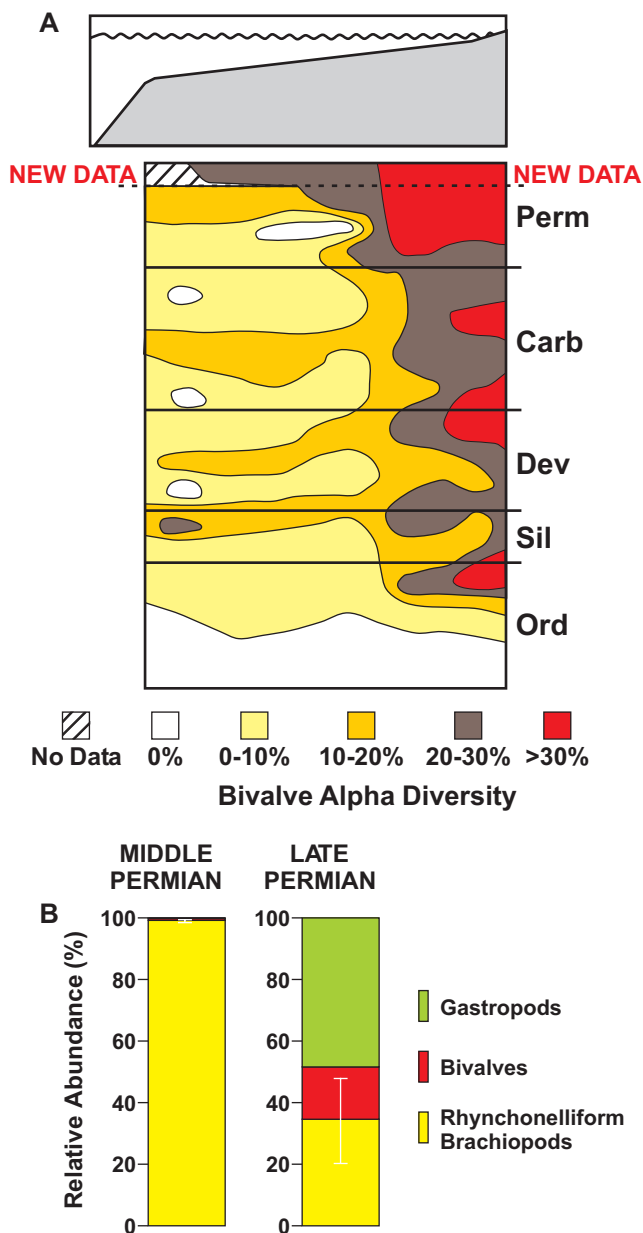


Figure 1. Paleocological changes in brachiopods and molluscs in the Paleozoic. (A) Time-environment pattern of Paleozoic bivalve alpha diversity, indicating an initial offshore expansion of diverse bivalve assemblages in the Permian; modified from Miller (1988). New Late Permian data (from Clapham and Bottjer, 2007a) show a major offshore increase in bivalve diversity. Hatched pattern in Late Permian slope and basin environments indicates a lack of data. (B) Mean relative abundance of rhyntonelliform brachiopods, bivalves, and gastropods from new Middle and Late Permian offshore samples (from Clapham and Bottjer, 2007a). Error bars indicate 95% confidence intervals.

fossil abundance (Clapham and Bottjer, 2007a, 2007b; Fraiser and Bottjer, 2007b) and semiquantitative assessment of the dominant group in shell accumulations (Fraiser and Bottjer, 2007b) document profound ecological changes in marine animal communities during the Late Permian and Early Triassic.

As part of the ecological assessment of organisms before and after mass extinctions, the paleoenvironmental context of important taxa must also be considered in order to under-

stand how changes in environmental conditions affect different habitats. Assessment of shifts in habitat occupation and environmental variation in diversity also provides a broader perspective on local community changes reconstructed from quantitative counts.

Time-environment (*T-E*) diagrams, which plot the presence or absence, diversity, or abundance of particular taxa against marine environments and geological time, have long been used to understand the evolutionary paleoecology and distribution of these taxa through time (e.g., Jablonski et al., 1983; Sepkoski and Miller, 1985; Bottjer and Jablonski, 1988; Miller, 1988; Powers and Bottjer, 2007) (Figs. 1A and 2A) (for detailed methodology, see Powers and Bottjer, 2007). Once hierarchical biotic changes are addressed at the local community scale through quantitative paleoecological analysis and at the regional scale through documentation of habitat occupation with *T-E* diagrams, the broadest scale of extinction processes is revealed by the changing paleobiogeographic patterns of specific animal groups (e.g., Powers and Pacht, 2008). Plots on paleogeographic maps of occurrences gathered from the primary literature document geographic variations in the severity of the extinction, including the existence of refugia where animals were able to avoid the most severe environmental perturbations and survive to recolonize the globe after conditions became more favorable.

PROPOSED MECHANISMS FOR LONG-TERM ENVIRONMENTAL STRESS AND MASS EXTINCTION

Mechanisms for environmental stress during the Permian-Triassic transition, including the end-Permian mass extinction, varied over space and time. Potential sources of environmental stress include a range of gradual and catastrophic processes, such as reduced concentrations of atmospheric O₂ (Huey and Ward, 2005), widespread oceanic anoxia (Wignall and Twitchett, 1996; Isozaki, 1997; Huey and Ward, 2005), euxinia (H₂S poisoning) (Nielsen and Shen, 2004; Grice et al., 2005; Kump et al., 2005), increased oceanic CO₂ concentrations (hypercapnia) (Knoll et al., 1996), massive volcanism and global warming (Renne et al., 1995; Kamo et al., 2003), CH₄ oxidation (Krull and Retallack, 2000; Ryskin, 2003), and an extraterrestrial impact (Becker et al., 2001).

Environmental stress during the Late Permian was likely initiated at the end of the Middle Permian, during the development of deep-water anoxic conditions associated with the Permian-Triassic superanoxia event (Isozaki, 1997). Deep waters were even euxinic in some basins during the early Late Permian, several million years before the end-Permian mass extinction (Nielsen and Shen, 2004). Geochemical and sedimentological data indicate that Late Permian deep-water environmental stress, including euxinia and high CO₂ concentrations, persisted into the Early Triassic (Isozaki, 1997; Woods et al., 1999; Payne et al., 2004; Pruss et al., 2004) and that upward excursion of these deep-water conditions into shallow environments was the ultimate cause of the end-Permian mass extinction, during which 80% of marine species and 49% and 63% of marine and terrestrial families disappeared (Rau and Sepkoski, 1982; Stanley and Yang, 1994; Benton, 1995). These deep-water, and intermittently shallow-water, H₂S-rich conditions were exacerbated by the effects of massive Siberian Trap

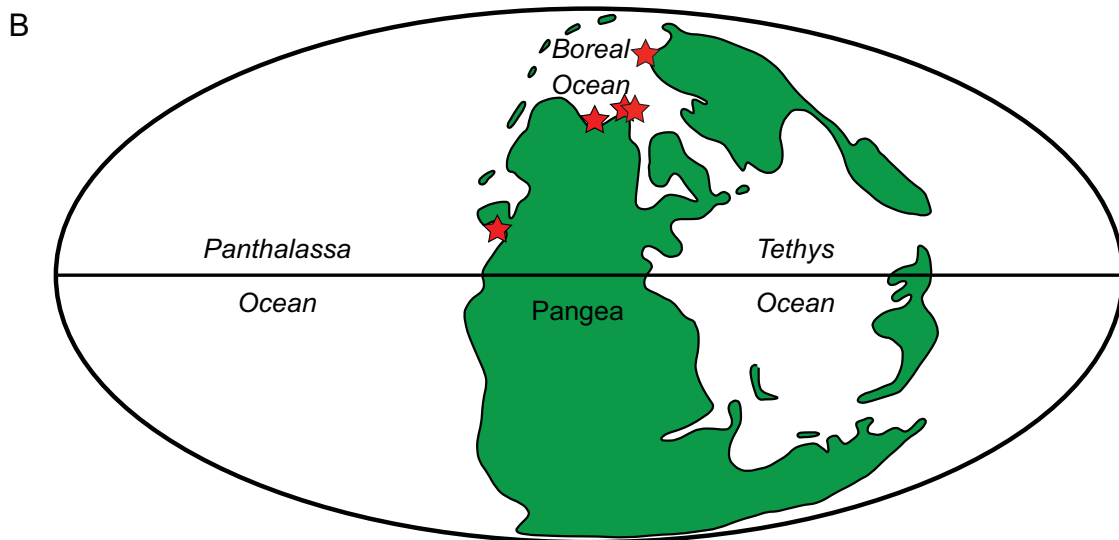
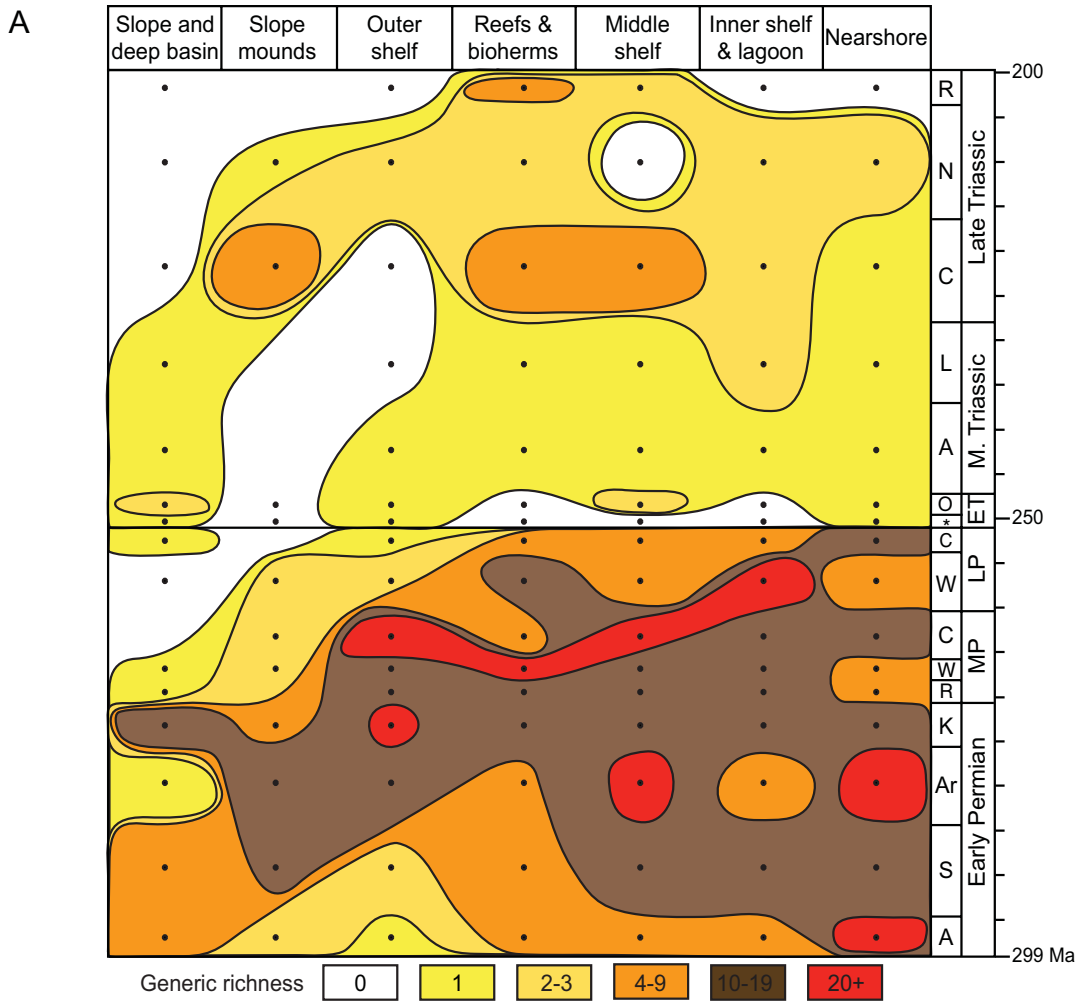


Figure 2. Environmental and geographic distribution of stenolaemate bryozoans. (A) Contoured Permian-Triassic time-environment (*T-E*) diagram of marine bryozoans. Each dot represents a data point, either for assemblage with the greatest bryozoan generic richness in each *T-E* bin, or for absence of bryozoans validated by the taphonomic control group; modified from Powers and Bottjer (2007). Abbreviations from the bottom up: A—Asselian; S—Sakmarian; Ar—Artinskian; K—Kungurian; R—Roadian; W—Wordian; C—Capitanian; W—Wuchiapingian; C—Changhsingian; *—Induan; O—Olenekian; A—Anisian; L—Ladinian; C—Carnian; N—Norian; R—Rhaetian; MP—Middle Permian; LP—Late Permian; ET—Early Triassic. (B) Paleobiogeographic distribution of Early Triassic bryozoans indicated by stars. Modified from Powers and Pachut (2008).

volcanism (Renne et al., 1995; Kamo et al., 2003), which increased atmospheric CO₂ concentrations, enhancing the possibility for hypercapnia and/or ocean acidification and biocalcification crises (Knoll et al., 1996).

PERMIAN PRELUDE

Compilations of marine animal diversity show that the shift in global taxonomic richness from diverse rhynchonelliform (“articulate”) brachiopods to diverse molluscs occurred at the Permian-Triassic boundary, coincident with the end-Permian mass extinction event (e.g., Sepkoski, 1981). That concurrence has been used to argue that the mass extinction was the primary cause of this ecological change by eliminating previously dominant brachiopods and allowing molluscs to rise to prominence (e.g., Gould and Calloway, 1980). Pioneering environmental and ecological analysis of the prelude to this transition through the use of *T-E* diagrams (e.g., Miller, 1988) showed the beginnings of an increase in bivalve molluscs across middle shelf environments in the Middle Permian (Fig. 1A), although data were not available from the Late Permian (Clapham and Bottjer, 2007a, 2007b) until recently.

Ecological changes at the local paleocommunity level prior to the end-Permian extinction have been reconstructed from abundance counts of >33,000 fossil individuals from 24 silicified Middle and Late Permian paleocommunities (Clapham and Bottjer, 2007a, 2007b). The counts document a significant ecological shift in fossil abundance in offshore environments, from rhynchonelliform brachiopods to gastropods and bivalves, between the Middle and Late Permian, despite the fact that the relative global taxonomic richness of those groups was essentially unchanged (Fig. 1B). The shift in numerical dominance was also accompanied by major ecological changes as motile gastropods and infaunal bivalves became more prominent members of Late Permian communities.

A compilation of the global onshore-offshore distribution of marine bryozoans within nearly 400 Permian-Triassic assemblages reveals that the pronounced ecological changes in local paleocommunities were symptomatic of a more widespread phenomenon affecting offshore habitats in the Late Permian. The generic richness of bryozoans declined significantly in the Late Permian, with the most severe effects observed in offshore settings from which bryozoans were progressively restricted and finally eliminated significantly before the extinction event (Powers and Bottjer, 2007) (Fig. 2A). Although not based on a similar comprehensive global data set, onshore-offshore trends in the mean abundance of microgastropods and maximum gastropod size can be observed in the Late Permian, with larger gastropods inhabiting shallow settings, while the microgastropod abundance and maximum size in offshore habitats were strikingly similar to the Early Triassic (Clapham and Bottjer, 2007a).

These new data on the environmental distribution and ecological structure of Late Permian assemblages further demonstrate that processes leading to the end-Permian mass extinction commenced around the Middle-Late Permian boundary (Clapham and Bottjer, 2007a, 2007b; Powers and Bottjer, 2007). The preferential drop in abundance of brachiopods and assemblage diversity of bryozoans in Late Permian offshore environments, coincident with the increase in molluscan abundance, indicates that stressful conditions for brachiopods and

bryozoans were encroaching over time from the deep ocean onto shelf environments, and argues against an extraterrestrial cause for the extinction. That this ultimately led to the end-Permian demise of brachiopods and bryozoans, contrasted with an increase in molluscs, indicates that the anoxic, and locally euxinic, nature of this deep ocean water was highly stressful to brachiopods and bryozoans but not to certain benthic molluscs (Clapham and Bottjer, 2007b).

EARLY TRIASSIC AFTERMATH AND RECOVERY

The end-Permian mass extinction marks the beginning of the second phase of the prolonged Permian-Triassic biotic crisis, with biotic recovery beginning only 4–5 m.y. later (Lehrmann et al., 2006), toward the end of the Early Triassic (Spathian). Full recovery, including a return to pre-extinction diversity and ecological complexity, did not occur until some time in the Middle Triassic (Hallam, 1991; Erwin and Pan, 1996). Carbon isotopic data demonstrate large negative and positive excursions throughout the Early Triassic, indicating changes in the carbon cycle not seen since Cambrian and earlier times (e.g., Atudorei, 1999; Payne et al., 2004; Corsetti et al., 2005; Pruss et al., 2006). Quantitative paleoecological analysis at various temporal and spatial scales has revealed short-term and long-term changes within benthic level-bottom shallow marine paleocommunities that were facilitated by protracted Early Triassic deleterious environmental conditions (Figs. 3 and 4).

One short-term paleoecological pattern revealed by analysis of Lower Triassic shell beds is the opportunistic proliferation of microgastropods—gastropods with greatest dimension <1 cm—in shallow marine subtidal to middle shelf environments (Fraiser and Bottjer, 2004; Fraiser et al., 2005) (Fig. 4). Microgastropod-dominated shell beds occur globally during the aftermath of the end-Permian mass extinction and represent a non-actualistic phenomenon. Fraiser and Bottjer (2007a) proposed that microgastropods were able to survive the chemically and/or physiologically harsh environmental conditions during the Early Triassic better than most skeletonized benthic marine invertebrates. This phenomenon had begun by the Late Permian in offshore environments, supporting the hypothesis that poisonous deep-waters contributed to changes in paleocommunity structure (Clapham and Bottjer, 2007a).

Quantitative data of fossil marine assemblages found in The Paleobiology Database (www.paleodb.org) show that rhynchonelliform brachiopods, in contrast to benthic molluscs (bivalves and gastropods), declined in abundance throughout the Late Permian and Early Triassic before recovering to abundance levels similar to those of the Late Permian during the Middle and Late Triassic (Fig. 3) (Clapham and Bottjer, 2007b). Field examination of Lower Triassic shell beds from around the world reveals a similar trend: bivalves dominate 70% of Lower Triassic shell beds, and rhynchonelliform brachiopods dominate only a small percentage of the studied shell beds (Fig. 4). Four bivalve genera, *Claraia*, *Eumorphotis*, *Promyalina*, and *Unionites*, are the most widespread and numerically abundant bivalve genera during the Early Triassic (Hallam and Wignall, 1997; Fraiser and Bottjer, 2007b). Of these, *Unionites* is typically the most common in shallow marine environments.

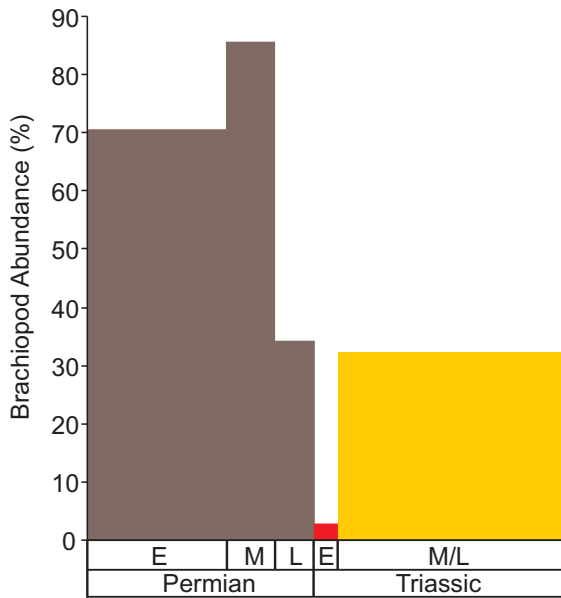
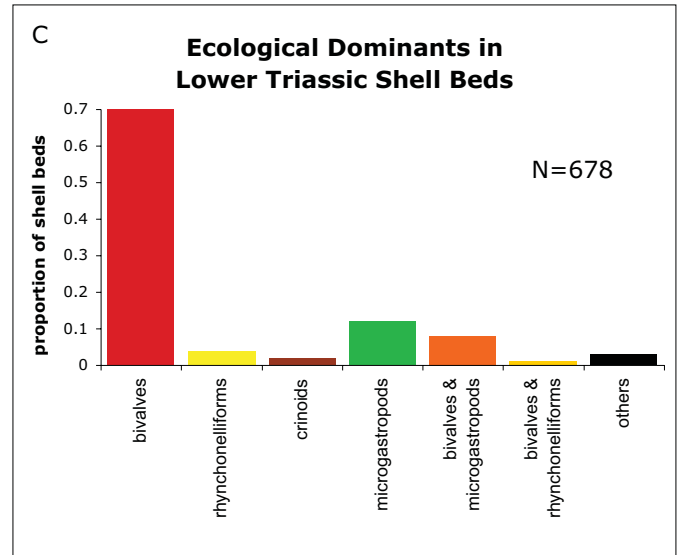
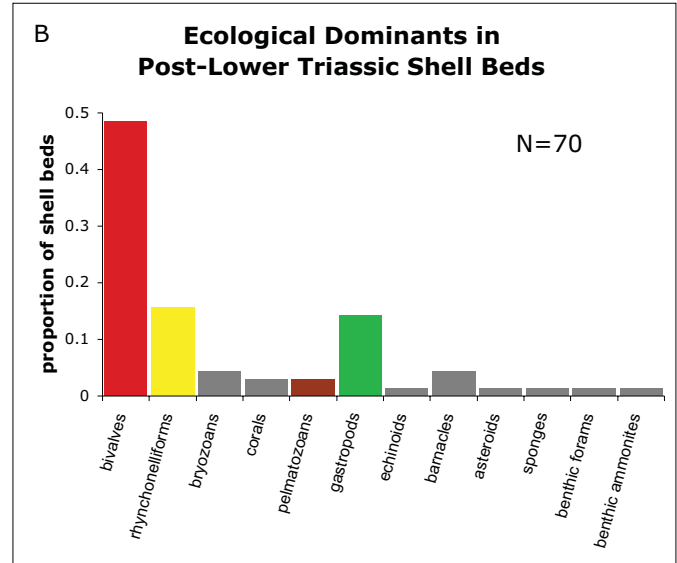
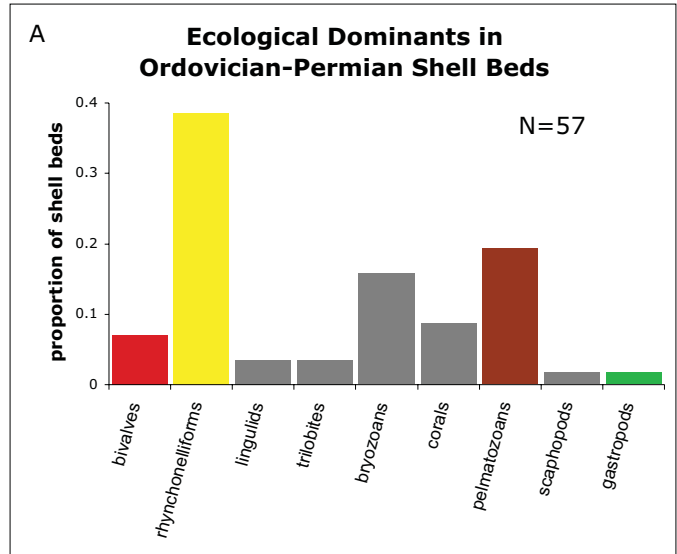


Figure 3. Relative abundance of rhynchonelliform brachiopods (normalized to include only brachiopods, bivalves, and gastropods) from 181 Permian and Triassic quantitative assemblages, indicating a Middle (M) to Late (L) Permian decline followed by a dramatic reduction in the Early (E) Triassic and then a recovery in the Middle and Late (M/L) Triassic. Modified from Clapham and Bottjer (2007b).

Analysis of shell bed data available in the primary literature places these results into a broader context (Fraiser and Bottjer, 2007b) (Figs. 4A and 4B). Tabulation of Ordovician to Permian and post–Early Triassic shell beds reflects major characteristics of Sepkoski’s evolutionary faunas, with dominance by rhynchonelliform brachiopod shell beds during the Paleozoic (Fig. 4A) and dominance by bivalve shell beds during the post–Lower Triassic (Fig. 4B) (Fraiser and Bottjer, 2007b). Not only was there a short-term increase in bivalves during the Early Triassic, but a long-term, permanent change was also facilitated: It was not until the aftermath of the end-Permian mass extinction that bivalves numerically dominated the majority of nearshore and shelf environments globally (Fraiser and Bottjer, 2007b) (Fig. 4C). Perhaps the ability of bivalves to become the most abundant skeletonized invertebrate in benthic marine environments was due to the large extinction of rhynchonelliform brachiopods during the end-Permian mass extinction, their preferential occupation of nearshore habitats, and physiological characteristics that enabled them to thrive during periods of oceanic and atmospheric stress during the Permian-Triassic transition.



Figure 4. Ecological dominants in post-Cambrian shell beds. (A, B) Ecological dominants in Ordovician to Permian and in post-Lower Triassic shell beds; from Kidwell (1991) and Fraiser and Bottjer (2007b). (C) Ecological dominants in Lower Triassic shell beds; data from Fraiser and Bottjer (2007b). Rhynchonelliform brachiopods numerically dominate Ordovician-Permian shell beds; bivalves numerically dominate Lower Triassic and post-Lower Triassic shell beds. N—total number of shell beds included in each analysis. No data for Lower Triassic shell beds were listed in Kidwell (1991). Data are from nearshore, inner shelf, and middle shelf environments.



The devastation of the end-Permian mass extinction is also reflected in the onshore-offshore distribution of bryozoans during the Early Triassic, with most environments containing no bryozoans and only one to two genera in others (Powers and Bottjer, 2007) (Fig. 2A). Bryozoan assemblage generic diversity remained low across all marine settings until the Late Triassic, when they recolonized most marine environments (Fig. 2A). The paleobiogeographic range of bryozoans in the Early Triassic mirrors their sporadic environmental distribution, with bryozoan localities restricted to high-latitude settings along northwest Pangea in eastern Panthalassa (Fig. 2B), and contrasts sharply with their Permian cosmopolitan distribution and widespread environmental range, particularly within the Tethyan Sea (Powers and Bottjer, 2009). This suggests that the Boreal realm may have acted as a geographic refugium during the Early Triassic (Powers and Pachut, 2008) (Fig. 2B). The Middle and Late Triassic environmental recovery of bryozoans (Fig. 2A) is also reflected by a much broader geographic distribution than in the Early Triassic (Powers and Pachut, 2008).

These new faunal analyses show that some combination of the euxinic marine conditions that first appeared at the Middle-Late Permian boundary with new CO₂ stress from Siberian volcanism continued through the Early Triassic (Isozaki, 1997; Payne and Kump, 2007). These environmental conditions adversely affected rhynchonelliform brachiopods and bryozoans but did not adversely affect a select group of benthic molluscs, which proliferated wildly during this time.

