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SCIENCE ARTICLE

4 Are plutons assembled over millions of years by amalgamation from small magma chambers?
ALLEN F. GLAZNER, JOHN M. BARTLEY, DREW S. COLEMAN, WALT GRAY, AND RYAN Z. TAYLOR
Are plutons assembled over millions of years by amalgamation from small magma chambers?

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ABSTRACT

Field and geochronologic evidence indicate that large and broadly homogeneous plutons can accumulate incrementally over millions of years. This contradicts the common assumption that plutons form from large, mobile bodies of magma. Incremental assembly is consistent with seismic results from active volcanic areas which rarely locate masses that contain more than 10% melt. At such a low melt fraction, a material is incapable of bulk flow as a liquid and perhaps should not even be termed magma. Volumes with higher melt fractions may be present in these areas if they are small, and this is consistent with geologic evidence for plutons growing in small increments. The large melt volumes required for eruption of large ignimbrites are rare and ephemeral, and links between these and emplacement of most plutons are open to doubt. We suggest that plutons may commonly form incrementally without ever existing as a large magma body. If so, then many widely accepted magma ascent and emplacement processes (e.g., diapirism and stoping) may be uncommon in nature, and many aspects of the petrochemical evolution of magmatic systems (e.g., in situ crystal fractionation and magma mixing) need to be reconsidered.

INTRODUCTION

Plutons are fundamental building blocks of the continental crust. Thought about plutons has been dominated by the tacit assumptions that plutons are largely molten during emplacement and that emplacement is geologically rapid (e.g., Buddington, 1959; Pitcher and Berger, 1972; Paterson et al., 1996; Petford et al., 2000). If plutons are emplaced by bulk magmatic flow, then during emplacement, the magma must contain a melt fraction of at least 30–50 vol% (Vigneresse et al., 1996). At lower melt fractions, crystals in the melt are welded to their neighbors; thus, a low melt-fraction material probably is better regarded not as magma but as a solid with melt-filled pore spaces because bulk flow of such a material requires pervasive solid-state deformation.

The concept of plutons as large ascending molten blobs (Fig. 1) is widespread in geologic thought and commonly guides interpretation of field relations (e.g., Buddington, 1959; Miller et al., 1988; Clarke, 1992; Bateman, 1992; Miller and Paterson, 1999). A contrasting view is that diapirc ascent of magma is too slow and energetically inefficient to be geologically important, and large magma bodies only form at the emplacement level where they are fed by dikes (e.g., Clemens and Mawer, 1992; Petford et al., 2000). Several lines of evidence indicate that, regardless of the ascent mechanism, at least some plutons were emplaced incrementally over time spans an order of magnitude longer than the thermal lifetime of a large magmatic mass (Coleman et al., 2004). No more than a small fraction of such a pluton can have contained melt at a given time, and thus apparently continuous bodies of plutonic rock appear to have grown in situ by amalgamation from many small, probably dike-fed, increments.

Magma volumes of 1000 km$^3$ or more clearly must exist at least ephemerally in the crust because ignimbrite eruptions of this size are well known from the geologic record (Lipman, 1984). However, it need not follow that large plutons were...
once large tanks of unerupted magma. Large ignimbrite eruptions, although geographically widespread, happen rarely compared to the much smaller eruptions that construct volcanoes. If construction of plutons resembles that of volcanoes, plutons may represent amalgamations of many small magmatic additions. If so, then we must reevaluate pluton emplacement mechanisms and, indeed, reevaluate the concept of a "pluton."

This perspective mirrors the development of thought about mid-ocean ridge magmatism. A spreading center once was thought to contain a large permanent magma chamber that underwent in situ crystal fractionation and recharge (Cann, 1974). However, seismic studies failed to locate such magma chambers (e.g., Detrick et al., 1990), and modeling suggests that it is thermally difficult to maintain even a small permanent magma chamber at any but the most rapidly spreading mid-ocean ridge (e.g., Lister, 1983). Accretion of the oceanic crust now is envisioned in terms of small ephemeral magma bodies that differentiate by complex processes at many sites (Sinton and Detrick, 1992).

In this paper, we summarize field, geochronologic, and geophysical evidence that many plutons were emplaced incrementally over significant time spans and argue that many of our fundamental assumptions regarding plutons and their relationships to host rocks must be reexamined.

**EVIDENCE FOR INCREMENTAL EMPLACEMENT OF PLUTONS**

**Field Evidence**

A growing body of data suggests that many plutons were assembled as a series of sheet-like intrusions that may be gently or steeply inclined. Wiebe and Collins (1998) described the progressive growth of large plutons by vertical stacking of intrusive sheets beneath a long-lived silicic magma cap and argued that a molten body of the size of the final pluton need never have existed. Similar large sheeted intrusions are now recognized worldwide and in many tectonic settings (e.g., Wiebe, 1993; Coleman et al., 1995; Brown and McClelland, 2000). Wiebe and Collins (1998) suggest that steeply dipping sheets at the margins of some plutons were emplaced subhorizontally and then tilted at the margin of a sagging floor.

Other plutons preserve evidence for emplacement as a series of steep dikes (e.g., Pitcher, 1970; Hutton, 1992; McNulty et al., 1996). For example, the Mc Dougale pluton of the central Sierra Nevada displays compelling evidence for emplacement by dike amalgamation (Mahan et al., 2003). The pluton is compositionally layered parallel to its contacts and contains numerous thin concordant panels of wall rock that preserve consistent fabric orientations and tectonostatigraphic order. Wall-rock bodies inside the pluton are interpreted to have remained in place as the pluton was intruded incrementally as a plexus of dikes (Mahan et al., 2003; cf. Pitcher, 1970).

The Tuolumne Intrusive Suite of Yosemite National Park has long been thought to have crystallized from several large batches of magma that were emplaced in rapid succession (Bateman and Chappell, 1979). However, at many places, the outer margin of the Tuolumne is clearly composed of granodiorite dikes that invaded wall rocks (Fig. 2). At May Lake the outermost unit of the Tuolumne in that area (tonalite of Glen Aulin) intrudes a screen of metamorphic wall rocks and is choked with wall-rock xenoliths (Fig. 3A), ranging from 250 × 20 m down to decimeter scale, all of which contain foliation and lineation parallel to that in the main screen (Fig. 3B). The tonalite exhibits contact-parallel sheeting defined by variations in mineral proportions and grades over 5–25 m into the next inner and younger unit, the Half Dome Granodiorite. We interpret the xenoliths as in-place bodies of wall rock isolated by dikes that, where their contacts are not marked by xenoliths, are recorded by the compositional sheets.

The Half Dome Granodiorite near the contact also contains sheets of varying composition and tabular swarms of mafic enclaves, but grades inward to a more homogeneous rock. Here the occurrence of dikes or sheets is less certain. However, a pattern of dikes and sheets at the margins passing into a more homogeneous interior is consistent with thermal models of incremental pluton growth that predict a transient sheeted-dike stage followed by formation of a central, possibly small, steady-state magma chamber (Hanson and Glazner, 1995).

The growth of sheeted intrusions is analogous to that of crack-seal veins (Ramsay, 1980). A crack-seal vein contains a superficially uniform fill that accumulated incrementally as the crack opened in a series of discrete events. Annealing of the vein fill can obscure evidence of individual fracturing events, and this also may apply to composite plutons. Mc Dougale granodiorite has the same coarse grain size from the center of the pluton to the thinnest dike, and shows no outcrop-scale evidence of chilling at any contact. Locally, truncated mafic enclaves reveal steep internal dike contacts but, away from truncated enclaves, the dike contacts become invisible (Mahan et al., 2003). These observations suggest that rock textures were homogenized by post-emplacement annealing that obscured internal contacts. The textural homogeneity of large plutons like the Half Dome Granodiorite could also reflect post-emplacement annealing of amalgamated dikes or sheets, and such a pluton thus might contain any number of cryptic contacts. As yet it is unclear how to recognize and to map such cryptic contacts to determine their prevalence and abundance. **Geochronologic Evidence**

Thermal models clearly show that crustal magma bodies should solidify rapidly, with small plutons cooling below the solidus in thousands of years and even large plutons in hundreds of thousands of years (e.g., Jaeger, 1957; Harrison and Clarke, 1979; Stimac et al., 2001). Figure 4 illustrates a simple two-dimensional thermal model of emplacement of a large rectangular magma body, comparable in width to the exposed Tuolumne Intrusive Suite. Temperatures were calculated using the HEAT program of Wohletz (2003). The magma body, silicic with an initial temperature of 900 °C, is 5 km thick and 20 km wide, and its top is set at a depth of 15 km in a crust with a geothermal gradient of 20 °C/km. The program calculates conductive cooling with a finite-difference solution to the heat flow equation, with latent heat of fusion released throughout the crystallization interval.
Figure 4 tracks the temperature at four points within the body. All fall below 750 °C within 500,000 years, and the volume fraction of the pluton above 750 °C falls linearly to zero in that time. If 750 °C is taken as an estimate of the temperature at which the magma is 50% crystallized (and thus no longer mobile), then the mobile fraction is gone by 500,000 years. We note that this two-dimensional model cools significantly more slowly than a fully three-dimensional model because there is no heat loss out the ends, and that convection of fluids in the wall rocks will speed cooling greatly.

Geochronologic data contradict these results. In particular, U-Pb zircon data from the Tuolumne Intrusive Suite (Coleman et al., 2004) demonstrate a regular time-space pattern of emplacement between 95 and 85 Ma, with the oldest intrusions at the margins and the youngest at the center (Fig. 5). The Half Dome Granodiorite was emplaced over a >3 m.y. period between 92.8 ± 0.1 and 88.8 ± 0.8 Ma, with older ages near the outer contact and younger ages near the inner. The Half Dome Granodiorite is mapped as a single continuous pluton that locally grades into an inner porphyritic facies, but the data demonstrate a lifetime far longer than single-intrusion thermal models allow. Although the thermal modeling and geochronologic data permit the possibility that small volumes of partial melt may have persisted throughout the Half Dome during amalgamation, they do not permit the possibility that it intruded as a single batch of magma. The Half Dome thus must be cryptically composite and amalgamated from at least several discrete intrusions, the forms of which (e.g., dikes, subhorizontal sheets, blobs) are yet unknown. Pitcher (1993, p. 186) recognized multipulse plutonic systems that are emplaced over a significant time span, but stated that “the entire magmatic life of a multipulse pluton may not exceed a million years.” Similarly, modeling by Petford et al. (2000) predicts intrusion over 1000 to 10,000,000 years for a pluton the size of...
Figure 3. (A) Geologic map of the area around May Lake, Yosemite National Park, showing large xenoliths of metasedimentary rocks caught up in the outermost unit of the Tuolumne Intrusive Suite. From Taylor (2004). (B) Equal-area plots of structural data from May Lake. Lineation in red and poles to foliation in blue, with best-fit axes as squares. Data from the xenoliths, which are entirely enclosed in the tonalite of Glen Aulin, are consistent with data from the main metamorphic screen, indicating that the xenoliths were not reoriented during detachment, as would be expected of stoped blocks. These data are instead consistent with isolation of the xenoliths by diking. For foliation data, best-fit axes on girdle represent point maximum on girdle and the axis perpendicular to it.

Figure 4. Evolution of temperatures in a two-dimensional magma body. Magma body, 5 km thick and 20 km wide, is emplaced at 15 km depth. Figure plots temperatures at four points in the body: 1 km below the top center, in the center, 1 km above the bottom center, and 1 km inside the side contact, vertically centered. The entire body is below 750 °C in ca. 500,000 years. The >3 m.y. lifetime of the Half Dome Granodiorite contradicts this single-pulse result.
Seismic Evidence

Active crustal magma bodies should be locatable using seismic methods because magmatic liquids slow and attenuate seismic waves. Hammond and Humphreys (2000) showed via finite-element calculations that just 2 vol% melt in the upper mantle should reduce $V_p$ by ~7% and $V_s$ by ~16%. Because S-waves do not propagate through liquids, a body sufficiently molten to undergo bulk magmatic flow should not transmit S-waves and thus should produce a shadow zone.

Comprehensive surveys of major active volcanic areas have failed to turn up evidence for significant quantities of highly molten (>50%) crustal magma (Iyer, 1984), and few clearly identifiable shadow zones are known in spite of careful surveys designed to find them (e.g., Sanders, 1993). Many areas are known worldwide in which partial melt is present, but decreases in P- and S-wave velocities are typically a few percent and rarely greater than 20% (Lees, 1992; Nelson et al., 1996; Schilling and Partzsch, 2001; Zandt et al., 2003). Silicic volcanic centers in the western United States are inferred to have only a few percent of dispersed melt beneath them (Iyer et al., 1990). In the Cascade Range, “anomalous structures attributable to active magma chambers are generally small and difficult to detect” (Iyer et al., 1990).

Schilling and Partzsch (2001) used both electrical and seismic methods to estimate the amount of melt in the crust under the central Andes. They conclude that at least 20% melt is required to explain observations, but that the absence of an S-wave shadow zone requires that such melt is localized in dikes and veins rather than forming large bodies of highly molten magma.

Therefore, wherever partially molten rocks have been seismically imaged, the melt fraction, at least over distances larger than the minimum resolution of the seismic data (typically 100–1000 m), is small enough that bulk flow would require deformation of a solid crystalline framework. This appears to contradict the widespread assumption that active volcanic areas are underlain by large magma bodies in the process of cooling to form plutons. However, bodies with higher melt fractions may yet be present if they are too small to resolve seismically. This possibility is compatible with the geologic evidence summarized above for plutons that formed in small increments.

We conclude that, as at mid-ocean ridges, seismic evidence for large magma bodies with a high melt fraction is rare or absent. Massive caldera-forming eruptions may reflect either large magma bodies that are ephemeral and develop only rarely, or eruption of silicic melt that is relatively dispersed rather than concentrated in a single magmatic mass.

WHY IS IT IMPORTANT TO RECOGNIZE INCREMENTALLY EMPLOYED PLUTONS?

If long-lived incrementally assembled plutons are common, then many widespread assumptions about the behavior of magma in the crust must be modified. These include the following.

Pluton Ascent and Emplacement Mechanisms

Diapirism, ballooning, and stoping are widely accepted processes that have been inferred for many plutons (e.g., Pitcher, 1993; Paterson et al., 1996). These processes require that plutons represent frozen magma chambers with at least 50 vol% liquid throughout a volume comparable to the size the pluton. This is not viable for any pluton that accumulated in small increments such that, at any time during its emplacement, most of the pluton was largely solid.

Rates of Magmatic Processes

Rates of pluton growth must be compatible with space-making rates in the wall rock (Paterson and Tobisch, 1992). A diapir must rise slowly and displace wall rocks by ductile
creep (e.g., Miller et al., 1988). In contrast, the rate of magma ascent along dikes is rapid enough to allow construction of large plutons in as little as \(10^3\)–\(10^4\) yr (Clemens and Mawer, 1992; Petford et al., 2000). Such volumetric emplacement rates imply extreme wallrock displacement rates of up to 0.1–1 m/yr, depending on the pluton shape and dilation pattern. However, a pluton may be incrementally assembled by dike injection at virtually any long-term rate, depending on the time between injection events. More detailed high-precision geochronologic studies of petrologically and textonically diverse plutons are needed to discover the actual range of long-term pluton emplacement rates.

**Timing and Rates of Tectonic Processes**

If growth of an individual pluton can last millions of years, determining the ages of structures and fabrics by isotopic dating of cross-cutting plutons becomes less straightforward. A single pluton may both cut and be cut by structures if the pluton’s magmatic lifetime overlaps deformation. These relationships could be exploited using careful isotopic dating to determine durations of events and to understand the interplay between intrusive and wall-rock processes.

**Interpretation of Magmatic Fabrics**

Interpretation of magmatic rock fabrics is controversial, and a review is beyond the scope of this paper. However, several plutons mentioned here (e.g., Half Dome, McDooge) contain a magmatic fabric that appears continuous in the field in spite of field and geochronologic evidence that rocks containing the fabric crystallized at significantly different times. Such a fabric clearly is time-trgressive and implies notably uniform strain associated with emplacement increments added at significantly different times. In examples where a single magmatic fabric cuts contacts between mapped intrusive phases (e.g., Morgan et al., 2000), emplacing the plutons in small increments does not help resolve the problem but neither does it appear to increase the difficulties.

**Magmatic Differentiation Processes**

Large plutons commonly are compositionally zoned on length scales of \(10^2\)–\(10^3\) m. Such zonation has been interpreted to result largely from crystal fractionation (e.g., Bateman and Chappell, 1979; Tindle and Pearce, 1981; Sisson and Moore, 1994) and/or magma mixing (Kistler et al., 1986; Frost and Mahood, 1987). However, for plutons assembled over millions of years with only small parts molten at one time, in situ crystal fractionation and/or magma mixing cannot account for the zonation. In such cases, textural and chemical homogeneity of a pluton probably reflects processes operating deeper than the observed crustal level. Indeed, a remarkable aspect of the Sierra Nevada is that the plutonic zoning of the Tuolumne—an outer, medium-grained, equigranular mafic granodiorite, a medial granodiorite with conspicuous euhedral hornblende, biotite, and titane phenocrysts, and an inner granodiorite with large K-feldspar megacrysts—is repeated several times along the length of the range (Tikoff and Teyssier, 1992) among plutons of similar age. This repetition cannot reflect derivation of the plutons from a common magma chamber and must instead reflect the recurrence of petrogenetic processes in the deeper crust.

**Size and Nature of Magma Chambers**

There is a fundamental discrepancy between geophysical images of “large magma chambers” with volumes on the order of \(10^3\) km\(^3\) but generally containing less than 10% melt (Iyer et al., 1990) and the common petrologic view of a magma chamber with comparable dimensions but a melt fraction in excess of 50%. Incremental emplacement of plutons by amalgamation of small intrusions is compatible with geophysical observations that indicate that magma chambers in the petrologic sense generally are small and transient.

**Correspondence between Plutons and Caldera-Forming Eruptions**

Caldera-forming eruptions with volumes on the order of 1000 km\(^3\) offer undeniable evidence that large magma bodies exist at least ephemeral in the crust. Growth of a magma body requires the rate of thermal input by magma to exceed the rate of thermal loss by cooling and eruption. In an area where the power input (Hildreth, 1981) is high, a large magma body can develop; where power input is low, cooling prevents development of a large magma body and a pluton may form incrementally (Fig. 6). It may be that, when power input is sufficiently high to form a large magma body in the upper to middle crust, the roof fails and a caldera-forming eruption results, evacuating the magma chamber to leave behind only minor plutonic residues. Neogene magmatism in the Basin and Range (Best et al., 1993), Sierra Madre Occidental of Mexico (McDowell and Clabaugh, 1979), and Bolivian Andes (de Silva, 1989) reflects large power input, development of dozens of large, shallow magma chambers, and common caldera collapse, but it is unknown if significant plutons were emplaced at the same time. However, caldera resurgence may be the surface manifestation of continued incremental input of magma to form newly amalgamating plutons.

**CONCLUSIONS**

Field and geochronologic evidence indicate that at least some large, superficially homogeneous plutons formed by amalgamation of numerous small intrusions, and that the field or petrologic record of their composite origins may be subtle. Coupled with the lack of geophysical evidence for modern large bodies of magma, this suggests that plutons may commonly form in many small increments in a manner analogous to growth of crack-seal veins. The resulting internal contacts apparently can be cryptic, and thus we know little as yet about typical geometric forms of individual increments or how the increments combine to form a pluton. However, present examples include plutons composed mainly of subhorizontal (e.g., Wiebe and Collins, 1998) and mainly of subvertical (e.g., Hutton, 1992; Mahan et al., 2003) intrusive sheets. A pluton composed of subhorizontal sheets will be laccolithic in overall form and likely have a gently dipping roof defined by the structurally highest intrusive sheet. A pluton composed of dikes should have an irregular roof at which the pluton grades into wall rock injected by many dikes, as is observed at one end of the McDooge pluton.