DISCUSSION

These results are consistent with a protracted oceanographic crisis during the Late Permian and Early Triassic. Unlike the mass extinction at the end of the Cretaceous, where taxonomic selectivity studies of brachiopods and bivalves indicate a crash in primary productivity associated with bolide impact (e.g., Rhodes and Thayer, 1991; Knoll et al., 2007), this Late Permian–Early Triassic crisis was likely caused by some combination of euxinia and/or high CO₂ in the oceans. Questions about the precise kill mechanisms and physiological reasons for survivorship and opportunism can now be addressed by revisiting pioneering experimental approaches (e.g., Thayer, 1985), taking advantage of research programs that have been initiated to understand the modern crisis of greenhouse gas–linked environmental change (e.g., Hoegh-Guldberg et al., 2007; Knoll et al., 2007).

For example, exposure of modern scleractinian corals to elevated CO₂ in microcosms resulted in skeleton dissolution and survival of the corals as soft polyps (Fine and Tchernov, 2007). As previously discussed, increased CO₂ concentrations in seawater, with corresponding ocean acidification, are also conditions that occurred during the end-Permian mass extinction and the Early Triassic (Fraiser and Bottjer, 2007a). One of the most pronounced biotic changes during the end-Permian mass extinction was the disappearance of Paleozoic tabulate and rugose corals and coral reefs from the geological record and the emergence of scleractinian corals and reefs after the recovery interval in the Middle Triassic (e.g., Stanley and Fautin, 2001; Stanley, 2003, 2007). The microcosm experiments confirm that rather than becoming extinct, corals may have existed as soft-bodied, anemone-like forms through the Early

Triassic, only reappearing in the fossil record after ocean acidification subsided in the Middle Triassic so that they could once again form mineralized skeletons (Stanley, 2007).

These remarkable results with microcosm experiments demonstrate that future work should focus on studies of other modern organisms similar to those that died, as well as those that thrived, where levels of O₂, CO₂, and H₂S can be experimentally manipulated. For example, the shallow infaunal burrower *Unionites* is the most abundant of the dominant Early Triassic bivalves (Fraiser and Bottjer, 2007b). At other times, members of this extinct genus inhabited stressed environments (e.g., Posenato, 2008), and if a suitable stand-in for Early Triassic *Unionites*, with similar skeletal and physiological properties, could be found in the modern fauna, it might be possible to determine whether its resilience in the face of reduced O₂ or increased CO₂ or H₂S concentrations would have allowed it to dominate shallow benthic environments. Continued use of such innovative new approaches places even more detailed understanding of the nature of this greatest Phanerozoic biotic crisis within reach.

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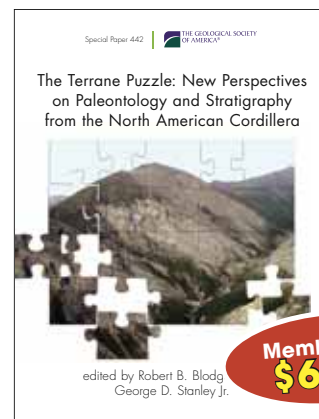
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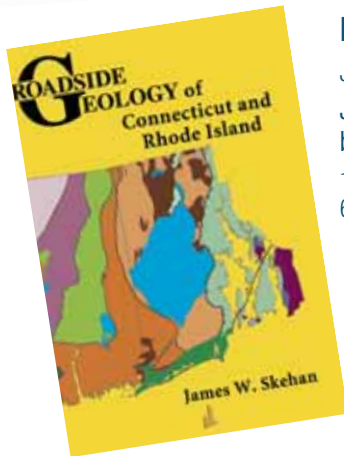
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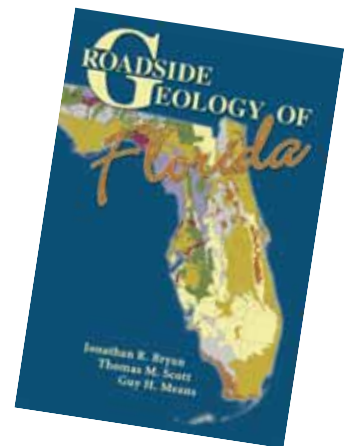
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GSA Presidential Address & Awards Ceremony



George R. Brown Convention Center,
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Saturday, 4 Oct., 7–9 p.m.

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Please join us Saturday evening when GSA President Judith Totman Parrish gives her Presidential Address, "A field geologist looks at a digital world." Following this address, the citations and responses for the 2008 recipients of the Penrose Medal, the Arthur L. Day Medal, the Young Scientist Award (Donath Medal), the President's Medal of the Geological Society of America, the GSA Public Service Award Medal, Bromery Award for the Minorities, the Subaru Outstanding Woman in Science Award, and the American Geological Institute (AGI) Medal in Memory of Ian Campbell will be presented. The newly elected Honorary Fellows, the John C. Frye Environmental Geology Awardee, and the newly elected GSA Fellows will also be announced.

A reception will immediately follow the ceremony.

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Celebrating the International Year of Planet Earth



Subaru Outdoor Life Keynote Address



In a Search for the Deepest Cave on Earth: The Blend of Exploration Adventure and Science

Alexander Klimchouk

Monday, 6 Oct., 6–7 p.m. • George R. Brown Convention Center, Room 350DEF

Alexander Klimchouk's story of the discovery of Krubera Cave is an outstanding illustration of the blend of adventure exploration and science that is speleology.

Klimchouk began a lifelong passion for cave exploration at the age of 11 and became a karst scientist at the Ukrainian Academy of Science in Kiev. In 1980, he brought his Ukrainian Caving Society to Arabika Massif in the Western Caucasus. This area had a reputation as "non-promising" for deep cave explorations, but in 1984 and 1985, Klimchouk organized dye-tracing experiments that proved a hydrologic connection between caves in the high-mountain sector of Arabika, large springs on the Black Sea shore, and submarine springs known in the area, thus establishing the deepest known karst hydrologic system in the world at that time.

In 2001, an expedition of the Ukrainian Speleological Association established the world's depth record at 1710 m in Krubera Cave. In 2004, the Ukrainian cave explorers pushed Krubera past the once-undreamed-of depth of 2000 m, and



Alexander Klimchouk

then in 2007, a depth of 2191 m was reached by a 46-m dive into the final sump. The gap between the deepest cave in the world and the second deepest has reached 560 m, and the underwater conduit steeply goes deeper still.

Why did Klimchouk decide that Arabika Massif was promising for deep caves, contrary to prevailing views at that time? How is it possible that the regional water table is reached in Krubera Cave at 110 m above sea level but 13 km into the mountains, far from the shore of the Black Sea? How far does Krubera's cave system

extend under water? How is Krubera Cave related to the evolution of the Black Sea?

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George R. Brown Convention Center, General Assembly Theater B

Tuesday, 7 Oct., noon–1:15 p.m.

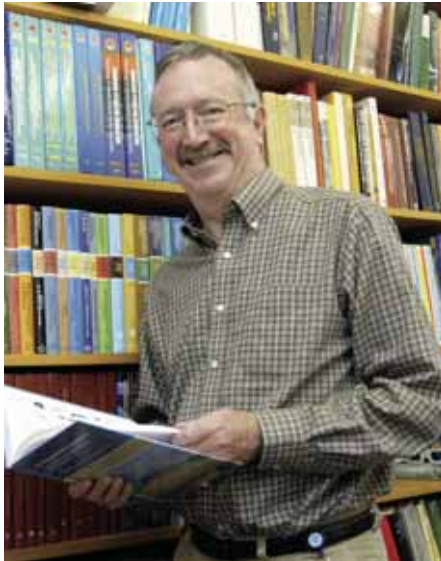
Evidence from ancient climates shows that decreasing carbon dioxide (CO₂) levels over the past 50 million years helped bring about a cooling trend that led to large-scale glaciation when CO₂ fell to levels our society will exceed within decades, barring prompt policy changes. If humanity wishes to preserve a planet similar to that on which civilization developed, CO₂ must be reduced to below the present atmospheric amount.

Michel T. Halbouty Lecture



World fossil fuel resources:
How much is left?

How valid are predictions about
future production?



Peter J. McCabe

Peter J. McCabe, *Petroleum Resources Division, CSIRO, North Ryde, New South Wales, Australia*

George R. Brown Convention Center, Ballroom C
Monday, 6 October 2008
8:05–8:45 a.m.

Resource assessment numbers for geologic commodities are not absolute measurements; rather, they represent judgments of the amount of available resource within the foreseeable future. With advances in geologic knowledge and technology and changing commodity prices and production costs, it is necessary to periodically reassess resources.

Successive assessments of conventional oil and natural gas have tended to increase the resource base. By contrast, assessments of coal and unconventional oil and gas resources have historically tended to overestimate the resource base either because of unrealistic economic considerations or because the geologic nature of the resource was poorly understood. History, however, shows that resources regarded as inaccessible or uneconomic may eventually be produced as technological advances reduce costs. Oil sands, shale gas, coal-bed methane, and deep-water oil are all resources that until recently were not viable sources for energy production.

Oil, gas, and coal have consistently supplied between 91% and 93% of the world's energy for the last 60 years. The combination of temporal variations in resource assessment numbers and economic uncertainties related to energy demand makes long-term prediction of actual fossil energy production difficult, but given their abundance, fossil fuels are likely to remain dominant in the world's energy mix for decades to come.

An understanding of the global geographic distribution of fossil fuel is critical to future energy scenarios. Fossil fuels are widespread but enriched in a few locations where accumulation and preservation were favorable in geologic history. Oil, for example, is produced in more than 110 countries, but over 50% of the remaining economic oil lies within just five countries: Saudi Arabia, Russia, the United States, Iran, and Iraq. This geographic concentration of energy resources has profound geopolitical implications, especially if there is instability within a major producing country or disruption in the supply routes.



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Field Geology

ILLUSTRATED

Terry S. Maley



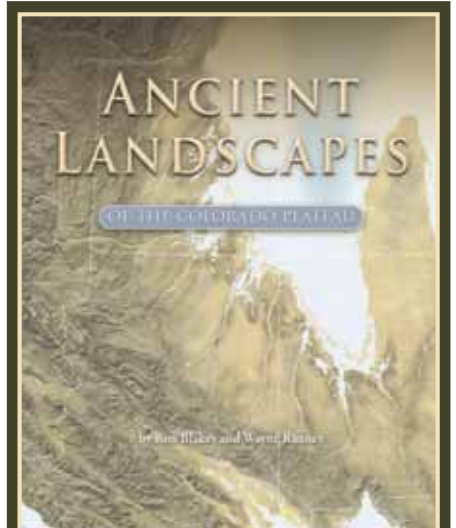
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Houston 2008 Joint Annual Meeting

UNDERSTANDING EVOLUTION: A Public Forum

Tuesday, 7 Oct., 7-9 p.m.

George R. Brown Convention Center, General Assembly Theater B



FREE and open to the public!

A leading panel of experts will give a non-technical presentation on the latest geological and biological evidence for evolution, the finding of "missing" links, and the nature of science, religion, and "intelligent design." An audience Q&A will follow.

See complete program information, including speaker bios, at www.geosociety.org/meetings/2008/publicforum.htm.



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Presidents' Student Breakfast Reception

Sunday, 5 Oct., 7–8:30 a.m.
Hilton Americas–Houston,
Ballroom of the Americas ABC

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**Hosted by GSA, SSSA, ASA, CSSA, GCAGS,
and HGS**

The presidents of the 2008 Joint Meeting invite all registered students to attend a free breakfast buffet sponsored by ExxonMobil Corporation. Members of each society's leadership, along with ExxonMobil staff members, will be on hand to answer questions and address student issues. Each student registered for the meeting will receive a complimentary ticket for the breakfast buffet. This is one of the most popular student events at the meeting—with good reason!

ALL-CONVENTION LUNCHEON



“Questions about the Earth the Moon Told Us to Ask”

Harrison “Jack” Schmitt
Hilton Americas–Houston Ballroom of
the Americas ABC

Monday, 6 Oct., noon–1:15 pm

Cost: Professionals—US\$25; Students—US\$15

Apollo 17 astronaut Harrison “Jack” Schmitt will present the keynote address: “Questions about the Earth the Moon Told Us to Ask.” During his *Apollo 17* mission, Schmitt, who has a Ph.D. in geology, spent some time on the surface of the moon; he later became a U.S. Senator from New Mexico.

*Lecture brought to you by the U.S. National Committee of
the International Year of Planet Earth.*

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GSA Bookstore — Headquarters — Exhibit Hall
Sun., 5 Oct., 7:00 – 9:00 p.m.



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Ron Blakey, Wayne Ranney

Apocalypse

Amos Nur

Dirt: The Erosion of Civilizations

David Montgomery

Evolution: What the Fossils Say and Why it Matters

Donald Prothero

Hoodoo

Susan Miller

Roadside Geology Florida

Jonathan Bryan, Thomas Scott, Guy Means



NOTE: IMAGES REFLECT VARIOUS GUESTS FROM PAST YEARS' EVENTS

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2008 JOINT ANNUAL MEETING

Pardee Keynote Sessions



INVITED PAPERS

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

Pardee Keynote Symposia are special events of broad interest to the geoscience community. The sessions are interdisciplinary, representing issues on the leading edge of a scientific discipline or area of public policy and addressing broad, fundamental issues. Selection was on a competitive basis; **all speakers are invited.**

SUNDAY, 5 October

8 a.m.–noon

P5. **Perspectives on an Emerging Workforce Crisis in Geology: Assessing a Looming Irony.**

John Holbrook, Univ. of Texas, Arlington, Tex., USA;
Kevin Bohacs, ExxonMobil Upstream Research Co., Houston, Tex., USA

The recent and rapid increase in demand for geologists has yet to foster a comparable surge in enrollment. Industries served by geology are scrambling for available graduates. Academia's response is hampered by competing priorities and limited resources. This session assembles diverse perspectives to assess the existence, intensity, and best response to this perceived "workforce crisis" in geology.

1:30–5:30 p.m.

P6. **Return to the Moon: A New Era of Lunar Exploration.**

Louise Prockter, Applied Physics Laboratory, Johns Hopkins Univ., Laurel, Md., USA; **Jeffrey Plescia**, Applied Physics Laboratory, Johns Hopkins Univ., Laurel, Md., USA

A new era of lunar exploration has begun, with current or soon-to-launch missions from Japan (Kaguya), China (Chang' E), the U.S. (Lunar Reconnaissance Orbiter), and India (Chandrayaan). This session will focus on recent and anticipated results from these missions. Cosponsored by *GSA Planetary Geology Division*.

MONDAY, 6 October

8 a.m.–noon.

P1. **Breakthroughs in Paleontology: The Paleontological Society Centennial Symposium.**

Jere H. Lipps, Univ. of California, Berkeley, Calif., USA;
J. William Schopf, Univ. of California, Los Angeles, Calif., USA

This session celebrates the Paleontological Society's centennial by highlighting the signal advances made in paleontology over the past 100 years. Presentations will fall into three major themes: (1) unveiling the record of life's history; (2) paradigm-changing breakthroughs; and (3) paleontology's contributions to society and the world. Cosponsored by *The Paleontological Society; Cushman Foundation; GSA Geobiology & Geomicrobiology, Geoscience Education, and History of Geology Divisions; and the Paleontological Research Institute.*

1:30–5:30 p.m.

P2. **Critical Zone Studies of Soils and Weathering: Implications for Interpreting Climate and Landscapes of the Past.**

Steven G. Driese, Baylor Univ., Waco, Tex., USA; **Lee Nordt**, Baylor Univ., Waco, Tex., USA

This session will focus on uniting the efforts of geoscientists studying ancient soil systems with those engaged in studies of modern surface soils and rock weathering, identifying important controls on rates and processes of weathering and soil formation in modern systems and relating these to interpreting climates and landscapes of the past. Cosponsored by *SSSA Div. S05 (Pedology); GSA Sedimentary Geology and Quaternary Geology and Geomorphology Divisions; and the Society for Sedimentary Geology (SEPM).*

TUESDAY, 7 October

1:30–5:30 p.m.

P4. **Large-Scale Continental Deformation at Plate Boundaries.**

Lucy M. Flesch, Purdue Univ., West Lafayette, Ind., USA;
Nathan Niemi, Univ. of Michigan, Ann Arbor, Mich., USA

This session is dedicated to understanding large-scale continental deformation along the North American plate boundary—both motions and processes. The session will address new results from the Plate Boundary Observatory (PBO), USArray, SAFOD, geologic data, and methods that integrate this data. Cosponsored by *GSA Structural Geology and Tectonics Division.*



2008 JOINT ANNUAL MEETING

Overarching Plenary Sessions



These 10 Joint Plenary Sessions (including four additional Pardee symposia) are specifically designed to engage all attendees. Some will be "blackout" sessions, meaning no other sessions or events will be scheduled at the same time. You won't want to miss these thought-provoking sessions and the invited speakers, so make your travel plans accordingly!

SUNDAY, 5 October

10 a.m.–noon

Climate Change through Time: Evidence in the Geologic Record

Carolyn Olson, Washington, D.C., USA

Climate change discussions commonly include evidence from the Holocene glacial record, dendrochronology, human historical documents, and future trends based on models of temperature increases and sea-level rise. The Intergovernmental Panel on Climate Change has recently released its assessment, strengthening its stand on human impacts associated with climate change. Discussions and reports often convey the uniqueness of these fluctuations in the last few centuries; however, the geologic record contains robust evidence of ancient climatic and sea-level changes that are often missing from the present debate. This session will bring together agronomists, biologists, glacial scientists, Quaternary geomorphologists, biostratigraphers, sequence stratigraphers, geochronologists, isotope geochemists, and other geoscientists to engage in an integrated and open session on the evidence.

5–7 p.m.

The Impending Global Water Crisis: Geology, Soils, Agronomy, and International Security

E.T. & Vam York Distinguished ASA Lectureship

Mark Alley, Virginia Polytechnical and State Univ., Blacksburg, Va., USA; **Joe Palca**, National Public Radio, Washington, D.C., USA

One of the most pressing challenges facing the global community is the availability of quality fresh water for food and fiber production and industrial and domestic uses. Human population growth and the distribution of population centers stress water resources worldwide. Continued growth and variations in the hydrologic cycle related to climate change mean continued stress on global water resources. Meeting the challenges of the impending global water crisis requires interdisciplinary research involving geologists, hydrologists, soil scientists, agronomists, engineers, resource economists, and social scientists.

MONDAY, 6 October

8–10:30 a.m.

Energy and the Global Market

Arthur D. Donovan, Houston, Tex., USA;

Ken Quesenberry, Univ. of Florida, Gainesville, Fla., USA

Rising gas prices have re-fueled debates over the future role of fossil fuels as affordable and sustainable energy sources and the role of bio-based fuels and other alternative energy resources. Some suggest that fossil fuel resources are insufficient to meet increasing global demands; others argue that higher prices will encourage new exploration, foster enhanced recovery techniques, and spur development of other fossil-fuel resources, such as tar sands and oil shales. Bio-based fuel sources like corn, sugar cane, and cellulosic plants (switch grass) have been identified as economically viable and renewable sources of fuel, but it is not clear that they are truly economic when cultivation, fertilization, processing, and transportation costs are factored in, along with the environmental costs associated with water utilization, soil erosion, deforestation, and loss of crop diversity. This session aims to bring together proponents from the fossil fuel and biofuel industries, energy resource experts, soil scientists, hydrologists, agronomists, and economists to discuss the roles of fossil fuels and bio-based fuels in meeting future energy needs.

1:30–3:30 p.m.

Globalization of Biogeochemical Cycles

Mark Alley, Virginia Polytechnical and State Univ., Blacksburg, Va., USA

Until recently, biogeochemistry has generally been defined as the study of the interaction of regional geochemistry with plant and animal life. This definition must change because millions of kilograms of minerals are routinely moved vast distances in response to the development of manufacturing centers, urban population growth, and the need to replenish soil nutrient levels to sustain food production—thus altering biogeochemical cycles. These alterations can be site-specific, watershed, continental, or global in scope, and degradation of water supplies, soil and plant contamination, and reduced biodiversity can result. Economic and national security are directly impacted by the availability and proper handling of strategic minerals; food security requires essential plant nutrient elements. This session challenges geologists, environmental scientists, soil scientists, hydrologists, agronomists, crop scientists, business leaders, and policymakers to identify problems and solutions for local and global alterations of biogeochemical cycles.

TUESDAY, 7 October

8 a.m.–noon

River Restoration: Environmental Success or Strategic Failure?—Pardee Keynote Symposium

Jerry R. Miller, Western Carolina Univ., Cullowhee, N.C., USA; **Benjamin Hayes**, Lewisburg, Pa., USA; **R. Craig Kochel**, Bucknell Univ., Lewisburg, Pa., USA

River restoration has become a billion-dollar-per-year mainstay of the environmental engineering industry and a widespread management strategy to mitigate the deleterious effects of urban and suburban development, agriculture, and past modifications to stream channels on riverine and riparian ecosystems. For more than two decades, engineered restoration has been conducted on the assumption that it results in ecological benefits; however, there is little synthesis of the science behind restoration or discussion regarding its effectiveness as a management strategy. Recent studies suggest that many river restoration projects have not performed as well as originally intended and that new approaches based on quantitative geomorphic, hydrologic, and biological data are required. This session will critically examine the science and engineering behind river restoration and provide a forum for vigorous debate over the science and policy of restoring rivers.

1:30–5:30 p.m.

Reducing Vulnerability of Gulf Coast Communities to Hurricane Impacts and Sea-Level Rise: Are Large-Scale Restoration and Engineering the Answer?—Pardee Keynote Symposium

Denise J. Reed, Univ. of New Orleans, New Orleans, La., USA; **Robert S. Young**, Western Carolina Univ., Cullowhee, N.C., USA

Federal and state governments are considering spending billions of dollars on re-engineering the U.S. Gulf Coast to protect infrastructure and communities. Projects range from large-scale river management and wetland restoration in coastal Louisiana to reconfiguring the barrier islands off the Mississippi coast. Some projects have been the subject of many years of scientific investigation (e.g. wetlands restoration) and some are responses to the impact of Hurricane Katrina (barrier island reconfiguration). This session examines the science and engineering behind various coastal restoration and engineering plans, the state of our knowledge regarding hazard assessment along the Gulf Coast, and the impacts of long-term climate change, subsidence, and human activities on hazards vulnerability.

WEDNESDAY, 8 October

8–10 a.m.

Geobiology and Biomineralization: From the Origins of Life to the Origins of Cities

H. Curtis Monger, New Mexico State Univ., Las Cruces, N.Mex., USA

This session brings together scientists working in geobiology, geomicrobiology, biomineralization, origins of life, and astrobiology to increase our understanding of how organisms interact with minerals at multiple spatial and time scales. This

exploration begins with the involvement of clay minerals in the origins of life on Earth and possibly other planets to the modern occurrence of biomineralization within single organisms, as well as collective biomineralization within societies of organisms, including the synthesis of minerals by humans to build modern cities and transportation structures.

1:30–3:30 p.m.

Emerging Trace Contaminants in Surface and Ground Water Generated from Waste Water and Solid Waste Application

Paul Bertsch, Univ. of Kentucky, Lexington, Ky., USA

A broad range of chemicals (e.g., organic compounds from human and veterinary pharmaceuticals, natural and synthetic hormones, detergent metabolites, plasticizers, herbicides, insecticides, fire retardants) and inorganic compounds (e.g., trace metals and newly emerging manufactured nanomaterials) occur in residential, industrial, and agricultural wastewaters as well as in sewage sludge and manures. Many are found at low concentrations in surface water downstream from areas of intense urbanization and animal production and in groundwater from wells near septic systems. Although present only in trace amounts, organic compounds may act as endocrine disrupters, causing developmental abnormalities and potentially being involved in the etiology of several diseases in humans and wildlife. Despite the benefits that will undoubtedly result from advances in nanotechnology, concerns surrounding its potential negative impacts have emerged, resulting in the new discipline of nanotoxicology. Trace elements (e.g., Cu and As) used as growth regulators/promoters and antibiotics in animal production systems can also create health hazards when present in soils, plants, and water; further research is needed on these compounds and their metabolites, as is a better understanding of the bio-availability of the compounds and their trophic transfer.

3–5:30 p.m.

Carbon Sequestration: Methods, Markets and Policy—Pardee Keynote Symposium

Jerry Hatfield, USDA–Agricultural Research Service, National Soil Tilth Laboratory, Ames, Iowa, USA

Terrestrial and ocean sequestration of carbon can potentially reduce atmospheric carbon dioxide concentrations and mitigate global warming. Terrestrial methods include (1) geologic sequestration, such as injection of captured carbon dioxide into various strata; (2) agricultural sequestration by increasing soil organic matter in agricultural lands; and (3) forest sequestration through reforestation and improved forest management. Proposed ocean sequestration of carbon involves (1) capture and injection of carbon dioxide into the deep oceans (i.e., below 3000 m); or (2) using iron fertilization to increase phytoplankton blooms in selected ocean areas. The effectiveness of the various methods will be compared and discussed; developing carbon markets will be examined, with specific emphasis on verification of carbon credits for specific practices; and government policy on carbon sequestration and the reduction of atmospheric carbon dioxide levels will be assessed.

THURSDAY, 9 October

8–10 a.m.

Human Influences on the Stratigraphic Record—Pardee Keynote Symposium

Amy Brock, Western Illinois Univ., Macomb, Ill., USA

This session brings together sedimentologists, geoarchaeologists, historians, soil scientists, and agronomists to explore the topic of humans as agents of erosion and sediment storage and the potential impact on the stratigraphic record. Participants will examine how natural sedimentation rates have been altered by traditional and industrial agriculture, urbanization, and dams, and discuss the effect and effectiveness of erosion control structures, as well as the role that dams and other human interventions may play in sediment delivery to the coasts.



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2008 JOINT ANNUAL MEETING

5–9 October 2008 • Houston, Texas, USA



Technical Session Calendar

All sessions will be held in the George R. Brown Convention Center in Houston.
Check <https://www.acsmeetings.org/> for updates, details, and the abstracts database.