The data cited above suggest that our understanding of the emplacement of
plutons and their chemical and structural evolution is incomplete, and the ideas presented here raise many questions and present testable hypotheses. Fruitful areas for future research might include:

- understanding the space-time pattern of incrementally emplaced plutons;
- reconsidering magmatic fabrics within the incremental growth framework;
- establishing clearer ties between the volcanic and plutonic records;
- understanding the chemical and petrologic evolution of plutons given that fractionation within, and mixing of, exposed units may be minimal;
- comparison of the emplacement rates of mafic versus felsic plutons; and
- comparison of incremental emplacement processes in varied tectonic settings.

ACKNOWLEDGMENTS

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Scientists, especially geoscientists, must increasingly focus research, training, and other work on the mitigation of natural hazards in less-developed countries. Each country is different: natural hazard mitigation occupies varying ranks in national priorities, and it is often difficult to complete work that has an impact on a country and builds its infrastructure. The requirements of such work may leave scientists feeling unprepared, and little comprehensive literature is available regarding these challenges. This volume meets a vital need: it focuses on a single country but provides information that will be useful for other countries as well. El Salvador is a small, third-world country with significant seismic, landslide, and volcanic hazards. Recent events in El Salvador include civil war, floods, drought, and major hurricanes, earthquakes, and landslides, and the country has forged a new plan to help face these severe natural hazards. This plan includes the development of a new geological agency, which is seeking outside assistance. Scientists throughout the world are already doing significant work aimed at helping with this effort, work that is part of a worldwide endeavor to enhance the local infrastructure’s ability to mitigate natural hazards. The effort in El Salvador is of interest to the entire community of natural hazards workers and particularly to geoscientists concentrating on hazard mitigation. This volume highlights volcanic, seismic, and landslide hazards, with contributions from Salvadorans as well as scientists from North America and Europe.

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American Association of Petroleum Geologists • Asociación Geológica Argentina • Geological Association of Canada
Geological Society of Australia • Geological Society of London • Geological Society of South Africa
Soil Science Society of America

GSA Welcomes These New Associated Societies
American Quaternary Association • American Rock Mechanics Association
PARDEE KEYNOTE SYMPOSIA

INVITED PAPERS

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

These Pardee keynote sessions are special events of broad interest to the geoscience community. They represent hot issues on the leading edge in a scientific discipline or area of public policy, address broad fundamental issues, and are interdisciplinary. Selection was on a competitive basis. This year’s eight Pardee Symposia were reviewed and accepted by the Annual Program Committee. (All speakers are invited.)

P1. Early Paleoproterozoic (2.5–2.0 Ga) Events and Rates: Bridging Field Studies and Models

Geochemistry Society; Astrobiology Program; GSA Sedimentary Geology Division; SEPM—Society for Sedimentary Geology
Precambrian Geology; Paleoclimatology/Paleoceanography; Tectonics

Andrey Bekker, Geophysical Lab, Carnegie Institution of Washington, Washington, D.C.; Mark E. Barley, The University of Western Australia, Western Australia, Australia; Robert H. Rainbird, Geological Survey of Canada, Ottawa, Ontario

Field-oriented and modeling studies dealing with the 2.5–2.0 Ga Earth’s evolution are invited. Session will be focused on relationships between tectonics, change in atmospheric composition, and climatic changes as well as the rates of these changes.

P2. Geoinformatics and the Role of Cyberinfrastructure in Geosciences Research

Geophysics/Tectonophysics/Seismology; Structural Geology; Tectonics

Randy Keller, University of Texas, El Paso, Texas; Lee Allison, Kansas Geological Survey, Lawrence, Kans.

This session consists of presentations on geoinformatics and the use of advanced information technology in support of research in the geosciences. The talks will provide an overview of cyberinfrastructure that is emerging and describe projects that are developing as well as using this cyberinfrastructure.

P3. Geoscientific Aspects of Human and Ecosystem Vulnerability

U.S. National Committee for Geosciences; GSA Critical Issues Caucus; GSA Geology and Public Policy Committee; GSA Geology and Society Division
Public Policy; Environmental Geoscience; Geoscience Information/Communication

Susan W. Kieffer, University of Illinois, Champaign-Urbana, Ill.; Grant Heiken, Los Alamos National Lab, Los Alamos, N.Mex.

Humans and the ecosystems on which they depend are vulnerable to a variety of natural hazards and their mismanagement. This session will explore the response to, and need for, mitigation of large-scale hazards with long time scales.

P4. Medical Geology

GSA Engineering Geology Division
Environmental Geoscience; Geoscience Education; Public Policy
Syed E. Hasan, University of Missouri, Kansas City, Mo.

Many health problems, including cancer, heart, and central nervous system diseases, etc., have links to geologic factors. Experts from geosciences, public policy, and health sciences will discuss new developments in the emerging field of medical geology.

P5. Adversity, Advantages, Opportunities: Phanerozoic Stromatolites as “Survivor” vs. “Disaster” Taxa

Paleontological Society
Paleontology/Paleobotany; Geomicrobiology; Sediments, Carbonates

Constance M. Soja, Colgate University, Hamilton, N.Y.; Robert Riding, University of Cardiff, Cardiff, United Kingdom

This interdisciplinary forum will reexamine the role of stromatolites in Phanerozoic ecosystems, particularly the importance of post-Cryozoic microbial communities; the biotic and abiotic agents that contributed to their development, decline, and preservation; and their co-evolutionary history with metazoans.

P6. Pre-Mesozoic Impacts: Their Effect on Ocean Geochemistry, Magnetic Polarity, Climate Change, and Organic Evolution

GSA Planetary Geology Division; Paleontological Society
Planetary Geology; Paleontology/Paleobotany; Paleoclimatology/Paleoceanography

Charles A. Sandberg, U.S. Geological Survey, Denver, Colo.; Jared R. Morrow, University of Northern Colorado, Greeley, Colo.; Christian Koeberl, University of Vienna, Vienna, Austria

Pre-Mesozoic comet and meteorite impacts produced extreme oceanic and climate changes, causing mass extinctions followed by rapid radiation of surviving organisms. Thus, they were the driving mechanism in the early evolution of life on Earth.

P7. Seeing Mars with New Eyes: Active Missions, Science Results and Geoscience Education

GSA Planetary Geology Division; Geoscience Education Division
Planetary Geology; Geoscience Education

Eric B. Grosfils, Pomona College, Claremont, Calif.; Susan Sakimoto, NASA/GSFC, Greenbelt, Md.

In 2004, multiple spacecraft are exploring Mars simultaneously. This session will present some of the most recent and exciting science results and demonstrate how the available data can be used to enhance geoscience education activities.

P8. Weathering, Slopes, Climate, and Late-Quaternary Geomorphic Change in Arid and Semi-Arid Landscapes

GSA Quaternary Geology and Geomorphology Division
Quaternary Geology/Geomorphology; Environmental Geoscience; Paleoclimatology/Paleoceanography
T1. The Future of Hydrogeology

GSA Hydrogeology Division; International Association of Hydrogeologists U.S. National Committee; National Ground Water Association

Hydrogeology


Visions of future science and practice in hydrogeology and related geosciences will be highlighted. Speakers include but are not limited to authors in upcoming issue of Hydrogeology Journal on “The Future of Hydrogeology.” ORAL

T2. Upcoming Revolutions in Observing Systems: Implications for Hydrogeology

GSA Hydrogeology Division

Hydrogeology; Geochemistry, Aqueous; Environmental Geoscience

John L. Wilson, New Mexico Institute of Mining and Technology, Socorro, N.Mex.; Richard P. Hooper, Consortium
CALL FOR PAPERS

First Announcement  •  2004 Denver Annual Meeting  •  November 7–10

of Universities for the Advancement of Hydrologic Science, Inc., Washington, D.C.

Proposed environmental observing systems provide opportunities for hydrogeology to test concepts and to refine understanding of fundamental hydrologic processes. Papers are solicited that explore how such systems aid in model testing and conceptual development. ORAL

T3. History of Hydrogeology in the United States: Celebrating the Contributions of O.E. Meinzer, Stan Lohman, and John Ferris

GSA Hydrogeology Division; International Association of Hydrogeologists U.S. National Committee

John Ezra Moore, U.S. Environmental Protection Agency, Denver, Colo.; Philip LaMoreaux, Tuscaloosa, Ala.

The session will describe the historical basis for the development of hydrogeology (1885–1985) in the United States. ORAL

T4. Over 40 Years of Influence in Environmental Hydrogeology: In Honor of Dick Parizek

GSA Hydrogeology Division

Hydrogeology; Environmental Geoscience; Engineering Geology

Ward E. Sanford, U.S. Geological Survey, Reston, Va.; E. Scott Bair, Ohio State University, Columbus, Ohio

After 40 years of research and advising 100 graduate students in environmental hydrogeology, Dick Parizek is being honored for his contributions to water-resource exploration, wastewater treatment, mining hydrology, karst hydrology, and nuclear waste disposal. ORAL

T5. Groundwater Depletion and Overexploitation in the Denver Basin Bedrock Aquifers

GSA Hydrogeology Division; International Association of Hydrogeologists U.S. National Committee; GSA Public Policy

Hydrogeology; Engineering Geology; Geoscience Information/Communication


Southeast Denver relies on bedrock aquifers to supply water for new housing developments. The developers told home buyers that the aquifers would supply water for 100 years. It now appears that in many areas the supply will be depleted in less than 10 years. ORAL

T6. Hydrologic Impacts of Urbanization and Suburbanization on Water Resources

GSA Hydrogeology Division; GSA Engineering Geology Division

Hydrogeology; Environmental Geoscience; Engineering Geology

Anne E. Carey, The Ohio State University, Columbus, Ohio; W. Berry Lyons, The Ohio State University, Columbus, Ohio; John E. McCray, University of Texas, Austin, Texas; John M. Sharp, The University of Texas, Austin, Texas

By 2005, approximately 65% of Earth’s population will inhabit urban areas and cause drastic effects on hydrologic systems. This session details the consequences of urbanization on water supply, water quality, ecosystem health, and land-use planning. ORAL

T7. The Occurrence, Storage, and Flow of Groundwater in Mountainous Terrain

GSA Hydrogeology Division; U.S. Geological Survey

Hydrogeology; Environmental Geoscience; Geochemistry, Aquous


Because mountain hydrologic studies have traditionally focused on surface water, little is known about groundwater in mountainous terrain. This session focuses on new and integrated approaches to understanding the physical controls on these complex systems. ORAL


GSA Hydrogeology Division

Hydrogeology

Geoffrey D. Thyne, Colorado School of Mines, Golden, Colo.; John E. McCray, University of Texas, Austin, Texas

This session invites topics in all aspects of mountain watershed pollutant transport and water-quality issues including groundwater surface-water interplay in pollutant transfer, impact mechanisms in environmentally sensitive watersheds, and innovative solutions to related environmental problems. ORAL

T9. Sustainable Management of Water Resources

GSA Geology and Public Policy Committee

Hydrogeology; Environmental Geoscience

Bridget R. Scanlon, University of Texas, Austin, Texas; Marios Sophocleous, The University of Kansas, Lawrence, Kans.

This session will focus on research related to management of water resources in a sustainable manner to meet human and ecosystem needs taking into account potential impacts of climate change, land use change, and projected population and water consumption increases on water resources. ORAL and POSTER

T10. Comprehensive Monitoring Approaches at Regional and Statewide Levels—Advantages and Limitations

GSA Hydrogeology Division; Association of Ground Water Scientists and Engineers, a Division of the National Ground Water Association

Hydrogeology; Geoscience Information/Communication

David R. Wunsch, Concord, N.H.; Charles J. Taylor

Regional and statewide groundwater monitoring is challenging because of the magnitude of scale, heterogeneity, and other hydrogeologic unknowns. We welcome contributions that describe advantages and limitations of monitoring schemes, technologies, and interagency collaboration. ORAL
T11. Hydraulic and Geochemical Behavior of Man-Made Aquifers

GSA Hydrogeology Division

Hydrogeology; Geochemistry, Aqueous

Joseph J. Donovan, West Virginia University, Morgantown, W.Va.; Mary Stoertz, Ohio University, Athens, Ohio

Anthropogenic aquifers formed by mining, waste disposal, and geotechnical projects create environmental impacts that may persist for years. This session will present investigations of their hydraulic and geochemical behavior, including remediation and/or beneficial use aspects. ORAL

T12. Fluid Flow and Solute Transport in Fractured Rocks

GSA Hydrogeology Division

Hydrogeology


Advances in quantitative analysis of field investigations in fractured rocks over a broad range of length scales, from contaminant sites to regional systems. ORAL

T13. Modeling Flow and Transport in Chemically and Physically Heterogeneous Media

GSA Hydrogeology Division

Hydrogeology

Zhenxue Dai, Wright State University, Dayton, Ohio; Robert W. Ritzi, Wright State University, Dayton, Ohio

Advances in characterizing and modeling groundwater flow and chemical transport will be shared by researchers and practitioners toward better describing and understanding transport processes in heterogeneous flow systems. ORAL and POSTER


GSA Geophysics Division; GSA Hydrogeology Division

Hydrogeology; Geophysics/Tectonophysics/Seismology; Environmental Geoscience

Dennis L. Harry, Colorado State University, Fort Collins, Colo.; David W. Hyndman, Michigan State University, East Lansing, Mich.

This session showcases integrated geophysical and geological studies as applied to groundwater issues. It will include case studies of successful field programs and reports on new data acquisition and analysis techniques. ORAL

T15. How Effectively Are We Using Advanced Groundwater Modeling Tools in Practice?

GSA Hydrogeology Division

Hydrogeology

David L. Rudolph, University of Waterloo, Waterloo, Ontario; Rene Therrien, Université Laval, Quebec City, Quebec

This session addresses current pitfalls, misuses, and limitations of fluid flow and solute transport models for groundwater investigations. Improving advanced model applications and assessing the value of input data are also examined. ORAL

T16. Linking Groundwater Models and Watershed Models

GSA Hydrogeology Division; GSA Engineering Geology Division

Hydrogeology; Environmental Geoscience


This session is intended to present the latest developments in integrating surface water into groundwater models and groundwater into watershed models, and to perhaps lay the foundations for new directions in these efforts. ORAL


GSA Hydrogeology Division

Hydrogeology; Geochemistry, Aqueous

Kenneth R. Bradbury, Wisconsin Geological and Natural History Survey, Madison, Wis.; Beth Parker, University of Waterloo, Waterloo, Ontario; David Hart, Wisconsin Geological and Natural History Survey, Madison, Wis.; Timothy T. Eaton, Wisconsin Geological and Natural History Survey, Madison, Wis.

This session focuses on recent advances in the hydrogeology of both near-surface and deeply-buried aquitards, including physical characterization, contaminant transport, geochemistry, monitoring, and modeling. ORAL

T18. Characterization, Attenuation, and Remediation of Contaminants in Runoff

GSA Hydrogeology Division

Hydrogeology; Geochemistry, Aqueous; Environmental Geoscience

Thomas Boving, University of Rhode Island, Kingston, R.I.; William Blanford, Louisiana State University, Baton Rouge, La.

This session encourages papers on novel approaches regarding the survey, characterization, attenuation, and remediation of organic and inorganic contaminants in runoff from urban, industrial, and agricultural land, including the deposition of airborne soot. ORAL

T19. Innovative Tracer Applications in Hydrogeology: New Techniques, Design and Interpretation Methods, and Case Studies

GSA Hydrogeology Division; International Association of Hydrogeologists—International Commission on Tracers

Hydrogeology; Geochemistry, Other

Craig E. Divine, Colorado School of Mines, Golden, Colo.; Jeffrey McDonnell, Oregon State University, Corvallis, Ore.

The use of tracers in hydrogeology has significantly increased in recent years. This session is open to papers that describe new techniques, methods for tracer test design and interpretation, and case studies in any hydrogeological application. ORAL

T20. Dissolved Gases as Indicators of Geochemical and Hydrogeologic Processes

GSA Hydrogeology Division

Hydrogeology; Geochemistry, Aqueous; Geomicrobiology

D. Kip Solomon, University of Utah, Salt Lake City, Utah; Stephen J. Van der Hoven, Illinois State University, Normal, Ill.
Dissolved gases have been used to investigate a variety of hydrogeologic processes (e.g., redox reactions, groundwater travel times, rates of recharge, denitrification, paleorecharge, etc.). Field, laboratory, and modeling studies will be included.

**ORAL and POSTER**

**T21. Vadose Zone Nitrogen: Sources, Fate and Transport**

_GSA Hydrogeology Division_

Hydrogeology; Geochemistry, Aqueous; Geomicrobiology

Scott W. Tyler, University of Nevada, Reno, Nev.; W. Mike Edwards, Oxford University, Oxford

This session seeks to bring together hydrologists, soil physicists, soil chemists, and microbiologists to shed light on the fate and transport of nitrogen species in environments ranging from such diverse environments as domestic septic tank discharge to the hyperarid nitrate deposits of the Atacama Desert.

**ORAL and POSTER**

**T22. Assessing the Importance of Colloids in Natural Waters**

_GSA Hydrogeology Division_

Hydrogeology; Geochemistry, Aqueous; Environmental Geoscience

James F. Ranville, Colorado School of Mines, Golden, Colo.; John C. Seaman, The University of Georgia, Aiken, S.C.

Colloids occur in most natural waters. A limited understanding of colloid abundance and characteristics hampers assessing their importance. Papers which describe new approaches to characterize colloids, model contaminant sorption, or model colloid migration are sought. **ORAL and POSTER**

**T23. Sources, Transport, Fate, and Toxicology of Trace Elements in the Environment**

_International Association of Geochemistry and Cosmochemistry_

Geochemistry, Aqueous; Environmental Geoscience; Geomicrobiology

David T. Long, Michigan State University, East Lansing, Mich.; LeeAnn Munk, University of Alaska Anchorage, Alaska; W. Berry Lyons, The Ohio State University, Columbus, Ohio

Papers are invited on the study of trace elements in the environment related to sources, transport, controls on mobility, toxicological consequences, ecology (e.g., food web dynamics, as limiting nutrients) and accumulation in sediments and soils.

**ORAL**

**T24. Organic Compounds in Near-Surface Environments as Drivers on the Redox-Reaction Highway: A Tribute to the Career of Mary Jo Baedecker**

_GSA Hydrogeology Division_

Hydrogeology; Geochemistry, Organic; Geomicrobiology


Elucidating fundamental redox reactions driven by organic matter in subsurface environments, focusing on hydrogeologic systems impacted by human activities, has been the major career contribution of Mary Jo Baedecker. Presentations building on her work are invited. **ORAL and POSTER**
T25. Stable Isotope Tracers of Water Balance and Biogeochemical Cycling in Large River Basins

_GSA Quaternary Geology and Geomorphology Division_

Geochemistry, Aqueous; Environmental Geoscience; Geochemistry, Other

Leonard I. Wassenaar, Environ Canada, Saskatoon, Saskatchewan; John Gibson, Environ Canada, Victoria, British Columbia

This session explores the application of stable isotope tracers of water, gases, and dissolved inorganic species in river discharge as a tool for examining spatio-temporal evolution of hydrologic and biogeochemical processes in large river basins. ORAL and POSTER

T26. Seasonal and Long-Term Groundwater Quality Changes in Alluvial Aquifer Systems

_GSA Hydrogeology Division_

Geochemistry, Aqueous; Hydrogeology; Environmental Geoscience

Wendy A. Timms, University of New South Wales; Manly Vale, New South Wales, Australia

Seasonal and long term (decadal) groundwater quality trends related to urban and agricultural development may downgrade beneficial use. Causal factors may be identified by demonstrating correlation, consistency, responsiveness and a physical process. ORAL and POSTER

T27. Characterization and Representation of Flow through Karst Aquifers

_GSA Hydrogeology Division_

Hydrogeology; Sediments, Carbonates; Environmental Geoscience

Allan D. Woodbury, University of Manitoba, Winnipeg, Manitoba; Ron Green, Southwest Research Institute, San Antonio, Texas

The overall theme of the session is to examine enhanced capabilities for karst aquifer characterization and flow representation to support the quantitative evaluation and management of the water resources of karst systems. We seek original contributions in new modeling tools, guidelines for applications of either new or existing tools, and improved understanding of data collection needs to support modeling efforts. ORAL

T28. New Perspectives in Karst Geomicrobiology and Redox Geochemistry

_GSA Hydrogeology Division; Karst Waters Institute; GSA Geobiology and Geomicrobiology Division_

Hydrogeology; Geomicrobiology; Geochemistry, Other

Annette Engel, The University of Texas, Austin, Texas; Toby Dogwiler, Winona State University, Winona, Minn.; Diana Northup, University of New Mexico, Albuquerque, N.Mex.