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
Sunday, 5 October			
1	10 a.m.	Climate Change through Time: Evidence in the Geologic Record	Ballroom C
51	8 a.m.	J9. Gains and Losses: Soil Nutrients and Moisture in Aridic Soils under Changing Climates (<i>GSA Quaternary Geology and Geomorphology Division; SSSA Div. S05 Pedology and S06 Soil & Water Management & Conservation</i>)	332AD
117	8 a.m.	Engineering Geology I—Natural Hazard Assessment, 3-D Modeling, and Site Characterization	310BE
118	8 a.m.	Hydrogeology I—Precipitation, Lakes, Streams, Springs, and Wetlands	320F
121	8 a.m.	P5. Perspectives on an Emerging Workforce Crisis in Geology: Assessing a Looming Irony (<i>All GSA Divisions</i>)	General Assembly Theater Hall A
122	8 a.m.	T2. Coastal and Aeolian Geomorphology Processes and Landforms (<i>GSA Quaternary Geology and Geomorphology Division</i>)	320DE
123	8 a.m.	T13. Sediment in Fluvial Systems: Production, Transport, and Storage at the Watershed Scale I (<i>GSA Quaternary Geology and Geomorphology Division</i>)	332BE
124	8 a.m.	T32. Mixed Siliciclastic-Carbonate Systems: Mixing through Time and Space (<i>GSA Sedimentary Geology Division; Society for Sedimentary Geology [SEPM]; Gulf Coast Association of Geological Societies [GCAGS]</i>)	342BE
125	8 a.m.	T44. Deep Time Earth Life Observatories (DETELOs): Focusing on Critical Transitions in the History of Life (<i>Paleontological Society; GCAGS</i>)	General Assembly Theater Hall B
126	8 a.m.	T49. What Good Are (Fossil) Plants Anyway? New Methods for Investigating Old Problems (<i>Paleontological Society; GCAGS</i>)	351CF



Sunday, 5 October, continued

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
127	8 a.m.	T51. Neontological Solutions to Paleontological Problems: Actualistic Studies of the Morphology, Behavior, and Ecology of Modern Analogs for Ancient Organisms (<i>Paleontological Society; GCAGS</i>)	351BE
128	8 a.m.	T65. Late Jurassic to Recent Geodynamic Evolution of the Caribbean Region (<i>GSA Geophysics Division; GCAGS</i>)	322AB
129	8 a.m.	T73. Advances in Discontinuum Numerical Modeling in the Study of Earth Structure and Deformation (<i>GSA Structural Geology and Tectonics Division</i>)	351AD
130	8 a.m.	T75. Modes of Lithospheric Extension: Oceanic and Continental Core Complexes (<i>GSA Geophysics, International & Structural Geology and Tectonics Divisions</i>)	332CF
131	8 a.m.	T87. Magnetism of Sedimentary Rocks and Sediments (<i>GSA Geophysics, Limnogeology, Sedimentology & Structural Geology and Tectonics Divisions; GCAGS</i>)	350DEF
132	8 a.m.	T93. Environmental Mineralogy (<i>Mineralogical Society of America [MSA]; GCAGS</i>)	320ABC
133	8 a.m.	T99. The Geology of Small Volcanic Vents and Their Associated Vent Fields throughout the Solar System (<i>GSA Planetary Geology Division</i>)	310AD
134	8 a.m.	T101. Geological and Geophysical Remote Sensing Applications for Earth, the Moon, and Mars (<i>GSA Engineering Geology, Geophysics, Planetary Geology & Structural Geology and Tectonics Divisions; GCAGS</i>)	342CF
135	8 a.m.	T135. Military Geology in the 21st Century (<i>GCAGS</i>)	342AD
136	8 a.m.	T153. Isotopic Tracers in Deep Groundwater Basins (<i>GSA Hydrogeology Division; GCAGS</i>)	352DEF
137	8 a.m.	T155. Mercury Cycling, Fate, and Bioaccumulation in Coastal Zones: The Next Big Stage for Mercury Research? (<i>GSA Hydrogeology Division</i>)	General Assembly Theater Hall C
138	8 a.m.	T166. Fault Seals or Conduits? Insights from Hydrologic and Petroleum Systems (<i>GSA Hydrogeology & Structural Geology and Tectonics Divisions; GCAGS</i>)	330A
139	8 a.m.	T203. Geology and Health Issues in Texas, Mexico, and Beyond (<i>GSA Geology and Health Division; GCAGS</i>)	330B
140	8 a.m.	T206. Geoscience Diversity 2008: Status, Strategies, and Successful Models I (<i>GSA Geology and Society & Geoscience Education Divisions; GSA Geology and Public Policy Committee; GCAGS</i>)	310CF
141	8 a.m.	Geochemistry; Geochemistry, Organic (Posters)	Exhibit Hall E
142	8 a.m.	Geoinformatics (Posters)	Exhibit Hall E
143	8 a.m.	Geophysics/Tectonophysics/Seismology (Posters)	Exhibit Hall E
144	8 a.m.	Paleontology (Posters) I—Diversity, Evolution, and Biogeography	Exhibit Hall E
145	8 a.m.	Precambrian Geology (Posters)	Exhibit Hall E
146	8 a.m.	Quaternary Geology (Posters)	Exhibit Hall E
147	8 a.m.	Structural Geology/Tectonics/Neotectonics/Paleoseismology (Posters)	Exhibit Hall E
148	8 a.m.	T2. Coastal and Aeolian Geomorphology Processes and Landforms (Posters) (<i>GSA Quaternary Geology and Geomorphology Division</i>)	Exhibit Hall E
149	8 a.m.	T4. Oceanic Geohazards: Distribution, Controls, and Risks (Posters) (<i>GCAGS</i>)	Exhibit Hall E
150	8 a.m.	T18. Soil Geomorphology and Chronosequences (Posters) (<i>GSA Quaternary Geology and Geomorphology Division; SSSA Div. S05 Pedology; GCAGS</i>)	Exhibit Hall E
151	8 a.m.	T26. Lake Cores: Climate Change and Tectonics (Posters) (<i>GSA Limnogeology & Structural Geology and Tectonics Divisions</i>)	Exhibit Hall E
152	8 a.m.	T31. The Future of Sedimentary Geology: Student Research (Posters) (<i>Society for Sedimentary Geology [SEPM]; GCAGS</i>)	Exhibit Hall E
153	8 a.m.	T49. What Good Are (Fossil) Plants Anyway? New Methods for Investigating Old Problems (Posters) (<i>Paleontological Society; GCAGS</i>)	Exhibit Hall E
154	8 a.m.	T65. Late Jurassic to Recent Geodynamic Evolution of the Caribbean Region (Posters) (<i>GSA Geophysics Division; GCAGS</i>)	Exhibit Hall E

Sunday, 5 October, continued


No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
155	8 a.m.	T112. Landslide Inventories, Landslide Hazards, Databases, and Mapping: Status of Information and Progress toward a Shared Standard (Posters) (<i>GSA Engineering Geology, Geology and Society & Quaternary Geology and Geomorphology Divisions; Association of American State Geologists; GCAGS</i>)	Exhibit Hall E
156	8 a.m.	T123. Real-Time, In-Field Geochemical Analysis: Current Capabilities and Future Prospects (Posters) (<i>International Association of GeoChemistry; GCAGS</i>)	Exhibit Hall E
157	8 a.m.	T140. Sigma Gamma Epsilon Undergraduate Research (Posters) (<i>Sigma Gamma Epsilon</i>)	Exhibit Hall E
158	8 a.m.	T177. Disseminating Hands-on Geological Knowledge and Creating a Greater Awareness for the Environment: Emphasis on the Involvement of Undergraduates and K-12 Students (Posters) (<i>GSA Geoscience Education Division; GCAGS</i>)	Exhibit Hall E
2	5:00 p.m.	The Impending Global Water Crisis: Geology, Soils, Agronomy, and International Security (<i>The York Lectureship</i>)	General Assembly Theater ABC
159	1:30 p.m.	Geoscience Education II: Best Practices for Teaching Geoscience	342AD
160	1:30 p.m.	Marine/Coastal Science	320DE
161	1:30 p.m.	Structural Geology/Tectonics/Neotectonics/Paleoseismology I	322AB
162	1:30 p.m.	P6. Return to the Moon: A New Era of Lunar Exploration (<i>GSA Planetary Geology Division</i>)	352DEF
163	1:30 p.m.	T5. Coastal Tectonics of the Pacific Rim: Geomorphology, Structure, and Hazards (<i>GSA Geophysics, Quaternary Geology and Geomorphology & Structural Geology and Tectonics Divisions; GCAGS</i>)	332CF
164	1:30 p.m.	T10. Ancient Polar Ecosystems and Environments: Proxies for Understanding Climate Change and Global Warming (<i>Paleontological Society; GCAGS</i>)	330A

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Sunday, 5 October, continued

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
165	1:30 p.m.	T13. Sediment in Fluvial Systems: Production, Transport, and Storage at the Watershed Scale II (<i>GSA Quaternary Geology and Geomorphology Division</i>)	332BE
166	1:30 p.m.	T20. Assessment of Speleothem Paleoenvironment Proxies Using Studies in Modern Karst Systems (<i>GSA Quaternary Geology and Geomorphology Division; GCAGS</i>)	332AD
167	1:30 p.m.	T33. Mesozoic Sedimentary Basins as Archives of Mexican Magmatic History and Paleogeography (<i>GSA Sedimentary Geology Division; GCAGS</i>)	351AD
168	1:30 p.m.	T52. Paleontological and Sedimentological Consequences of Calcite and Aragonite Sea Dynamics (<i>Paleontological Society; GCAGS</i>)	351CF
169	1:30 p.m.	T55. Phylogenetic Perspectives on Assembling the Tree of Life in Deep Time (<i>Paleontological Society; GCAGS</i>)	351BE
170	1:30 p.m.	T91. Strengthening Links between Metamorphic Conditions and Time: New Advances in High-Temperature Geochronology and Tracing <i>P-T-t</i> Paths of Metamorphic Terranes (<i>MSA</i>)	310BE
171	1:30 p.m.	T102. Water-Rock Interaction on Mars: Spacecraft Data, Meteorites, Models, and Analogs (<i>MSA; Lunar and Planetary Institute</i>)	310AD
172	1:30 p.m.	T143. The Origin of Mima Mounds and Similar Micro-Relief Features: Multidisciplinary Perspectives (<i>GSA Archaeological Geology & Quaternary Geology and Geomorphology Divisions; SSSA Div. S05 Pedology; GCAGS</i>)	320F
173	1:30 p.m.	T148. Management and Protection of Regional Karst Aquifers (<i>GSA Hydrogeology Division; GCAGS</i>)	342BE
174	1:30 p.m.	T154. Managed Underground Storage of Recoverable Water (<i>GSA Geology and Society & Hydrogeology Divisions; GCAGS</i>)	350DEF
175	1:30 p.m.	T174. Teaching and Learning about Complex Earth Systems: Effective Strategies in Undergraduate Classrooms and Teacher Development Programs (<i>GSA Geology and Society & Geoscience Education Divisions; GCAGS</i>)	342CF
176	1:30 p.m.	T206. Geoscience Diversity 2008: Status, Strategies, and Successful Models II (<i>GSA Education & Geology and Society Divisions; GSA Geology and Public Policy Committee; GCAGS</i>)	310CF

Monday, 6 October

3	8 a.m.	Energy and the Global Market	Ballroom C
52	8 a.m.	J4. Characterization and Interpretation of Soils and Geologic Formations with Carbonates, Gypsum, and Other Soluble Salts (<i>GSA Quaternary Geology and Geomorphology Division; SSSA Div. S05 Pedology and Div. S09 Soil Mineralogy; MSA</i>)	332AD
53	8 a.m.	J12. Land Subsidence Attributable to Subsurface Fluid Extraction in Coastal Lowlands: Contributions to Relative Sea-Level Rise (<i>GSA Hydrogeology & Structural Geology and Tectonics Divisions; National Ground Water Association [NGWA]–Association of Ground Water Scientists and Engineers; Harris-Galveston Subsidence District; USGS Subsidence Interest Group; GCAGS</i>)	352DEF
54	8 a.m.	J14. Natural Zeolite Utilization in Agriculture, Environmental Science, and Industry: Characterization, Properties, and Applications (<i>MSA; SSSA Div. S02 Soil Chemistry, Div. S09 Soil Mineralogy, and Div. S11 Soils & Environmental Quality</i>)	351AD
55	8 a.m.	J15. Organic Contaminants in Water, Soil and Sediments: Sources, Interactions and Ecological Impacts I (<i>GSA Geobiology and Geomicrobiology, Geology and Health & Hydrogeology Divisions; NGWA–Association of Ground Water Scientists and Engineers; ASA Div. A05 Environmental Quality; GCAGS; SSSA Div. S02 Soil Chemistry, Div. S03 Soil Biology & Biochemistry, and Div. S11 Soils & Environmental Quality</i>)	General Assembly Theater Hall C



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Houston Geological Society

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
56	8 a.m.	J20. Soils through Time: Critical Zone Studies of Processes and Their Effects (GSA Quaternary Geology and Geomorphology Division; Geochemical Society; SSSA Div. S05 Pedology)	General Assembly Theater Hall B
57	8 a.m.	J3. Biologically Induced Dissolution and Precipitation of Minerals in Soils and Sediments (Posters) (GSA Geobiology and Geomicrobiology Division; The Clay Minerals Society; SSSA Div. S03 Soil Biology & Biochemistry, Div. S05 Pedology, Div. S07 Forest, Range & Wildland Soils, Div. S09 Soil Mineralogy, and Div. S10 Wetland Soils; GCAGS)	Exhibit Hall E
58	8 a.m.	J5. Desert Pavements and Vesicular A-Horizons (Posters) (GSA Quaternary Geology and Geomorphology Division; SSSA Div. S05 Pedology)	Exhibit Hall E
59	8 a.m.	J14. Natural Zeolite Utilization in Agriculture, Environmental Science, and Industry: Characterization, Properties, and Applications (Posters) (MSA; SSSA Div. S02 Soil Chemistry, Div. S09 Soil Mineralogy, and Div. S11 Soils & Environmental Quality)	Exhibit Hall E
177	8 a.m.	Engineering Geology II—Landslides: Characterization, Mapping, and Monitoring	310BE
178	8 a.m.	Geomorphology	350DEF
179	8 a.m.	Paleontology I—Macroevolution, Diversity, and Biogeography	351CF
180	8 a.m.	P1. Breakthroughs in Paleontology: The Paleontological Society Centennial Symposium (Paleontological Society; Cushman Foundation; GSA Geobiology and Geomicrobiology, Geoscience Education & History of Geology Divisions; Paleontological Research Institute)	General Assembly Theater Hall A
181	8 a.m.	T6. Estuarine and Fjord Sedimentary Processes in Modern and Holocene Systems (GSA Quaternary Geology and Geomorphology Division; Gulf Coast Section SEPM; GCAGS)	320DE



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No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
182	8 a.m.	T25. Terrestrial Response to Climate Variability during the Medieval Warm Period: Lakes, Tree-Rings, and Human Adaptation (<i>GSA Archaeological Geology, Limnogeology & Quaternary Geology and Geomorphology Divisions</i>)	310CF
183	8 a.m.	T46. Leaving Traces—Making Marks I: In Honor of H. Allen Curran (<i>Paleontological Society; GCAGS</i>)	351BE
184	8 a.m.	T74. Models of Folding and Structural History of Shale Basins (<i>GSA Structural Geology and Tectonics & Geophysics Divisions; GCAGS</i>)	330A
185	8 a.m.	T77. Recent Advances in the Understanding of Adirondack and Southern Grenville Province Tectonics I: In Honor of James McLelland (<i>GSA Structural Geology and Tectonics Division; GCAGS</i>)	322AB
186	8 a.m.	T78. From the Forearc to the Foreland: Contrasting Tectonics, Paleogeography, and Paleoenvironments of the North American Cretaceous (<i>GSA Geophysics, Sedimentary Geology & Structural Geology and Tectonics Divisions; Society for Sedimentary Geology [SEPM]; GCAGS</i>)	332CF
187	8 a.m.	T96. Planetary Pummeling: Cataclysmic Bombardment of the Solar System as Catastrophe, Catalyst, Cauldron, and Crucible (<i>GSA Planetary Geology Division</i>)	310AD
188	8 a.m.	T145. From Quaternary Geology and Physical Volcanology to Geoarchaeology and Paleoanthropology: A Memorial to Harold E. Malde (<i>GSA Archaeological Geology & Quaternary Geology and Geomorphology Divisions; USGS; GCAGS</i>)	332BE
189	8 a.m.	T147. Innovative Methods for Investigating Flow and Transport in Karst Systems I (<i>GSA Hydrogeology Division; GCAGS</i>)	342BE
190	8 a.m.	T160. Hydrogeophysics: Characterization and Monitoring of Subsurface Parameters and Processes (<i>GSA Geophysics & Hydrogeology Divisions</i>)	342AD

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Monday, 6 October, continued

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
191	8 a.m.	T176. The Human Connection with Planet Earth: What Is It and Why Is It Important? (<i>National Association of Geoscience Teachers [NAGT]; GSA Geoscience Education Division; GCAGS</i>)	342CF
192	8 a.m.	T209. Forensic Geology	330B
193	8 a.m.	Mineralogy/Crystallography; Petrology, Experimental; Igneous; Metamorphic (Posters)	Exhibit Hall E
194	8 a.m.	Paleoclimatology/Paleoceanography (Posters)	Exhibit Hall E
195	8 a.m.	Planetary Geology (Posters)	Exhibit Hall E
196	8 a.m.	Remote Sensing/Geographic Information Systems (Posters)	Exhibit Hall E
197	8 a.m.	Volcanology (Posters)	Exhibit Hall E
198	8 a.m.	T35. Paleozoic Oceanographic and Climatic Changes: Evidence from Seawater Geochemistry and Sedimentology Records (Posters) (<i>GCAGS</i>)	Exhibit Hall E
199	8 a.m.	T36. The Astronomically Forced Sedimentary Record: From Geologic Time Scales to Lunar-Tidal History (Posters) (<i>GSA Sedimentary Geology Division; GCAGS</i>)	Exhibit Hall E
200	8 a.m.	T90. Whole Earth Systems Science: New Perspectives on the "Rock Cycle" from the Deep Earth to the Atmosphere to Life (Posters) (<i>Geochemical Society; GCAGS</i>)	Exhibit Hall E
201	8 a.m.	T94. Nano-Phases and Nano-Structures in Earth Environments (Posters) (<i>MSA; GSA Geobiology and Geomicrobiology Division; GCAGS</i>)	Exhibit Hall E
202	8 a.m.	T174. Teaching and Learning about Complex Earth Systems: Effective Strategies in Undergraduate Classrooms and Teacher Development Programs (Posters) (<i>GSA Geology and Society & Geoscience Education Divisions; GCAGS</i>)	Exhibit Hall E
801	8 a.m.	GC9. Visualization of Depositional Systems	320ABC
802	8 a.m.	GC4. GCAGS Poster Session (Posters)	Exhibit Hall E
4	1:30 p.m.	Globalization of Biogeochemical Cycles	Ballroom C
60	1:30 p.m.	J13. Land Use and Short-Term Erosion Processes (<i>GSA Quaternary Geology and Geomorphology Division; SSSA Div. S05 Pedology and Div. S06 Soil & Water Management & Conservation; ASA Div. A02 Military Land Use & Management</i>)	350DEF
61	1:30 p.m.	J15. Organic Contaminants in Water, Soil, and Sediments: Sources, Interactions, and Ecological Impacts II (<i>GSA Geobiology and Geomicrobiology, Geology and Health & Hydrogeology Divisions; NGWA—Association of Ground Water Scientists and Engineers; ASA Div. A05 Environmental Quality; SSSA Div. S02 Soil Chemistry, Div. S03 Soil Biology & Biochemistry, and Div. S11 Soils & Environmental Quality; GCAGS</i>)	General Assembly Theater Hall C
62	1:30 p.m.	J17. Soil Hydrology (<i>GSA Hydrogeology & Quaternary Geology and Geomorphology Divisions; SSSA Div. S01 Soil Physics and Div. S05 Pedology</i>)	General Assembly Theater Hall B
203	1:30 p.m.	Environmental Geoscience I—Natural Hazard Assessment, 3D Modeling, and Site Characterization	310BE
204	1:30 p.m.	Geophysics/Tectonophysics/Seismology	332AD
205	1:30 p.m.	P2. Critical Zone Studies of Soils and Weathering: Implications for Interpreting Climate and Landscapes of the Past (<i>GSA Sedimentary Geology & Quaternary Geology and Geomorphology Divisions; SSSA Div. S05 Pedology; Society for Sedimentary Geology [SEPM]</i>)	General Assembly Theater Hall A
206	1:30 p.m.	T8. Late Quaternary of the Northern Gulf of Mexico Margin: Climate Change, Sea-Level Change, and the Depositional Record (<i>GSA Quaternary Geology and Geomorphology & Sedimentary Geology Divisions</i>)	320DE
207	1:30 p.m.	T9. Crises on the Reefs? Anticipating the Effects of Global Warming on Reefs by Reference to the Fossil Record—Is the Past Really the Key to the Present in the New Field of Conservation Paleobiology? (<i>Paleontological Society; Society for Sedimentary Geology [SEPM]; Paleontologic Research Institute; Cushman Foundation; GCAGS</i>)	351CF
208	1:30 p.m.	T21. Lakes, Playas, and Soils (<i>GSA Limnogeology, Quaternary Geology and Geomorphology & Sedimentary Geology Divisions</i>)	320F

continued on p. 32

FUTURE GSA ANNUAL MEETINGS

2009 **Portland, Oregon, USA** 18–21 October



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2010	Denver, Colorado, USA	31 October–3 November
2011	Minneapolis, Minnesota, USA	9–12 October
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No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
209	1:30 p.m.	T36. The Astronomically Forced Sedimentary Record: From Geologic Time Scales to Lunar-Tidal History (<i>GSA Sedimentary Geology Division; GCAGS</i>)	361DE
210	1:30 p.m.	T46. Leaving Traces—Making Marks II: In Honor of H. Allen Curran (<i>Paleontological Society; GCAGS</i>)	351BE
211	1:30 p.m.	T63. Foreland Basins: Their Tectonic Setting, Structural Geology, Sedimentology, and Economic Significance (<i>GSA Structural Geology and Tectonics Division</i>)	330A
212	1:30 p.m.	T77. Recent Advances in the Understanding of Adirondack and Southern Grenville Province Tectonics II: In Honor of James McLelland (<i>GSA Structural Geology and Tectonics Division; GCAGS</i>)	322AB
213	1:30 p.m.	T86. Reconciling Geologic and Geodetic Rates of Deformation (<i>GSA Geophysics, Quaternary Geology and Geomorphology & Structural Geology and Tectonics Divisions; GCAGS</i>)	332CF
214	1:30 p.m.	T110. Analog Sites and Field Exercises for Training Planetary Field Geologists (<i>GSA Geoscience Education & Planetary Geology Divisions; GCAGS</i>)	310AD
215	1:30 p.m.	T132. Biofilms and Biomineralization: Evidence from Ancient and Modern Systems (<i>GSA Geobiology and Geomicrobiology Division; GCAGS</i>)	352DEF
216	1:30 p.m.	T142. Soils as Components of Archaeological Landscapes (<i>GSA Archaeological Geology & Quaternary Geology and Geomorphology Divisions; SSSA Div. S05 Pedology; GCAGS</i>)	332BE
217	1:30 p.m.	T147. Innovative Methods for Investigating Flow and Transport in Karst Systems II (<i>GSA Hydrogeology Division; GCAGS</i>)	342BE
218	1:30 p.m.	T163. Groundwater Flow in Coastal Ecosystems (<i>GSA Hydrogeology Division; GCAGS</i>)	342AD
219	1:30 p.m.	T167. Combined Use of Groundwater and Optimization Models to Address Groundwater Management Challenges: Case Studies and Innovative Solution Approaches (<i>GSA Hydrogeology Division; GCAGS</i>)	330B
220	1:30 p.m.	T171. The Gulf of Mexico as a Geologic Laboratory: Making New Links in Depositional Systems from the Coastal Plain to Deep Water (<i>GSA Sedimentary Geology Division; GCAGS</i>)	351AD
221	1:30 p.m.	T175. What Should Students Be Learning in Our Geology Classrooms? (<i>GSA Geoscience Education Division; NAGT; GCAGS</i>)	342CF

Resolving the Late Paleozoic Ice Age in Time and Space

edited by
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Special Paper 441

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
803	1:30 p.m.	GC5. Integrated Pore Pressure Predictions: Case Studies	310CF
804	3:30 p.m.	GC12. Advances in Seismic Imaging—Impact on Exploration through Production: Case Studies	310CF
805	1:30 p.m.	GC16. Environmental Geology I and Hydrology	320ABC
Tuesday, 7 October			
5	8 a.m.	Pardee Keynote Symposium: River Restoration: Environmental Success or Strategic Failure?	Ballroom C
63	8 a.m.	J19. Soil Respiration: From Human to Geologic Time Scales (<i>SSSA Div. S03 Soil Biology & Biochemistry, Div. S05 Pedology, Div. S07 Forest, Range & Wildland Soils, and Div. S09 Soil Mineralogy; Clay Minerals Society</i>)	General Assembly Theater Hall C
64	8 a.m.	J21. Subsurface Fate and Transport of Agricultural Contaminants (<i>GSA Hydrogeology & Geology and Society Divisions; SSSA Div. S02 Soil Chemistry, Div. S06 Soil & Water Management & Conservation, and Div. S11 Soils & Environmental Quality</i>)	351AD
65	8 a.m.	J7. Digital Detection, Interpretation, and Mapping of Soil, Sediments, and Bedrock (Posters) (<i>GSA Geoinformatics Division; SSSA Div. S05 Pedology and Div. S09 Soil Mineralogy</i>)	Exhibit Hall E
66	8 a.m.	J15. Organic Contaminants in Water, Soil, and Sediments: Sources, Interactions, and Ecological Impacts (Posters) (<i>GSA Geobiology and Geomicrobiology, Geology and Health & Hydrogeology Divisions; NGWA—Association of Ground Water Scientists and Engineers; ASA Div. A05 Environmental Quality; SSSA Div. S02 Soil Chemistry, Div. S03 Soil Biology & Biochemistry, and Div. S11 Soils & Environmental Quality; GCAGS</i>)	Exhibit Hall E
67	8 a.m.	J21. Subsurface Fate and Transport of Agricultural Contaminants (Posters) (<i>GSA Geology and Society & Hydrogeology Divisions; SSSA Div. S02 Soil Chemistry, Div. S06 Soil & Water Management & Conservation, and Div. S11 Soils & Environmental Quality</i>)	Exhibit Hall E
68	8 a.m.	J22. U.S. Agriculture's Role in Soil Carbon Sequestration and Greenhouse Gas Mitigation (GRACENet) (Posters) (<i>GSA Geobiology and Geomicrobiology Division; SSSA Div. S03 Soil Biology & Biochemistry and Div. S06 Soil & Water Management & Conservation</i>)	Exhibit Hall E
222	8 a.m.	Geochemistry; Geochemistry, Organic	320DE
223	8 a.m.	Structural Geology/Tectonics/Neotectonics/Paleoseismology II	330A
227	8 a.m.	T7. The Mississippi River Delta as a Natural Laboratory for Evaluating Coastal Response to Relative Sea-Level Rise and Innovations in Transgressive Coastal Management: Shea Penland Memorial Session (<i>USGS; Louisiana Department of Natural Resources; Pontchartrain Institute for Environmental Sciences; New Orleans Geological Society; GSA Sedimentary Geology Division; GCAGS</i>)	General Assembly Theater Hall A
228	8 a.m.	T11. Global Warming Science: Implications for Geoscientists, Educators, and Policy Makers I (<i>GSA Geology and Health, Geology and Society, Geoscience Education & Quaternary Geology and Geomorphology Divisions; American Quaternary Association [AMQUA]; NAGT; GCAGS</i>)	General Assembly Theater Hall B
335	8 a.m.	T17. Integration of Soils and Geomorphology in Deserts: A Tribute to the 50 Years of Soil Research of Dan Yaalon (<i>GSA Quaternary Geology and Geomorphology Division; SSSA Div. S05 Pedology; GCAGS</i>)	372DE
229	8 a.m.	T30. River-Dominated Continental Margin Processes: Modern and Ancient (<i>GSA Quaternary Geology and Geomorphology & Sedimentary Geology Divisions; Gulf Coast Section SEPM; GCAGS</i>)	320F
230	8 a.m.	T35. Paleozoic Oceanographic and Climatic Changes: Evidence from Seawater Geochemistry and Sedimentology Records I (<i>GCAGS</i>)	361DE
231	8 a.m.	T40. After the Last Ammonite and before the First Horse: Patterns of Ecological and Climatic Change during the Paleocene (<i>Paleontological Society; Denver Museum of Nature & Science</i>)	351CF