In the ten years since the Karst Waters Institute–sponsored conference, there has been considerable progress in understanding microbial systems, geochemical processes, and the interactions between them in cave and karst settings. We welcome contributions that highlight these major achievements and latest advances. We encourage interdisciplinary participation from related hydrogeologic and biogeochemical settings. ORAL and POSTER

T29. From Subterranean Crawlways to Scientific Hallways: Research on Our Public Cave and Karst Lands

_National Park Service; National Cave and Karst Research Institute_

Quaternary Geology/Geomorphology; Hydrogeology; Environmental Geoscience

Louise D. Hose, National Cave and Karst Research Institute, Carlsbad, N.Mex.; Penelope J. Boston, New Mexico Institute of Mining and Technology, Socorro, N.Mex.

Public lands provide unique national laboratories and have facilitated important advancements in our understanding of cave and karst systems. This session focuses on both fundamental and significant discoveries to applied research in publicly managed karst terrains. ORAL and POSTER

T30. New and Multidisciplinary Approaches to Dating Cave Deposits

_GSA Archaeological Geology Division; Karst Waters Institute_

Archaeological Geology; Quaternary Geology/Geomorphology; Geochemistry, Other

Donald McFarlane, The Claremont Colleges, Claremont, Calif.; Joyce Lundberg, Carleton University, Ottawa, Ontario

Addressing the integration of technological and methodological advances in the dating of cave deposits, with the experimental and/or successful application of multiple and/or innovative techniques to resolve long and complex speleological records. ORAL and POSTER

T31. Impacts of Water Storage and Consumption on Watershed Processes

_GSA Quaternary Geology and Geomorphology Division; GSA Engineering Geology Division_

Quaternary Geology/Geomorphology

Sara L. Rathburn, Colorado State University, Fort Collins, Colo.; Ellen E. Wohl, Colorado State University, Fort Collins, Colo.

Water storage and consumption structures dictate water and sediment delivery to most watersheds. The myriad responses of watersheds to the imposed regulation informs us of the resilience and future of our fluvial systems. ORAL


_GSA Quaternary Geology and Geomorphology Division; GSA Engineering Geology Division; GSA Geology and Society Division; GSA Geology and Public Policy Committee; GSA Hydrogeology Division; Association of American State Geologists_

Quaternary Geology/Geomorphology; Hydrogeology; Engineering Geology


Geological mapping is a key to environmental protection and management of water and land resources. The session will highlight innovative mapping products that are being used by an increasingly broad range of users. POSTER
T33. Geologic Disposal of Radioactive Waste: Rising to the Challenge of Regulatory Requirements and Environmental Protection at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, and the Yucca Mountain Site, Southern Nevada

GSA Hydrogeology Division; U.S. Department of Energy; GSA Geology and Public Policy Committee
Public Policy; Environmental Geoscience; Hydrogeology

Recertification of WIPP and license application submittal for Yucca Mountain present technical and regulatory challenges concerning repository performance. Presentations highlight science and engineering supporting the development and safe operation of geologic repositories for radioactive waste. ORAL


GSA Hydrogeology Division
Environmental Geoscience; Hydrogeology; Public Policy

Critical geo-input to be obtained and retained in computer models for performance assessment. Case histories. Focus positive—identify critical features and measurements and assure that these are represented and updated in site (performance) models. ORAL

T35. Assessment and Characterization of Geologic Formations for Long-Term CO₂ Storage (Sequestration)

GSA Geology and Public Policy Committee
Stratigraphy; Hydrogeology; Structural Geology

This session will explore novel approaches to assess the capacity and integrity of geologic formations for long-term CO₂ storage (sequestration). These approaches may include aspects of geochemistry, hydrogeology, geospatial analysis, or other innovative methods. ORAL

T36. Geophysical Solutions for Characterizing and Locating Geological Sites for Carbon Dioxide Sequestration

GSA Geophysics Division
Geophysics/Tectonophysics/Seismology; Engineering Geology; Public Policy


Papers are solicited on using geophysical and geological subsurface remote sensing for locating, characterizing, and mapping buried structures that could serve as sites for carbon dioxide sequestration as well as on the societal issues involved. ORAL

T37. GIS, GPS, and Remote Sensing in Geologic Hazard Assessment

GSA Engineering Geology Division
Engineering Geology; Remote Sensing/Geographic Information System; Public Policy
William C. Haneberg, Haneberg Geoscience, Seattle, Wash.; Norman S. Levine, Charleston, S.C.

Case histories and research using geographic information system, Global Positioning System, or remote sensing (including LiDAR [light detection and ranging], InSAR [interferometric synthetic aperture radar], digital elevation models, or hyperspectral imaging) for mapping or simulating landslides, debris flows, floods, neotectonic and volcanic processes, subsidence, karst, and other hazards. ORAL and POSTER

T38. Rural Source Water Protection—Stakeholder Needs, Public Policy, and Hydrogeologic Realities for Small Systems

GSA Hydrogeology Division; U.S. Environmental Protection Agency, Office of Water
Environmental Geoscience; Geoscience Information/Communication; Hydrogeology
John All, Western Kentucky University Technical Assistance Center for Water Quality, Bowling Green, Ky.; Chris Groves, Hoffman Environmental Research Institute, Bowling Green, Ky.; Stephen Kenworthy, Western Kentucky University Technical Assistance Center for Water Quality, Bowling Green, Ky.

Clean drinking water is a fundamental requirement for human health. Supplies depend on hydrogeologic, economic, and cultural variables and rural systems face particular challenges. We solicit papers on source water protection strategies serving these goals. ORAL

T39. Current Perspectives in Environmental Biogeochemistry

GSA Hydrogeology Division; GSA Geobiology and Geomicrobiology Division
Environmental Geoscience; Geochemistry, Aqueous; Hydrogeology
Dibyendu Sarkar, University of Texas, San Antonio, Texas; Rupali Datta, University of Texas, San Antonio, Texas

This session will promote interchange of scientific information among earth scientists interested in environmental biogeochemical issues. It will provide a forum for researchers to present recent findings that can stimulate development of future interdisciplinary research. ORAL
T40. Hydrogeomorphology, Chemistry, Archaeology, and Evolution of Coastal Plain Depressions and Related Features

_GSA Hydrogeology Division_

Hydrogeology; Quaternary Geology/Geomorphology; Stratigraphy

C. William Zanner, University of Nebraska, Lincoln, Nebr.; Andrew H. Ivester, University of West Georgia, Carrollton, Ga.

This session explores current understanding of the geomorphic and hydrologic histories of Carolina bays and related depressional features. ORAL and POSTER

T41. The Gulf of Mexico—Past, Present, and Future: Relating Ecology to Geology

_Marine/Coastal Science; Environmental Geoscience; Quaternary Geology/Geomorphology_

Charles W. Holmes, Center for Coastal Geology, St. Petersburg, Fla.; John W. Tunnell, Harte Institute for Gulf of Mexico Research, Corpus Christi, Texas

The session's goal is twofold: (1) to update the status of geologic knowledge in the Gulf of Mexico, and (2) to relate the surface geologic processes to the ecology of various regions. ORAL and POSTER

T42. Authigenic Minerals in Modern and Ancient Terrestrial Aquatic Environments

_GSA Limnogeology Division; GSA Sedimentary Geology Division_

_Limnogeology; Sediments, Carbonates; Sediments, Clastic_

Daniel Larsen, University of Memphis, Memphis, Tenn.; Daniel Deocampo, California State University, Sacramento, Calif.

This session will present new ideas and concepts toward understanding and interpreting authigenic mineral processes in ancient and modern terrestrial aquatic environments, ranging from riverine or wetland to deep lacustrine settings. ORAL

T43. Hydrologic and Paleoclimatic Significance of Nonmarine Microbial Carbonates (Tufas, Microbialites, Stromatolites and Thrombolites)

_GSA Limnogeology Division_

_Limnogeology; Sediments, Carbonates; Paleoclimatology/Paleoceanography_

Michael R. Rosen, U.S. Geological Survey, Carson City, Nev.; Robin Renaut, University of Saskatchewan, Saskatoon

This session explores the sedimentological record of nonmarine microbial carbonates and demonstrates the diversity of records that can be derived from these deposits. Emphasis is on lacustrine systems, but other nonmarine microbial carbonates will be considered. ORAL
T44. Lacustrine Records of Landscape Evolution

GSA Limnogeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division

Limnogeology; Quaternary Geology/Geomorphology; Sediments, Clastic

Jeffrey T. Pietras, BP Exploration Alaska, Inc., Anchorage, Alaska; Eric C. Carson, San Jacinto College, Houston, Texas; Alan R. Carroll, University of Wisconsin, Madison, Wis.

Lacustrine strata contain a bountiful archive of terrestrial geomorphic, tectonic and climatic events. This session addresses the intersections of geomorphology, sedimentology, and stratigraphy for interpreting the lacustrine geologic record of terrestrial landscape change, focusing on the Cenozoic. ORAL

T45. Alkaline Evaporative Lakes and Playas: Insights into Microbial Physiology and Mineral Facies in Semi-arid Settings

GSA Geobiology and Geomicrobiology Division; Limnogeology and Sedimentary Geology

Geomicrobiology; Geochemistry, Aqueous; Limnogeology


This session will elucidate the role of alkaline solutions in weathering, evaporite precipitation, and microbial physiology. Topics will focus on the geochemical and isotopic signatures of alkalophilic microbes, mineral facies, and redox gradients. ORAL and POSTER

T46. Biomineralization in Terrestrial Hot Springs: The Preservation of Thermophiles in Past and Present-Day Systems

GSA Geobiology and Geomicrobiology Division

Geomicrobiology; Paleontology/Paleobotany; Geochemistry, Aqueous

Paul A. Schroeder, University of Georgia, Athens, Ga.; Sherry L. Cady, Portland State University, Portland, Ore.

This session invites those who study modern terrestrial hot springs with an eye for mineral-microbe relationships and how evidence for life might be preserved. Analog studies of ancient hot spring deposits are also welcomed. ORAL

T47. Ocean Chemistry through the Precambrian and Paleozoic

Paleoclimatology/Paleoceanography; Sediments, Carbonates; Geochemistry, Other

Matthew R. Saltzman, The Ohio State University, Columbus, Ohio; Michael C. Pope, Washington State University, Pullman, Wash.

Considerable evidence reveals significant changes in the chemistry of the oceans during the Precambrian and Paleozoic. These changes have implications for Earth’s climate and biosphere. We will focus on a combined data-modeling approach. ORAL

T48. Unraveling the History of Ocean Crust Production: Evidence For and Against Changes in Seafloor Spreading Rates Since the Mesozoic

Paleoclimatology/Paleoceanography; Tectonics; Geochemistry, Other

Jenney M. Hall, Yale University, New Haven, Conn.; David B. Rowley, University of Chicago, Chicago, Ill.; Mark Pagani, Yale University, New Haven, Conn.

This session invites evidence for and against changes in the rate of seafloor crust production as well as implications regarding the global carbon cycle and secular changes in seawater chemistry from both modeling results and empirical data. ORAL and POSTER

T49. Stable Isotopes in Fossils and Paleosols: Records of Late Cenozoic Environmental Change

Geochemistry, Other; Paleoclimatology/Paleoceanography; Paleontology/Paleobotany

Yang Wang, Florida State University and National High Magnetic Field Laboratory, Tallahassee, Fla.; Pennilyn Higgins, University of Florida, Gainesville, Fla.

Stable isotope analysis has been established as a valuable tool for reconstructing past terrestrial environments. This session will examine isotopic records to better understand the links among biological, climatic, and tectonic change. ORAL

T50. Marine Hard Substrates: Colonization and Evolution

Paleontological Society

Paleontology/Paleobotany; Marine/Coastal Science; Stratigraphy


Marine hard substrates represent a distinct suite of habitats that have seen a range of evolutionary innovations during the Phanerozoic. This meeting will review new data and ideas on these ecosystems and their evolution. ORAL

T51. Protistan Paleobiodiversity: Understanding Evolutionary Patterns

Cushman Foundation

Paleontology/Paleobotany; Paleoclimatology/Paleoceanography; Geomicrobiology

Susan T. Goldstein, University of Georgia, Athens, Ga.; Brian T. Huber, Smithsonian Institution, Washington, D.C.

Rich and well-documented, the protistan fossil record provides the foundation for diverse global change studies. This session focuses on understanding the evolutionary mechanisms and phylogenetic relationships underpinning protistan biodiversity in modern and ancient systems. ORAL

T52. The Hunters and the Hunted: Predation On and By Gastropods

Paleontological Society

Paleontology/Paleobotany
This session will explore the paleontology, stratigraphic setting, and historical study of the late Eocene plants, insects, and vertebrates from Florissant, including recent work in taxonomy, taphonomy, paleoecology, lithostratigraphy, magnetostratigraphy, conservation, and applications of information technology. ORAL

T57. The Concept of Layer-Cake Stratigraphy—Then and Now

GSA History of Geology Division; GSA Sedimentary Geology Division

History of Geology; Stratigraphy

Charles W. Byers, University of Wisconsin, Madison, Wis.

The concept of layer-cake (time-parallel) stratigraphy was widely accepted during the nineteenth century. It was eclipsed by the facies concept for decades but has made a resurgence in the guise of sequence and event stratigraphy. ORAL

T58. Sedimentary and Stratigraphic Principles and Concepts Applied to the Study of Metamorphic Terranes and Igneous Provinces

North American Commission on Stratigraphic Nomenclature

Petrology, Metamorphic; Sediments, Clastic; Economic Geology


This session will focus on integration of modern sedimentologic and stratigraphic concepts with studies of metamorphic and igneous provinces. These methods may improve our understanding of continental accretion, paleoplacers, ore deposits, and layered mafic intrusions. ORAL

T59. Resolving the Late Paleozoic Gondwanan Ice Age in Time and Space: Comparison of Southern and Northern Hemisphere Records

Stratigraphy; Sediments, Clastic; Sediments, Carbonates

Christopher R. Fielding, University of Nebraska, Lincoln, Nebr.; Tracy D. Frank, University of Nebraska, Lincoln, Nebr.

This session aims to bring together stratigraphers, sedimentologists and geochemists who are working on the climate record of the Carboniferous and Permian systems worldwide. Emphasis will be placed on integrating geochemical with lithostratigraphic archives. ORAL

T60. Sedimentary Geology and Earth History: Retrospective and Prospective: In Honor of the Career and Contributions of Robert H. Dott Jr.

GSA Sedimentary Geology Division; GSA History of Geology Division

Stratigraphy; History of Geology; Geoscience Education

Joanne Bourgeois, University of Washington, Seattle, Wash.; Marjorie A. Chan, University of Utah, Salt Lake City, Utah; Gary Kocurek, University of Texas, Austin, Texas

Bob Dott’s career has spanned important changes in sedimentary geology and Earth’s history and in the philosophy of geology. Students and colleagues of Bob Dott will reflect on those changes, and on his research and educational contributions. ORAL and POSTER
T61. Frontier in Understanding the Geologic Record of Climate Change: A Session in Honor of William W. Hay

GSA Sedimentary Geology Division; GSA Geobiology and Geomicrobiology Division; GSA Limnogeology Division; GSA Structural Geology and Tectonics Division

Paleoecology; Paleoceanography; Marine/Coastal Science; Paleontology/Paleobotany

Eric J. Barron, Pennsylvania State University, University Park, Pa.; Robert DeConto, University of Massachusetts, Amherst, Mass.

A remarkable revolution has taken place in the geosciences associated with a growing understanding of climate and climate change. This revolution is providing context for much of our interpretation and understanding of the earth system. ORAL and POSTER

T62. Wild Coal Fires: Burning Questions with Global Consequences?

GSA Coal Geology Division

Coal Geology; Environmental Geoscience; Engineering Geology

Glenn Blair Stracher, East Georgia College, University System of Georgia, Swainsboro, Ga.; Ed Heffern, Cheyenne, Wyo.

This session will feature presentations and discussions about all aspects of these catastrophic fires, including global consequences. ORAL

T63. Raton Basin: From Coal to Coalbed Methane

GSA Coal Geology Division

Coal Geology; Tectonics; Hydrogeology


This session is designed to highlight the latest regional coal geology, tectonic, geochemistry and hydrologic research being done throughout the Raton Basin. The session will be dedicated to Charles Pillmore. ORAL and POSTER

T64. Genetic Links among Syngenetic Metal Accumulations in Sedimentary Basins: Giant Sediment-Hosted Metal Deposits to Metalliferous Black Shales

Society of Economic Geologists

Economic Geology


This multidisciplinary session will explore the origin of sediment-hosted metal accumulations, the conditions that result in formation of diverse types in correlative strata, and their links to secular variations in ocean chemistry. ORAL

T65. Stable Isotopes of Ore-forming Metals: Analysis and Applications

Economic Geology; Geochmistry, Other; Environmental Geoscience

Jamie J. Wilkinson, Imperial College London, London

The aim of this session is to bring together researchers who are at the cutting edge of the new field of transition metal isotope geochemistry, applying metal isotope systematics to understanding problems in ore deposit genesis. ORAL

T66. Widespread Importance of Immiscible H2O-CO2 Fluids for Petrologic and Geochemical Processes in Low to Moderate Temperature Crustal Environments

Geochemical Society

Geochemistry; Aqueous; Geochemistry, Other; Petrology, Metamorphic


Geochemical reaction models include CO2 as a major ligand and precipitate, but have generally neglected multiphase fluid implications. This session is intended to explore and contrast the evidence and behavior of high CO2 natural systems. ORAL

T67. Advanced Characterization of the Structures and Behaviors of Minerals

 Mineralogical Society of America

Mineralogy/Crystallography


Innovations in microanalytical and microstructural characterization techniques are providing a deeper understanding of the factors that control mineral reaction mechanisms. This session invites contributions that explore the relation between atomic scale structure and macroscale behavior. ORAL

T68. Nano-Geochemistry and Nano-Structures in Earth Systems

Geochemistry, Other; Mineralogy/Crystallography; Environmental Geoscience

Huifang Xu, University of New Mexico, Albuquerque, N.Mex.

Nano-structures and self-assembled nano-structures can provide information about their formation. Geochemical reactions in confined nanopores are different from those in bulk systems. This session will focus on nano-scale processes in geological environments. ORAL and POSTER

T69. Looking Forward to the Past: A Session in Honor of Paul Ribbe and the Reviews in Mineralogy and Geochemistry

Mineralogical Society of America

Mineralogy/Crystallography; Petrology, Experimental; Petrology, Metamorphic


Contributions that reflect on any past, present or future aspect of the topics that have been covered by the Reviews in Mineralogy and Geochemistry are invited for this mineralogy session in honor of Paul Ribbe. ORAL and POSTER
T70. Modeling Grain-Scale Processes in Metamorphic Rocks
Mineralogical Society of America; GSA Structure and Tectonics Division
Petrology, Metamorphic; Structural Geology; Mineralogy/Crystallography
W.D. Carlson, University of Texas, Austin, Texas; C.T. Foster, University of Iowa, Iowa City, Iowa

This session will synthesize recent advances stemming from a broad range of approaches to modeling deformation and reaction processes at the nm to cm scale in metamorphic rocks. ORAL and POSTER

T71. Granitic Pegmatites: Recent Advances in Mineralogy, Petrology, and Understanding
Mineralogical Society of America
Petrology, Igneous; Mineralogy/Crystallography; Geochemistry, Other
David London, University of Oklahoma, Norman, Okla.

Recent contributions to the mineralogy, petrology, and genesis of granitic pegmatites are welcome. Topics to be covered include mineral chemistry and stability, melt inclusions, experimental petrology, numerical models, field geology, and mining. ORAL and POSTER

T72. Impact Geology
GSA Planetary Geology Division
Planetary Geology
David King, Auburn University, Auburn, Ala; Jared Morrow, University of Northern Colorado, Greeley, Colo.

A session devoted to the emerging field of impact studies, including astronomy, impact-related archaeology, cratering, impact modeling, shock metamorphism, mass extinctions, meteoritics, tektite studies, and ejecta stratigraphy. ORAL and POSTER

T73. Early Paleoproterozoic (2.5–2.0 Ga) Events and Rates: Bridging Field Studies and Models
Precambrian (At Large); Geochemical Society; GSA Sedimentary Geology Division, SEPM—Society for Sedimentary Geology, Astrobiology Program
Precambrian Geology; Paleoclimatology/Paleoceanography; Tectonics
Andrey Bekker, Geophysical Lab, Carnegie Institution of Washington, Washington, D.C.; Mark E. Barley, The University of Western Australia, Western Australia, Australia; Robert H. Rainbird, Geological Survey of Canada, Ottawa, Ontario

Field-oriented and modeling studies dealing with the 2.5–2.0 Ga Earth’s evolution are invited. Session will be focused on relationships between tectonics, change in atmospheric composition, and climatic changes as well as the rates of these changes. ORAL

T74. 1500 to 2500 Ma: A Period of Changing Mantle Regimes in Earth History?
Precambrian (At Large); GSA Geophysics Division

Precambrian Geology; Tectonics; Paleoclimatology/Paleoceanography
Kent C. Condie, New Mexico Institute of Mining and Technology, Socorro, N.Mex.; Dallas Abbott, Lamont-Doherty Earth Observatory, Palisades, N.Y.

This session will focus on change and interaction of earth systems between 1500 and 2500 Ma. Papers are especially solicited that deal with mantle dynamics, crustal evolution, the supercontinent cycle, and paleoclimatic regimes. ORAL

T75. A Xenolith Perspective on the Physical and Chemical Evolution of Continental Lithosphere
GSA Structural Geology and Tectonics Division; Mineralogical Society of America; GSA Geophysics Division
Geochemistry, Other; Geophysics/Tectonophysics/Seismology; Petrology, Metamorphic
Jane Selverstone, University of New Mexico, Albuquerque, N.Mex.; Roberta L. Rudnick, University of Maryland, College Park, Md.

We seek contributions from a diversity of disciplines to examine the role that mantle and crustal xenolith studies play in constraining the composition, age, physical properties, and petrologic evolution of continental lithosphere. ORAL and POSTER

T76. Pre-EarthScope Synthesis of the Rocky Mountains I: Framing the Key Geological, Geophysical, and Geodynamic Controversies
GSA Structural Geology and Tectonics Division; GSA Geophysics Division; Rocky Mountain Association of Geologists; Colorado Scientific Society; EarthScope
Tectonics; Geophysics/Tectonophysics/Seismology; Quaternary Geology/Geomorphology
Karl E. Karlstrom, University of New Mexico, Albuquerque, N.Mex.; Rick Aster, New Mexico Institute of Mining and Technology, Socorro, N.Mex.

Synthesis of controversies related to lithospheric evolution of the Rocky Mountain region, with linkages among the geology, geophysics, geomorphology, and geodynamics communities to help shape an interdisciplinary approach to a still-embryonic EarthScope science program. ORAL and POSTER

T77. Pre-EarthScope Synthesis of the Rocky Mountains II: Surface Processes, Geodynamics, and the Roles of Neotectonics and Climate in Development of Modern Topography
GSA Structural Geology and Tectonics Division; GSA Geophysics Division; GSA Quaternary Geology and Geomorphology Division; Rocky Mountain Association of Geologists; Colorado Scientific Society; EarthScope
Tectonics; Geophysics/Tectonophysics/Seismology; Quaternary Geology/Geomorphology
Eric Kirby, Pennsylvania State University, University Park, Pa.

Studies of rock and surface uplift and development of the present topography, including studies of paleoelevation, mantle to surface interconnections, geodynamics of intracratonic deformation, and relative importance of neotectonics versus climate in development of relief. ORAL and POSTER
CALL FOR PAPERS

GSA Structural Geology and Tectonics Division; GSA Geophysics Division; Wyoming Geological Association; Rocky Mountain Association of Geologists; Colorado Scientific Society; EarthScope

Structural Geology; Tectonics; Geophysics/Tectonophysics/Seismology

Eric Erslev, Colorado State University, Fort Collins, Colo.; David Lageson, Montana State University, Bozeman, Mont.; Arthur Snoke, University of Wyoming, Laramie, Wyo.

This session honors Don Blackstone’s pioneering work on Rocky Mountain structures by presenting new geological and geophysical studies of Laramide structures that provide important insights into the linkage between basement-involved foreland structures and lithospheric processes. ORAL and POSTER

T79. Pre-EarthScope Synthesis of the Rocky Mountains IV: New Ideas on Late Paleozoic Intraplate Orogenesis: The Greater Ancestral Rocky Mountains
GSA Structural Geology and Tectonics Division; GSA Geophysics Division; Friends of the Ancestral Rocky Mountains; EarthScope
Tectonics; Stratigraphy; Structural Geology


This session will provide a forum for new data and interpretations on late Paleozoic tectonics and tectonic-climatic interactions in western Pangea, enabling integration of ideas from diverse geographic settings and scientific disciplines. ORAL and POSTER

GSA Structural Geology and Tectonics Division; GSA Geophysics Division; Rocky Mountain Association of Geologists; Colorado Scientific Society; EarthScope
Tectonics; Geophysics/Tectonophysics/Seismology; Quaternary Geology/Geomorphology

Michael Williams, University of Massachusetts, Amherst, Mass.; Karl E. Karlstrom, University of New Mexico, Albuquerque, N.Mex.

Studies of processes of accretion of juvenile lithosphere, location of major sutures, lithospheric stabilization and reaction processes, and cumulative tectonic evolution of the basement leading to today’s geophysical state of the crust and upper mantle. ORAL and POSTER

T81. Regional Geology of the Northern Rockies: A Session Honoring Betty Skipp
GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division; SEPM—Society for Sedimentary Geology
Tectonics; Structural Geology; Stratigraphy

Paul K. Link, Idaho State University, Pocatello, Idaho; Susanne Janecke, Utah State University, Logan, Utah; David Lageson, Montana State University, Bozeman, Mont.

For 50 years, Betty Skipp, U.S. Geological Survey, has, learned, taught, and led by example in understanding the palaeontological, sedimentary, and structural development of the northern Rocky Mountains. Historical syntheses, state-of-the-art ideas, and student papers are welcomed. ORAL and POSTER

T82. Bill Braddock’s Backyard—Proterozoic to Recent Geology of the Northern Colorado Front Range
GSA Structural Geology and Tectonics Division
Precambrian Geology; Structural Geology; History of Geology

An eclectic session reflecting the broad interests and accomplishments of one of Colorado’s premier field geologists in one of the most scenic and geologically diverse outdoor laboratories. A tribute to the career of William A. Braddock. ORAL

T83. Cordilleran Arc Magmatism, BATHOLITHS and Continental Crustal Genesis
GSA Geophysics Division; GSA Structural Geology and Tectonics Division
Tectonics; Petrology, Igneous; Geophysics/Tectonophysics/Seismology

Mihai N. Ducea, University of Arizona, Tucson, Ariz.; Christopher Andronicos, University of Texas, El Paso, Texas; Paul Wetmore, University of Arizona, Tucson, Ariz.

Petrologists, geochronologists, structural geologists, and geophysicists will present data and models on the evolution of continental arcs, with a special emphasis on the Coast Mountains batholith and preliminary data from the National Science Foundation Continental Dynamics project BATHOLITHS. ORAL

T84. Terrane Translation, Orogenesis, and Plate Interactions in the Late Mesozoic to Early Cenozoic North American Cordillera, and Implications for Paleogeographic Reconstructions
GSA Geophysics Division; GSA Structural Geology and Tectonics Division
Tectonics; Stratigraphy; Geophysics/Tectonophysics/Seismology

Paul Umhoefer, Northern Arizona University, Box 4099, Flagstaff, Ariz.; Sandra Wyld, University of Georgia, Athens, Ga.; James E. Wright, University of Georgia, Athens, Ga.

Session will focus on the interrelations among terrane translation, orogenesis, and plate motions; the amount and sense of terrane displacements; and the implications of new and existing data for paleogeographic and tectonic reconstructions. ORAL and POSTER

GSA TODAY, APRIL/MAY 2004
**T85. Whence the Mountains? New Developments in the Tectonic Evolution of Orogenic Belts: Celebrating the Dynamic Career of Raymond A. Price at the 50-Year Mark**

**GSA Structural Geology and Tectonics Division; Geological Association of Canada**

Tectonics; Structural Geology; Geophysics/Tectonophysics/Seismology

James W. Sears, University of Montana, Missoula, Mont.; Tekla A. Harms, Amherst College, Amherst, Mass.; Carol Evenchick, Natural Resources Canada, Vancouver, British Columbia

An investigation into the tectonic evolution of ancient and active mountain belts from around the globe, using traditional and innovative methods at all scales of observation. ORAL and POSTER

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**T86. Ribbon Continents: Their Origin, Development, and Role in Rifting and Orogenesis**

**GSA Structural Geology and Tectonics Division; GSA Geophysics Division**

Tectonics; Structural Geology; Geophysics/Tectonophysics/Seismology

Phil J.A. McCausland, University of Michigan, Ann Arbor, Mich.; Stephen T. Johnston, University of Victoria, Victoria, British Columbia

Ribbon continents, long assemblages of rifted continental fragments and intraoceanic arcs, are a locus of crustal deformation and growth. This session explores their occurrence and role in the evolution of continental margins and orogenic belts. ORAL

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**T87. Recent Advances in Himalayan Geology**

**GSA Structural Geology and Tectonics Division**

Tectonics; Volcanology; Geophysics/Tectonophysics/Seismology

Elizabeth J. Catlos, Oklahoma State University, Stillwater, Okla.; Richard A. Marston, Oklahoma State University, Stillwater, Okla.

Recent discoveries regarding the evolution of the Himalayas will be examined with the goal of disseminating and exploring broader implications of information gained from this type locality of continent-continent convergence. ORAL

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**GSA Structural Geology and Tectonics Division; GSA Geophysics Division**

Tectonics; Geophysics/Tectonophysics/Seismology; Structural Geology

Delores M. Robinson, University of Alabama, Tuscaloosa, Ala.; Nadine McQuarrie, California Institute of Technology, Pasadena, Calif.

We encourage papers that explore the linkage between foreland fold-thrust belts and adjacent hinterland plateaus in orogenic systems through deformation and elevation histories and mechanisms, rates of uplift and erosion, kinematic processes, and morphology. ORAL and POSTER

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**T89. Tectonic Evolution of the Arctic Basin and its Margins**

**GSA Structural Geology and Tectonics Division**

Tectonics; Geophysics/Tectonophysics/Seismology; Marine/Coastal Science

Jaime Toro, West Virginia University, Morgantown, W.Va.; Jeffrey M. Amato, New Mexico State University, Las Cruces, N.Mex.

This session highlights the tectonic evolution of one of the least understood regions of Earth: the Arctic oceanic basin and the surrounding margins and continental terranes. ORAL and POSTER

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**T90. Low-angle Normal Faults and Faulting: Field Studies, Fault Rocks, Mechanics, and Weakening Mechanisms**

**GSA Structural Geology and Tectonics Division; GSA Geophysics Division**

Structural Geology; Tectonics; Petrology, Metamorphic Geophysics/Tectonophysics/Seismology; Geophysics Division

Robert E. Holdsworth, University of Durham, Durham, United Kingdom; Darrel S. Cowan, University of Washington, Seattle, Wash.; Cristiano Collettini, Università di Perugia, Perugia, Italy

An interdisciplinary session where field geologists, experimentalists, seismologists, geodynamicsists, and others can present observational evidence and theoretical insights on low-angle normal faults and faulting. ORAL and POSTER

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**T91. Paleomagnetism and Rock Magnetism Perspective of Shear Zone Kinematics**

**GSA Geophysics Division; GSA Structural Geology and Tectonics Division**

Geophysics/Tectonophysics/Seismology; Tectonics; Structural Geology

Tim F. Wawrzyniec, University of New Mexico, Albuquerque, N.Mex.; Mike Petronis, University of New Mexico, Albuquerque, N.Mex.

Integrated studies of shear-zone processes benefit greatly from applied paleomagnetic and rock magnetic investigations. The goal of this session is to demonstrate from a geophysical perspective the applications and caveats of applied paleomagnetism and rock magnetic studies in understanding shear zone kinematics. ORAL and POSTER

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**T92. Neotectonics and Earthquake Potential of the Eastern Mediterranean Region**

**GSA Structural Geology and Tectonics Division; GSA Geophysics Division**

Geophysics/Tectonophysics/Seismology; Neotectonics/Neoseismology; Tectonics

Ibrahim Cemen, Oklahoma State University, Stillwater, Okla.; Eric Sandvol, University of Missouri, Columbia, Mo.; Omer Emre, MTA, Ankara, Turkey

Different research groups have been studying neotectonics and earthquake potential of major tectonic features of different portions of the eastern Mediterranean region. This session plans to provide a formal discussion on problems related to neotectonics of the region. ORAL and POSTER
Q: On What Fossilized Creature Would You Find a Pygidium?

Like trivia? Get a team together and battle it out during GSA’s first Geoscience Trivia Night at the GSA Annual Meeting in Denver!

GEOSCIENCE TRIVIA NIGHT
Tuesday, November 9, 2004
8–10 p.m.
(Location to be announced.)

Put your knowledge to the test in this competition with your peers and friends on more than 100 geoscience trivia questions.

For more information and team registration, e-mail Gary Lewis at glewis@geosociety.org.

T93. Crustal Seismic Anisotropy as a Measure of Regional Tectonic Deformation (Posters)
GSA Geophysics Division; GSA Structural Geology and Tectonics Division
Geophysics/Tectonophysics/Seismology; Tectonics; Structural Geology
David Okaya, University of Southern California, Los Angeles, Calif.; Nikolas Christensen, University of Wisconsin, Madison, Wis.

This session explores how crustal seismic anisotropy may serve as a proxy for intracrustal deformation by combining tectonic formation and regional distributions of shear and metamorphic fabrics, anisotropic material properties, and observations of seismic waves. POSTER

T94. Geoinformatics and Geological Sciences: The Next Step (Posters)
GSA Geophysics Division
Geophysics/Tectonophysics/Seismology; Tectonics; Geoscience Information/Communication
Ramon Arrowsmith, Arizona State University, Tempe, Ariz.; Charles Meertens, UNAVCO, Inc., Boulder, Colo.

Present results of geoinformatics projects in the geoscience community, in particular from those associated with distributed data and computational resource integration efforts. Explore areas where information technology developments can address geoscience problems. POSTER

T95. Differentiating Climatic from Tectonic Controls on Landscape Evolution (Posters)
GSA Quaternary Geology and Geomorphology Division; GSA Structural Geology and Tectonics
Quaternary Geology/Geomorphology; Tectonics; Structural Geology
Claudia J. Lewis, Los Alamos National Lab, Los Alamos, N.Mex.; Eric V. McDonal, Desert Research Institute, Reno, Nev.; John Gosse, Dalhousie University, Halifax, Nova Scotia

Dynamic response of mountainous landscapes to climate-driven denudation bedevils determination of tectonic uplift. We seek papers that quantify landscape and lithospheric responses to climatic and tectonic forcing in active orogens and mountain belts undergoing postorogenic exhumation. POSTER

T96. Records of Late Quaternary Climatic Change from the Americas: Interhemispheric Synchronicity or Not
GSA Quaternary Geology and Geomorphology Division
Quaternary Geology/Geomorphology; Paleoecology/Paleoecanography
Donald T. Rodbell, Union College, Schenectady, N.Y.; John T. Andrews, University of Colorado, Boulder, Colo.; Geoffrey O. Seltzer, Syracuse University, Syracuse, N.Y.

We seek papers that review high-resolution physical, chemical, and biological archives of climate change during the past ~30,000 years from the Americas, and also including Antarctica and Greenland. Our focus is mainly on terrestrial evidence,
Come to the other side of the Rockies!

117th Annual Meeting and Exposition!

Salt Lake City, Utah
October 16–19, 2005
but we also welcome near-shore marine records that directly record terrestrial events. ORAL and POSTER

**T97. Geologic History and Processes of the Colorado River**  
_GSA Quaternary Geology and Geomorphology Division_  
Quaternary Geology/Geomorphology; Environmental Geoscience; Stratigraphy  
The history of the Southwest’s Colorado River has intrigued scientists and the public for over a century. This session will explore Cenozoic geologic history and processes of the river from the Rockies to Mexico. ORAL and POSTER

**T98. Evolution of the Great Plains Landscape**  
_GSA Quaternary Geology and Geomorphology Division_  
Quaternary Geology/Geomorphology  
Joseph A. Mason, University of Wisconsin, Madison, Wis.; James B. Swinehart, School of Natural Resources, Lincoln, Nebr.; J. Elmo Rawling, University of Wisconsin, Platteville, Wis.  
This session will highlight research on late Cenozoic landscape evolution of the Great Plains. Topics will include rates and causes of stream incision, drainage network development, and the evolution of tablelands, badlands, dunefields, and playas. ORAL and POSTER

**T99. The Midwest from Deglaciation to Settlement**  
_GSA Quaternary Geology and Geomorphology Division_  
Quaternary Geology/Geomorphology; Paleoclimatology/Paleoceanography; Limnogeology  
Kathy J. Licht, Indiana University–Purdue University Indianapolis, Indianapolis, Ind.; Tom Lowell, University of Cincinnati, Cincinnati, Ohio  
This interdisciplinary session will explore the landscape impacts of deglaciation, the postglacial transition and Holocene environments from the prairie-woodland boundary to the Appalachians. Investigations of lacustrine, loess, fluvial, and vegetation records are welcome. ORAL

**T100. Glacial Outburst Floods: Causes and Consequences**  
_GSA Quaternary Geology and Geomorphology Division_  
Quaternary Geology/Geomorphology  
Amir Mokhtari Fard, Stockholm University, Stockholm, Sweden  
This session would consider the less-explored causes and consequences of sudden and catastrophic events of release of large volumes of melt water from a glacier or glacier-dammed lake. ORAL

**T101. The Red River Raft of Louisiana**  
_GSA Quaternary Geology and Geomorphology Division_  
Quaternary Geology/Geomorphology; Engineering Geology; Hydrogeology  
Nalini Torres, U.S. Army Corps of Engineers, Vicksburg, Miss.; Danny W. Harrelson, U.S. Army Engineer Research and Development Center, Vicksburg, Miss.  
This is a review and description of the historic and current geomorphic evolution of the Red River to the development and removal of the raft. ORAL

**T102. Quaternary Paleoenvironments of the Middle East: Proxy Records, Human Prehistory, and Regional Cross-Correlation**  
_GSA Archaeological Geology Division; GSA Quaternary Geology and Geomorphology Division_  
Quaternary Geology/Geomorphology; Archaeological Geology; Paleoecology/Paleoceanography  
Carlos E. Cordova, Oklahoma State University, Stillwater, Okla.; Caroline Davies, University of Missouri, Kansas City, Mo.  
This session will bring together Quaternary geoscientists and geoarchaeologists working in Middle Eastern countries to present and discuss paleoenvironmental records, and their application to issues of climate change chronologies, human prehistory, and regional geomorphological evolution. ORAL

**T103. Documenting the Geomorphic and Ecosystem Evolution of National Park Landscapes Using Repeat Photography**  
_GSA Quaternary Geology and Geomorphology Division; National Park Service, Natural Resources Program Center, Geologic Resources Division_  
Quaternary Geology/Geomorphology; Environmental Geoscience; Remote Sensing/Geographic Information System  
Harold S. Pranger, Denver, Colo.  
Repeat photographs often clearly document recent historic changes to native and disturbed landscapes. National Parks are ideal locations for using repeat photographs to understand natural and anthropogenic changes to geomorphic and ecological systems. ORAL and POSTER

**T104. Unveiling the Hidden Components in Archaeological Landscapes—The Role of Geoscience Techniques in Archaeological Site Analysis**  
_GSA Archaeological Geology Division_  
Archaeological Geology; Quaternary Geology/Geomorphology; Environmental Geoscience  
Cynthia A. Stiles, University of Wisconsin, Madison, Wis.  
A forum for research emphasizing integration of physical and geochemical techniques used in the geosciences field with archaeological studies to gain a better understanding of the interactive role humans have had with their environment. ORAL and POSTER

**T105. Archaeological Geology of Stratigraphically Complex Localities**  
_GSA Archaeological Geology Division_  
Archaeological Geology; Quaternary Geology/Geomorphology; Sediments, Clastic  
E.A. Bettis III, University of Iowa, Iowa City, Iowa  
Stratigraphically complex localities contain some of the most complete and important archaeological records on Earth. This session addresses the interpretation of the complex array of
CALL FOR PAPERS

T106. Geological Context of Early Humans from Ethiopian Rift Basins

GSA Archaeological Geology Division; GSA Sedimentary Geology Division; GSA Limnogeology Division

Archaeological Geology; Stratigraphy; Paleontology/Paleobotany

Jay Quade, University of Arizona, Tucson, Ariz.; Jonathon Wynn, University of Oregon, Eugene, Ore.