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
232	8 a.m.	T42. Breaking the Curve: Historical Development, Current State, and Future Prospects for Understanding Local and Regional Processes Governing Global Diversity I (<i>Paleontological Society; GCAGS</i>)	351BE
233	8 a.m.	T59. EarthScope: Bringing Geology and Geophysics together to Study the 4-D Evolution of the Lithosphere (<i>GSA Geoinformatics, Geophysics & Structural Geology and Tectonics Divisions; GCAGS</i>)	332AD
234	8 a.m.	T79. The Himalayan Orogen and Rise of the Tibetan Plateau: An Earth Systems Approach to the Tectonic and Landscape Evolution of Asia (<i>GSA Geophysics, History of Geology, International, Quaternary Geology and Geomorphology, Sedimentary Geology & Structural Geology and Tectonics Divisions; GCAGS</i>)	332CF
235	8 a.m.	T80. Antarctic Science in the International Polar Year—Geologic Evolution of the Antarctic Peninsula: Changes in Tectonics, Biota, and Climate over Time (<i>GCAGS</i>)	322AB
236	8 a.m.	T88. Evolution of Simple Granite Systems (Haplogranites) and Rhyolites: A 50th Anniversary Perspective of the Tuttle and Bowen Studies (<i>MSA</i>)	330B
237	8 a.m.	T104. The Role of Field Geology and Geophysics in the Return to the Moon (<i>GSA Planetary Geology Division; Field Exploration and Analysis Team [FEAT]</i>)	310AD
238	8 a.m.	T136. Sulfates in the Solar System (<i>GSA Geobiology and Geomicrobiology Division; GCAGS</i>)	310BE
239	8 a.m.	T139. Sources, Transport, Fate, and Toxicology of Trace Elements in the Environment I (<i>International Association of GeoChemistry; GSA Hydrogeology Division</i>)	352DEF
240	8 a.m.	T146. Hypogenic Karst: Shedding Light on Once Poorly Understood Hydrologic and Morphologic Features (<i>National Cave and Karst Research Institute; GSA Hydrogeology Division; GCAGS</i>)	332BE

continued on p. 36

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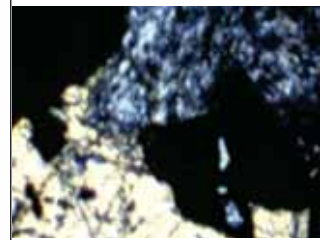
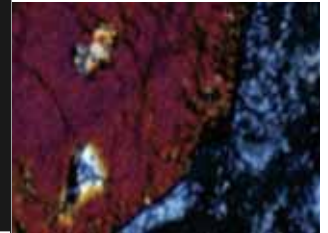
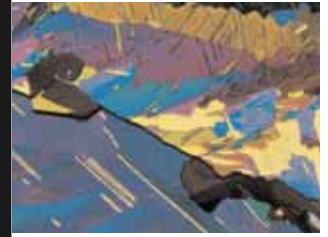
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MICROSYSTEMS

Tuesday, 7 October, continued

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
241	8 a.m.	T152. In Situ Approaches for Measuring Biodegradation Potential and Rates in Subsurface Environments (<i>GSA Hydrogeology Division; GCAGS</i>)	342AD
242	8 a.m.	T162. Advances in Surface Water–Groundwater Interactions: Investigations of Rivers, Lakes, and Wetlands (<i>GSA Hydrogeology Division; GCAGS</i>)	342BE
243	8 a.m.	T184. Advances in Using Recent and Emerging Technologies to Facilitate Learning of the Geosciences in the Classroom, Laboratory, and Field (<i>GCAGS</i>)	342CF
244	8 a.m.	T187. Research on Geoscience Teaching and Learning in Experiential Environments (<i>NAGT; GSA Geoscience Education Division; GCAGS</i>)	350DEF
245	8 a.m.	T207. Alpine Concepts in Geology and the Evolution of Geological Thought (<i>GSA Geophysics, History of Geology, International & Structural Geology and Tectonics Divisions; NAGT</i>)	361C
246	8 a.m.	Archaeological Geology (Posters)	Exhibit Hall E
247	8 a.m.	Environmental Geoscience (Posters)	Exhibit Hall E
248	8 a.m.	Geoscience Education (Posters)	Exhibit Hall E
249	8 a.m.	Paleontology (Posters) II—Paleoecology, Taphonomy, and Traces	Exhibit Hall E
250	8 a.m.	T37. The Western Interior Seaway (Posters) (<i>Paleontological Society; GSA Sedimentary Geology Division; GCAGS</i>)	Exhibit Hall E
251	8 a.m.	T59. EarthScope: Bringing Geology and Geophysics together to Study the 4-D Evolution of the Lithosphere (Posters) (<i>GSA Geoinformatics, Geophysics & Structural Geology and Tectonics Divisions; GCAGS</i>)	Exhibit Hall E
252	8 a.m.	T97. Terrestrial Impact Structures: Origin, Structure, and Evolution (Posters) (<i>GSA Geophysics, Planetary Geology, Sedimentary Geology & Structural Geology and Tectonics Divisions; International Continental Scientific Drilling Program [ICDP]; GCAGS</i>)	Exhibit Hall E
253	8 a.m.	T147. Innovative Methods for Investigating Flow and Transport in Karst Systems (Posters) (<i>GSA Hydrogeology Division; GCAGS</i>)	Exhibit Hall E
254	8 a.m.	T162. Advances in Surface Water–Groundwater Interactions: Investigations of Rivers, Lakes, and Wetlands (Posters) (<i>GSA Hydrogeology Division; GCAGS</i>)	Exhibit Hall E
806	8 a.m.	GC2. Applied Micropaleontology: Tools and Techniques for the 21st Century (<i>Cushman Foundation for Foraminiferal Research; Paleontological Society; GCAGS; Society for Sedimentary Geology [SEPM]; Paleontological Research Institute [PRI]</i>)	310CF
807	8 a.m.	GC6. The Geology of the GOM Coastal Plain: Insights into Offshore GOM Exploration	320ABC
808	10 a.m.	GC11. Old Fields–New Life: How New Technologies or New Ideas Have Made a Difference (<i>GSA Structural Geology and Tectonics Division; GCAGS</i>)	320ABC
6	1:30 p.m.	Pardee Keynote Symposium: Reducing Vulnerability of Gulf Coast Communities to Hurricane Impacts and Sea-Level Rise: Are Large Scale Restoration and Engineering the Answer?	Ballroom C
69	1:30 p.m.	J7. Digital Detection, Interpretation, and Mapping of Soil, Sediments and Bedrock (<i>GSA Geoinformatics Division; SSSA Div. S05 Pedology and Div. S09 Soil Mineralogy</i>)	350DEF
70	1:30 p.m.	J22. U.S. Agriculture's Role in Soil Carbon Sequestration and Greenhouse Gas Mitigation (GRACEnet) (<i>GSA Geobiology and Geomicrobiology Division; SSSA Div. S03 Soil Biology & Biochemistry and Div. S06 Soil & Water Management & Conservation</i>)	General Assembly Theater Hall C
71	1:30 p.m.	J23. Urban Geochemistry and Associated Human and Ecological Health Issues (<i>SSSA Div. S02 Soil Chemistry and Div. S11 Soils & Environmental Quality; GSA Geology and Health Division</i>)	332CF
255	1:30 p.m.	Archaeological Geology	322AB
256	1:30 p.m.	Economic Geology	320F
257	1:30 p.m.	Environmental Geoscience II	310BE
258	1:30 p.m.	Geoscience Education I: Learning Geoscience in the Outdoor Classroom	330B

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
259	3:00 p.m.	MSA Awards, Lectures, Presidential Address, and Annual Business Meeting	371E
260	1:30 p.m.	Paleontology II—Organismal and Morphological Paleontology	351CF
261	1:30 p.m.	Sediments, Carbonates/Clastic	320DE
263	1:30 p.m.	P4. Large-Scale Continental Deformation at Plate Boundaries (<i>GSA Structural Geology and Tectonics Division</i>)	General Assembly Theater Hall A
264	1:30 p.m.	T11. Global Warming Science: Implications for Geoscientists, Educators, and Policy Makers II (<i>GSA Geology and Health, Geology and Society, Geoscience Education & Quaternary Geology and Geomorphology Divisions; AMQUA; NAGT; GCAGS</i>)	General Assembly Theater Hall B
265	1:30 p.m.	T24. Lakes in Extreme Environments: Earth and Beyond (<i>GSA Limnogeology Division; GCAGS</i>)	330A
266	1:30 p.m.	T35. Paleozoic Oceanographic and Climatic Changes: Evidence from Seawater Geochemistry and Sedimentology Records II (<i>GCAGS</i>)	361DE
267	1:30 p.m.	T42. Breaking the Curve: Historical Development, Current State, and Future Prospects for Understanding Local and Regional Processes Governing Global Diversity II (<i>Paleontological Society; GCAGS</i>)	351BE
268	1:30 p.m.	T95. Mineralogic and Petrologic Mapping of Planetary Surfaces: The G.K. Gilbert Award Session (<i>GSA Planetary Geology Division</i>)	310AD
269	1:30 p.m.	T97. Terrestrial Impact Structures: Origin, Structure, and Evolution (<i>GSA Geophysics, Planetary Geology, Sedimentary Geology & Structural Geology and Tectonics Divisions; ICDP; GCAGS</i>)	342CF
270	1:30 p.m.	T111. Modeling and Simulation of Dangerous Phenomena, and Innovative Techniques for Hazard Evaluation, Mapping, and Mitigation (<i>GCAGS</i>)	320ABC

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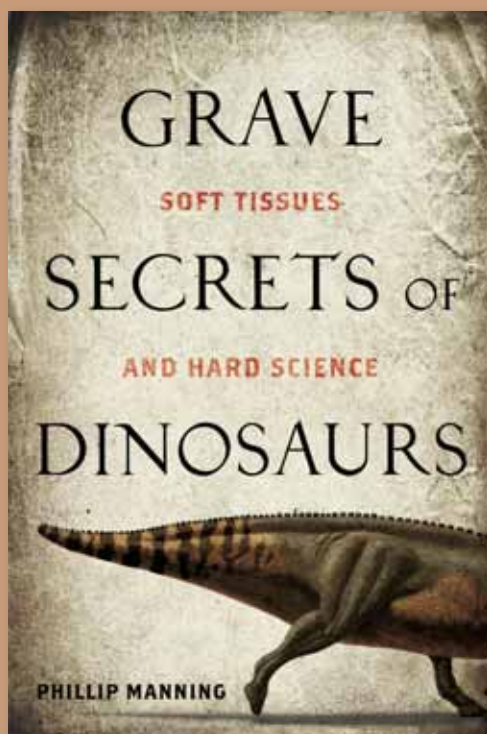
Tuesday, 7 October, continued

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
271	1:30 p.m.	T133. Microbialites: A 3.5-Billion-Year Record of Microbe-Sediment Interactions (GSA Geobiology and Geomicrobiology & Sedimentary Geology Divisions; GCAGS)	342BE
272	1:30 p.m.	T139. Sources, Transport, Fate, and Toxicology of Trace Elements in the Environment II (International Association of GeoChemistry; GSA Hydrogeology Division)	352DEF
273	1:30 p.m.	T170. From San Salvador and Beyond: A Tribute to Don and Kathy Gerace and the Development of the Gerace Research Centre (Paleontological Society; GSA Hydrogeology & Sedimentary Geology Divisions; GCAGS)	342AD
274	1:30 p.m.	T179. Geocognition: Researching Student Learning in the Geosciences (GSA Geoscience Education Division; GCAGS)	332AD
275	1:30 p.m.	T182. Teaching Petrology and Structural Geology in the 21st Century (GSA Geoscience Education & Structural Geology and Tectonics Divisions; On the Cutting Edge; GCAGS)	332BE
276	1:30 p.m.	T208. History of the Influence of Religion on Geology and Geology on Religion (GSA Geology and Society & History of Geology Divisions)	361C
809	3:15 p.m.	GC3. Sedimentology and Stratigraphy	310CF
810	1:30 p.m.	GC14. Risk Management and Uncertainty	310CF
811	1:30 p.m.	GC15. Gulf of Mexico Coastal Plain Paleontology (Paleontological Society; GCAGS)	351AD
812	5:00 p.m.	GC17. Environmental Geology II	310CF

continued on p. 40

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No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
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Wednesday, 8 October

7	8 a.m.	Geobiology and Biomineralization: From the Origins of Life to the Origins of Cities	Ballroom C
72	8 a.m.	J6. Developments in Aeolian Research: Bridging the Interface between Soil, Sediment, and Atmosphere I (<i>GSA Geology and Health & Quaternary Geology and Geomorphology Divisions; SSSA Div. S05 Pedology and Div. S06 Soil & Water Management & Conservation; International Society of Aeolian Research [ISAR]</i>)	General Assembly Theater Hall B
73	8 a.m.	J11. Agriculture, Aquifers, and Climate Change (<i>ASA Div. A04 Extension Education; GSA Hydrogeology Division</i>)	General Assembly Theater Hall C
74	8 a.m.	J16. Scaling Methods in Hydrological Research (<i>GSA Hydrogeology Division; SSSA Div. S01 Soil Physics</i>)	342AD
75	8 a.m.	J24. Variably Saturated Flow in Soil and Rock: What's the Same, What's Different? (<i>SSSA Div. S01 Soil Physics and Div. S05 Pedology; GSA Hydrogeology Division</i>)	351BE
76	8 a.m.	J20. Soils through Time: Critical Zone Studies of Processes and Their Effects (Posters) (<i>GSA Quaternary Geology and Geomorphology Division; Geochemical Society; SSSA Div. S05 Pedology</i>)	Exhibit Hall E
277	8 a.m.	Paleontology III—Paleoecology, Geochronology, and Education	330B
278	8 a.m.	Quaternary Geology	352DEF
282	8 a.m.	T1. Response of Coastal Environments to Accelerated Sea Level Rise (<i>GSA Geology and Society & Quaternary Geology and Geomorphology Divisions; GCAGS</i>)	General Assembly Theater Hall A
283	8 a.m.	T12. Channel Networks as a Template for Earth and Environmental Processes: Toward an Integrative Process Model for Landscape Evolution (<i>GSA Quaternary Geology and Geomorphology Division; National Center for Earth Dynamics</i>)	332AD
284	8 a.m.	T27. From Mud to Mudrock: Use of Modern Depositional Settings as Analogs for the Interpretation of Ancient Mudrocks (<i>GCAGS</i>)	332BE
285	8 a.m.	T41. Recoveries from Mass Extinction: Patterns, Processes, and Comparisons I (<i>Paleontological Society; GCAGS</i>)	320DE
286	8 a.m.	T47. Sclerochronological Archives from Rivers to the Sea: Documentation, Interpretation, and Utility (<i>Paleontological Society</i>)	330A
287	8 a.m.	T48. Exploring the Role of Endobenthic Organisms in Enhancing Porosity and Permeability of Sedimentary Aquifers and Reservoirs (<i>Paleontological Society; NGWA; GSA Sedimentary Geology Division; GCAGS</i>)	320F
288	8 a.m.	T56. Spatial and Temporal Evolution of Transform Faults (<i>GSA Structural Geology and Tectonics Division; GCAGS</i>)	332CF
289	8 a.m.	T64. Lithospheric Structure and Geologic Evolution of the Gulf of Mexico Passive Margin (<i>GSA Geophysics & Structural Geology and Tectonics Divisions; GSA South-Central Section; GCAGS</i>)	322AB
290	8 a.m.	T68. Brittle Deformation and Diagenesis as Coupled Processes (<i>GSA Geophysics, Sedimentary Geology & Structural Geology and Tectonics Divisions; GCAGS</i>)	320ABC
291	8 a.m.	T76. Gondwana-Laurentia Terrane Transfers during the Pangean and Rodinian Supercontinent Cycles (<i>GSA Geophysics Division; GCAGS</i>)	351CF
292	8 a.m.	T92. Discovering Petrologic Truth in Minerals I: In Honor of Bernard W. Evans (<i>MSA</i>)	351AD
293	8 a.m.	T105. Preparations for the New Era of Lunar Science: Laboratory Measurements and New Insights into the Moon (<i>GSA Planetary Geology Division; GCAGS</i>)	310AD
294	8 a.m.	T127. Geochemical Tracers of Changes in Seawater Chemistry (<i>Geochemical Society; GCAGS</i>)	310CF
295	8 a.m.	T130. Opportunities at the Interface: Minerals, Bugs, and Aqueous Solutions (<i>Geochemical Society</i>)	350DEF
296	8 a.m.	T138. New Strategies for Survival and Transport of Pathogens in Soils, Surface Waters, and Aquifers (<i>GSA Hydrogeology Division; GCAGS</i>)	310BE

Wednesday, 8 October, continued

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
297	8 a.m.	T149. Groundwater Arsenic: A Global Environmental Health Problem and Sustainable Mitigation I (<i>GSA Geology and Health, Geology and Society, International & Hydrogeology Divisions; Geochemical Society; International Association of Hydrogeologists; International Society of Groundwater Sustainable Development</i>)	342BE
298	8 a.m.	T192. Professional Society, Organization, Institution, and Federal Agency Achievements Supporting K–12 Teachers and Students (<i>GSA Geology and Society & Geoscience Education Divisions; National Earth Science Teacher Association; GCAGS</i>)	342CF
299	8 a.m.	Geomorphology (Posters)	Exhibit Hall E
300	8 a.m.	Geoscience Information/Communication (Posters)	Exhibit Hall E
301	8 a.m.	Hydrogeology (Posters)	Exhibit Hall E
302	8 a.m.	Paleontology (Posters) III—Sclerochronology: Geoarchaeology, Climate, and Environment	Exhibit Hall E
303	8 a.m.	Paleontology (Posters) IV—Stratigraphy and Morphology	Exhibit Hall E
304	8 a.m.	Sediments, Carbonates/Clastic (Posters)	Exhibit Hall E
305	8 a.m.	Stratigraphy (Posters)	Exhibit Hall E
306	8 a.m.	T7. The Mississippi River Delta as a Natural Laboratory for Evaluating Coastal Response to Relative Sea-Level Rise and Innovations in Transgressive Coastal Management (Posters): Shea Penland Memorial Session (<i>USGS; Louisiana Department of Natural Resources; Pontchartrain Institute for Environmental Sciences; New Orleans Geological Society; GSA Sedimentary Geology Division; GCAGS</i>)	Exhibit Hall E
307	8 a.m.	T122. Soil Geochemistry: Databases and Applications at Regional to Continental Scales (Posters) (<i>Geochemical Society; GCAGS; GSA Geology and Health Division</i>)	Exhibit Hall E

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No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
308	8 a.m.	T182. Teaching Petrology and Structural Geology in the 21st Century (Posters) (<i>GSA Geoscience Education & Structural Geology and Tectonics Divisions; On the Cutting Edge; GCAGS</i>)	Exhibit Hall E
309	8 a.m.	T185. Teaching with New Tools: Visualizations, Models, Online Data, Games, and More (Posters) (<i>NAGT</i>)	Exhibit Hall E
8	1:30 p.m.	Emerging Trace Contaminants in Surface and Groundwater Generated from Waste Water and Solid Waste Application	General Assembly Theater Hall A
9	3:00 p.m.	Pardee Keynote Symposium: Carbon Sequestration: Methods, Markets, and Policy	General Assembly Theater Hall C
77	1:30 p.m.	J1. A Celebration of Soil Science, Solute Transport, and National-Scale Water-Quality Research: In Honor of Jacob Rubin (<i>GSA Hydrogeology Division; SSSA Div. S01 Soil Physics</i>)	352DEF
78	1:30 p.m.	J6. Developments in Aeolian Research: Bridging the Interface between Soil, Sediment, and Atmosphere II (<i>GSA Geology and Health & Quaternary Geology and Geomorphology Divisions; SSSA Div. S05 Pedology and Div. S06 Soil & Water Management & Conservation; International Society of Aeolian Research [ISAR]</i>)	General Assembly Theater Hall B
79	1:30 p.m.	J10. Hydrogeomorphology and Hydropedology: Emerging Disciplines that Embrace Earth and Soil Sciences (<i>GSA Quaternary Geology and Geomorphology Division; SSSA Div. S01 Soil Physics, Div. S05 Pedology, and Div. S06 Soil & Water Management & Conservation</i>)	350DEF
310	1:30 p.m.	Coal Geology	320ABC
311	1:30 p.m.	Geoscience Education III: Research on Learning in the Geosciences	342AD
312	1:30 p.m.	History of Geology	310CF


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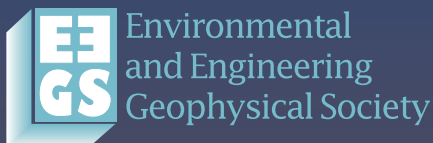


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Wednesday, 8 October, continued

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
313	1:30 p.m.	Hydrogeology II—Groundwater, Non-Darcian Flow, and Nomenclature	332AD
314	1:30 p.m.	Paleoclimatology/Paleoceanography	310BE
315	1:30 p.m.	Paleontology IV—Exceptional Preservation and Taphonomy	320F
317	1:30 p.m.	T15. Trends in Geomorphology: Advances and Innovations in Measurement and Analysis (<i>GSA Quaternary Geology and Geomorphology Division; GCAGS</i>)	332BE
318	1:30 p.m.	T41. Recoveries from Mass Extinction: Patterns, Processes, and Comparisons II (<i>Paleontological Society; GCAGS</i>)	320DE
319	1:30 p.m.	T50. Quantifying the Early Evolution of Life: Numerical Approaches to the Evaluation of Precambrian-Cambrian Animals and Ecosystems (<i>Paleontological Society; GCAGS</i>)	330B
320	1:30 p.m.	T81. Continental and Marine Fold and Thrust Belts I (<i>GSA Structural Geology and Tectonics Division; IUGS Task Group on Structural Geology and Tectonics; GCAGS</i>)	332CF
321	1:30 p.m.	T82. Southwest Pacific Cenozoic Tectonics and Comparisons with Other Orogenic Belts (<i>GSA Geophysics, International & Structural Geology and Tectonics Divisions; GCAGS</i>)	351CF
322	1:30 p.m.	T83. Mid- to Lower Crustal Deformation Processes: Strain, Kinematics, and Relationships to Upper Crustal Structures (<i>GSA Geophysics & Structural Geology and Tectonics Divisions; GCAGS</i>)	322AB
323	1:30 p.m.	T92. Discovering Petrologic Truth in Minerals II: In Honor of Bernard W. Evans (<i>MSA</i>)	351AD
324	1:30 p.m.	T106. Current Research Issues in Lunar Stratigraphy (<i>GSA Planetary Geology Division; AAPG Astrogeology Committee</i>)	310AD
325	1:30 p.m.	T122. Soil Geochemistry: Databases and Applications at Regional to Continental Scales (<i>Geochemical Society; GCAGS; GSA Geology and Health Division</i>)	342CF
326	1:30 p.m.	T144. Geochemical and Geoarchaeological Analysis of Shell Middens: Climate, Ecology, and Culture (<i>GSA Archaeological Geology Division; GCAGS</i>)	330A
327	1:30 p.m.	T149. Groundwater Arsenic: A Global Environmental Health Problem and Sustainable Mitigation II (<i>GSA Geology and Health, Geology and Society, Hydrogeology & International Divisions; Geochemical Society; International Association of Hydrogeologists; International Society of Groundwater Sustainable Development</i>)	342BE
328	1:30 p.m.	T198. Libraries in Transformation: Exploring Topics of Changing Practices and New Technologies (<i>Geoscience Information Society</i>)	351BE

Thursday, 9 October

10	8 a.m.	Pardee Keynote Symposium: Human Influences on the Stratigraphic Record	General Assembly Theater Hall A
80	8 a.m.	J2. Biofuels Production: Environmental Challenges for Soil and Water (<i>GSA Hydrogeology Division; SSSA Div. S03 Soil Biology & Biochemistry, Div. S06 Soil & Water Management & Conservation, and Div. S11 Soils & Environmental Quality</i>)	General Assembly Theater Hall C
81	8 a.m.	J8. Energy from Renewables Using Soil Microbes and Microbial Processes (<i>GSA Geobiology and Geomicrobiology Division; SSSA Div. S03 Soil Biology & Biochemistry and Div. S10 Wetland Soils; USDA-NRI Soil Processes Program</i>)	General Assembly Theater Hall B
82	8 a.m.	J18. Soil Physics and Vadose Zone Hydrology: Our Future Contributions (<i>GSA Hydrogeology Division; SSSA Div. S01 Soil Physics and Div. S05 Pedology</i>)	351AD
330	8 a.m.	Hydrogeology III—Uranium, Metals, and Other Contaminants in Groundwater	342BE
331	8 a.m.	Mineralogy/Crystallography; Petrology, Experimental; Igneous; Metamorphic	351BE
336	8 a.m.	T19. Loess and Loess Soils (<i>GSA Quaternary Geology and Geomorphology Division; GCAGS</i>)	332BE
337	8 a.m.	T28. Permian and Triassic Terrestrial Biotic Responses to Global Perturbations (<i>GSA Sedimentary Geology Division; Paleontological Society; Society for Sedimentary Geology [SEPM]; GCAGS</i>)	330A

Thursday, 9 October, continued

No.	TIME	DESCRIPTION (SPONSORS)	LOCATION
338	8 a.m.	T29. Recent Advances in Deepwater Sedimentology: Science Driven by the Search for Natural Resources (GCAGS)	320DE
339	8 a.m.	T43. Field and Quantitative Paleontology, Micropaleontology, and Taxonomy: A Memorial to Roger L. Kaesler (<i>Paleontological Society; Society for Sedimentary Geology [SEPM]; GCAGS</i>)	320F
340	8 a.m.	T54. Integrative Systematic Paleontology for a New Century: Advancing Evolutionary, Phylogenetic, Biogeographic, and Ecologic Theory with Specimen-Based Studies (<i>Paleontological Society</i>)	330B
341	8 a.m.	T57. Evolution of the Lithosphere and Upper Mantle in the Western U.S. (<i>GSA Geophysics Division</i>)	332AD
342	8 a.m.	T62. Recent Advances in the Study of the Laramide Orogeny and Related Processes in Mexico and the Southern United States (<i>GSA Geophysics & Structural Geology and Tectonics Divisions</i>)	322AB
343	8 a.m.	T81. Continental and Marine Fold and Thrust Belts II (<i>GSA Structural Geology and Tectonics Division; IUGS Task Group on Structural Geology and Tectonics; GCAGS</i>)	332CF
344	8 a.m.	T84. Exhumation of Continental Ultrahigh-Pressure Terranes (<i>GSA Structural Geology and Tectonics Division; UNESCO International Lithosphere Program Task Force IV: Ultra-Deep Continental Crust Subduction; GCAGS</i>)	351CF
345	8 a.m.	T108. Living on a Dusty Moon (<i>GSA Geology and Health & Planetary Geology Divisions</i>)	310AD
346	8 a.m.	T119. The Science of Oil Shale (GCAGS)	342AD
347	8 a.m.	T124. Roles of Speciation and Molecular Structure in Soil Processes (GCAGS)	310BE
348	8 a.m.	T172. Outdoor Classrooms for Water Resources Education (GCAGS)	342CF



The Geological Society of America



Soil Science Society of America



American Society of Agronomy



Crop Science Society of America



Gulf Coast Association of Geological Societies with the Gulf Coast Section SEPM



Houston Geological Society

Information for Presenters



For details on the speaker ready room, posters, and registration, go to <https://www.acsmeetings.org/>.