Basin deposits in the Ethiopian rift are the richest source of fossil hominins in the world. This session will bring together recent research by expedition geologists on the geological context of these finds. ORAL

T107. Toward Effective Interdisciplinary Education in Archaeological Geology: Progress and Prospects

GSA Archaeological Geology Division; GSA Geoscience Education Division

Archaeological Geology; Geoscience Education; Quaternary Geology/Geomorphology

Jennifer R. Smith, Washington University, St. Louis, Mo.

Educators and geoscience professionals share their perspectives on the “ideal” training for archaeological geologists and on overcoming the particular philosophical and bureaucratic challenges of developing interdisciplinary curricula at the graduate and undergraduate levels. ORAL

T108. Geoarchaeology, Geoconservation, and Georesources: Integrated Approaches to Investigating, Conserving, and Managing Past and Present Landscapes

GSA Archaeological Geology Division; GSA Geology and Geomorphology Division; GSA Geology and Public Policy Committee

Environmental Geoscience; Archaeological Geology; Geoscience Education

Jasper Knight, Loughborough University, Loughborough, United Kingdom

This session explores relationships between geology, geomorphology, human activity and landscape, and implications for management and conservation of landscape resources. Methodological and field-based papers using mapping, stratigraphic analysis, dating, geographic information system, and modeling are all invited. ORAL and POSTER

T109. Geology, Decisionmakers, and the Public: Challenges in Communication

GSA Geology and Society Division; GSA Geology and Public Policy Committee

Public Policy; Environmental Geoscience; Geoscience Information/Communication


The engagement of geology in public policy relies upon effective communication. This session will focus on examples of successful and unsuccessful communication experiences. Both invited and volunteered presentations will be included. ORAL

T110. Information Technology Initiatives in the Geosciences: Policy, Strategy, and Management Issues

Geoscience Information/Communication; Public Policy; Geoscience Education

Soumava Adhya, University at Albany, SUNY, Albany, N.Y.

This session focuses on the experiences of the geosciences community regarding barriers and enablers to adoption and implementation of emerging information technologies, particularly on knowledge about and experiences with policy, strategy, and management. ORAL

T111. Geoscience Information and Librarianship in a Global Context

Geoscience Information Society

Linda R. Musser, Pennsylvania State University, University Park, Pa.

As geoscience becomes more global in scope, the tools librarians provide must also adapt. How well have traditional tools and processes changed to meet these new demands? What changes still need to be made? ORAL and POSTER


Geoscience Information Society; Paleontological Society; CHRONOS

Cinzia Cervato, Iowa State University, Ames, Iowa; Walter S. Snyder, National Science Foundation, Arlington, Va.

Talks and posters will present results from the efforts of the geoinformatics community on database and data networking projects, demonstrate analytical and visualization tools, and illustrate community involvement and educational activities related to Earth's history. ORAL and POSTER

T113. Geology in the National Forests—Stewardship, Education, and Research

USDA Forest Service, Minerals and Geology Management Program


This session will explore some of the many aspects of geology conducted on the National Forests. Topics include paleontology, cave and karst geology, engineering geology and natural-hazard mitigation, hydrogeology, interpretive and recreational geology, geocology, and more. ORAL
T114. Geology in the National Parks: Research, Mapping, and Resource Management

National Park Service

Geoscience Information/Communication; Paleontology/
Paleobotany; Marine/Coastal Science

Bruce A. Heise, National Park Service, Geologic Resources
Division, Lakewood, Colo.; Tim Connors, National Park
Service, Denver, Colo.; Rebecca Beavers, National Park
Service, Denver, Colo.; Greg McDonald, National Park Service,
Lakewood, Colo.; Jeff Mow, Florissant Fossil Beds National
Monument, Florissant, Colo.

This session will address the role of geoscience in the
National Parks. Presentations are invited on geologic research,
geologic mapping, paleontology, shoreline geology, and re-
source management in National Parks, Monuments, Seashores,
and Historic Sites. ORAL

T115. The Keys to Opportunities with the National Park Service

National Park Service, Geological Society of America; American
Geological Institute; Association for Women Geoscientists

Public Policy; Geoscience Information/Communication;
Geoscience Education

Judy Geniac, Denver, Colo.; Gary Lewis, GSA Education and
Outreach, Boulder, Colo.; Ann Beenbow, Alexandria, Va.;
Marguerite Toscano

Discover the growing number of geoscience opportunities in
national parks for professors, students, retirees, organizations,
universities, and companies. Examine and discuss existing
partnerships and access to research, programs, projects, and
volunteer and paid positions. ORAL

T116. Geology for the Masses: Engaging the Public through Informal Geoscience Education in Parks, Monuments, Open Spaces, and Public Lands

GSA Geoscience Education Division; National Park Service;
Bureau of Land Management, Association of Earth Science
Editors

Geoscience Education; Geoscience Information/
Communication; Environmental Geoscience

Jim Wood, National Park Service, Denver, Colo.; Allyson
Mathis, National Park Service, Grand Canyon, Ariz.; Marion
Malinowski, Bureau of Land Management, Lakewood, Colo.;
Carol Ruthven, Association of Earth Science Editors, Lexington,
Ky.; Monica Gaiswinkler Easton, Ministry of Northern
Development and Mines, Sudbury, Ontario

This session will explore programs and products (e.g., dis-
plays, publications, signs, Web sites, virtual and real field trips)
for effective informal science education about the geology of
parks, monuments, open spaces, and public lands. ORAL and
POSTER

T117. Innovative Approaches to Teaching “Geology of National Parks”: Tales from the Classroom, Field, Page, Web, and Beyond

GSA Geoscience Education Division; National Association of
Geoscience Teachers

Geoscience Education; Geoscience Information/
Communication

Robert J. Lillie, Oregon State University, Corvallis, Ore.; Carol
J. Ormand, Wittenberg University, Springfield, Ohio; Joseph F.

This session will bring together those who teach geology by
using examples from National Parks to share their expertise,
exercises, written and electronic resources, techniques, and
strategies for successfully educating students on park geology.
ORAL

T118. The Science of Sustainability: How Can We Most Effectively Educate Students, the Public, and Policymakers?

Critical Issues Caucus, GSA Geology and Public Policy
Committee

Geoscience Education; Environmental Geoscience; Public Policy

Paul H. Reitan, SUNY at Buffalo, Buffalo, N.Y.; Christine V.
McLelland, GSA Education and Outreach, Boulder, Colo.

Public understanding about the role of earth systems is
central to a sustainable future. We have a special obligation to
communicate this effectively in schools and for the public and
policymakers. How can we do this? ORAL

T119. Sigma Gamma Epsilon Student Research (Posters)

Sigma Gamma Epsilon

Environmental Geoscience

Donald W. Neal, East Carolina University, Greenville, N.C.;
Charles Mankin, Oklahoma Geological Survey, Norman, Okla.

All students are welcome to present their research in any
area of geology. POSTER

T120. Integrative Interdisciplinary Undergraduate Research in the Earth Sciences (Posters)

Council on Undergraduate Research—Geosciences Division
Geoscience Education

Edward C. Hansen, Hope College, Holland, Mich.; Karen H.
Fryer, Ohio Wesleyan University, Delaware, Ohio

This session highlights examples of research involving under-
graders that straddles traditional disciplinary boundaries
both within and beyond the earth sciences. Presentations
should concentrate on the process of doing such research in-
cluding the challenges and rewards. POSTER

T121. Involvement of Undergraduates in Geological Research: Critical Tools for Background Enrichment (Posters)

GSA Geoscience Education Division

Geoscience Education

Nazrul I. Khandaker, York College of CUNY, New York, N.Y.

This session invites posters on geological/environmental
topics involving field, computer-assisted, and laboratory-ori-
ented investigations. Topics may include a wide spectrum of
various geological and environmental aspects. Student partici-
ipation should be dominant. Undergraduate and K–12 students
are encouraged to submit abstracts. POSTER
T122. Inspiring First-rate Research through Undergraduate Teaching: A Special Session in Honor of John B. Reid Jr.

National Association of Geoscience Teachers; GSA Quaternary Geology and Geomorphology Division

Quaternary Geology/Geomorphology; Petrology, Igneous; Geoscience Education

Eric J. Steig, University of Washington, Seattle, Wash.; John Eichellberger, University of Alaska, Fairbanks, Alaska; Daniel P. Murray, University of Rhode Island, Kingston, R.I.

This session will explore ways in which students at any level (K–12 through graduate) have been engaged in the research process, whether through innovative inquiry-based teaching methods, access to equipment, interaction with more advanced students, or simply through excellent mentoring. ORAL

T123. Teaching Structural Geology in the 21st Century

GSA Structural Geology and Tectonics Division; National Association of Geoscience Teachers; On the Cutting Edge

Geoscience Education; Structural Geology

Barbara Tewksbury, Hamilton College, Clinton, N.Y.; Robert Burger, Smith College, Northampton, Mass.; Jan Tullis, Brown University, Providence, R.I.; Michael Williams, University of Massachusetts, Amherst, Mass.

We invite abstracts that showcase effective methods of teaching structural geology in the classroom, laboratory, and field. This session will also present outcomes from the 2004 workshop, Teaching Structural Geology in the 21st Century (http://dlesecommunity.carleton.edu/NAGTWorkshops/structure04/index.html). ORAL and POSTER

T124. Using Field Observations and Field Experiences to Teach Geoscience: An Illustrated Community Discussion (Posters)

National Association of Geoscience Teachers; GSA Education Division

Geoscience Education

David W. Mogk, Montana State University, Bozeman, Mont.; Cathryn A. Manduca, Carleton College, Northfield, Minn.; Barbara Tewksbury, Hamilton College, Clinton, N.Y.

Presentations will demonstrate ways that field observations and experiences can be used to enhance students’ understanding of geoscience. Contributions can document both successful teaching practice and potential use of field research to enhancing students’ learning. POSTER

T125. Using Digital Geological Maps to Build Deeper Understanding of Earth Science Relationships (Posters)

Geoscience Education; Geoscience Information/Communication

Andrew H. Wulff, Western Kentucky University, Bowling Green, Ky.

This session will focus on the use of digital geological maps; specifically how to make these interactive data sets more accessible and how their use may facilitate the deeper understanding of geological relationships. POSTER

T126. Teaching Geology and Human Health: Expanding the Curriculum

National Association of Geoscience Teachers; GSA Geoscience Education Division

Geoscience Education

Jean M. Bahr, University of Wisconsin, Madison, Wis.; H. Catherine W. Skinner, Yale University, New Haven, Conn.; Jill K. Singer, SUNY—College at Buffalo, Buffalo, N.Y.

This session is designed to provide an opportunity for those involved in development of course materials linking geology and human health to share instructional practices and case studies across the geoscience curriculum. ORAL and POSTER

T127. STEMS: Science Teaching Enhanced with Museums and Surveys

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education

Sarah D. Zellers, Central Missouri State University, Warrensburg, Mo.; Ann Molineux, University of Texas, Austin, Texas

Museums, state and national surveys, and departments have published, produced, and collected data and collections to enhance educational opportunities. This session will showcase outreach and curriculum design utilizing collections, data, and scientific expertise to complement earth science education. ORAL and POSTER

T128. Integration of Geoscience into Programs of Integrated Science and Math

GSA Engineering Geology Division; GSA Geoscience Education Division

Geoscience Education; Environmental Geoscience; Engineering Geology

John D. Rockaway, Northern Kentucky University, Highland Heights, Ky.; Denice N. Robertson, Northern Kentucky University, Highland Heights, Ky.

Presentations discussing the incorporation of geoscience into programs integrating science and math for the purpose of introducing students to the sciences and for encouraging them to think outside their nonscience disciplines. ORAL

T129. Innovative and Unique Advanced Geology/Geoscience Courses at the K–12 Level

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education; Geoscience Information/Communication

Steve Kluge, Fox Lane High School, Bedford, N.Y.

Session features presentations by K–12 teachers of advanced geology/geoscience courses. Presenters will highlight those aspects of their courses that make them unique and discuss affiliations with colleges/organizations that lend legitimacy to their programs. ORAL
T130. Authentic Research Collaborations: Bringing Scientific Researchers, K–12 Schools, and Other Community Groups Together in the Scientific Endeavor

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education

William Slattery, Wright State University, Dayton, Ohio; Dave Mayo, California State University, Los Angeles, Los Angeles, Calif.

This session will highlight the efforts of scientific researchers, K–12 educators and other community groups participating as partners in authentic collaborative research. The topic will be explored from the perspectives of those different groups. ORAL

T131. Online Geoscience Education at Two-Year Colleges: Hybrid or Strictly Distance Learning Instruction for Nontraditional Students

GSA Geoscience Education Division

Geoscience Education; Geoscience Information/Communication; Remote Sensing/Geographic Information System

Suzanne G. Traub-Metlay, Front Range Community College, Boulder County Campus, Longmont, Colo.

How do online geoscience educators provide meaningful field or laboratory experiences for college students who do not report to a classroom? Online instructors can successfully teach adults about earth science and related topics—learn how! ORAL

T132. Why Earth Science Curriculum: National Science Foundation–Funded Projects for Improving Earth Science Education

GSA Geoscience Education Division; American Geological Institute, National Science Foundation

Geoscience Education


Geoscience educators and curriculum developers are taking critical steps for improving earth science education in all academic levels with support of the National Science Foundation. Curriculum has been developed and implemented to build science literacy across the nation. POSTER

T133. Current Research on Situated Teaching and Learning in Geoscience: Field-Based, Case-Based, Problem-Based, Place-Based

National Association of Geoscience Teachers; GSA Geoscience Education Division

Geoscience Education; Geoscience Information/Communication; Public Policy

Steven Semken, Arizona State University, Tempe, Ariz.; Eric Riggs, San Diego State University, San Diego, Calif.

Situated teaching methods are thought to improve learning in geoscience, enhancing relevance and context by building on the physical locality and local culture, events, and problems. This session features quantitative and qualitative research into the theory and effectiveness of these methods. ORAL and POSTER

T134. We Can Do Better: Alternatives to the Same Old Lab-Lecture Format in the College Classroom

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education

Elizabeth M. King, Illinois State University, Normal, Ill.; Dexter Perkins, University of North Dakota, Grand Forks, N.Dak.

During the past decade, it has become increasingly clear that there are many excellent alternatives to the standard lab-lecture format used by most college science teachers. This session will provide a chance to share innovations in teaching style. ORAL and POSTER

T135. Improving Delivery in Geoscience Education (IDIG): A Session Celebrating Dorothy LaLonde Stout

National Association of Geoscience Teachers; GSA Geoscience Education Division

Geoscience Education; Public Policy


In this session, IDIG participants/associates will present the outcomes of their implemented plans for improving the delivery of geoscience education. The session goal is to share and disseminate the practices IDIG educators have found effective. ORAL

T136. Electronic Student Response Technology in the Geoscience Classroom: Is it a Valuable Teaching and Learning Tool?

National Association of Geoscience Teachers; GSA Geoscience Education Division

Geoscience Education

Lisa Greer, Washington and Lee University, Lexington, Va.; Peter J. Heaney, Pennsylvania State University, University Park, Pa.

Electronic student response technology has been cited as a method for overcoming barriers to engagement and effective learning in the classroom. This session will explore the implementation and assessment of SRT in the geoscience classroom. ORAL
T137. Minorities, Women, and Persons with Disabilities in the Geosciences: Continuing Issues and Innovative Solutions

GSA Geoscience Education Division; GSA Committee on Minorities and Women in the Geosciences

Geoscience Education; Public Policy; Geoscience Information/Communication

Maya Elrick, University of New Mexico, Albuquerque, N.Mex.; Marc Carrasco, University of California, Berkeley, Calif.; John William Pennington, Oregon State University, Corvallis, Ore.; Cassandra Runyon, College of Charleston, Charleston, S.C.

This session will address the current issues confronting minorities, women, and persons with disabilities in the geosciences and explore new and existing ideas and programs that seek to attract and retain members of these underrepresented groups. ORAL and POSTER

T138. New Methods and Technologies in Teaching Geology to Nontraditional and Disabled Students—The Aspects of Change to Incorporate Technology and Hands-On Methods

GSA Geoscience Education Division

Geoscience Education; Geoscience Information/Communication; History of Geology

Mark Howe, Arizona State University, Tempe, Ariz.; Connie Gibb, University of Nebraska, Lincoln, Nebr.

The geological sciences are heavy in math, physics, chemistry, and procedures. Today, more older, nontraditional and disabled people are taking courses in the sciences. This session focuses on the “geoteaching” and the processes that entail. ORAL and POSTER

T139. Geoscience Education Strategies and Methods that Encourage ALL Students (Especially Students with Disabilities) to Participate in the Geosciences

GSA Geoscience Education Division; National Science Foundation; National Aeronautics and Space Administration

Geoscience Education

Roderic Brame, American Geological Institute, Alexandria, Va.; Wendi Williams, University of Arkansas at Little Rock, Little Rock, Ark.

Geoscience educators with support of the National Science Foundation are on the forefront of inclusion and accessibility in science. This session will highlight advances in accessibility and the impact it is having on the geoscience education community. ORAL

T140. Beyond Video Games—Promoting Active Learning for All Students

Geoscience Education

Terry L. Oroszi, Biological Sciences, Wright State University, Dayton, Ohio; Heidi J. Turner, CLASS—Wright State University, Dayton, Ohio

A selection of science activities designed for the participation of ALL students is solicited. Available technologies/equipment that encourage active learning from students with disabilities will be discussed. ORAL

T141. Building a Digital Library that Supports Diversity: Goals, Lessons Learned, and Future Directions

National Association of Geoscience Teachers; Geoscience Information Society: GSA Geoscience Education Division

Geoscience Education; Geoscience Information/Communication; Public Policy

Mary R. Marlino, University Corporation for Atmospheric Research (UCAR), Boulder, Colo.; Rajul E. Pandya, UCAR, Boulder, Colo.

The session will explore current and ongoing efforts to promote diversity in the Digital Library for Earth System Education (DLESE), focusing on early successes, lessons learned, and strategies for moving the library forward. ORAL and POSTER

T142. Building Strong Geoscience Departments: Opportunities, Successes, and Challenges

National Association of Geoscience Teachers; GSA Geoscience Education Division

Geoscience Education

R. Heather Macdonald, College of William and Mary, Williamsburg, Va.; Cathryn A. Manduca, Carleton College, Northfield, Minn.; Randall M. Richardson, University of Arizona, Tucson, Ariz.