Speaker Ready Room

George R. Brown Convention Center, Room 340AB

Friday, 3 Oct., 3–6 p.m.

Saturday, 4 Oct., 7 a.m.–8 p.m.

Sunday–Wednesday, 5–8 Oct., 6:30 a.m.–6 p.m.

Presenters have until 1 October to upload PowerPoint files for oral presentations prior to the meeting. If you don't take advantage of the early upload, you must upload your presentation in the Speaker Ready Room no later than the day before your presentation. For all speakers: It's always a good idea to stop by the speaker ready room and double-check your presentation at least one day before your talk.

Poster Sessions

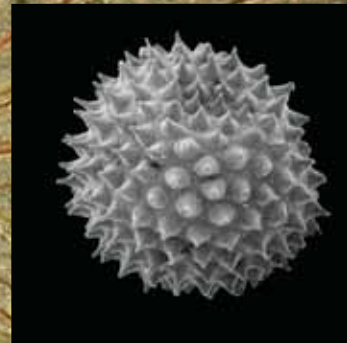
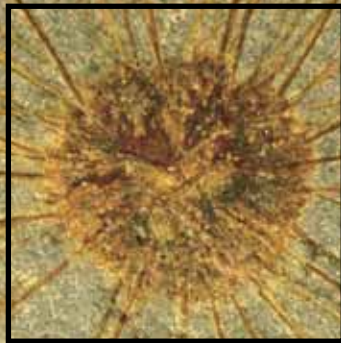
George R. Brown Convention Center, Exhibit Hall E

DAY	SET-UP TIME*	DISPLAY TIME	REMOVAL TIME
Sunday	7–8 a.m.	8 a.m.–4:45 p.m.	4:45–5 p.m.
Monday	7–8 a.m.	8 a.m.–6 p.m.	6–7 p.m.
Tuesday	7–8 a.m.	8 a.m.–6 p.m.	6–7 p.m.
Wednesday	7–8 a.m.	8 a.m.–6 p.m.	6–7 p.m.

***Note:** Posters cannot be set up the previous night.

THE PALEONTOLOGICAL SOCIETY

Centennial
1908 - 2008



Celebrating 100 years of advancement
of the science of paleontology



THE PALEONTOLOGICAL SOCIETY

Centennial Celebration

Geological Society of America
Houston, October 2008



Join us all week at PS Booth #658 in the exhibit hall for Centennial treats, a photographic look at the 100 years of the Society, and PS publications!

Saturday, October 4th

8 AM - 5 PM Centennial Short Course

From Evolution to Geobiology: Research Questions Driving Paleontology at the Start of a New Century

Organized by Patricia H. Kelley and Richard K. Bambach
George R. Brown Convention Center
General Assembly Hall C

6:30 PM Centennial Reception and Dinner

Paleontology Hall, Houston Museum of Natural Science
Tickets available through GSA registration
Free raffle, giveaways, entertainment, and more



Monday, October 6th

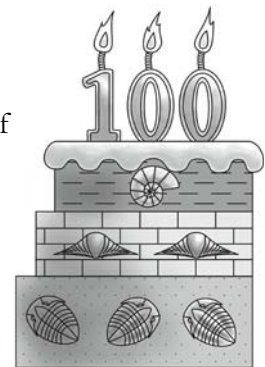
8 AM - 12 PM Pardee Keynote Symposium

Breakthroughs in Paleontology

Organized by Jere H. Lipps and J. William Schopf
George R. Brown Convention Center

4 PM - 6 PM Awards Reception

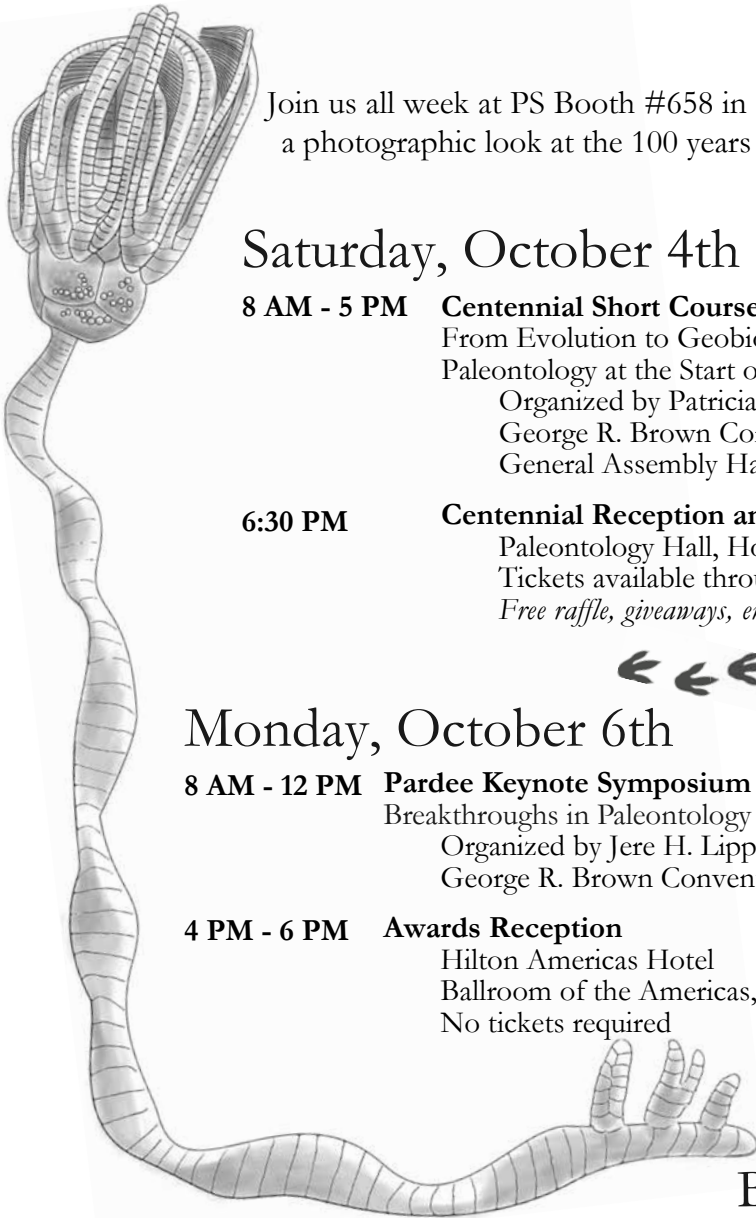
Hilton Americas Hotel
Ballroom of the Americas, F
No tickets required



PS@100

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see www.paleosociety.org



2008 JOINT ANNUAL MEETING

K-12 Education Events



TEACHER FORUM: Evolution in the Classroom

George R. Brown Convention Center, General Assembly Theater B

Sat., 4 Oct., 1-4:30 p.m.

Join GSA for an afternoon with experts in the field of evolution. The forum will cover the latest research and provide activities and answers to your questions about the challenges of teaching evolution. Teachers will also receive free evolution resources. See complete program info. including speaker bios at www.geosociety.org/meetings/2008/K12evolution.htm.

K-12 FIELD TRIP

418. Texas Coastal Systems: K-12 Teachers Trip to Galveston Island and the Brazos River.

Sunday, 5 Oct.

No fee; lunch and refreshments provided. *Cosponsored by the Houston Geological Society and the Region 4 Texas Education Service Center.*

K-12 SHORT COURSES

515. Teaching Darwin.

Saturday, 4 Oct., 9 a.m.-noon.

University of Houston, University Center. Fee: US\$70. *Cosponsored by the GSA History of Geology Division.*

533. More! Rocks in Your Head: Earth Science Professional Development for Teachers Grades 3-8 (K-12 Welcome).

Friday, 3 Oct., 8 a.m.-4:30 p.m.

Meet at the Field Trip Check-in Desk, Entrance E of the George R. Brown Convention Center, at 7:15 a.m. No fee; lunch provided, along with a manual, labeled rock and mineral samples, the U.S. Geological Survey *Time and Terrain Tapestry* map of the United States, Texas Assessment of Knowledge and Skills correlation charts, and a "Hunt for Fossil Fuels" oil exploration game. *Cosponsored by the Ellison Miles Geotechnology Institute; AAPG; Houston Geological Society; and the Region 4 Texas Education Service Center.*

534. Discovering Plate Boundaries for Middle and High School Teachers.

Friday, 3 Oct., noon-5 p.m.

Meet at the Field Trip Check-in Desk, Entrance E of the George R. Brown Convention Center, at 11:15 a.m. No fee; lunch provided. *Cosponsored by the Houston Geological Society and the Region 4 Texas Education Service Center.*

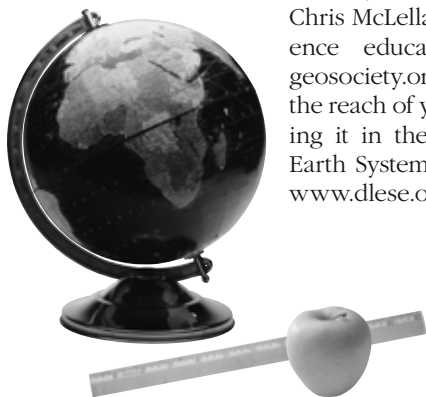
FREE K-12 LESSON PLANS

Need a lesson plan or resource for that earth science class?

GSA has loads of free teacher resources. Go to www.geosociety.org/educate/ to view and download quality lesson plans, developed and classroom-tested by your fellow teachers.

Have a lesson plan you want to share?

Go to www.geosociety.org/educate/, complete our lesson plan template (Microsoft Word format), then send it via e-mail to Chris McLelland, GSA's earth science educator, at educator@geosociety.org. GSA will extend the reach of your work by including it in the Digital Library for Earth System Education (DLESE); www.dlese.org.



THE
GEOLOGICAL
SOCIETY
OF AMERICA®

Annual Geoscience Educators' Social Reception

George R. Brown Convention Center
George Bush Grand Ballroom, Prefunction

Saturday, 4 Oct., 5-7 p.m.

The GSA Education Committee, National Association of Geoscience Teachers (NAGT), GSA Geoscience Education Division, Cutting Edge, Digital Library for Earth System Education (DLESE), IRIS Consortium, American Geological Institute (AGI), EarthScope, National Earth Science Teachers Association (NESTA), Deep Earth Academy, and UNAVCO would like to invite all educators to a relaxing forum for socializing, sharing ideas, and meeting other geoscience community members interested in education.

Appetizers and cash bar provided.

2008 JOINT ANNUAL MEETING

Mentor Programs



Read full program descriptions at www.geosociety.org/mentors/. For additional information contact Jennifer Nocerino, jnocerino@geosociety.org.

WOMEN IN GEOLOGY MENTOR PROGRAM

Cosponsored by Subaru of America, Inc.
through the GSA Foundation



Sunday, 5 Oct., noon–1:30 p.m.

Hilton Americas–Houston, Lanier Grand Ballroom A

This mentoring program addresses the issues faced by women in the earth sciences. The social hour will begin with a few key women speakers, followed by a relaxing forum for socializing, sharing ideas, and meeting other women in earth science. Make sure you arrive early; space is limited. *Appetizers provided.*

Speakers include Judy Parrish, GSA's President; Lorraine Lisiecki, the 2007 Subaru Outstanding Woman in Science Award recipient; and Carolyn Olson, USDA–Natural Resources Conservation Service. The Master of Ceremonies for this event is Jean Bahr, GSA's Vice President.

GEOLOGY IN GOVERNMENT MENTOR PROGRAM

Sponsored by the GSA Foundation



Monday, 6 Oct., 11:30 a.m.–1 p.m.

Hilton Americas–Houston, Ballroom of the Americas F

This **FREE lunch** for undergraduate and graduate students is a popular annual event, featuring a select panel of mentors representing various government agencies. These mentors invite questions from students, offer advice about preparing for a career, and comment on the prospects for current and future job opportunities within their agencies. Make sure you arrive early; space is limited.

Agencies represented include the U.S. Geological Survey, the USDA–Natural Resources Conservation Service, the U.S. Forest Service, the Santa Monica National Recreation Area, the Wisconsin and Colorado Geological Surveys, and the GSA Congressional Science Fellow.



GEOLOGY IN INDUSTRY MENTOR PROGRAM

Cosponsored by Chevron,
ExxonMobil, and the
Foundation Coal Company
through the GSA Foundation



Tuesday, 7 Oct., 11:30 a.m.–1 p.m.

Hilton Americas–Houston, Ballroom of the Americas A

This **FREE lunch** for undergraduate and graduate students features a select panel of mentors representing various industries. These mentors will invite questions from students, offer advice about preparing for a career in industry, and comment on the prospects for current and future job opportunities within their industries. Make sure you arrive early; space is limited.

Companies represented include ExxonMobil, Foundation Coal, Chevron, Vulcan Materials, CH2M Hill, Geoclimate, and ENSR Engineering.

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2008 JOINT ANNUAL MEETING

Guest Seminars

All registered guests are invited to attend the following complimentary seminars and workshops.

Welcome to Houston

Hilton Americas–Houston, Room 343AB

Sunday, 5 Oct., 3–4 p.m.

A representative of the Greater Houston Convention and Visitors Bureau will present an overview of Houston, highlight some of the sites, provide literature and maps, and answer questions.

Permaculture

Hilton Americas–Houston, Room 343AB

Monday, 6 Oct., 9:15–10 a.m. (immediately after the Presidents' Guest Breakfast)

Cas Vanwoerden, Houston Permaculture Guild, Permaculture Instructor, and co-owner of Animal Farm and Learning Center, will discuss permaculture, a practical concept that can be applied in the city, on the farm, and in the wilderness. The principles of permaculture empower people to establish highly productive environments, providing food, energy, and shelter and meeting other material and nonmaterial needs (e.g., economic). By carefully observing the natural patterns of a particular site, the permaculture designer gradually discerns optimal methods for integrating water catchment, human shelter, and energy systems with tree crops, edible and useful perennial plants, domestic and wild animals, and aquaculture.

The Power of Reading People

Hilton Americas–Houston, Room 343AB

Tuesday, 7 Oct., 10–11 a.m.

Join Alice Weiser, speaker, jury consultant, handwriting analyst, and co-author of *Judge the Jury*. Experience the power of analyzing handwriting and reading people, and discover the "Seven Significant Signs of a Serious Liar." Although the subject is serious, Weiser's presentation includes humor, entertaining stories, and audience participation.

Houston Building Stones

Hilton Americas–Houston, Room 343AB

Tuesday, 7 Oct., 1–3 p.m.

Neal Immega, geologist with the Houston Gem and Mineral Society, will take you on a walking tour of downtown Houston to take a closer look at the decorative stones covering downtown buildings. Learn how they were formed, where they came from, and even find some fossils! Depart from the Guest Hospitality Suite.

Meet the Houston Greeters: Try a Mini Adventure

Hilton Americas–Houston, Room 343AB

Wednesday, 8 Oct., 9–10 a.m.

Meet with members of "Houston Greeters," a dynamic group of generous Houston residents who love to meet guests and share what they love about Houston. Each Greeter will lead a mini-adventure around Houston. Maximum of six guests per Greeter.

Guest Hospitality Suite

Hilton Americas–Houston, Room 343AB

Phone: +1-713-576-5413

Sunday–Wednesday, 5–8 Oct., 8 a.m.–5:30 p.m.

Thursday, 9 Oct., 8 a.m.–noon

All registered guests are invited to visit the Guest Hospitality Suite, a resource center with abundant information on Houston and the surrounding area. Local experts will be on hand to answer your questions, and complimentary light refreshments will be served throughout the day.



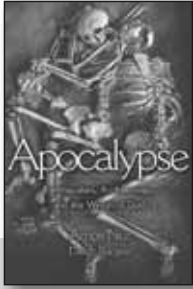
Guest Hospitality Suite

Hilton Americas–Houston, Room 343AB

Monday, 6 Oct., 8:30–9:15 a.m.

Meet the Presidents and Executive Directors of GSA, the Soil Science Society of America, the American Society of Agronomy, the Crop Science Society of America, the Gulf Coast Association of Geological Societies with the Gulf Coast Section SEPM, and the Houston Geological Society and enjoy a complimentary breakfast just for registered guests!

New from Princeton



Apocalypse

Earthquakes,
Archaeology, and the
Wrath of God

Amos Nur

With Dawn Burgess

Cloth \$26.95

Amos Nur will sign
copies of *Apocalypse* at
GSA's annual meeting
author event in Houston
October 5, 2008
at 7:00 p.m.



Geochemical Kinetics

Youxue Zhang

Cloth \$70.00

Archaeological Oceanography

Edited by Robert D. Ballard

Cloth \$45.00

Revised Edition

Hubbert's Peak

The Impending World Oil Shortage

Kenneth S. Deffeyes

*Including new commentary
by the author*

Paper \$16.95

What Bugged the Dinosaurs?

Insects, Disease, and
Death in the Cretaceous

*George Poinar, Jr. &
Roberta Poinar*

Cloth \$29.95

New in Paperback

*With a new foreword by
Carl Zimmer*

T. rex and the Crater of Doom

Walter Alvarez

Paper \$16.95

Extinction

How Life on Earth Nearly
Ended 250 Million Years Ago

Douglas H. Erwin

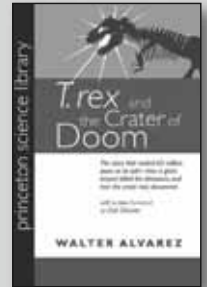
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How Humans Took Control
of Climate

William F. Ruddiman

Paper \$17.95



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Call for Papers



The Geological Society of America is now accepting manuscripts for *Lithosphere*, a journal to be launched in early 2009. *Lithosphere* will focus on tectonic processes at all scales that affect the crust and upper mantle, from the surface to the base of the lithosphere, and will highlight research that addresses how the surface, crust, and mantle interact to shape the physical and chemical evolution of the lithosphere at all spatial and temporal scales.

SUBMIT YOUR MANUSCRIPT ONLINE AT
<http://www.editorialmanager.com/lithosphere/>

**FOR DETAILS ON MANUSCRIPT
SUBMISSION, VISIT**

<http://www.geosociety.org/pubs/lithosphere/lsGuide.htm>

Lithosphere

Lithosphere welcomes contributions from a wide variety of earth science disciplines, including (but not limited to), structural geology, geodynamics, geophysics, seismology, tectonic geomorphology, petrology, and geochemistry, as well as results from integrative, interdisciplinary projects (e.g., Canada's Lithoprobe, EarthScope in the United States). The journal particularly encourages articles that address how complex systems in the solid Earth operate and how coupling between those systems occurs.

Formats will include:

- short research contributions (letters) of new and innovative ideas and concepts;
- longer research articles with complete presentations of field-based and other data sets, experimental results, theoretical analyses, or numerical simulations;
- review articles that facilitate communication among disciplines;
- brief overviews of articles in the issue; and
- special issues or sections devoted to a topic.

For information on article submission and other updates,
please follow the *Lithosphere* links at

www.gsajournals.org

2008 JOINT ANNUAL MEETING

Exhibitors



Exhibitors are listed by category as registered by press copy deadline.

Computer Hardware

Walcott Scientific

Computer Software

Agronomix Software Inc.
Drilling Info Inc.
ESRI
Geomodeling Corp.
GEON 2.0
GrailQuest Corp.
GSI Co. Ltd.
Gylling Data Management
IVS 3D Inc.
P2 Energy Solutions
PETROSYS
Transform Software & Services Inc.

GCAGS/GCSSEPM

GCAGS Bookstore
Gulf Coast Section SEPM and the GCSSEPM Foundation
Shreveport Geological Society—Host of GCAGS 2009

Gems/Minerals Dealers, Jewelry/Gifts

Cal Graeber
Columbia Trading Company
D.A.W. Trading Co.
Finesilver Designs/Jewelry
Gems & Crystals Unlimited
Geographics
IKON Mining & Exploration
Komodo Dragon
Nature's Own

General Educational Products

Armfield
Brooks/Cole—Cengage Learning
Little River Research & Design
Paleomap Project
ProQuest CSA
Ward's Natural Science Est. LLC

Geographic Supplies & Related Equipment (including GIS)

FarrWest Environmental Supply Inc.
Forestry Suppliers Inc.
Rite in the Rain

Geological Services (Exploration, Laboratories, Consulting, & others)

Activation Laboratories Ltd.
Allen-Hoffman Exploration Company
Alpha Mud Logging Services
Baker Hughes
Beta Analytic Inc.
Cambe Geological Services Inc.
Core Laboratories
Crown Geochemistry Inc.
Deloitte—Petroleum Services
DOSECC
Environmental Isotope Laboratory
Fugro-Jason Inc.
Geomap Company
Gerace Research Centre
INEXS
The Mudlogging Company USA LP
Paleo Control Inc.
Paleo-Data Inc.
Paradigm
Resolve Geosciences Inc.
Subsurface Consultants & Associates LLC

Geological Society of America

GSA Bookstore
GSA Engineering Geology Division
GSA Foundation
GSA Geoinformatics Division
GSA Geology and Public Policy Committee
GSA Geology and Society Division
GSA Geoscience Education Division
GSA Headquarters Services
GSA History of Geology Division and the History of Earth Sciences Society
GSA Limnogeology Division
GSA Membership
GSA Planetary Geology Division
GSA Sections

Geological & Geophysical Instrumentation/Workstations

Advanced Geosciences Inc.
ASC Scientific
ASD Inc.
Australian Scientific Instruments Pty Ltd.
Cameca Instruments Inc.
Campbell Scientific Inc.
DeltaNu Inc.
EmCal Scientific Inc.
Fairfield Industries Inc.
Gatan Inc.
Geophysical Survey Systems Inc.
GISCO
Hitachi High Technologies America Inc.
Horiba Instruments Inc.
In-Situ Inc.
IXRF Systems Inc.
Leica Microsystems Inc.
Los Gatos Research
MALA Geoscience USA Inc.
Meiji Techno America
New Wave Research
Optech Inc.
PANalytical Inc.
Rigaku Americas Corporation
Soil Measurement Systems Inc.
Thermo Scientific
TreeRadar Inc.
Wescor

Geophysical Services & Consulting

Aeroquest Limited
CGGVeritas
dGB Earth Sciences
eSeis Inc.
Fugro Gravity and Magnetic Services
Fugro Multi Client Services Inc.
Fugro Robertson Inc.
GETECH
Global Geophysical Services Inc.
Gravity Map Service
Halliburton
Integrated Geophysics Corporation

Knowledge Reservoir LLC
Petroleum Geo-Services
Schlumberger/WesternGeco
SeaBird Exploration
Seitel Data Ltd.
TGS-NOPEC Geophysical Company
Wood Mackenzie

Government Agencies (Federal, State, Local, International)

Minerals Management Service
NASA
National Mine Map Repository
National Park Service
National Science Foundation
Office of Surface Mining
Oklahoma Geological Survey
Rocky Mountain Oilfield Testing Center
U.S. Bureau of Land Management
USDA Forest Service
USDA Natural Resources Conservation Service
U.S. Department of Energy Genomics GTL Program
U.S. Geological Survey
U.S. Nuclear Regulatory Commission

Laboratory Supplies and Related Equipment

CETAC Technologies
Claisse USA—A Division of Claisse Canada
Convion
Elementar Americas Inc.
Everest Interscience
Innov-X Systems
IsotopX Inc.
Phenotype Screening Corporation
Qubit Systems Inc.
Savillex Corporation
Soilmoisture Equipment Corp.

Other

Agricullex Inc.
Agrotain International
AMS Inc.
Apogee Instruments

Ben Meadows
 Bio Chambers
 Chevron
 CID Inc.
 Consortium for Ocean Leadership
 Consortium of Universities for the Advancement of Hydrologic Science Inc. (CUAHSI)
 Convention & Visitors Bureau of Greater Portland
 Decagon Devices
 Delta-T Devices
 Diversified Well Logging Inc.
 Dynamax
 EarthScope
 EARTHTIME
 Environmental Growth Chambers
 Geological Institute of America
 GeoCare Benefits Insurance Programs
 Giddings Machine Co.
 Happy Feet Inc.
 Hortau
 IHS Energy
 IRIS Consortium
 Irometer Company
 Juniper Systems Inc.
 Landviser LLC
 Leco Corp
 LI-COR Biosciences
 Micro Strat Inc.
 MJ Systems
 National Center for Science Education
 Neuralog
 OI Analytical
 Onset Computer Corporation
 Opti-Sciences Inc.
 PMS Instrument Company
 PP Systems
 Research Partnership to Secure Energy for America (RPSEA)
 Samuel Roberts Noble Foundation
 Science Technology Resources
 Seed Research Equipment Solutions
 Seismic Exchange Inc.
 Shell Oil Company
 SmartCrop™ by Accent Engineering Inc.
 Solinst Canada Ltd.
 Spectrum Technologies
 Stevens Water Monitoring Systems Inc.
 Subaru of America, Inc.
 Swift Machine Ltd.
 Systea Scientific
 UNAVCO
 Veris Technologies

Visit Pittsburgh
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Planting/Harvesting Supplies & Related Equipment

ALMACO
 Kincaid Equipment Manufacturing
 NTech Industries Inc.