This session seeks examples of successful departmental activities or discussions of critical issues facing departments in undergraduate and/or graduate curriculum; recruiting, retaining, and advising students, retaining faculty, integrating research and education, and/or departmental planning. ORAL and POSTER

T143. Pre-Mesozoic Impacts: Their Effect on Ocean Geochemistry, Magnetic Polarity, Climate Change, and Organic Evolution (Posters)

GSA Planetary Geology Division; Paleontological Society

Planetary Geology; Paleontology/Paleobotany; Paleoclimatology/Paleoceanography

Charles A. Sandberg, U.S. Geological Survey, Denver, Colo.; Jared R. Morrow, University of Northern Colorado, Greeley, Colo.; Christian Koeberl, University of Vienna, Vienna, Austria

Pre-Mesozoic comet and meteorite impacts produced extreme oceanic and climate changes, causing mass extinctions followed by rapid radiation of surviving organisms. Thus, they were the driving mechanism in the early evolution of life on Earth. POSTER
HOW TO SUBMIT YOUR ABSTRACT

Please use the online abstract form found on the GSA Web site, www.geosociety.org. An abstract submission fee of $18 for all students and $30 for all others will be charged. If you cannot submit your abstract electronically, contact Nancy Carlson, (303) 357-1061, ncarlson@geosociety.org.

From the home page of www.geosociety.org, click on “Submit an Abstract” and follow the steps given. If you lose your Internet connection before you are finished, you can resume making a submission when you log back on.

You and your coauthors will be provided (by e-mail) with a record of the abstract identification number and password, and you can access your abstract and revise it as necessary from any Internet connection up until the published abstract submission deadline date. The system supports the submission of complex abstracts that contain subscripts, superscripts, italic and boldface type, tables, Greek letters, and equations.

Presentation Modes
Select your preferred mode of presentation: oral, poster, or either (no preference). Please Note: The program organizers will do their best to fit you into your preferred mode. However, they will override your original mode selection if they feel your paper would fit well in a particular session with other compatible abstracts. The decision of the program organizers is final.

Oral Mode. This is a verbal presentation before a seated audience. The normal length of an oral presentation is 12 minutes, plus three minutes for discussion.

Poster Mode. Each poster session presenter is provided with one horizontal, freestanding display board approximately 8' wide and 4' high. Precise measurements will appear in the Speaker Guide, which will be posted on the GSA Web site in September. Speakers must be at their poster booths for at least two of the four presentation hours.

Papers for discipline sessions may be submitted in either oral or poster mode. Papers for topical sessions are to be submitted only in the mode noted in the session description. If a topical abstract is submitted in the incorrect mode, the abstract will be transferred automatically to a discipline session.

Abstract Body
Please keep the abstract body to 2,000 characters or fewer. The online abstract system will reject it if it exceeds this limit.

You can include a table with your abstract, but understand that the table might reduce the number of words allowed in your abstract. Taken together, the body of the abstract should take up no more space than would be occupied by roughly 2,000 characters alone.

Check the spelling of the abstract’s body and title using your own word processor. Then read it again and make sure that it is something the whole world should see. (We won’t check or edit it for you.)

For typing and pasting, add an extra line between paragraphs or they will run together when displayed (you can do this before copying, after pasting, or while typing).

Abstracts Fee
Once the abstract is in place, a window to submit payment will appear. The nonrefundable submission fee is $18 for students; $30 for all others.

You May Present Only One Volunteered Abstract
- Please submit only one volunteered abstract as speaker or poster presenter in topical and/or discipline sessions. This helps avoid speaker-scheduling conflicts and gives everyone an equal opportunity to be heard. Multiple submissions as speaker-presenter will result in rejection of all abstracts.
- This limitation does not apply to, nor does it include, invited contributions to keynote symposia or topical sessions.

JTPC to Finalize Program in Early August
The Joint Technical Program Committee (JTPC) selects abstracts and determines the final session schedule. All authors will be notified in August. The JTPC includes representatives from those GSA Associated Societies and Divisions participating in the technical program. GSA Council approved the JTPC technical program chairs.

Abstracts Deadline: July 13

Call for Papers

First Announcement  •  2004 Denver Annual Meeting  •  November 7–10

GSA Today, April/May 2004
DENVER 2004 FIELD TRIPS

Come experience the Rockies! The 2004 GSA Annual Meeting in Denver will provide abundant opportunities for field trips viewing the geology of the southern Rocky Mountains. A full array of trips will be offered, ranging from multi-day excursions delving into the tectonic development of northern New Mexico to one-day trips visiting Dinosaur Ridge. These trips will minimize the impact of possible Rocky Mountain snowstorms by emphasizing one-day trips in the eastern slope of the Rockies and multi-day trips to southern locations with warmer and dryer weather. Some trips will be unaffected by inclement weather: underground, the cool temperatures of the Henderson Mine are constant regardless of the weather and the heat from underground coal fires can be quite pleasant when combined with a little Rocky Mountain powder snow. If a blizzard requires that GSA cancel a field trip, we will return your field trip fee and provide information on the abundant in-town opportunities for exploration, from the Denver Museum of Nature & Science to the Wynkoop Brewery, which was cofounded by geologist John Hickenlooper, the current mayor of Denver.

Most trips will start and end in Denver. Air travel plans that include a Saturday night stay over can substantially offset field trip costs. The following list is tentative and subject to change. Further details will be given when registration for the meeting begins in June.

The field trip co-chairs for the Denver 2004 meeting are Eric Erslev, Department of Geosciences at Colorado State University, and Eric Nelson, Department of Geology and Geological Engineering at Colorado School of Mines. For more information about the trips, please contact the field trip leader or Eric Erslev, Department of Geosciences, Colorado State University, Fort Collins, CO 80523, (970) 491-5661, erslev@cnr.colostate.edu.

PREMEETING FIELD TRIPS

Navajo Sand Sea of Near-Equatorial Pangea: Tropical Westerlies, Slumps, and Giant Stromatolites
Tues.–Sat., Nov. 2–6. David Loope, Dept. of Geosciences, University of Nebraska, Lincoln, NE 68508, (402) 472-2647, fax 402-472-4917, dloope1@unl.edu; Len Eisenberg; Erik Waiss. Max.: 15. Cost: $475.

Strike-Slip Tectonics and Thermochronology of Northern New Mexico
Thurs.–Sat., Nov. 4–6. Eric Erslev, Dept. of Geosciences, Colorado State University, Fort Collins, CO 80523, (970) 491-5661, fax 970-491-6307, erslev@cnr.colostate.edu; Steven Cather; Seth Fankhauser; Matt Heizler; Rob Sanders. Max.: 40. Cost: $255. Begins and ends in Denver or Santa Fe, New Mexico.

Geology of the Silvercliff–Rosita Hills Mining District and Spanish Peaks Area
Fri. and Sat., Nov. 5–6. Cosponsored by GSA Sedimentary Geology Division. Paul R. Krutak, P. Krutak Geoservices International, P.O. Box 369, 2118 Main Street, Rye, CO 81069-0369, (719) 489-2282 (phone and fax), pkrutakgeos@hotmail.com; John R. Barwin; Marty Horn. Max.: 36. Cost: $185.

Hyperpycnal Wave-Modified Turbidites of the Pennsylvanian Minturn Formation, North-Central Colorado.

Structural Implications of Underground Coal Mining in the Mesaverde Group, Somerset Coal Field, Delta and Gunnison Counties, Colorado

A New K-T Boundary in the Denver Basin

Buried Paleo-Indian Landscapes and Sites in the High Plains of Northwestern Kansas and Eastern Colorado

Continental Accretion—Colorado Style: Proterozoic Island Arcs and Back Arcs of the Central Front Range

APRIL/MAY 2004, GSA TODAY
Eco-Geo-Hike along the Dakota Hogback North of Boulder, Colorado
Sat., Nov. 6. Peter Birkeland, Dept. Geological Sciences (retired), University of Colorado, Boulder, CO 80309, birkelap@colorado.edu; Ven Barclay; Edwin Larson; Ralph Shroba. Max.: 20. Cost: $45. Begins and ends in Boulder.

Geological Reconnaissance of Dinosaur Ridge, Red Rocks, and Front Range of the Rocky Mountains near Morrison, Colorado

Overview of Laramide Structures along the Northeastern Flank of the Front Range
Sat., Nov. 6. Glen B. Stracher, Dept. of Science and Mathematics, East Georgia College, Swainsboro, GA 30401; (478) 289-2073, fax 478-289-2080, stracher@ega.edu; Gary Colalizzi, Steve Renner, Janet L. Stracher; Tammy P. Taylor. Max.: 45. Cost: $105.

Paleoclimate, Paleohydrology, and Paleoecology of the Morrison Formation in the Front Range of Colorado
Sat., Nov. 6. Stan Dunagan, Dept. of Geology, Geography & Physics, University of Tennessee, Martin, TN 38238, (731) 587-7959, fax 731-587-1044, sdunagan@utm.edu; Christine Turner; Fred Peterson; Tim Demko. Max.: 30. Cost: $105.

Paleontology and Volcanic Setting of the Florissant Fossil Beds
Sat., Nov. 6. Herb Meyer, National Park Service, Florissant Fossil Beds National Monument, P.O. Box 185, Florissant, CO 80816, (719) 748-3253, fax 719-748-3253, herb_meyer@nps.gov; Steven Veatch. Max.: 36. Cost: $125.

Stratigraphy and Paleobiology of Mammoth Sites in the Denver Area

HALF DAY—DURING THE MEETING

Tour of U.S. Geological Survey National Earthquake Information Center, Golden, Colorado

POSTMEETING FIELD TRIPS

Upper Cambrian and Lower Ordovician Stratigraphy of West Texas and Southern New Mexico

Ancient Depositional Environments Control Modern Aquifer Quality: Stratigraphy of Groundwater Resources in the Denver Area

Cenozoic Geology and Fossils of the Pawnee Buttes Area, Northeast Colorado
Thurs., Nov. 11. Emmett Evanoff, Dept. of Geological Sciences, Campus Box 399, University of Colorado, Boulder, CO 80309-0399, (303) 444-2644 (phone and fax), emmettevanoff@earthlink.net. Max.: 36. Cost: $85.

Consequences of Living with Geology: A Model Field Trip for the General Public

Eldorado Canyon: Shorefront Property and Birthplace of Mountains
Thurs., Nov. 11. Lin Murphy, 3625 Catalpa Way, Boulder, CO 80304, (303) 447-0656, info@earthlink.net. Max.: 36. Cost: $90.

Geological Reconnaissance of Dinosaur Ridge, Red Rocks, and Front Range of the Rocky Mountains near Morrison, Colorado

Laramide Horizontal Shortening in the Rockies: Faulting and Folding in Oblique Backlimb-Tightening Structures of the Northeastern Flank of the Front Range, Colorado

Underground Tour of Henderson Molybdenum Mine
Walking with Dinosaurs along Colorado’s Front Range

DENVER 2004 SHORT COURSES

GSA-SPONSORED SHORT COURSES
STANDARD REGISTRATION DEADLINE: SEPTEMBER 30

Registration information and course descriptions will be published in the June issue of GSA Today. For additional information, contact Edna Collis, GSA headquarters, ecollis@geosociety.org, or see GSA’s Web site, www.geosociety.org.

Evaporites: A Practical Approach

Introduction to Geographic Information Systems (GIS), Using ArcGIS9 for Geological Applications

Multi-Temporal Stereo Aerial Photography

Calibrated Peer Review Training for Faculty and Teaching Assistants: Writing Exercises for Large and Small Classes without the Pile of Papers to Grade
Sat., Nov. 6. Cosponsored by GSA Geoscience Education Division and National Association of Geoscience Teachers. Elizabeth Heise, University of Texas at Brownsville, Brownsville, Texas; Cinzia Cervato, Iowa State University, Ames, Iowa; Amanda Palmer-Julson, Blinn College, Bryan, Texas. Fee: $340. CEU: 0.8.

Characterization and Toxicity Assessment of Mine-Waste Sites

Estimating Rates of Groundwater Recharge

Hydrogeologic Field Methods

Management and Leadership Skills for Academic Administrators in the Geosciences

Practical Geoscience Ethics: Elements and Examples

OTHER COURSES AND PANELS

Registration and information can be obtained from the contact person listed.

Sequence Stratigraphy for Graduate Students
Fri. and Sat., Nov. 5–6. Free short course for graduate students. Cosponsored by British Petroleum (BP) and ExxonMobil. Instructors: Art Donovan (BP) and Kirt Campion (ExxonMobil). Information and registration: Art Donovan, donovan@bp.com, or Kirt Campion, kirt.m.campion@exxonmobil.com.

Biological Revolutions in the Neoproterozoic and Cambrian
Sat., Nov. 6. Sponsored by Paleontological Society. Organizers: Ben Waggoner, Dept. of Biology, University of Central Arkansas, Conway, AR 72035-5005, (501) 450-5037, fax 501-450-5914, benw@mail.uca.edu; Jere Lipps, Museum of Paleontology, University of California, Berkeley, CA 94720-4780, (510) 642-9006, fax 510-642-1822, jlipps@uclink4.berkeley.edu.

K–16 PROGRAM

Attention College Faculty, K–12 Teachers, Teacher Trainers, and Pre-Service Teachers:

Look for the K–16 Education Workshops listing in the June issue of GSA Today. Questions? Contact Christine McLelland, cmclelland@geosociety.org or (303) 357-1082, for more information.

The Annual Review of Earth and Planetary Sciences is ranked #3 by impact factor of all Geosciences, Multidisciplinary publications among the 122 publications, and #8 by impact factor of all Astronomy & Astrophysics publications among the 43 publications assessed by the ISI® Journal Citation Reports (JCR®).

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Do you ever feel the only way you can afford to go to a meeting is to panhandle? Now you don’t have to! Become a student volunteer and offset your meeting costs.

No upfront meeting registration fee required!

**FREE registration if you volunteer**

just 10 hours of your time.

**FREE Abstracts with Programs volume**

by volunteering 15 hours.

Additionally, volunteers receive a stipend of $25 for each half-day (5 hours) volunteered at the meeting. (Stipends can only be issued to students who have a U.S. government–issued Social Security Number, Green Card, or Student Work Visa.) New this year: optional partial food stipend available.
Guests Invited!

GSA extends a warm welcome to all spouses, family members, and friends to register for the Guest Program. Registration for the Guest Program begins in June.

The guest or spouse registration fee of $80 per person ($70 if you register by July 13) is for non-geologist spouses or family members and friends of professional and/or student registrants to the GSA Annual Meeting. The guest registration fee is required to attend guest activities, gain entrance to the Exhibit Hall, attend seminars and workshops (to be listed in the June issue of GSA Today), and take advantage of refreshments in the Guest Hospitality Suite. Formal tours (also listed in the June issue of GSA Today) will be offered at an additional cost. Fees cover the cost of professional tour guides, round-trip transportation, admission fees, and gratuities. Reservations for all tours will be accepted on a first-come, first-served basis. Since the tour operator requires a final guarantee weeks in advance, most tours have attendance minimums and maximums. Please register early to guarantee your spot.

Tours may be canceled if minimum attendance is not met.

The guest registration fee will NOT provide access to all technical sessions. However, guests can sign in with the hostess in the Guest Hospitality Suite and get visitor badges that allow them to attend a specific presentation.

Make plans now to participate in the GSA Guest Program at the Annual Meeting in Denver. After sightseeing trips, exploring Denver, and browsing in the Exhibit Hall, you’ll appreciate having a quiet place to sit down and have a beverage!

Guest Hospitality Suite Hours
Sun.—Wed., Nov. 7–10
8 a.m.—5:30 p.m.

Look for registration information in the June issue of GSA Today, or register online at www.geosociety.org.
**GSA MENTOR PROGRAMS**

at the GSA Annual Meeting

**ATTENTION**

**Students**

**Pursuing a Hydrogeology Career Path!**

The new Mann Mentors in Applied Hydrogeology Program makes it possible for up to 25 students to attend the distinguished Hydrogeology Division Luncheon and Awards Presentation luncheon, without cost to the students. Eligible students will have the chance to meet some of the nation's top hydrogeologists and observe the presentations of the coveted O.E. Meinzer Award, the Student Research Grants Awards, and the Distinguished Service Award from the membership of the GSA Hydrogeology Division. Eligible students are those who have indicated their professional interest in hydrology/hydrogeology on their GSA membership applications and who register for the GSA Annual Meeting by September 30, 2004. FREE tickets will be awarded to the first 25 students who respond to an e-mail invitation, based on the eligibility criteria above. Registration is required. Time and location to be announced.

For more information, contact Karlon Blythe, kblythe@geosociety.org.

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**Seeking Employment?**

Plan to attend the Careers Roundtable Discussions (formerly the Employment Opportunities in the Geological Sciences Roundtable Discussions). Along with getting a new name, this event has expanded, with mentors offering one-on-one career advice. These mentors hail from a broad range of geoscience-related careers representing academics, industry, and government agencies. If you are seeking employment now, or will be in the future, join this group for networking opportunities and job-market perspectives.

This FREE come-and-go event is open to everyone. Registration is not required.

For more information, contact Karlon Blythe, kblythe@geosociety.org.

**Careers Roundtable Discussions**

Sat., Nov. 6, 1–3 p.m.

Ballroom 1 (adjacent to GSA Employment Services)

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**Students: Check Out the Geology in Government Mentor Program!**

Plan to arrive early for this FREE lunch for undergraduate and graduate students. This popular annual event will feature a select panel of mentors representing various government agencies. Mentors will invite questions, offer advice about preparing for a career, and comment on the prospects for current and future job opportunities with their agencies.

Registration is not required; however, every student registered for the GSA Annual Meeting will receive a ticket to this event along with their badge. Limited attendance—arrive early!

For more information, contact Karlon Blythe, kblythe@geosociety.org.

**Geology in Government Mentor Program**

Mon., Nov. 8, 11:30 a.m.–1 p.m.

Location TBA

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Find us on the Web at www.geosociety.org.
STUDENTS: Apply for Travel Grants Today

The GSA Foundation has awarded $4,500 in grants to each of the six GSA sections. The money, when combined with equal funds from the sections, is used to help GSA undergraduate Student Associates and graduate Student Members travel to GSA meetings. For information and deadlines, please visit the Web sites from each Section listed below or contact the Section secretary directly.

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<td>Elizabeth Y. Anthony</td>
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<td><a href="mailto:eanthony@geo.utep.edu">eanthony@geo.utep.edu</a></td>
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<td><a href="http://www.geosociety.org/sectdiv/southe/">www.geosociety.org/sectdiv/southe/</a></td>
<td>Donald W. Neal</td>
<td>(252) 328-4392</td>
<td><a href="mailto:neald@mail.ecu.edu">neald@mail.ecu.edu</a></td>
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Call for Applications and Nominations for Geology Co-Editor

GSA is soliciting applications and nominations for the position of co-editor of Geology, an international geosciences journal for rapid publication of leading research. The co-editor will serve a four-year term, beginning in January 2005 (exact start date to be negotiated), and will be one of a three-editor team. A co-editor with expertise and broad interests in tectonics/structural geology would best complement the continuing editors’ strengths, but fields are flexible.

Desirable characteristics for the successful candidate include:

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

GSA provides the editor with a small stipend, as well as expenses for administrative assistance, mail, and telephone online. The editor will work out of his/her current location at work or home—no move is necessary.

If you wish to be considered, please submit a curriculum vitae and a brief letter describing why you are suited for the position. If you wish to nominate another, please submit a letter of nomination and the individual's permission and CV. Send nominations and applications to Jon Olsen, Director of Publications, GSA, P.O. Box 9140, Boulder, CO 80301, olsen@geosociety.org no later than September 7, 2004.


As the evidence for abrupt climatic and environmental change grows, the task of assessing the effects of rapid geological processes is becoming more important. Interest is growing in tracking and reporting landscape changes that take place within a normal human lifetime (<100 years), especially where there are high risks from natural hazards.

With support from GSA, the International Union of Geological Sciences is working to emphasize the importance of tracking rapid geological change in State of the Environment (SoE) reporting, national park management, long-term ecosystem monitoring and environmental impact assessments in general. Using the geoindicator framework developed primarily for non-geologists, a series of workshops and related activities has been held over the past five years to review and promote geological monitoring in Lithuania, Poland, Zambia, Egypt, Mauritania, Australia, Argentina, Peru, Colombia, the United States, and Canada. Further meetings are being planned for the Arctic, Algeria, Mozambique, Turkey, and Southeast Asia.

Despite the current global trend to reduce government services, including many national efforts to monitor and assess environmental change, there are encouraging signs. In the United States, the National Park Service has been engaged for several years in a series of meetings to identify geological processes of importance to park ecosystems and management. This process includes scoping out the human influences on landscape components. Ways to include geoindicators in monitoring the ecological integrity of national parks are also being developed in Canada. In Colombia, geoindicators are assisting in designing a national system to assess the environmental impacts of mining and quarrying. In Australia and Argentina, national networks are being developed to promote the tracking of abiotic landscape change. The geoindicators framework is proving to be helpful in setting the background for understanding more fully the ways in which past settlements and societies have responded to rapid landscape change. This is being done in cooperation with a major international project titled “Dark Nature—Rapid Natural Change and Human Responses” and a similar effort by International Geological Correlation Programme (IGCP) Project 490 (“The Role of Holocene Environmental Catastrophes in Human History”). The goal is to inform current efforts to adapt and mitigate the landscape effects of climate warming. For further information, see www.geoindicator.org and www.brunel.ac.uk/depts/geo/igcp490/igcp490home.htm.
Meet face-to-face with prospective students in a relaxed, informal setting by participating in the Graduate School Information Forum (GSIF) during the GSA Annual Meeting. Take advantage of this excellent opportunity to promote your school to more than 1,500 students.

Located just inside the entrance to the Exhibit Hall, next to the poster sessions, the GSIF booths are in a highly visible area. The forum will be open Sunday, 8 a.m.–8:30 p.m. This coincides with the Welcoming Reception in the Exhibit Hall on Sunday evening. The hours for Monday through Wednesday are 8 a.m.–5:30 p.m. You may choose from one day to all four days. Space is limited, and Sunday and Monday will be the first to sell out. Those schools reserving multiple days will be assigned first and to the most visible booths.

Participating schools will be promoted in the October GSA Today (pending submittal date of your reservation form), the 2004 Annual Meeting Program, and e-mail links on the GSA Web site so that prospective students may schedule appointments prior to the Annual Meeting.

Go online to reserve your space at https://rock.geosociety.org/forms/xGSIF_form.asp.

For more information, contact Kevin Ricker at (303) 357-1090 or kricker@geosociety.org.

Don’t delay—

GRADUATE SCHOOL INFORMATION FORUM

The Biggs Award was established by GSA to reward and encourage teaching excellence in beginning professors of earth science at the college level.

Eligibility
Earth science instructors and faculty from all academic institutions engaged in undergraduate education who have been teaching full-time for 10 years or fewer. (Part-time teaching is not counted in the 10 years.)

Award Amount
An award of $750 is made possible as a result of support from the Donald and Carolyn Biggs Fund (maintained by the GSA Foundation), the GSA Geoscience Education Division, and GSA’s Education and Outreach Programs. In addition, this award also includes up to $500 in travel funds to attend the award presentation at the GSA Annual Meeting.

Deadline and Nomination Information
Nomination forms for the 2004 Biggs Earth Science Teaching Award are posted at www.geosociety.org/aboutus/awards/biggs.htm. Or, contact Diane Lorenz, (303) 357-1026, dlorenz@geosociety.org. Nominations must be received by May 1, 2004.

Mail nomination packets to:
Diane Lorenz
Program Officer, Grants, Awards, and Medals
GSA
P.O. Box 9140
Boulder, CO 80301-9140

RESERVE YOUR SPACE NOW!
Secular Variation in Tectonics and Allied Fields

October 22–28, 2004

St. George, Utah

Conveners:
Dwight Bradley, U.S. Geological Survey, 4200 University Drive, Anchorage, AK 99508, (907) 786-7434, fax 907-786-7401; dbradley@usgs.gov
John Dewey, Geology Department, University of California, One Shields Avenue, Davis, CA 95616, (530) 754-7472, fax 530-752-0951, jfdewey@blue.ucdavis.edu

Plate reconstructions are a time-honored approach to synthesizing earth history. Geologic, paleomagnetic, and paleontological data have together revealed the broad outlines of global paleogeography and plate interactions back to the late Paleozoic. But the plate-reconstruction approach has two shortcomings: robust reconstructions are impossible for the deep past (because not enough rocks have survived), and even the best reconstructions do not reveal much about the past workings of the earth system.

This Penrose Conference will highlight a complementary approach to the study of earth history, which might be referred to as secular analysis. This involves the tracking of individual geologic variables as a function of geologic age. One such variable is Earth’s radiogenic heat production, which has declined exponentially since 4.5 Ga and thus has slowed the tectonic engine. Others include the strontium-isotopic composition of seawater, K/Na ratios of shales, ages of juvenile continental crust, and abundances of key rock types such as komatiites, blueschists, and red bed-copper deposits. To the growing number of practitioners, two advantages of secular analysis stand out: (1) many broad-scale problems are tractable despite the scarcity of rocks of certain ages; and (2) any viable explanation for a particular secular trend must also honor all other trends—hence the value of an encyclopedic approach.

Information on secular variation is now widely scattered, much of it in specialized literature, and it has never been synthesized on the scale that we visualize for this conference. Participants will be sought who can shed light on secular variations in the following broad areas:
- Earth’s tectonic regime
- particular tectonic settings
- plate reconstructions and plate-mosaic evolution
- the sedimentary record
- the igneous record
- the metamorphic record
- structural geology
- the fossil and organic record
- ore deposits
- paleoclimate
- atmospheric composition
- paleo-oceanography
- sea-level and continental hypsometry
- extraterrestrial events and forcings
- geodynamics
- global heat production
- geochemical cycles
- mantle evolution
- crustal growth and recycling

The meeting will cover the state of knowledge, working hypotheses, and key questions in long-term secular variation within these fields and perhaps others not listed. The goal is to achieve an atmosphere for new ideas, cross fertilization, and identification of new research opportunities. It will not be a surprise if huge gaps in knowledge are revealed, especially in structure and regional tectonics. In keeping with the complexity of the earth system, and mindful of the interplay between tectonics and most other fields, the conference is intentionally broad in scope. The focus will be on long time scales, ranging from the entire span of earth history down to a few hundred million years. Problems involving preservation, age assignments, sampling bias, and real versus apparent secular variation will be aired. Participants will be asked to key their data to an agreed-upon current geologic time scale, and, for ease of comparison, to plot results using a standardized time axis.

Planned Volume on Secular Variation. A separate call for papers will follow for contributions to a multi-chapter, post-conference volume, Secular Variation in Tectonics and Allied Fields. The deadline for papers will be around December 2005 and the target date for publication around December 2006. Contributors need not attend the conference. Contact editor Dwight Bradley to express an interest.

Venue and Logistics. The conference will be cosponsored by the U.S. Geological Survey, and it will be held at the Holiday Inn in St. George, southwestern Utah. This is a spectacular part of the world, only 42 miles from Zion National Park and 165 miles from the Grand Canyon. The estimated registration fee of $975 will cover lodging, meals, and the field trip, but will not cover transportation to the meeting site. The closest large airport is in Las Vegas, 120 miles to the south.

Field trip through the Grand Staircase. There is no better place than the Colorado Plateau to be reminded of the...
vastness of geologic time. Two out of the five meeting days will be devoted to a field trip through the “Grand Staircase” when we’ll visit the North Rim of the Grand Canyon, Zion National Park, Bryce Canyon National Park, and other locales. The formations of the Grand Staircase represent most of Phanerozoic time and were deposited in tectonic settings that include passive margin and foreland basin—all laid out in spectacular exposures.

To Apply. Contact the co-conveners by e-mail for application materials. We encourage interested graduate students to apply; some partial subsidies will be available. The conference will be limited to 75 participants.

Application deadline: July 1, 2004
Abstract deadline: September 1, 2004

Registrants with Special Needs. GSA is committed to making Penrose Conferences accessible to all. If you require special arrangements or have special dietary concerns, please contact one of the conveners.

From Ron Blakey’s Web site (http://jan.ucc.nau.edu/~rcb7/Grand_Staircase_topo.jpg)

University of Urbino
Summer School in Paleoclimatology

July 12-20, 2004
Urbino, Italy

Paleoceanography
Micropaleontology
Geochemistry
Climate Modeling

Instructors:

For more information: http://www.uniurb.it/USSP
Application deadline April 15, 2004

Rocky Mountain–Cordilleran Sections Joint Meeting
May 3–5, 2004 • Boise Centre on the Grove, Boise, Idaho

Information: C.J. Northrup, Boise State University, Department of Geosciences, 1910 University Dr., Boise, ID 83725, (208) 426-1009, cjnorth@boisestate.edu

Students: If you have career-related questions, plan to attend the Shlemon Mentor Program at the Cordilleran–Rocky Mountain Sections Joint Meeting to chat one-on-one with practicing geoscientists. These volunteers will answer your questions and share insights about how to get a job after graduation. Each day's program will offer a different set of mentors. These programs are made possible by the Roy J. Shlemon Fund, administered by the GSA Foundation.

Shlemon Mentor Program
Mon. and Tues., May 3–4, 11:30 a.m.–1 p.m.
Perch Room, Boise Centre on the Grove
Students will receive a FREE LUNCH ticket along with their registration badge to attend each Shlemon Program. However, space is limited. First come, first served.

www.geosociety.org/sectdiv/sections.htm
Wörner reviewed the latest interpretations of processes at canic belts, keynote speakers Charles Langmuir and Gerhard Andes in Colombia and the Cordillera and Cascades of the western United States. The case of México was compared with continental-volcanoes, volcaniclastic sedimentation, and related volcanic styles that promote explosive eruptions, sector collapse of the “Ring of Fire.” Discussions included the complexities of volcanic styles that promote explosive eruptions, sector collapse of volcanoes, volcaniclastic sedimentation, and related volcanic hazards. The case of México was compared with continental-margin volcanism at other places in the Americas, such as the Andes in Colombia and the Cordillera and Cascades of the western United States.

Working upward from the roots of continental margin volcanic belts, keynote speakers Charles Langmuir and Gerhard Wörner reviewed the latest interpretations of processes at convergent plate margins. Using compositional data mostly from the trans-Mexican volcanic belt lavas and thermal melting models of the subduction process, Langmuir proposed that controls of the degree of melting include wedge geometry and thermal structure, source compositions, and convergence rates.

Working with samples from the well-exposed eruption sequences of the central Andes, Wörner concluded that magma genesis through space and time was controlled by crustal heterogeneity and thickening since the Miocene. The posters covered mostly recent petrological studies of volcanic complexes in México, Central America, the Cascades, and New Zealand.

Stephen Grand described a newly funded project to image the Mexican convergent margin with a 50+ seismometer array, a work that should tie well into the many petrological transects of the volcanic belt.

Based on the Smithsonian database for the 1926 Mexican volcanoes, Jim Luhr concluded that the three main magmatic suites in México are (1) calc-alkaline magmas of the trans-Mexican volcanic belt and Northern Mexican Extensional Province, (2) lamprophyres of the western trans-Mexican volcanic belt, and (3) intraplate type mafic alkaline rocks of the Northern Mexican Extensional Province and Pacific Islands. Sixteen posters covered a wealth of new work on the petrology of trans-Mexican volcanic belt volcanoes, including the Chichinautzin volcanic field, which rims the southern end of the Valley of México. Xitle, one of the Chichinautzin monogenetic volcanoes, produced a lava flow with a $^{14}$C age of 1665 years B.P., which partly buried Cuicuilco pyramid and now underlies the campus of the National University.

While pungent smells from Popocatépetl occasionally swept the conference complex at Metepec, Fraser Goff and James Gardner gave keynote lectures on the physical role of gases in continental margin volcanism. Given the great depth of Popocatépetl’s crater and the possibility of eruptions at any time, in-situ gas sampling has been impossible. Therefore, most of Goff’s data were from simultaneous FTIR and COSPEC measurements of eruption plumes. Like most volcanoes at convergent margins, emissions from Popocatépetl are mostly water vapor with high values of $\text{SO}_2$, $\text{F}$, $\text{As}$, and $\text{Hg}$ (with respect to $\text{Cl}$). Over a four-year period, the $\text{HCl}/\text{SO}_2$ ratio has been increasing and $\text{HF}/\text{SO}_2$ ratios have been decreasing. $\text{CO}_2$ fluxes range from 40,000 t/day to >100,000 t/day. Plume emissions also contain $\text{SiF}_4$. The observed range of gas ratios indicates temperatures of 200 ± 20 °C, which may indicate reaction of gases with conduit walls or with ash particles in the cooling plume.

With an emphasis on rhyolites, James Gardner reviewed the dynamics of bubble growth in magmas, integrating observation with experiments. The pumice, ash, and gases erupted are all products of bubble nucleation, growth, and degassing. Bubble interactions and partial connectivity can produce coexisting bubbles that differ in size by more than 20 times. During the roundtable discussion, it was noted that there is passive degassing during eruptive phases.

Zimmer and Erzinger’s continuous measurements of fumaroles at Merapi, Indonesia, demonstrate the influence of rainfall on gas flux and temperatures; during the dry season, fumarole temperatures are constant. Using data from Mount Pinatubo, Philippines, Hammer concluded that the explosive eruption
of dense, microlite-rich, partly-degassed tephra, along with vesicular, microlite-free pumice during pulsatory eruptions reflects variable magma travel times.

Having constructed the volcanoes, the meeting moved on to their destruction via sector collapse, avalanches, and lahars. This session was an excellent introduction to the field trip during the last day of the meeting to deposits left by at least three sector collapses of the Paleo-Popocatépetl cone; the youngest of these deposits is ~23,000 yr B.P. Hummocky terrain and debris avalanche deposits south-southwest of Popocatépetl cover over 300 km$^2$ and have a cumulative volume of >30 km$^3$. The youngest of the avalanche deposits are overlain by blast and pyroclastic flow deposits. Preliminary studies indicate that runout was at least 70 km south of the cone. Sector collapse and debris avalanches have occurred at nearly all large Mexican composite cones.

In the Cascade Range of the United States, the dense forest makes documentation of lahar (volcanic mudflow) deposits extremely difficult. Kevin Scott is now documenting the extent and magnitude of lahar deposits with lidar imagery. This application has enhanced evaluation of lahar hazards, which in the past have been very conservative. He explained that lahar mobility is difficult to demonstrate to disaster planners and has found that comparing it with water floods gets the message across. Lahar warnings are possible. Survivors of the Nevado del Ruiz catastrophe felt ground tremors before the lahar arrived. On that basis, acoustic flow monitors have been installed in the valleys around Mount Rainier to provide at least a 45-minute warning to downstream towns.

In the panel discussion it was agreed that the sector collapse, avalanche, and mudflows that were generated by the 1980 eruption of Mount St. Helens was the turning point in recognizing this widespread hazard. Since 1980, 300 sector collapse deposits have been identified at volcanoes along continental margins; their volumes range from 0.1 to 5 km$^3$ (Lee Siebert). Hot research themes include the transition of sector collapse avalanches to debris flows and why some debris avalanches stop and others liquefy and keep moving; for example, the lahars formed during the last eruption of Cotopaxi reached the sea, 300 km downstream. The sedimentary aftermath of a large-scale eruption may be a hazard larger than the eruption itself. James White described eruptions on the North Island of New Zealand that buried entire drainage systems and created lakes. Subsequent failure of the tephra dams produced high-concentration flows that swept downstream areas now occupied by cities.

México has some of the largest ignimbrite deposits in the world. For example, in the Sierra Madre Occidental, ignimbrite sequences can be thousands of meters thick and have volumes of hundreds or even thousands of km$^3$. Most are associated with Miocene calderas and may have been erupted during the opening of the Gulf of California. Much work needs to be done on this province in spite of the difficulties offered by the terrain and isolation. Mike Branney provided a summary of what is known about massive ignimbrite deposits (“large explosive eruptions” were defined by Branney as those with volumes of >1 km$^3$ to >1000 km$^3$). Most are characterized by high mass flux sustained for hours or days and associated caldera collapse. The pyroclastic density currents produced during these eruptions can be fully dilute or granular-fluid-based, based on conditions near the lower flow boundaries. Complex deposit architectures are affected by the nature of the density current and the complexity of underlying terrain.

Within volcanic provinces with large volumes of rhyolite, it is often difficult to distinguish between densely-welded rheomorphic ignimbrites and clastogenic lava flows. Using examples from the Snake River Plain, Bill Bonnichsen described transitions from non-welded ignimbrites to high-grade rheomorphic ignimbrites to clastogenic lava flows and on out to domes having little evidence for fragmentation.

Dealing with a deadly but much smaller-scale eruption type than the large ignimbrites, the session on block and ash flows associated with dome collapse focused on recent eruptions at volcanoes like Colima, México, and
Montserrat. Block and ash flows begin with dome collapse and formation of decameter-sized blocks (Marcus Bursik). In the final deposit the same blocks have been fragmented into particles ranging in size from 1 mm to 2 m. High on the dome slopes (~35°), the deposits are 1 to 2 m thick, but in distal regions with slopes of 10° to 20° they are up to 8 m thick. Many are preceded by pyroclastic surges. Much of the mechanical crushing seems to occur at breaks in slope. Bursik also discussed modeling of these flows but emphasized “numerical models are useless without field observation.”

The last link in the chain of discussions that began with magma genesis was that of reducing risk at continental-margin volcanoes. The mitigation issues reviewed by Robert Tilling are:

- increasing population growth and air traffic;
- no capability to reliably predict explosive eruptions;
- the fact that most volcanoes are not monitored;
- a low frequency of destructive events; and
- effective communication between scientists, civil authorities, news media, and the population is at risk.

A major quandary concerns monitoring parameters versus time; when do you force local officials to make decisions? There is also the dilemma of acquiring funding for monitoring for infrequent but catastrophic activity. Hazard maps are useful for those who understand how to read them, but don’t work well for the public. Public lectures and pamphlets are useful but reach only about 1% of the public. Visualization of processes and videotapes of actual events are more effective, but not if the media will not present them to the public. Methods of reaching the public were discussed during the roundtable, with the suggestion that a system similar to that used by the weather service for tornado warnings be implemented.

Gavilanes noted that mixed signals put the population at risk during eruptions of Volcán de Colima during 1999–2003. There were many conferences in the villages, but conflicting signals from the authorities and the army created confusion and frustration among the residents. He also noted the great need for sociologists to work with volcanologists for effective hazard mitigation.

In slightly less than one week, this dynamic group of 104 workshop participants (including about 30 students) went from the mostly academic pursuit of petrology to the sociological aspects of volcanic disaster mitigation. What was evident is that all of the pieces are available to complete the puzzle, but that the volcanological community has a long way to go to assemble those pieces and to mitigate volcanic hazards. There is hope for increased volcanological research and successful disaster mitigation in México; at this Penrose Conference it was evident that, in addition to the well-respected Mexican volcanological community, there are many talented students at Mexican universities who will carry this work into the future.

For more information on the conference, visit http://tepetl.igeofcu.unam.mx/penrose/index.html. A GSA publication is also in preparation (Volcanic hazards in the México City metropolitan area from eruptions at Popocatépetl, Nevado de Toluca, and Jocotitlán stratovolcanoes and monogenetic scoria cones in the Sierra Chichinautzin volcanic field, by C. Siebe and J.L. Macías).