Professional Societies & Associations

AAPG Foundation
 AASP – The Palynological Society
 American Geological Institute
 American Geophysical Union
 American Institute of Professional Geologists
 American Meteorological Society
 American Quaternary Association
 Association for Women Geoscientists
 Association of American State Geologists
 Association of Earth Science Editors
 Association of Environmental & Engineering Geologists
 Association of Women Soil Scientists
 The Clay Minerals Society
 Council on Undergraduate Research–Geosciences Division
 Cushman Foundation
 Environmental and Engineering Geophysics Society
 Geochemical Society
 Geoinformatics for Geochemistry/Paleostrat/Marine Geoscience Data System
 Geoscience Information Society
 Houston Geological Society
 International Association of GeoChemistry
 International Plant Nutrition Institute
 International Year of Planet Earth
 Mineralogical Association of Canada
 Mineralogical Society of America
 National Association of Black Geologists and Geophysicists
 National Association of Geoscience Teachers
 National Association of State Boards of Geology
 National Cave and Karst Research Institute
 National Earth Science Teachers Association
 The Palaeontological Association

The Paleontological Society
 Petroleum Technology Transfer Council
 Sigma Gamma Epsilon
 Society for Sedimentary Geology

Publications, Maps, Films

Allen Press Inc.
 American Association of Petroleum Geologists
 Cambridge University Press
 CRC Press–Taylor & Francis Group LLC
 Elsevier
 Geological Association of Canada
 GeoScienceWorld
 Grand Canyon Association
 Historic Urban Plans Inc.
 McGraw-Hill Higher Education
 Micropaleontology Project
 Mountain Press
 Nature Publishing Group
 Oxford University Press
 Paleontological Research Institution
 Pearson
 Springer
 Taylor & Francis
 University of California Press
 Vedams eBooks Private Ltd.
 Waveland Press
 W.H. Freeman & Company
 W.W. Norton & Company Inc.
 Wiley-Blackwell

SSSA-ASA-CSSA

The Society Center

State Surveys

Bureau of Economic Geology
 Louisiana Geological Survey

Universities/Schools

Baylor University, Dept. of Geology
 Colorado School of Mines
 Desert Research Institute
 Johns Hopkins University
 Kansas State University, Dept. of Geology
 Louisiana State University, Dept. of Geology & Geophysics
 Mississippi State University
 Paleobiology Database
 Rutgers—The State University of New Jersey, Earth & Planetary Sciences Dept.
 Universidad Autónoma de Nuevo Leon
 University of Houston, Dept. of Earth and Atmospheric Sciences
 University of Nevada–Las Vegas
 University of Nevada–Reno
 University of South Carolina
 University of Texas at Austin–Jackson School of Geosciences
 University of Texas at San Antonio, Dept. of Geological Sciences
 University of Wyoming, Geology & Geophysics Dept.
 Yale University, Dept. of Geology and Geophysics

Exhibits Opening & Welcome Reception
 Sunday, 5 Oct., 7–9 p.m.

Exhibit Hall Hours
 Sunday, 5 Oct., 7–9 p.m.
 Monday, 6 Oct., 9 a.m.–6 p.m.
 Tuesday, 7 Oct., 9 a.m.–6 p.m.
 Wednesday, 8 Oct., 9 a.m.–2 p.m.



2008 JOINT ANNUAL MEETING

Graduate School Info. Forum



George R. Brown Convention Center, Exhibit Hall E

Sunday, 5 Oct., 8 a.m.–7:30 p.m. • Monday–Wednesday, 6–8 Oct., 8 a.m.–5:30 p.m.

Searching for the right graduate school? Meet with university representatives from across the nation at the Graduate School Information Forum. The participating schools (as of press time) are listed below. To check if a school has a booth in the Exhibit Hall, go to <http://rock.geosociety.org/gcif/>.

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Binghamton University		X			University of Alabama		X	X	
Central Washington University	X	X			University of Arkansas	X	X	X	
Colorado State University		X			University of California at Davis		X	X	
Dartmouth College	X	X	X		University of California at Davis–Geology	X	X	X	
Duke University	X	X	X	X	University of California at Riverside	X	X		
East Carolina University	X	X			University of Florida	X	X		
Indiana University	X	X			University of Idaho	X	X		
Iowa State University		X			University of Illinois		X		
Miami University–Ohio	X	X			University of Iowa		X		
Michigan State University		X			University of Kansas	X	X	X	
Michigan State University–Geology	X	X	X		University of Massachusetts–Amherst	X	X		
Missouri State University	X	X			University of Memphis				
Missouri University of Science & Technology		X	X		University of Michigan	X	X	X	X
Northern Arizona University		X	X		University of Minnesota–Duluth	X	X		
Northwestern University		X			University of Missouri–Columbia	X	X		
Ohio State University	X	X	X		University of Montana	X			
Oklahoma State University	X	X	X		University of Notre Dame	X	X	X	
Penn State University	X	X			University of Oklahoma	X	X	X	
Purdue University	X	X			University of Southern California	X	X	X	
Rice University	X	X	X		University of Wisconsin–Madison	X	X	X	
South Dakota School of Mines & Technology	X	X			University of Wisconsin–Milwaukee		X	X	
Syracuse University	X	X	X		University of Utah		X		
Texas A&M University–Geology	X	X			Utah State University	X	X		
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Badges will not be mailed this year. Please pick up your badges on-site at the Joint Annual Meeting Registration Desk, located on Level 2 of the George R. Brown Convention Center. For your convenience, registration will open at noon on Friday, 3 Oct., and will remain open through Thursday morning, 9 Oct.

Registration Desk Hours

Friday	3 Oct.	noon–6 p.m.
Saturday	4 Oct.	7 a.m.–6 p.m.
Sunday	5 Oct.	6:30 a.m.–7 p.m.
Monday–Wednesday	6–8 Oct.	7 a.m.–4:30 p.m.
Thursday	9 Oct.	7–10:30 a.m.

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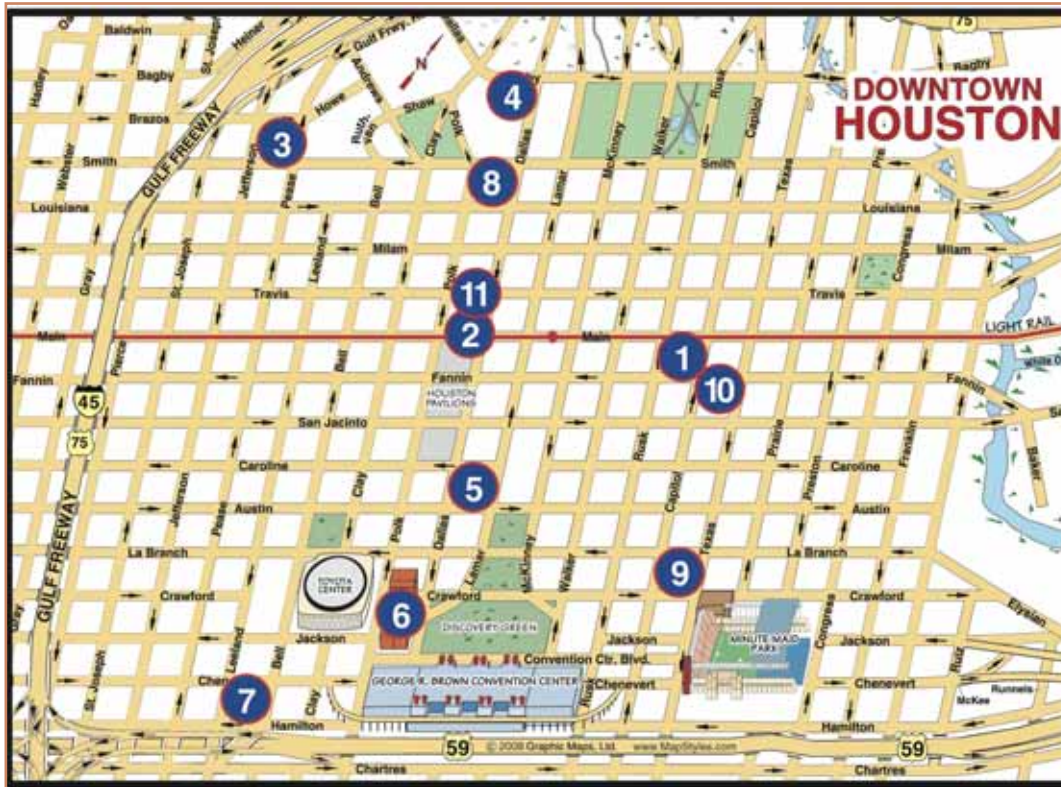


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Downtown Houston Hotels

- | | |
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| 2 Courtyard by Marriott Houston Downtown | 8 Hyatt Regency Houston |
| 3 Crowne Plaza Houston Downtown | 9 Inn at the Ballpark |
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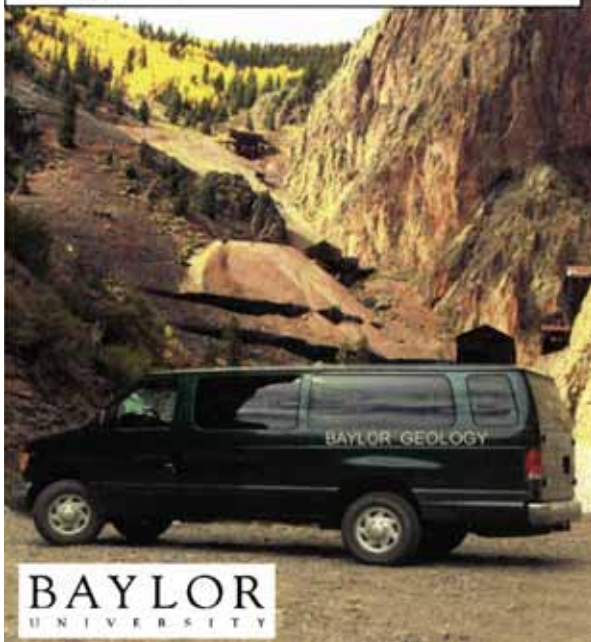


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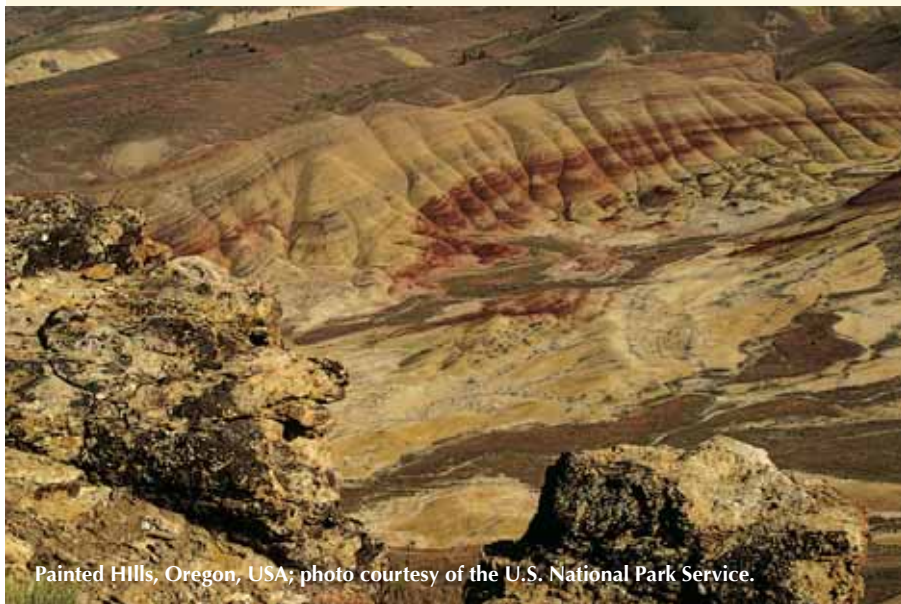
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16–17 March

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22–24 March

Abstract deadline:

16 December 2008

North-Central Section

Rockford, Illinois, USA
2–3 April

Abstract deadline:

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Cordilleran Section

Kelowna, British
Columbia, Canada
7–9 May

Abstract deadline:

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Rocky Mountain Section

Orem, Utah, USA
11–13 May

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David Szymanski

2008–2009 Congressional Geoscience Fellow Named

David Szymanski has been named the GSA–U.S. Geological Survey Congressional Science Fellow for 2008–2009. Szymanski earned his Ph.D. from Michigan State University (MSU) in 2007; his research focused on the chemical evolution of silicic magmas in northern Costa Rica. Since 2005, Szymanski has managed the inductively coupled plasma–mass spectrometer and X-ray fluorescence spectrometer geoanalytical laboratories for MSU’s department of geological sciences. Szymanski’s master’s degree in structural geology is also from MSU, and in 1998 he worked as an intern geologist at Union Pacific Resources in Fort Worth, Texas. Szymanski earned a B.A. in geology from the University of St. Thomas in St. Paul, Minnesota, in 1996.

In addition to his broad background in the geological sciences, Szymanski is a practicing forensic scientist and also holds a master’s degree in forensic chemistry from MSU. He works as a consultant in civil and criminal cases and is a court-qualified expert witness in Michigan, where he is a contract analyst for the Michigan State Police.

Szymanski’s diverse scientific background and interest in science policy are linked by a desire to address societal problems through teaching science to non-scientists. “The ability to communicate the essence of scientific issues is paramount to the integrity of the judicial process, and I believe fostering scientific literacy is equally important to the legislative process,” says Szymanski. While pursuing his doctorate, Szymanski worked with a multidisciplinary research group on teaching college science to understand how students learn complex systems in geology and biology. He recently co-authored an article related to this research for the *Journal of Geoscience Education*. Teaching students to think in terms of systems continues to fuel his interest in science policy. “No single legislator or staff can have a breadth and depth of knowledge on all scientific issues,” says Szymanski, “but given the right tools, citizens and legislators alike can judge the soundness of the science behind policy.”

Szymanski is grateful for the opportunity to serve as the GSA-USGS Congressional Science Fellow for 2008–2009. He anticipates returning to the classroom after his year on Capitol Hill, bringing back a unique perspective on the relationships between science and public policy to share with students and colleagues. “I want to convey how scientific literacy informs social and political decision making. In turn, understanding earth processes can help students make sound civic decisions on ‘voting issues’—the policy questions directly related to earth cycles.”



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REPORT: GSA Ad Hoc Committee on Accreditation

A meeting of the GSA Associated and Allied Societies in 2005 spontaneously generated a discussion of whether a system of academic accreditation for undergraduate programs would be good for the geosciences. As an outgrowth of that discussion, an ad hoc committee was formed to explore the concept of academic accreditation for geoscience departments. The committee, which was hosted by GSA, includes members from a spectrum of the Associated Societies.

In 2007, the committee designed a survey that GSA circulated to department chairs only. The survey included several questions about the design of possible accreditation systems, and it concluded with a direct question: *Are you in favor of some type of formal accreditation of academic programs?* Department chairs responded almost evenly: 51% No and 49% Yes. Respondents also had the opportunity for comment on many of the questions, and many of the comments seemed to be based on respondents' assumptions about the organization of any possible system.

In order to more fully probe these results, a new survey was designed to include several alternatives for various organizational aspects of a system of accreditation, and survey distribution was expanded to include all sectors of geoscience employment. Several of GSA's Associated Societies circulated the survey link to their members. This second survey was conducted in February-March 2008, **and survey results are summarized here.**

The survey document was designed around a "program description matrix" that described five hypothetical models for accreditation in terms of six characteristics: participation, curriculum requirements, reporting responsibilities, administration of the program, awarding of accreditation, and recognition for students who complete accredited degrees (see Table 1). Not identified in the survey, the five models included the following: (1) the existing system of no accreditation specific to the geosciences, but a requirement for reviews by regional accrediting boards for colleges and universities; (2) a general system designed specifically for the survey to be less restrictive than any existing systems of formal accreditation; (3) the current system used in chemistry and administered by the American Chemical Society with modifications specific to the geosciences; (4) the current system used for geosciences in the UK and administered by The Geological Society (London); and (5) the current system used in engineering and administered by ABET.

Like the 2007 survey, the 2008 survey concluded with the summary question: *Are you in favor of some type of formal accreditation of academic programs?* The 2008 survey response shows 79% in favor and 21% opposed. Various demographic sorts show approximately the same distribution of responses among academic, government, corporate, and consulting geoscientists, as well as among members of professional societies. Preferences among the five models showed strongest support for the characteristics of the systems currently being conducted by The Geological Society (London) and by the American Chemical Society.

Respondents were asked for their comments on each of the six characteristics of the five models. More than 20% of the

respondents offered comments, and most of these provide useful advice for implementation of a system of accreditation; however, a substantial number simply indicated that they had nothing more to suggest.

While a significant majority of respondents favored some system of accreditation, a minority clearly had strong concerns about the positive effectiveness of accreditation. The primary concerns fall into three categories: (1) the impact of reporting requirements for paperwork and other efforts on the part of teaching faculty; (2) restriction of the opportunity for innovation in curriculum design; and (3) a negative impact on small departments—the possibility that a college or university might choose to close a department rather than strengthen it to meet accreditation standards. Mitigating the first two of these concerns must be a primary goal of any accreditation system design. The third concern is not as strongly shared by chairs of small departments, who in the 2007 survey voted 60% in favor of accreditation, in contrast to the 49% favorable rating for the entire survey.

The charge to the ad hoc Committee on Accreditation was to explore the level of support for the concept of accreditation for geoscience departments. The results of the most recent survey show very strong support for pursuing these discussions and for developing plans to establish a system of accreditation for the geosciences.

The committee made the following recommendations to GSA's Associated Societies:

1. A coalition of societies should establish a working group to be charged with developing a system of accreditation for undergraduate programs in the geosciences. The establishment of the working group must be a high priority for the societies, and the working group should proceed both expeditiously and with appropriate caution. Careful study of the comments from the 2008 survey is recommended, because they provide much useful advice about the various issues to be considered.
2. The coalition should ask the American Geological Institute (AGI) to provide coordination for the effort. AGI represents a broad cross section of geoscience organizations and is the natural lead institution for this effort.

Finally, the Committee on Accreditation made the following recommendation to the GSA Council: GSA should participate fully in the coalition of societies to establish a working group for development of a system of accreditation for undergraduate programs in the geosciences. This is not and should not be a program of any one society, but it must represent a broad spectrum of societies; therefore, GSA should be represented.

Ad Hoc Committee on Accreditation

William A. Thomas, chair

John B. Anderson; Michael A. Arthur; David M. Best; Duane A. Eversoll; Robert Eves; Joan E. Fryxell; Mary Beth Gray; J. Christopher Hepburn; G. Randy Keller; Ira D. Sasowsky; Darrel Schmitz; John M. Sharp Jr.; John W. Hess, GSA liaison; Edmund Nickless, The Geological Society (London), conferee.

Table 1. Program Description Matrix: General Accreditation Program Designs

	Model 1	Model 2	Model 3	Model 4	Model 5
Participation	Departments do not participate in a national system for curriculum content design.	Voluntary choice for any dept. that offers a baccalaureate degree; a dept. that offers an accredited degree program also may offer specialized degree programs that do not meet all accreditation standards.	Voluntary by degree option within dept. with clearly stated benefits to departments & graduates.	Voluntary for any school/dept. offering geoscience programs. Institutions with accredited programs may also offer non-accredited programs, which are likely to be designed for students not intending to pursue a professional career in the geosciences (less field work, which is expensive).	Only one degree program acceptable and must meet agency specified accreditation requirements, which may or may not reflect significant society input.
Curriculum	No specified curriculum content; each dept. designs a unique program.	Program content defined in terms of topical areas; each dept. is free to design courses to incorporate topical areas; required topical areas must leave time in curriculum for electives in specialty areas for each student.	Emphasis on core topical areas, broadly defined, with specific requirements for laboratory & field work, research experience, advanced courses, related studies (e.g., math, physics), and foreign language.	Essential skills defined and tailored to the various types of geoscience programs (e.g., environmental geoscience, geophysics, etc.). The complete curriculum for each degree program, which must include the essential skills but may be otherwise unique, is submitted for review by an accreditation panel.	Program content defined by requiring specific courses, which have specified content.
Reporting	Departmental self-study conducted on approx. 5-year cycle for regional accreditation of colleges and universities.	An approx. 5-year cycle of self-reporting of curriculum content in a check-list format (simplified from departmental self-study), student statistics (no. of majors, degrees completed), and major-student:faculty ratio; annual report of list of graduates.	Annual report of number of graduates per degree option; 5-year renewal of certification by written report; if problems appear, a site visit may be scheduled.	Annual request for confirmation that accredited programs are still being taught and have not been significantly modified. Significant changes must be reported and approved. Full submission for reaccreditation required on a 6-year cycle.	An approx. 5-year cycle of self-reporting of course-work with content, faculty size & specialty, and resources provided to program in check-list format, student statistics (no. of majors, degrees completed), and major-student:faculty ratio.
Administration	Self-study generally includes visiting external review team, reporting to the campus administration, which is responsible for reaction to a regional accrediting agency; review team responds to general educational standards that are not discipline specific.	Review panel reviews self reports; accreditation awarded to departments that offer recommended curriculum in topical areas.	Review panel considers questionnaires completed by departments; meets with dept. chair (at a professional meeting); one panel member conducts a 1-2-day site visit. Following evaluation, program may be approved, have approval deferred, or have approval for certification withheld. Costs covered centrally.	Accreditation panel of 12 certified professional members, supported by an accreditation officer, reviews submissions. No site visits made. Accreditation awarded to individual programs that meet essential requirements and provide appropriate additional teaching relevant to the type of program. For any program, the panel may require adjustments to the curriculum for accreditation to be awarded and may withhold accreditation if these requirements cannot be met.	Review panel reviews self reports & conducts site visits; accreditation awarded to degree programs that meet all specified criteria.
Accreditation	Depts. subject to general university requirements for regional accrediting boards for colleges and schools; no specific requirements or recognized accreditation for department.	Dept. receives formal notification of accreditation; department may advertise accredited program.	When approved, dept. may advertise certified status. Department's approved program(s) appear on a central list maintained by the approving body, and graduates are counted in its annual report.	School/dept. receives formal notification of accreditation. An accreditation logo and a display certificate may be used by the institution to advertise accredited programs.	Each degree program receives formal notification of accreditation action; degree programs may advertise accredited programs. Accrediting organization provides a list of accredited programs to the public.
Professional recognition of programs and graduates	Graduates receive certificate (diploma) from institution, with no national certification.	Graduates receive certificate of completion of accredited program; recipients of degrees from accredited programs may list this on resumé.	Dept.'s certified program(s) listed nationally; dept. chair awards certified degrees to graduates of approved programs; certified graduates may list this on resúmes. Certified graduates are immediately eligible for full member status in professional society without professional experience, in associate member status.	Graduates do not receive certificate of completion of an accredited program unless it is issued by the school/dept./university. Records are centrally maintained, and accredited programs publicized on a central Web site. Graduates may list their degree as accredited on resúmes. Holding an accredited degree may accelerate application for formal professional status following a period of appropriate professional development.	Graduates receive diploma from institution which may or may not indicate degree program accreditation. Full professional status requires accredited degree, professional experience, and successful completion of an exam.

ACADEMIC PROGRAM ACCREDITATION SURVEY STATISTICS

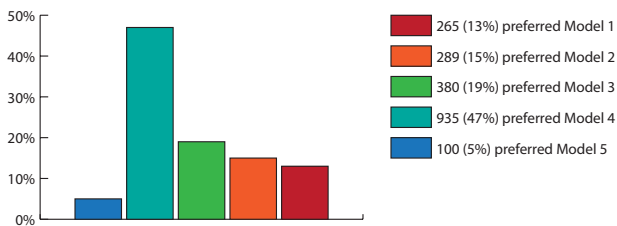
Of the survey's total respondents, 2000 answered the question, "Are you in favor of some type of formal accreditation of academic programs?" significantly in the affirmative.

Yes 1589 79%
No 411 21%

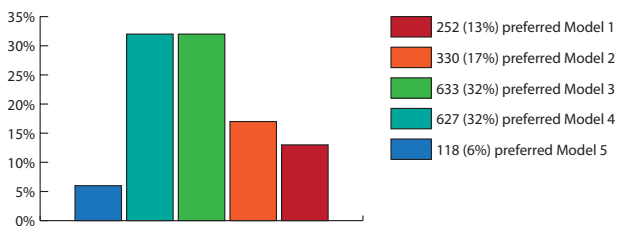
Six Properties

Respondents were presented with six properties common to the five alternative models for accreditation (see Table 1) and asked to mark which model they preferred for each property listed. Following is a breakdown of the six properties—participation, curriculum, reporting, administration, accreditation, and recognition—and how many respondents preferred which model on the basis of each property.

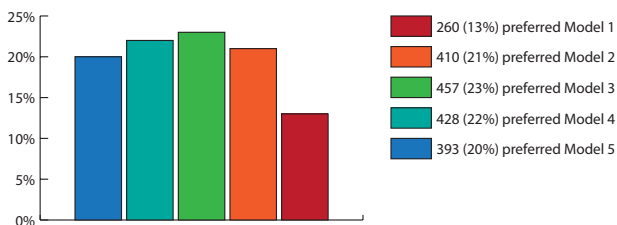
Participation



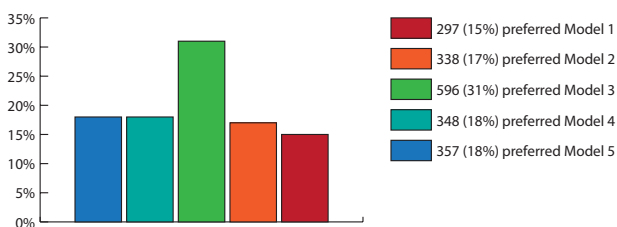
Curriculum



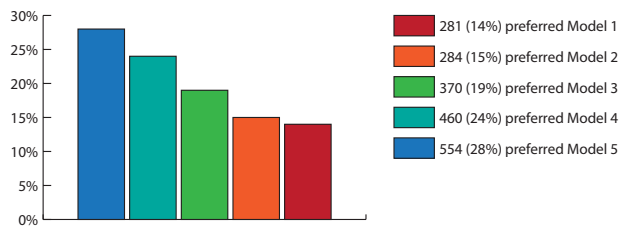
Reporting



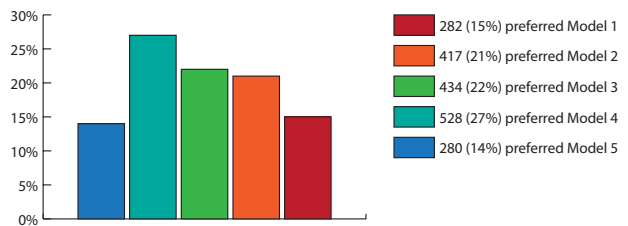
Administration



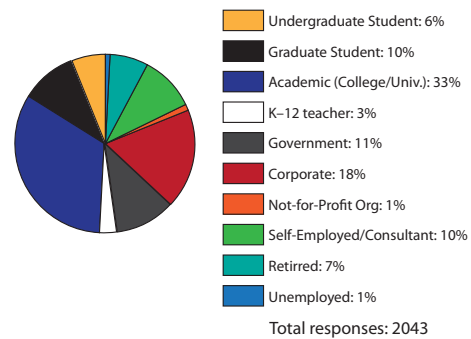
Accreditation



Recognition



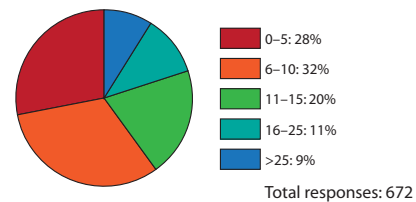
Respondent Employment Status



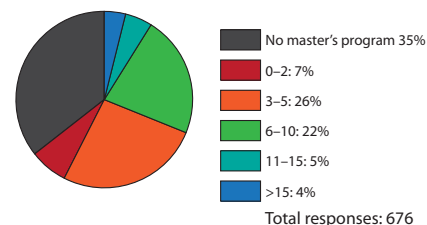
Academics

Those employed in academia were asked how many bachelor's, master's and Ph.D. degrees, on average, were awarded by their department each year.

Bachelor's degrees:

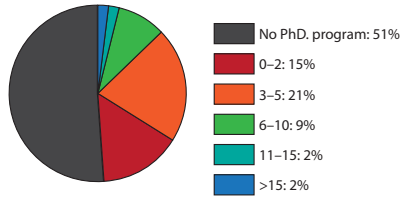


Master's degrees:



Academics *continued*

Ph.D. degrees:

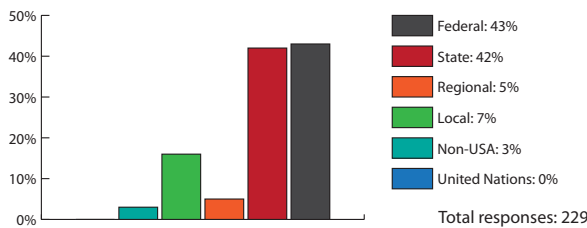


Total responses: 676

Government Employees

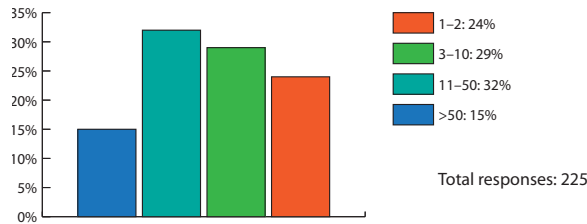
Those employed in government agencies were asked to classify their agencies and to give an idea of how many professional geologists are employed with their agencies.

Government agency type



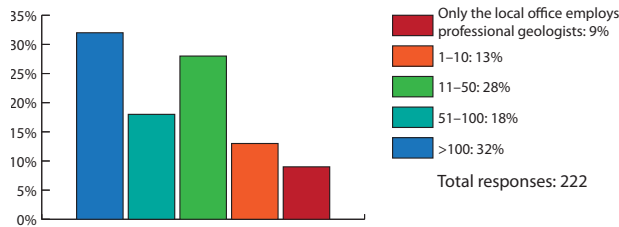
Total responses: 229

How many professional geologists are employed with your local office?



Total responses: 225

How many professional geologists are employed in all the combined offices of your government agency?

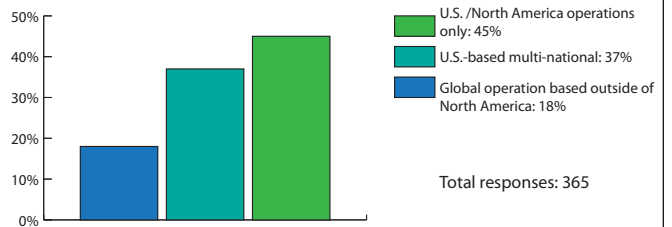


Total responses: 222

Corporate Employees

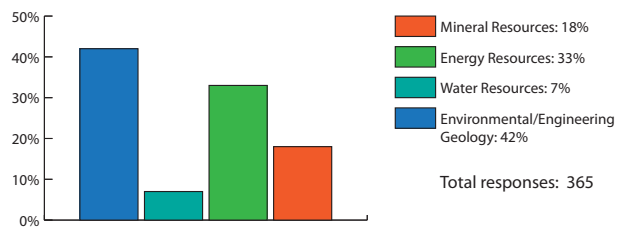
Corporate employees were asked to classify their companies and to give an idea of how many professional geologists they employ.

Which category best describes the scope of your company's operations?



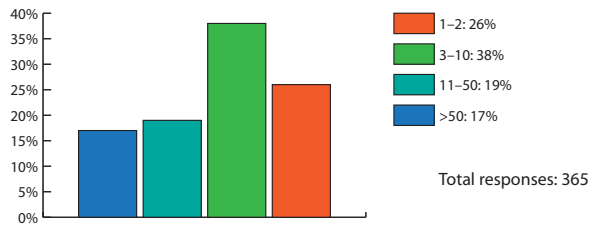
Total responses: 365

Which category best describes the primary purpose of your company's operations?



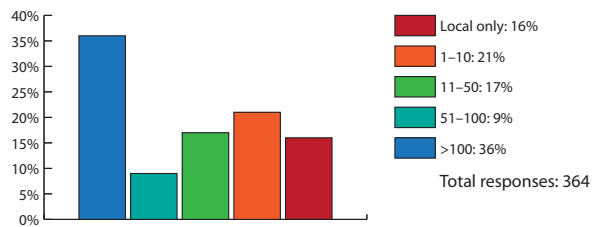
Total responses: 365

How many professional geologists are employed at your local corporate office?



Total responses: 365

How many professional geologists are employed by your company in all locations?

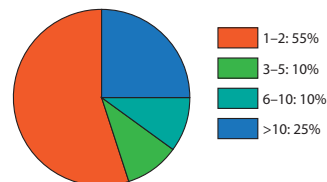


Total responses: 364

Non-Profit Employees

Employees of non-profit organizations were asked just one follow-up question:

How many professional geologists are employed with your organization?



Total responses: 20



GSA Foundation's Annual Silent Auction

The GSA Foundation's 9th Silent Auction will be open to all attendees at the Joint Annual Meeting in Houston this October. Silent Auction items can be viewed in the Foundation Booth in the Headquarter Services Area of the George R. Brown Convention Center beginning Sunday night, 5 October, 7-9 p.m. We hope you will take a few moments to stop by and place your bid. All proceeds from the auction will go into the "Greatest Needs Fund."

We're still accepting donations for the auction!

Help support the Silent Auction: You can donate fossils, mineral specimens, jewelry, rare geologic books or maps, wine, field supplies, antiques, and more. Questions? Please contact Donna Russell at +1-303-357-1054 or drussell@geosociety.org. You may ship donations directly to Donna Russell at the GSA Foundation, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301, USA.

Your name will be listed as the donor on the auction item, and you will receive a receipt for your tax-deductible donation that is based upon the retail value of the donated item.

If you don't have anything to auction, we're happy to accept a cash donation. You may send your check directly to the Foundation office, or go to the Foundation's Web site, gsafweb.org, click on the "Make a Donation" tab, and follow the instructions. Be sure to note in the comment field that your gift is for the Silent Auction.

The Greatest Needs Fund

For several years, GSA Foundation's "Greatest Needs Fund" has been a source of funding for many GSA programs. The Greatest Needs Fund doesn't have the same limitations as a restricted fund and therefore has the flexibility to support the programs and projects in most need of immediate funding.

Most recently, the Greatest Needs Fund has supported:

- The Research Grants Program
- The GeoCorps America™ Program
- International travel to the GSA Annual Meeting
- The GSA Public Service Award
- Student Travel Grants to Section Meetings
- Education & Outreach Programs
- The Congressional Science Fellowship
- GSA Annual Meeting events

Contributions from GSA Members to the Greatest Needs Fund provide an essential financial base to augment many other GSA programs, including science and outreach, electronic publications, and member services. As gifts to this Fund increase, so will the available funding for GSA.

You may make a donation via the coupon below, or go to the Make a Donation tab on our Web site, gsafweb.org, and follow the instructions.

Most memorable early geologic experience:

During his seminal study of periglacial features, Bob Black visited my childhood home at Northway Alaska in the early 1950s. His intense interest in the science of landforms impressed me tremendously even as a pre-teen. Wow—maybe I could be a scientist!

—Monte D. Williams



Support GSA Programs

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- *Utilizes SEM Stage Automation as a "sample tray" for high sample analysis volume
- *Higher SEM Vacuum means better light element analysis than standalone XRF units
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Classified Rates—2008

Ads (or cancellations) must reach the GSA Advertising office no later than the first of the month, one month prior to issue. Contact Advertising Department: advertising@geosociety.org; +1.800.472.1988 x1053; +1.303.357.1053. Complete contact information, including mailing and email address, must be included with all correspondence. Rates are in U.S. dollars.

Classification	Per Line for 1st month	Per line each add'l month (same ad)
Positions Open	\$8.00	\$7.75
Opportunities for Students		
First 25 lines	\$0.00	\$4.20
additional lines	\$4.20	\$4.20
Fellowship Opportunities	\$8.00	\$7.75
Situations Wanted	\$3.60	\$3.60

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.

Positions Open**STRUCTURAL GEOLOGIST
UNIVERSITY OF AKRON**

The University of Akron, Dept. of Geology and Environmental Science (GES), invites applications for a tenure-track Assistant Professor position with a structural geology focus starting 24 August 2009. This is a 9-month, tenure-track position. A Ph.D. in a geoscience related field prior to appointment, along with the ability and willingness to teach a junior level structural geology class and field camp, are required. Applicant is expected to engage in professional service and to develop an externally funded research program that engages Masters-level and undergraduate students.

UA serves about 25,000 students, and is a public institution of the University System of Ohio. Our department houses 10+ faculty members with diverse research specialties that include a focus on terrestrial records of environmental change and geoscience education. We offer bachelor and masters level degrees under a variety of options. See www.uakron.edu/geology for department details. Please submit a letter of application, full CV, statements of research and teaching interest, and names of 3 references to Dr. David Steer; Chair, Structural Search Committee; Department of GES; University of Akron; Akron, OH 44325-4101. Review of applications will begin on November 15th and continue until the position is filled. The University of Akron is committed to a policy of equal employment opportunity and to the principles of affirmative action in accordance with state and federal laws.

**ASSISTANT PROFESSOR—ALL RESEARCH AREAS
INDIANA UNIVERSITY—PURDUE UNIVERSITY
FORT WAYNE (IPFW)**

The Department of Geosciences at Indiana University—Purdue University Fort Wayne (IPFW) invites applications from all research disciplines for a tenure-track position at the assistant professor level. The successful applicant will demonstrate strong teaching skills, and be able to lead undergraduate courses in introductory geology, the solar system, GIS, structural geology, and geomorphology. Teaching loads are typically 9–11 contact hours each week.

Geoscience faculty maintain active research programs. The department is well-supported in both equipment (e.g. thin section lab, SEM/EDX, wet chemistry, XRD, Total Station, etc.) and funding opportunities for new faculty. Fully staffed the department consists of six faculty, a technician and a secretary. IPFW is located in the state's second largest city and is a division 1 school enrolling over 12,000 students in a broad spectrum of disciplines. The area supports a diversity of arts, professional sports, fairs and other activities. Housing is very affordable.

Send curriculum vitae, undergraduate and graduate transcripts (unofficial OK), names and contact information for three references, and a letter that highlights strengths and interests to: Anne Argast, Search Committee Chair, Department of Geosciences, Indiana University—Purdue University Fort Wayne, 2101 East Coliseum Blvd., Fort Wayne, IN 46805, USA. E-mail questions to argast@ipfw.edu. Ph.D. required, thought ABDs near completion are encouraged to apply. Review of applications will begin 3 November 2008. IPFW is an equal opportunity, equal access, affirmative action employer.

**VICE PRESIDENT, EXPLORATION
EARTHWATER GLOBAL**

EarthWater Global uses proprietary exploration protocols to locate, develop, and manage previously overlooked, large-scale, sustainable groundwater resources to help governments and other entities solve their fresh water shortages. For more information, see www.earthwaterglobal.com.

Desired Experience/Qualifications: An advanced degree in Geology or Geophysics; 15+ years of economic minerals and/or petroleum exploration experience and a demonstrated ability as an earth scientist, project leader, and business manager; experience building and developing a team, setting direction, developing programs, and bringing them to fruition; track record of increasing team performance; capable of developing and implementing strategic decisions; organized and disciplined; well-developed oral and written communication skills; able to communicate well and deal persuasively with all levels; reputation for integrity, maturity, and sound business judgment.

Specific Duties/Responsibilities: Position will report directly to the President; communicate and coordinate with regional and governmental leaders and agencies; formulate strategies and review exploration objectives, budgets, and plans; establish criteria to measure operations and regularly evaluate results against established standards; expand the company's exploration program by leading the generation of new concepts on a continuing basis; develop and implement a structured screening process for project identification and evaluation; work with regional management to maintain a sound plan to ensure technical expertise, professional development, and timely staffing; design exploration programs and rank new prospects; ensure that quality standards are met, milestones are achieved, and costs are managed on each ongoing project.

Benefits: The chance to work with world-class scientists on the cutting edge of groundwater exploration to solve the world's water shortages. Compensation is attractive and includes a significant equity stake in a well-financed, high growth company. Benefit package is exceptional and includes medical insurance, life insurance and retirement plan.

Contact: Peter Karlen, jobs@ewg-llc.com, +1-212-342-7438; +1-917-691-0792.

**EXPLORATION GEOLOGIST/GIS EXPERT
EARTHWATER GLOBAL**

EarthWater Global uses proprietary exploration protocols to locate, develop, and manage previously overlooked, large-scale, sustainable groundwater resources to help governments and other entities solve their fresh water shortages. For more information, see www.earthwaterglobal.com.

Desired Experience/Qualifications: Proficient in GIS and Visualization Software Applications in the Earth Sciences and Cartography; training and 10+ years experience in Geological exploration programs, preferably in the private sector; degree and/or professional experience in geology, geography, or cartography GIS data management; outstanding administrative and organizational skills; proficiency in the use and application of ArcGIS and related software.

Specific Duties/Responsibilities: Position will require the handling (i.e., database, edit, load, maintain, and manage) of a wide variety of land, geological, geophysical, and engineering/well data; manage and maintain all components of enterprise GIS and exploration databases; perform certain geological mapping and GIS analysis; maintain and manage certain components of data room (repository) by collecting, organizing, and processing hard copy and digital land, geological, geophysical, and engineering data.

Benefits: The chance to work with world-class scientists on the cutting edge of groundwater exploration to solve the world's water shortages. Compensation is attractive and includes equity stake in a well-financed, high growth company. Benefit package is exceptional and includes medical insurance, life insurance and retirement plan.

Contact: Peter Karlen; jobs@ewg-llc.com; +1-212-342-7438; +1-917-691-0792.

**ASSISTANT PROFESSOR IN HYDROGEOLOGY
DEPARTMENT OF GEOLOGY
UNIVERSITY AT BUFFALO, SUNY**

We invite applications for a tenure-track assistant professor position in hydrogeology. We seek a scientist with demonstrated physical hydrogeology expertise who will complement our existing strength in this and related disciplines. Of particular interest are researchers who have field experience in characterizing watershed or regional

scale systems, groundwater-surface water interactions and/or contaminant transport or remediation in geological systems.

We expect faculty to develop and maintain an innovative, extramurally funded research program. The successful applicant must have a Ph.D. degree at the time of appointment, demonstrated research publication potential, and a commitment to effective teaching. Teaching duties will include undergraduate and graduate level courses in the candidate's specialty. More information about our department can be found at www.geology.buffalo.edu.

Applications must be submitted through the UB Jobs Web site at www.ubjobs.buffalo.edu/applicants/Central?quickFind=52161 by 1 Nov. 2008, when we will begin our review of candidates. The University at Buffalo is an Equal Opportunity Employer/Recruiter.

**ENVIRONMENTAL CHEMISTRY
HAVERFORD COLLEGE**

Haverford College seeks to fill an open rank tenure-track position in environmental chemistry, broadly defined. Applicants from all areas of chemistry are encouraged to apply, but expertise should focus on topics related to the environment. The successful candidate will teach chemistry courses at all undergraduate levels and play a formative role in a new interdisciplinary program in Environmental Studies. Candidates must have a strong commitment to teaching and the establishment of a vigorous research program involving undergraduate students. A Ph.D. and postdoctoral experience are required. Applicants should submit a CV, statements of research plans and teaching philosophy electronically to hc-chemistrysearch@haverford.edu. Undergraduate and graduate transcripts, and three letters of recommendation should be mailed to Merleen Macdonald, Search Administrative Assistant; Haverford College, 370 Lancaster Avenue, Haverford, PA 19041, USA. Questions should be directed to Dr. R. Scarrow, Professor of Chemistry (rsarrow@haverford.edu). For full consideration, applications must be completed by October 10, 2008. More information is available from www.haverford.edu/chemistry.

Haverford College (www.haverford.edu) is located 12 miles northwest of Philadelphia in the Delaware River watershed, an area of intense industrial, urban, and agricultural activity which also includes many parks and protected natural areas. Haverford is an Equal Opportunity/Affirmative Action employer, committed to excellence through diversity, and strongly encourages applications and nominations of persons of color, women, and members of other under-represented groups.

**HYDROCLIMATOLOGY
MICHIGAN STATE UNIVERSITY**

The Department of Geography at Michigan State University is seeking applications for a tenure-track position in hydroclimatology. The appointment will be at the rank of Assistant Professor, beginning August 2009. A Ph.D. degree in geography or closely related discipline such as atmospheric science, environmental science, geology, or hydrology is required at the time of appointment. Research interests should include land-atmosphere interactions related to the hydrologic cycle. Expertise in environmental and related modeling is preferred. International experience or a demonstrated interest in international regions is an advantage. The successful candidate will be expected to participate in interdisciplinary research and contribute to MSU's strengths in climatology and climate change research, geomorphology, groundwater hydrology, Great Lakes studies, biogeography, paleoenvironments, and environmental decision-making. Duties include developing an externally funded research program, teaching undergraduate and graduate student courses, and mentoring graduate students. Applicants should send a letter stating research interests, a current CV, and names of three referees. Michigan State University is an equal opportunity institution and strongly encourages applications from women and minorities. Apply to Professor Julie Winkler, Search Committee Chair, 116 Geography Building, Michigan State University, East Lansing, MI 48824-1117, USA, winkler@msu.edu, +1-517-353-9186. Review of applications will begin 1 December 2008 and continue until the position is filled. Geography 38-326.

**STRUCTURAL GEOLOGY AND TECTONICS
COLLEGE OF WOOSTER**

Applications are invited for a tenure-track assistant professor position in the Department of Geology at The College of Wooster beginning in August 2009. The successful candidate will teach Structural Geology,

Processes and Concepts of Geology and introductory geology courses which may include Oceanography, Environmental Geology, and Geology of Natural Hazards. Skills in remote sensing and GIS are also desirable. Wooster has a strong undergraduate Independent Study program in which the successful candidate will participate as an advisor. Participation in the College's interdisciplinary programs, including First-Year Seminar, is expected. Applicants for this position should have a Ph.D. or be ABD. Interested persons should send a letter of application, a curriculum vitae, graduate transcripts, and three letters of recommendation by 20 December 2008, to Mark A. Wilson, Department of Geology, The College of Wooster, 1189 Beall Avenue, Wooster, OH 44691, USA.

Wooster seeks to ensure diversity by its policy of employing persons without regard to age, sex, color, race, creed, religion, national origin, disability, veteran status, sexual orientation, or political affiliation. The College of Wooster is an Equal Opportunity/Affirmative Action Employer.

POST-DOCTORAL FELLOWSHIP PALEOBIOLOGY AND EARTH HISTORY STANFORD UNIVERSITY

The Paleobiology Laboratory at Stanford University seeks a post-doctoral scholar with interest in the relationship between environmental change and biological evolution as observed in the rock and fossil records. Applicants with experience in quantitative paleobiology, carbonate sedimentology and stratigraphy, isotope geochemistry, and/or modeling of (bio)geochemical cycles are particularly encouraged. Ongoing projects in the lab include studies of extinction selectivity in the fossil record, body size evolution, and sedimentary and geochemical studies of the end-Permian and end-Triassic mass extinctions. Applicants who can contribute to ongoing projects or are interested in initiating new projects within the lab are welcome. Funding will be provided initially for one year, with an anticipated extension for a second year.

Stanford University is an equal opportunity/affirmative action employer.

Please email a cover letter, CV, and the names and contact information for three references to jlpayne@stanford.edu.

TENURE-TRACK POSITION, BOSTON COLLEGE EARTH SYSTEM SCIENTIST SEDIMENTARY PROCESSES

The Department of Geology and Geophysics at Boston College seeks to hire an Assistant Professor in the broad area of Earth System Science with a focus in Sedimentary Processes to start in Fall 2009. Areas of expertise might include (but are not limited to): basin analysis, reflection seismology, sediment transport, global environmental change, and biogeochemical processes in sedimentary systems. The successful candidate will be expected to develop a vigorous externally funded research program integrated with excellence in teaching within the geology-geophysics-environmental geoscience curriculum at both the undergraduate and graduate levels, including teaching a course in Sedimentology and Stratigraphy for majors. Information on the department, faculty, and research strengths can be viewed at www.bc.edu/geosciences. Applicants should send a curriculum vita, statements of teaching and research interests, and the names and contact information of at least three references as a single PDF-file e-mail attachment to sed_position@bc.edu. Review of applications will begin on 14 November 2008. Department faculty will be available at the GSA and AGU fall meetings to meet with applicants. Boston College is an academic community whose doors are open to all students and employees without regard to race, religion, age, sex, marital or parental status, national origin, veteran status, or handicap.

SCRIPPS INSTITUTION OF OCEANOGRAPHY-UCSD LECTURER WITH POTENTIAL FOR SECURITY OF EMPLOYMENT

The Scripps Institution of Oceanography at the University of California San Diego invites applications for a position of Lecturer with Potential for Security of Employment in Earth Science. We seek a motivated, broad-thinking individual with the appropriate expertise to teach undergraduate courses in our Earth Science curriculum (see http://sio.undergrad.ucsd.edu/curriculum/curriculum_overview.php).

Successful candidates will be expected to teach six undergraduate courses per year (one quarter each), and to perform service at the university and/or national lev-

CHAIR OF THE DEPARTMENT OF GEOLOGICAL SCIENCES

The University of Alabama invites nominations and applications for the position of chair of the Department of Geological Sciences. The Department seeks an outstanding Geoscientist with a Ph.D. in Geoscience or related field, excellent leadership and interpersonal skills, and nationally recognized scholarly achievements. The successful candidate must have demonstrated administrative experience, the understanding and vision required to continue our successful undergraduate and graduate teaching and research programs, the interest to facilitate collaborative and multidisciplinary research efforts in a collegial environment, and the enthusiasm to continue to foster strong relations with our alumni. This position is at the full professor level with tenure.

Applications will be accepted until the position is filled with the consideration of applications beginning October 1, 2008. The expected start date is August 16, 2009. To apply on-line, please go to the University of Alabama jobs website at facultyjobs.ua.edu. Letter of application, curriculum vitae, description of administrative experience, statements of administrative and teaching philosophy, teaching interests, research plan, and a list of five potential referees should be submitted on-line. Please contact Ernest A. Mancini, Chair of the Search Committee, Department of Geological Sciences, Box 870338, University of Alabama, Tuscaloosa, Alabama 35487 or at 205-348-5096. Information about the Department is available on our web site at www.geo.ua.edu. The University of Alabama is an Equal Opportunity/Affirmative Action employer and actively seeks diversity among its employees. Women and minority candidates are strongly encouraged to apply.

MINIMUM QUALIFICATIONS: Geoscientist with a Ph.D. in Geoscience or related field. Administrative experience: served as a department chair, research or education center director, administrator for a major education unit, or extensive experience (at least 8 years) in advising undergraduate and graduate students and participating as a chair and member of department, college and university level committees.

Teaching experience: undergraduate and graduate levels, or in an education training program.

Research experience: published in peer-reviewed national/international Geoscience journals, presented at national/international Geoscience conferences and meetings, and established a funded Geoscience research program. Excellent communication and interpersonal skills and ability to administer effective undergraduate and graduate and collaborative research programs.

PREFERRED QUALIFICATIONS: Directed research of undergraduate and graduate students. Obtained funding from governmental agencies, foundations, and/or industry to establish a research program. Active in national/international Geoscience societies. Served in leadership positions in the academic community. Outstanding teaching portfolio.

Open Until Filled
Starting Date: 08-16-2009

The University of Alabama is an Affirmative Action/Equal Opportunity Employer. Applications from women and minorities are encouraged.

Crimson is
THE UNIVERSITY OF ALABAMA

els. The position requires a PhD and strong evidence for excellent teaching.

Review of applications will begin on 8 September 2008 and will continue until the position is filled. Applicants should send a letter including (1) a detailed description of their teaching experience, (2) syllabi and course descriptions for at least two classes, (3) a list of at least six classes that he or she is prepared to teach. Please also provide immigration status and the names of three potential referees, along with their complete institutional address, phone and fax numbers. Send applications to Chair, Lecturer Search Committee, Department of the Scripps Institution of Oceanography, University of California, San Diego, 9500 Gilman Dr., La Jolla, CA 92093-0208, USA.

Questions about submission of applications may be addressed to Leslie Costi, +1-858-534-3205, lcosti@ucsd.edu. Salary per UCSD pay scales.

UCSD is an Equal Opportunity Employer with a strong institutional commitment to excellence through diversity. Applicants are welcome to include in their cover letter a personal statement summarizing their contributions to diversity.

CURATOR OF EARTH SCIENCES DENVER MUSEUM OF NATURE & SCIENCE

The Denver Museum of Nature & Science, the nation's 4th largest natural history museum, is planning to develop a major new permanent exhibition and associated educational programming to showcase the Rocky

Mountain region's exquisite geological story and its interconnections with global processes and climate change. We seek a **Curator of Earth Sciences** to lead this effort and to maintain an active research program based in the Rocky Mountains. This energetic Ph.D. scientist will have a broad Earth systems perspective, superb leadership and communication skills, a history of interdisciplinary collaboration, an ability and desire to communicate science to the public, strong interest in museum-based science, and a record of grants and peer-reviewed publications. Send application including letter of interest, curriculum vitae, and contact information for three references to Kirk Johnson at geology.job@dmns.org. Application review will begin on 15 September. EEOE.

GEOLOGY, BRYN MAWR COLLEGE

The Department of Geology at Bryn Mawr College invites applications for a full-time, tenure-track Assistant Professor position to begin 1 July 2009 in the general area of paleontology. Ph.D. expected at the time of appointment. Applicants are expected to demonstrate strong potential for excellent teaching and creative research, as well as an interest in offering courses in paleontology, historical geology and evolution. The candidate's research interest ideally will complement other faculty members in our department. We would welcome expertise in one or more of the following areas: paleoceanography, paleoecology, paleogeography, geomicrobiology, stable isotope geochemistry, Earth system science or geoarchaeology.

Located in suburban Philadelphia, Bryn Mawr College is a highly selective liberal arts college for women who share an intense intellectual commitment, a self-directed and purposeful vision of their lives, and a desire to make meaningful contributions to the world. Bryn Mawr comprises an undergraduate college with 1,200 students, as well as coeducational graduate schools in some humanities, sciences, and social work. The College participates in a consortium together with Haverford and Swarthmore Colleges and the University of Pennsylvania. Bryn Mawr College is an Equal Opportunity, Affirmative Action Employer. Minority candidates and women are especially encouraged to apply.

Applicants should submit a cover letter, CV, a statement of teaching and research goals, and the names and contact information of three references to: Geology Paleo Search Committee, Department of Geology, Bryn Mawr College, 101 N. Merion Avenue, Bryn Mawr, PA 19010-2899, USA.

Deadline for application: 15 November 2008.

TENURE TRACK POSITION IN HYDROGEOLOGY SAN FRANCISCO STATE UNIVERSITY

San Francisco State University's Department of Geosciences seeks candidates for a tenure-track position in hydrogeology at the Assistant Professor level to begin in August 2009. A Ph.D. in Geology or closely-related discipline is required, and postdoctoral experience is preferred. We seek a scientist committed to furthering the quantitative understanding of the movement of fluids at or below Earth's surface, with research interests and experience in areas such as saturated and unsaturated flow in porous and fractured media, contaminant transport and remediation, interaction of fluids with rock and soil, surface-subsurface linkages, and impacts of local and global environmental change on groundwater resources. The ideal candidate will have a proven commitment to excellence in teaching and practical experience in the broad field of hydrology.

Applicants should demonstrate the ability to maintain an outstanding, externally-funded research program involving undergraduate and graduate students. The successful candidate will be expected to teach courses in hydrogeology, contaminant transport, and general education courses such as environmental geology, and will have the opportunity to develop courses related to their specialty and to collaborate with the university's interdisciplinary Environmental Studies Program.

The Department of Geosciences (<http://tornado.sfsu.edu/>) offers B.S. programs in Geology, Meteorology, and Oceanography, a B.A. program in Earth Sciences, and a M.S. program in Geosciences; currently, the department has about 60 undergraduate majors, 30 M.S. students, and 12 tenured/tenure-track faculty members.

San Francisco State University (SFSU), a large urban university, is part of the 23-campus California State University system and serves a diverse student body in liberal arts, sciences, and professional programs. The mission of the University is to maintain an environment for learning that promotes an appreciation of scholarship, freedom, and human diversity; to foster excellence in instruction and intellectual accomplishment; and to

provide broadly accessible higher education. SFSU faculty are expected to be effective in teaching; to demonstrate professional achievement and growth through continued research, publications, and/or creative activities; and to contribute their academic expertise and leadership to the campus and community.

To apply, send a curriculum vitae, a statement of research interests, a statement of teaching philosophy or teaching portfolio, and names and contact information of three references, to the chair of the search committee: Dr. Leonard Sklar, Dept. of Geosciences, San Francisco State University, San Francisco, CA 94132, USA. Dr. Sklar can be contacted by phone at +1-415-338-1204 and by e-mail at leonard@sfsu.edu. The search committee will begin reviewing applications on 3 November 2008. A short list of candidates to be invited to campus visits will be selected by the end of December 2008. San Francisco State University is an Equal Opportunity/Affirmative Action employer.

TENURE TRACK ASSISTANT PROFESSOR EARLHAM COLLEGE

The Department of Geosciences at Earlham College invites applications for a tenure track position beginning in Fall 2009. Candidate area of specialization is open; however, successful applicants will likely

- be broadly trained in earth science;
- complement our existing strengths in process sedimentology and tectonics;
- provide undergraduate students with research opportunities in their subfield;
- demonstrate interest in teaching a wide variety of undergraduate geology classes.

Course responsibilities include participation in introductory geoscience and environmental science courses, as well as upper-level courses in his or her specialty. We expect that the candidate will participate in the Environmental Science program, supervise undergraduate student research projects, and participate in the senior capstone seminar. A Ph.D. is required and previous teaching experience at the undergraduate level is preferred. Women, underrepresented minorities, and Quakers are especially encouraged to apply. Interested candidates should send curriculum vitae, materials demonstrating teaching effectiveness, and a statement detailing how your research interests will enhance the education of undergraduate students, along with the full contact information of at least three references to: Dr. Andrew Moore, Department of Geosciences, Earlham College, 801 National Rd. West, Richmond, IN 47374, USA, +1-765-983-1672, moorean@earlham.edu. Applications may be submitted electronically to moorean@earlham.edu. To ensure full consideration, please submit applications by 1 November. For expanded information, please visit Earlham's jobs page at www.earlham.edu/jobs.

MINERALOGY/PETROLOGY DENISON UNIVERSITY

The Department of Geosciences at Denison University invites applications from candidates with a background in mineralogy, petrology and high-temperature geochemistry for a tenure-track position (assistant professor) to begin in Fall 2009. We seek a broadly trained scientist to teach Physical Geology, Earth Materials, Igneous/Metamorphic Petrology and other courses that complement our program. The ideal candidate should be committed to teaching excellence in a liberal arts setting, have a strong field background, have broad interests beyond their specialty, and be able to provide a balance of classroom, field and laboratory experiences for our students. A Ph.D. at the time of appointment is required. Denison is a highly selective liberal arts college strongly committed to, and supportive of, excellence in teaching and active faculty research that involves undergraduate students.

All application materials will be handled electronically at <http://employment.denison.edu>.

Please include a letter of application; statements of your approaches to teaching and research in a liberal arts setting; a vita; academic transcripts; and contact information for three references. Please contact Dr. Tod Frothingham, Department of Geosciences, Denison University, Granville, OH 43023, USA, +1-740-587-6217, frothing@denison.edu, for more information about the position. Application materials should be posted by 15 October 2008 for full consideration. We encourage early applications. We would like to meet with candidates attending GSA, 6-8 October, and invite finalists to campus in early November. Denison University is an Affirmative Action, Equal Opportunity Employer. In a continuing effort to diversify our Campus Community, we strongly encourage women and people of color to apply.

TENURE-TRACK POSITION EXPLORATION GEOPHYSICS BOONE PICKENS SCHOOL OF GEOLOGY OKLAHOMA STATE UNIVERSITY

The Boone Pickens School of Geology at Oklahoma State University (OSU) invites applications and nominations for a geophysicist with strong research background to fill a tenured or tenure-track position in exploration geophysics at any rank (assistant, associate, or full professor). In addition, distinguished applicants with demonstrated international reputations, meeting the requirements for full professor will be considered for the Boone Pickens Chair of Exploration Geophysicist. Applicants are required to have a Ph.D. degree in geophysics or related field at the time of appointment.

The applicants should have a broad background in the geophysical sciences. Specific research areas may include, but are not restricted to seismology, seismic data processing and quantitative seismic analysis for reservoir characterization, reflection seismology, electromagnetic techniques, and ground penetrating radar. Applicants must have a strong research and publication record and a demonstrated ability to attract external funding. Salary and benefits will be competitive and commensurate with experience and future potential.

The successful candidate will be expected to pursue a vigorous research program and help strengthen our petroleum geosciences program. The candidate will supervise M.S. and Ph.D. students and develop courses in his or her specialty and participate in preparing students for employment in the energy and environmental industries.

The successful candidate will join a faculty of twelve geoscientists, including two other geophysicists, and will be part of a sedimentary geology and tectonics research group that include six other faculty and has close ties to the petroleum industry. The School of Geology has a well equipped geophysical laboratory with a Geometrics 48 channel seismograph, an Iris Syscalpro 10 channel resistivity system, an AGI Supersting resistivity system, a Scintrex C-G5 gravimeter, a Geometrics control source audio magnetotelluric system (Stratagem), a Pulse Ekko GPR system, a Geonics EM-34 system, a Geometrics 858 Cs vapor magnetometer, and state of the art software for processing both potential field and seismic data. In addition the School has recently constructed the Devon Teaching and Research Laboratory, which contains state-of-the-art 3-D image processing facilities.

Applicants are encouraged to submit a complete vita/resume, statement of research and teaching interests, and a list of five references, including names, phone numbers, e-mail addresses, and complete mailing addresses to Geophysics Search, Boone Pickens School of Geology, 105 Noble Research Center, Oklahoma State University, Stillwater, Oklahoma 74078-3031, USA; phone: +1-405-744-6358; fax: +1-405-744-7841. Screening of candidates will begin in November 2008 and will continue until the position is filled. The starting date for this position will be Fall Semester 2009 or as negotiated.

Inquires about this position may be directed to Dr. Estella Atekwana, estella.atekwana@okstate.edu, or Dr. Jay Gregg, jay.gregg@okstate.edu, at the above address. More information on OSU and the Boone Pickens School of Geology can be found on the Web at <http://osu.okstate.edu/> and <http://geology.okstate.edu/>, respectively.

Committed to health and safety Oklahoma State University maintains a tobacco free work environment.

Oklahoma State University is an Affirmative Action/Equal Opportunity/E-Verify employer committed to diversity.

TENURE-TRACK OR TENURED POSITION GEOCHRONOLOGY, PETROLOGY AND GEODYNAMICS STANFORD UNIVERSITY

The Department of Geological and Environmental Sciences seeks an outstanding scientist to lead a vibrant research program in the broad areas of geochronology, petrology and geodynamics in order to address large-scale petrologic and tectonic processes in the Earth's crust and mantle. Our preference is to make an appointment at the junior or mid-career level, but applications from scientists at all career levels will be considered. The successful applicant will build on newly established and long-standing strengths in geochronology, tectonics, and isotope geochemistry within the Department, interface with solid-earth processes, crustal evolution, seismology and other areas in the School of Earth Sciences, and teach at the undergraduate and graduate level. We especially welcome applications from scientists who integrate geochemical/petrological and/or physical/computational approaches to problem solving.

The Stanford School of Earth Sciences now houses a full range of isotope geochemistry/geochronology/thermochronology facilities. These feature the Stanford-USGS SHRIMP-RG ion microprobe and associated TIMS laboratory; a new multi-collector ICP-MS and high-resolution ICP-MS facility supported by newly commissioned clean labs; new $^{40}\text{Ar}/^{39}\text{Ar}$ and (U-Th)/He, and fission-track thermochronology laboratories containing multi-collector and single-collector mass spectrometers and state-of-the-art extraction lines; and cosmogenic radionuclide laboratories. In addition, an electron microprobe, a scanning electron microscope with EDAX and cathodoluminescence imaging, and sample preparation and mineral separation laboratories are available. Related facilities include stable isotope laboratories, ICP-AES and GC-MS capabilities, high-pressure experimental capabilities including a diamond-anvil cell laboratory, and the recently established Center for Computational Earth and Environmental Science.

Stanford University is an equal opportunity employer and is committed to increasing the diversity of its faculty. It welcomes nominations of and applications from women and members of minority groups, as well as from others who would bring additional dimensions to the University's research and teaching missions.

Please apply online in electronic format (.pdf only) with the following application material: cover letter, curriculum vitae, a statement outlining research and teaching experience and interests, and the names and addresses (including e-mail addresses) of three potential referees, at <http://pangea.stanford.edu/jobs/>. Select the Geochronology, Petrology and Geodynamics faculty position.

Questions can be directed to Elizabeth Miller, elmiller@stanford.edu.

We will begin reviewing applications September 30, 2008. Deadline for receipt of applications is 30 November 2008.

Opportunities for Students

MS Assistantship in Fire Ecology (2) and Watershed Management (1) at Humboldt State University—We are searching for 3 graduate students (M.S. only) as part of an interdisciplinary project in fire-prone forests surrounding Lake Tahoe, California. One student will work with Dr. Andrew Stubblefield (aps14@humboldt.edu) on quantifying the effects of fire severity on erosion and two will work with Dr. Morgan Varner (jmvarner@humboldt.edu) on topics related to forest floor fire behavior and effects in Basin forests. In addition to exceeding College minimum GPA (3.0) and GRE scores (1000), competitive applicants will have field research experience, lack a discomfort for statistics, and have experience with either fire or hydrological research. Interested applicants should contact Drs. Stubblefield or Varner. Students will attend Humboldt State University (www.humboldt.edu), a small college town in the heart of the redwoods and along the Pacific Ocean, known for its strong natural-resource programs. The positions will be funded at US\$12,000 per year with modest housing and travel funds. The deadline for applications is 15 September 2008.

Geoscience and Public Policy Internship. The American Geological Institute's (AGI) Government Affairs Program seeks outstanding geoscience undergraduate or graduate students with a strong interest in federal science policy for a semester-long internship. Representing the geoscience community in Washington D.C., the program actively works with Congress and federal agencies to foster sound public policy in areas that affect geoscientists, including water, energy, and mineral resources; geologic hazards; environmental protection; and federal funding for geoscience research and education. Applications for the spring semester are due by 15 October 15, 2008. For more information about the internship, including how to apply, visit www.agiweb.org/gap/interns/index.html.

Travel Tours

2009 Arctic Sea Expedition is seeking accredited scientific voyagers to provide abstracts in the following areas:

- Arctic plate tectonic status
- Arctic Global warming status
- Aurora Borealis and geomagnetic status
- Planetary core geology and polar status
- Deep ocean chemistry

- Atmospheric anomalies
- Arctic sea floor topography
- Sub-ice photography
- Infrared ocean floor spectroscopy

This is a single voyage to an uncharted Arctic sea region recently opened by Arctic melting. Filmed documentary may include some or all participants in the finished production. Accommodations and fees included

in US\$25k per person. Sponsorships and grants are welcome. Contributors must submit abstracts no later than 15 October 2008. There are 84 positions available aboard a 23-kiloton icebreaker for 15 days. The expedition will not take place unless all positions are filled. Qualifying abstracts will be contacted for full proposals. Make all inquiries to Arctic Expedition, P.O. Box 266, Odessa, WA 99159, USA.

Alberta Geological Survey

www.ags.gov.ab.ca

Stratigraphic Mapping Career Opportunities

Alberta Geological Survey (AGS) provides geoscience information and expertise to government, industry and the public to support exploration, development, conservation and regulation of Alberta's energy, mineral and groundwater resources.

Within the AGS Mapping Section, we are creating the first digital atlas of Alberta's geology. Additional geologists are needed to map and interpret the lithostratigraphy and sequence stratigraphy of the Western Canada Sedimentary Basin, the Rocky Mountains and the Rocky Mountain Foothills within Alberta. Motivated individuals with expertise in both two-dimensional and three-dimensional stratigraphic mapping are required for the positions listed below.

Clastic Stratigrapher: Ph.D. (preferred) or M.Sc.

Carbonate Stratigrapher: Ph.D. (preferred) or M.Sc.

Mapping Geologist: M.Sc. (preferred) or B.Sc.

At AGS, you will have the opportunity to work in a stimulating environment on challenging field and office-based projects, work with advanced technology, and remain current in your field while making significant contributions to your community of practice.

Join us and enjoy the Alberta advantage!

Please visit www.ags.gov.ab.ca/employment.html for full job descriptions and application details.





THE PETROLEUM INSTITUTE ABU DHABI, UNITED ARAB EMIRATES

Institution: The Petroleum Institute (PI) was created in 2001 with the goal of establishing itself as a world-class institution in engineering education and research in areas of significance to the oil and gas and the broader energy industries. The PI's sponsors and affiliates include Abu Dhabi National Oil Company and four major international oil companies. The campus has modern instructional laboratories and classroom facilities and is now in the planning phase of three major research centers on its campus. The PI is affiliated with the Colorado School of Mines, the University of Maryland (College Park), and Leoben and Linz Universities. PI is in the process of developing future working relationships with other major universities and research institutions around the world to capitalize on joint research areas of interest. For additional information, please refer to the PI website: www.pi.ac.ae.

PETROLEUM GEOSCIENCES ENGINEERING POSITIONS

The Petroleum Institute in Abu Dhabi is seeking applications in Petroleum Geosciences Engineering for the following positions:

- Program Director**
- Faculty at all levels**
(Chaired and Distinguished Professor,
Professor, Associate Professor, Assistant Professor)
- Research Associate**
- Research Assistant**
- Lab Engineer**
- Post Doc Fellows**

Candidates are encouraged to submit applications at the earliest convenience. Review of applications begins upon receipt and positions remain open until successfully filled.

Details are available on PI-web site: <http://www.pi.ac.ae/jobs>

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<http://rock.geosociety.org/Enews/>

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- ★ GeoCorps America™ ★ GeoVentures
- ★ GSA Connection
- ★ GSA Annual Meeting News for nonmembers
- ★ GSA Geology & Public Policy information (for Members only)



Photo by K.E. Asmus

2008 Joint Meeting Highlights

Don't forget to check out these special Annual Meeting activities!

Saturday, 4 October

Annual Geoscience Educators' Social Reception, p. 48
GSA Presidential Address & Awards Ceremony, p. 13

Sunday, 5 October

Presidents' Student Breakfast Reception, p. 17
Exhibits Opening & Welcome Reception, p. 53
Meet the Authors and Book Signing, p. 17

Monday, 6 October

Halbouty Lecture by Peter J. McCabe, p. 15
All-Convention Luncheon with talk by Harrison "Jack" Schmitt, p. 17
Subaru Outdoor Life Keynote Address by Alexander Klimchouk, p. 14
Group and Private Alumni Receptions*

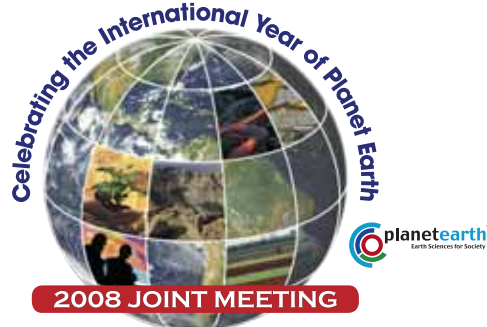
Tuesday, 7 October

5K Fun Run/Walk to Celebrate Planet Earth*
Generational Perspectives of Women Scientists Luncheon*
Special Lecture by James E. Hansen, p. 14
Public Forum: Understanding Evolution, p. 16

Wednesday, 8 October

Closing Reception*

**These activities and more are detailed in the Annual Meeting Program book, which you can pick up at the meeting, or check them out at www.acsmeetings.org.*



2008 JOINT ANNUAL MEETING

5-9 October 2008 • Houston, Texas, USA



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Breadth and Depth Across Disciplines

Top 10 in four of the five areas where *U.S. News* ranks earth sciences.

<u>Disciplines</u>	<u># Faculty & Researchers</u>
Structural Geology and Tectonics	28
Hydrogeology	12
Sedimentology & Stratigraphy	29
Petrology and Geochemistry	7
Environment & Climate	11
Geophysics	27
Paleontology	7
Energy & Earth Resources	24

Major Influx of New Faculty

Large body of 52 faculty and 100 research scientists includes addition of at least 15 new faculty in 2008, a 40 percent increase. Expansion under way in four strategic programs: Climate Systems, Energy Geoscience, Earth Surface and Hydrologic Processes, and Crust/Mantle/Core Dynamics.

Largest Academic Geoscience Community in U.S.

World-wide alumni network with leaders in government, industry, academia.
Great placement services, large recruiter base.

Visit us at booth 1116 at GSA!



USGS Mendenhall Postdoctoral Research Fellowship Program (Fiscal Year 2010)

The U.S. Geological Survey (USGS) invites applications for the Mendenhall Postdoctoral Research Fellowship Program for Fiscal Year 2010. The Mendenhall Program provides opportunities to conduct research in association with selected members of the USGS professional staff. Through Mendenhall postdoctoral appointments the USGS will acquire current expertise in science to assist in implementation of the scientific goals of its programs. Fiscal Year 2010 begins in October 2009.

Opportunities for research are available in a wide range of topics including: climate change research; shale gas systems; karst geomorphology and hydrology; properties and dynamics of permafrost; coastal change; tsunami hazard; environmental effects of mineral mining; applications of airborne gravity gradient measurements; in situ oil shale retorting; landscape change; assessment of earthquake hazard and impact; fluid and heat transport in hydrothermal systems; carbon sequestration by marine processes; applied remote sensing; preferential flow in the unsaturated zone; urban hazards; development of joint inverse methods; risk and vulnerability of communities to natural hazards; dynamics of volcanic tephra plumes; valuating landscape and ecological services; in situ chemical oxidation in contaminated aquifers.

The postdoctoral fellowships are 2-year appointments. The closing date for applications is November 12, 2008. Appointments will start October 2009 or later, depending on availability of funds. A description of the program, research opportunities, and the application process are available at <http://geology.usgs.gov/postdoc>. The U.S. Geological Survey is an equal opportunity employer.

Program Contacts: Dr. Rama K. Kotra, rkotra@usgs.gov, 703-648-6271; Ms. Kimberly Reed, kbreed@usgs.gov, 703-648-7436

U.S. Department of the Interior
U.S. Geological Survey

UNIVERSITY OF WYOMING

Isotope Geology

The Department of Geology and Geophysics at the University of Wyoming invites applications for a tenure-track faculty position in the broad field of isotope geology. This appointment will most likely be made at the Assistant Professor level beginning in August 2009.

We encourage applications from promising scientists that apply radiogenic and/or stable isotopes to problems in the fields of geologic or environmental processes, including but not restricted to topics as diverse as aqueous/environmental geochemistry, climate change, crustal and mantle petrogenesis, mineral deposits, paleoaltimetry, sedimentary provenance, and structural geology. The successful candidate will be expected to develop a research program in their field, and contribute to the graduate and undergraduate teaching missions of the Department of Geology and Geophysics.

The Department has strength in radiogenic isotopes and thermochronology, including laboratories with TIMS instrumentation and fission-track dating facilities. Furthermore, the Department supports a full range of aqueous analytical instrumentation, an electron microprobe, and SEM. Additional information on the Department Geology and Geophysics can be obtained at <http://home.gg.uwyo.edu/>. There is a well-equipped University stable isotope facility with multiple IRMS linked to TC/EA, EA, GasBench, and other peripheral devices (<http://uwacadweb.uwyo.edu/sif/>).

Applications should include a statement of research and teaching interests, curriculum vitae, and the names and contact information for at least three individuals who can provide letters of evaluation. Review of completed applications will begin September 24, 2008. Send an electronic copy of your application to: Ms. Carol Pribyl at cpribyl@uwyo.edu; if you have additional application materials to send, please direct them to the Isotope Geology Search Committee, Department of Geology and Geophysics, University of Wyoming, 1000 East University Avenue, Dept. 3006, Laramie, WY 82071-2000.

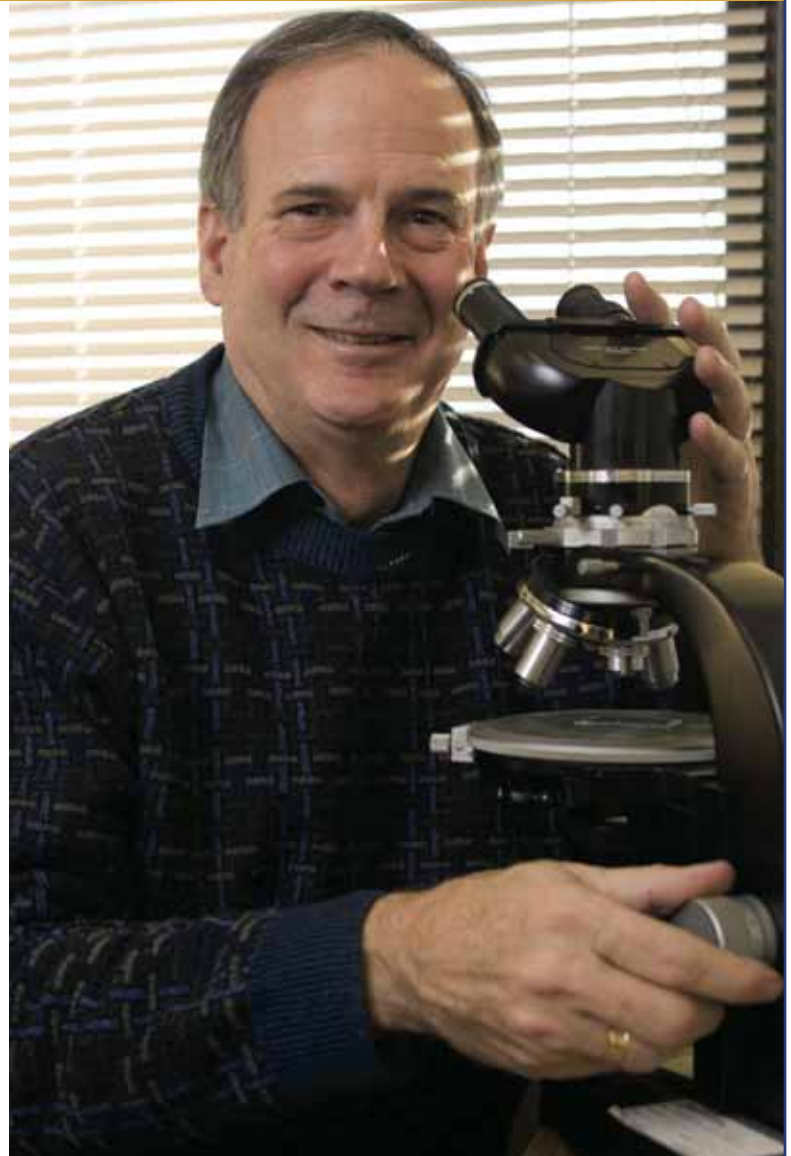
The University of Wyoming is an equal opportunity/affirmative action employer.

Diverse opportunities are yours to explore

Whether you're a seasoned professional or just beginning your geosciences career, you'll find your niche in the BC Public Service.

B.C. offers one of Canada's most varied landscapes, with opportunities in mineral exploration, petroleum and mining. You'll have unparalleled career options including more responsibility and diversity within your role. Grow your career and discover a rewarding future in geology with the BC Public Service.

John, Regional Geologist



For more information about careers with the BC Public Service,
please visit: employment.gov.bc.ca



Where ideas work



Employers: *Looking for Qualified Candidates in the Geosciences?*

The **GSA Employment Service Center** offers a database of candidates seeking positions in more than 30 geoscience specialties.

- ▶ Search online by specialty, experience, location.
- ▶ Post your open position(s)
- ▶ Only US\$300 through 30 April 2009

Live interview service at GSA's 2008 Joint Annual Meeting in Houston, 5–9 October 2008.

- ▶ Includes interview booth, appointment scheduling, posting of your open position(s), access to applicant database, message service, and more!

Job Seekers: *Looking for Employment in the Geosciences?*

Post your profile and résumé online NOW. This is a FREE service to all GSA members.

GSA's Employment Service Center
www.geosociety.org/Employment_Service
 +1-800-472-1988 ext. 1036



Articles Coming Soon to GSA Today

October Science Article

"Turbulent lifestyle: Microbial mats on Earth's sandy beaches—today and three billion years ago" by Nora Noffke

- * GSA Divisions: Build on Your Interests!
- * Call for Award Nominations
- * Preliminary Announcement and Call for Papers: GSA Southeastern, South-Central, and Northeastern Sections



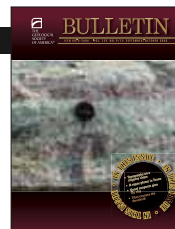
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Journal Highlights

SEPT./OCT. GSA BULLETIN

- Topography on a slippery slope
- A vapor plume in Texas
- Usual suspects give the slip
- Tibet crosses the threshold



AUGUST GEOSPHERE

- Fault-y timing in Nevada
- Mapping a massif basement
- In the zone ... the shear zone



SEPTEMBER GEOLOGY

- Ups and downs of the Mississippi Delta
- Holy guano, Batman, it's the Younger Dryas!
- Karin family breakup ends on ice
- Tension still grips the Indo-Asian collision zone



MAY ENVIRONMENTAL & ENGINEERING GEOSCIENCE

- Coyote Mountain landslides
- Kaiserstuhl cluster analysis
- San Bernardino slippage
- Strikes-and-dips get mean

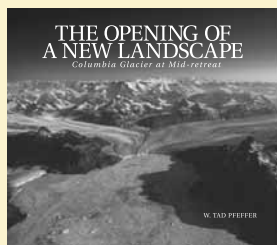


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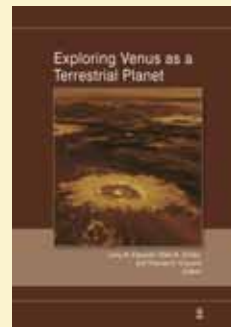
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