Additional Sponsoring Organizations:

- International Association of Volcanology and Chemistry of the Earth’s Interior
- Coordinación de la Investigación Científica, Universidad Nacional Autónoma de México (UNAM)
- Instituto de Geofísica, UNAM
- Instituto de Geología, UNAM
- Centro de Geociencias (Juriquilla, Querétaro), UNAM
- Centro Universitario para la Prevención de Desastres, Benemérita Universidad Autónoma de Puebla
- Gobierno del Estado de Puebla, México
- Volkswagen de México (Puebla)

Participants
Gerardo J. Aguirre-Díaz
Lilia Arana Salinas
José L. Arce
Zachary D. Atlas
Dawnika L. Blatter
Bill Bonnichsen
Michael Branney
REMINDER:
PENROSE CONFERENCE SCHEDULED

Mass Redistribution in Continental Magmatic-Hydrothermal Systems

September 6–12, 2004

Yellowstone National Park and Butte (Fairmont Hot Springs), Montana

Conveners:

John H. Dilles, Department of Geosciences, Wilkinson Hall 104, Oregon State University, Corvallis, Oregon 97331-5506, USA, (541) 737-1245, fax: 541-737-1200, dillesj@science.oregonstate.edu

Greg B. Arehart, Department of Geological Sciences, University of Nevada, Reno, Nevada 89557-0138, USA, (775) 784-6470, arehart@unr.edu

Peter I. Nabelek, Department of Geological Sciences, University of Missouri, Columbia, Missouri 65211, USA, (573) 884-6463, fax 573-882-5458, nabelekp@missouri.edu

Todd C. Feeley, Department of Earth Sciences 4 Hitching Post Road, Montana State University, Bozeman, Montana 59717-0348, USA, (406) 994-6917, fax 406-994-6923, tfeeley@montana.edu

Application Deadline: June 1, 2004

For complete information on this conference, see the December 2003 issue of GSA Today (also posted at www.geosociety.org/pubs/gsatoday/) or visit www.geosociety.org/penrose/.
Lee J. Suttner, Chair, Board of Trustees

The GSA Foundation is pleased to announce the addition of GSA Fellow James Slosson, chief engineering geologist and president of Slosson & Associates to its Board of Trustees.

Slosson received his entire formal academic training in geology at the University of Southern California. Prior to starting his company, which specializes in various areas of applied geoscience, including hazard mitigation and prevention, forensic geology, earthquake/seismic studies, and groundwater geology, he was state geologist for California and chief of the California Division of Mines in Geology. He has also spent over 35 years teaching in academic institutions.

Slosson has served on a number of local, state, and national commissions and advisory boards. He has also authored more than 100 papers, chiefly on natural and human-caused geologic hazards and their consequences. The Society has bestowed on him its Richard Jahns Distinguished Lecturer Award, the Distinguished Practice Award, and the E.B. Burwell, Jr., Award, the latter for his coauthored book *Forensic Engineering*. He was the first to be chosen as a GSA Roy J. Shlemon Applied Geology Mentor.

The Board will benefit greatly from the wisdom and associations Slosson has obtained during his broad and successful career in applied geoscience. Please join me in expressing appreciation to him for assuming this important responsibility.

Most memorable early geologic experience:
In late June (about 1970) Clarence Hall and I met Ben Page and Tom Dibblee in the central coast range to talk geology. Tom confirmed the legend that he supplemented his field diet with vegetables that fell off produce trucks!

—W.G. Ernst
GSA FOUNDATION SEEKS PRESIDENT

The Foundation of the Geological Society of America seeks a geoscientist, preferably with national recognition for achievements in the geosciences and administration, to be its president. The individual should have a strong interest and experience in, or working knowledge of, fund raising and development. Primary responsibilities will include oversight and direct participation in fund raising for GSA programs and activities; identifying, cultivating, and soliciting major donor prospects including individuals, corporations, and foundations; stewardship of funds; and staff administration. This person will be expected to have a major role in designing and implementing a strategic fund raising and development plan for the Foundation, and to closely and regularly interact with the executive director of the Geological Society of America and members of its staff, the GSA Foundation Board of Trustees, and the GSA Council. The president will report to the GSA Foundation Board of Trustees and be assisted in the Foundation by a full-time director of operations and a data manager.

The position will be approximately half time, with a flexible schedule and with the bulk of the activities to be conducted from the Society’s headquarters in Boulder, Colorado, although full-time relocation to the Boulder area may not be required. A range of compensation options exists, depending on experience and qualifications of the candidate, and the length of the appointment. Interested persons should electronically transmit a letter of application, resume/vita, and the names, addresses, and telephone numbers of three references to Lara Womack, GSA Human Resources Director, lwomack@geosociety.org, or, if unable to transmit electronically, mail the information to GSAF President Search Committee, c/o Lara Womack, P.O. Box 9140, Boulder, CO 80301-9140. Nominations of potential candidates by members of the geoscience community are also encouraged. Effective closing date for the applications is May 15, 2004, with a target starting date of September 1, 2004. The GSA Foundation is a non-profit corporation and an Equal Opportunity, Affirmative Action Employer.
MEETINGS CALENDAR

2004


October 20  Ohio River Valley Soils Seminar XXXV—Rock engineering and tunneling, Louisville, Kentucky. Information: Tom Rockaway, University of Louisville, Department of Civil and Environmental Engineering, Louisville, Kentucky 40292, (502) 852-3272, trockaway@louisville.edu. (Abstract deadline: May 1, 2004.)


2005

November 6–10  International Annual Meetings of the American Society of Agronomy (ASA), Crop Science Society of America (CSSA) and Soil Science Society of America (SSSA), Salt Lake City, Utah, USA. Information: Keith Schlesinger, kschlesinger@agronomy.org, www.asa-cssa-sssa.org/anmeet, (608) 273-8080.

2006

November 12–16  International Annual Meetings of the American Society of Agronomy (ASA), Crop Science Society of America (CSSA) and Soil Science Society of America (SSSA), Indianapolis, Indiana, USA. Information: Keith Schlesinger, kschlesinger@agronomy.org, www.asa-cssa-sssa.org/anmeet, (608) 273-8080.

Visit www.geosociety.org/calendar/ for a complete list of upcoming geoscience meetings.

History of Geology Division Initiates Student Award

GSA’s History of Geology Division is soliciting proposals for a student award for the amount of $500 for a paper to be given at the national GSA meeting. It may be a history of geology paper or a literature review of ideas for technical work.

Are you interested in where the ideas that you work with came from? How do you know your research is original? What ideas have been prominent in the literature review you have done for your thesis or dissertation? Were there ideas that didn’t work out? Why? Is your portion of our science “refining the numbers” and extending observations, or are you working on a novel theory? Is there part of geology whose origins you would like to investigate?

The History of Geology Division would like to hear from you! Mentors are available to help you with this process, or you may work with your own faculty. For proposal guidelines and application forms, contact: Professor William Brice, wbrice@pitt.edu, Geology and Planetary Science, University of Pittsburgh at Johnstown, Schoolhouse Road, Johnstown, PA 15904.

Due date for proposals and application is May 1, 2004, so that content and the official GSA abstract can be refined. The Division award committee will make the selection.

Science Fellowship at the Library of Congress

The Nielsen & Bainbridge Corporation, a leading manufacturer of products to preserve art work, will sponsor a fellowship in conservation science at the Library of Congress. The 12-month fellowship will begin in the fall of 2004 and offer a $35,000 stipend.

The goal of the fellowship, located in Library Services, Preservation Directorate, Research and Testing Division, will be to conduct research into the effects of zeolites (molecular sieves) on the long-term stability of library materials and to develop practical library applications for this technology. An important element of the fellowship involves working closely with scientists from
In Memoriam

Francis R. (Joe) Boyd Jr.
Washington, D.C.
January 12, 2004

Tudor T. Davies
Woodbridge, Virginia
November 27, 2003

Jose R. Dominguez
Caracas, Venezuela
January 14, 2004

Renaud M. DuDresnay
Rabat, Morocco
November 9, 2003

Sidney S. Galpin
Clarksburg, Washington
November 17, 2003

William R. Moran
La Canada, California
January 22, 2004

Edward L. Reed
Midland, Texas
November 27, 2003

Donald W. Peterson
Albuquerque, New Mexico
December 12, 2003

Clay T. Smith
Socorro, New Mexico
November 20, 2003

Wilhelmus T. Van Middelaar
Stamford, Connecticut
January 23, 2003

Robert A. Vargo
California, Pennsylvania
January 9, 2004

the Getty Conservation Institute in Los Angeles who have conducted important research into zeolites.

Individuals interested in applying for the fellowship should submit a cover letter describing their interest in this opportunity, a resume that outlines pertinent experience and the names of three references who can attest to their qualifications.


For additional information, visit www.loc.gov/preserv.

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Ethical Guidelines for Publication

Society publications are the vehicle in which the results of scientific inquiry, guided by the scientific method, are shared with other geoscience researchers and made available to a wider public audience. Results presented in Society publications advance research, inform governmental policy decisions, educate students, and assist the private sector in a wide range of endeavors. Thus it is important for the Society to maintain a level of quality and integrity in its publication process. This responsibility rests with all involved in the publication process—authors, reviewers, editors, GSA officials, and GSA staff. The following document outlines a set of ethical guidelines for all those involved in GSA publications (journals, books, maps, abstracts, electronic media). Adherence to these guidelines should promote fair treatment of manuscripts through the peer review process.

This document draws heavily on ethical guidelines prepared by other scientific societies, most notably the American Chemical Society. The list of sources below also includes more general documents on ethics in science consulted in preparation of these guidelines.

- National Academy of Sciences: On Being A Scientist: Responsible Conduct In Research (stills.nap.edu/html/obas)
- American Physical Society (www.aps.org/statements/02_2.html)
- American Geophysical Union (www.agu.org/pubs/pubs_guidelines.html)
- American Mathematical Society (www.ams.org/secretary/ethics.html)

1. Society Officers, Councilors, and Society Staff

1.1. Council is responsible for setting policy for all GSA publications and appointing editors of books and journals. The Publications Committee, as an appointed committee of Council, offers advice and makes recommendations on publication policy to Council.

1.2. The Executive Director is responsible for ensuring that publications policies enacted by Council are carried out.

1.3. Editors of books and journals are expected to carry out editorial duties in a manner consonant with policies set by Council and consistent with the Bylaws of the Society. They should work closely with the Executive Director and appropriate GSA headquarters staff (e.g., Director of Publications, Managing Editors, etc.).

1.4. Editors have full responsibility for editorial and technical decisions on journal and book content. Society Officers, Councilors, and headquarters staff (including the Executive Director) should not intervene or comment on editorial decisions on individual manuscripts.

1.5. Inquiries from Councilors and Officers on manuscripts under consideration will be handled in the same manner as communications from the general membership, which reflects the editorial staff’s standard practices. Communications from Officers and Councilors about editorial business are considered official Society business, unless otherwise identified. Official inquiries will receive prompt and complete action that becomes part of the Society’s official record.

2. Editors, Associate Editors, and Guest Editors of Books

2.1. Editors will give manuscripts unbiased consideration.

2.2. Editors should process manuscripts rapidly.

2.3. The Editor has sole responsibility for acceptance or rejection of a manuscript. Manuscripts should have peer review, but the Editor may reject or accept for cause (inappropriate for journal, clearly of poor quality, contents previously published elsewhere, etc.)

2.4. The Editor and editorial staff should not disclose information about submitted manuscripts except to reviewers, Associate Editors, Editorial Board members, and GSA publications staff. Information about a manuscript may be shared, with the author’s permission, once a manuscript is accepted and scheduled for publication (e.g., new releases, pre-publication posting of the abstract, or inclusion in a list of contents, etc.).

2.5. Responsibility for manuscripts submitted by the Editor should be delegated to another Editor, Associate Editor, or Editorial Board member.

2.6. The Editor should not handle manuscripts for which there is a real or perceived conflict of interest. Examples include, but are not restricted to, past (within the last 5 years) or current collaboration, personal friend, employer or employee, family relationship, institutional relationship, past or present graduate advisor or advisee, someone with whom the reviewer has had a past or ongoing scientific controversy, or situations where the Editor could stand to gain economically by publication or rejection of the manuscript. Editorial responsibility should be delegated to another Editor, Associate Editor, or Editorial Board member.

2.7. The Editor should not use information, data, theories, or interpretations of submitted manuscript in her/his own work until that manuscript is in press or published unless the author has given permission to do so.

2.8. If an Editor is presented with convincing evidence that the main
3. Authors and Co-authors

3.1. Manuscripts should contain original, new results, data, ideas and/or interpretations not previously published or under consideration for publication elsewhere (including electronic media and databases).

3.2. Authors should be encouraged to avoid fragmentation of their published submitted work where practical.

3.3. Authors should inform the Editor of related manuscripts under consideration elsewhere and provide copies if requested.

3.4. Fabrication of data, results, selective reporting of data, theft of intellectual property of others, and plagiarism are unethical practices and unacceptable.

3.5. Information obtained privately (e.g., in conversation, correspondence, or discussion with third parties) should not be used or reported in a manuscript without explicit permission from the party with whom the information originated. Information obtained in the course of confidential services (e.g., refereeing manuscripts or grant applications) should be treated similarly.

3.6. Manuscripts will contain proper citation of works by others, especially publications of the original hypotheses, ideas, and/or data upon which manuscript is based.

3.7. Data and/or samples (especially unusual or rare materials) upon which a publication is based should be made available to other scientists, except in special circumstances (patent protection, privacy, etc.), in the manuscript or through accessible data repositories, databases, museum collections, or other means when requested.

3.8. Authorship

3.8.1. Authorship should be limited to those who have made significant contributions to the concept, design, execution or interpretation of the work reported in a manuscript; others who have contributed should be acknowledged.

3.8.2. Author order should be agreed on by all authors as should any changes in authors and order that occur while the manuscript is under review or revision. Changes in authorship must be submitted to the Editor in writing and must be signed by all authors involved.

3.8.3. Authors and co-authors should review and ensure the accuracy and validity of results prior to submission; co-authors should have opportunity to review manuscript before submission.

3.9. Authors should reveal to the Editor any potential conflict of interest (e.g., a consulting or financial interest in a company), that might be affected by publication of the results contained in a manuscript. The authors should ensure that no contractual relations or proprietary considerations exist that would affect the publication of information in a submitted manuscript.

3.10. Authors are encouraged to disclose major funding sources (e.g., government agencies, private foundations, private industry, universities) for reported research.

3.11. Prepublication via Internet or other methods is prohibited.

4. Reviewers

4.1. A reviewer should disclose real or perceived conflict of interests to the Editor before agreeing to write a review. Examples include, but are not restricted to, past (within the last 5 years) or current collaboration, personal friend, employer or employee, family relationship, institutional relationship, past or present graduate advisor or advisee, someone with whom the reviewer has had a past or on-going scientific controversy, or situations where the reviewer could stand to gain economically by publication or rejection of the manuscript. The Editor will decide if the conflict is severe enough to prevent the reviewer from writing a fair, objective review.

4.2. A reviewer should decline to review a manuscript if she/he feels technically unqualified, if a timely review can’t be done, or if the manuscript is from a scientific competitor with whom the reviewer has had an acrimonious professional relationship, or a conflict of interest as defined above (section 4.1).

4.3. Reviewers should be encouraged, but not required, to sign reviews. The Editor will preserve anonymity of reviewers should a reviewer elect to remain anonymous.

4.4. Reviewers should treat the manuscript as confidential.

4.5. Reviewers should ask the Editor for permission to discuss the paper with others for specific advice, giving names and reasons for such consultation.

4.6. Reviewers should not pass the manuscript to another to carry out the review without permission from the Editor.

4.7. Reviewers should not use information, data, theories, or interpretations of the manuscript in their own work until that manuscript is in press or published unless the author has given permission to do so.

4.8. Reviewers should clearly support and justify the basis for their review analysis.

4.9. Reviewers should alert the Editor to similar manuscripts published or under consideration for publication elsewhere in the event they are aware of such. However, it is the responsibility of the Editor, not the reviewer, to decide on the proper course of action once so informed.
EMERGENCE OF A PARADIGM

Once considered vast and unconnected, Earth’s surface environment is now seen as finite and highly interconnected by a complex web of feedbacks among the biota, oceans, atmosphere, lithosphere, and cryosphere. This Earth systems paradigm is being shaped by geoscientists and their colleagues in diverse disciplines of the natural sciences. Together we are seeking a better understanding of the nature of these feedbacks in the modern world, how they have emerged and evolved over Earth history, and how they will respond to human perturbations in the future.

The Geological Society of America (GSA) and the Geological Association of Canada (GAC) are combining their resources, as GSA did with the Geological Society of London in 2001, to co-convene a broad, interdisciplinary meeting to discuss the advances made in the last four years in our understanding of Earth System Processes.

THE THEMES

Ancient Earth Systems will explore the contentious hypotheses describing the nature and drivers of environmental and biotic evolution on geologic time scales, some of which involve extraterrestrial influences and exchange with Earth’s deep interior. As we clarify the processes that drive evolution of the Earth system, we come closer to understanding our origins and the future of our planet. We also learn how to refine our search for habitable environments and life elsewhere in the universe.

Modern Earth System Processes will delve into the processes that link the components of the Earth system across all scales of space and time. Interdisciplinary studies are just now beginning to elucidate these feedbacks through observation, experimentation, and modeling. These studies provide the phenomenological basis for the investigation of the evolution and future of the Earth system.

Earth System Futures will address important questions about the Earth’s future. Can we understand the interactions of the Earth system well enough to predict how human-induced and natural changes in one component will affect other components over the next century to millennium? Can we make scientific, social and economic decisions that will minimize the likelihood of catastrophic stress on the biosphere?

THE VENUE

Earth System Processes 2 will be held at the spacious and well-appointed Westin Hotel in Calgary, Alberta, Canada. Calgary is strikingly beautiful in its high plains setting just beyond the foothills of the Canadian Rockies, and the comfortable, friendly city is well known for welcoming visitors from all over the globe. Plan to travel with family or friends and include a vacation to explore all the classic geology, paleontology and geomorphology that Alberta offers. Enjoy August in Calgary and the Rockies—long, sunny days, crisp clear nights—a perfect spot to gather with fellow scientists and advance our understanding of Earth system processes.

CALL FOR THEME SESSION PROPOSALS

The organizing committee seeks your help in putting together a suite of theme sessions that represents cutting-edge research on the general themes of the meeting. Theme sessions may fit squarely into one of the three general themes or may cut across them. They should attract a core representation from the geosciences, but should also draw in our colleagues from other disciplines.

Proposals for Theme Sessions should be submitted electronically at the ESP2 website, and include:
1. A brief description of the theme.
2. A justification for inclusion in ESP2, including indications that the session will draw sufficient abstracts and be well attended.
3. A list of possible invited speakers and the topic they would likely discuss.

Theme Session Proposals must be submitted electronically and received by September 15, 2004. If you have questions, please contact one of the technical program chairs or any of the members of the technical program committee.
Positions Open

GLACIAL GEOLOGIST

The Department of Earth Sciences and The Climate Change Institute of the University of Maine seek to hire an entry-level Ten Track Assistant Professor to begin in the Fall of 2004. The opening is to fill a retirement position, and will be in the area of Glacial and Quaternary Geology. The successful candidate will have an appointment that is approximately 70% research and 30% teaching. He/she will be expected to teach undergraduate and graduate courses in glacial geology and develop and teach graduate courses in her/his specialty. He/she will be expected to advise graduate students. A completed Ph.D. in Geology will be required by September 1, 2004. Other criteria include a record of publication, evidence of commitment to funded research, and excellent teaching abilities. Published research interests in the region comprising New England, the Maritimes, and adjacent areas will be a plus, but willingness to direct student projects in the region is a must. The University of Maine is located in a region of outstanding Pleistocene glacial and glaciomarine landforms and stratigraphy, complex land-sea level interactions, and key sections for unraveling timing and processes of climatic interactions. The successful candidate will have research interests in glacial geology such as glacial processes, glacial landforms, Quaternary stratigraphy, dating and mapping. The Department and Institute have a tradition of strong interdisciplinary research interests among geologists, glaciologists, paleoecologists, historians, climate modelers, and anthropologists, with active participation in the Maine Geological Survey, and internationally. The successful candidate will have a demonstrated record and interest in continuing interdisciplinary science collaboration.

Applicants should send a cover letter, curriculum vitae, and the names, addresses, phone numbers (and e-mail addresses, if possible) of three referees to: Chair, Glacial Geologist Search Committee, Department of Earth Sciences, University of Maine, 111 Bryant Global Sciences Building, Orono, ME 04469-5790. Reviews of applications will begin April 16, 2004, and continue until the position has been filled. For additional information, visit our websites at: http://www.geology.umaine.edu/ and http://www.ume.umaine.edu/geocel/. The University of Maine is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply.

POSTDOCTORAL RESEARCH POSITIONS

NATIONAL CENTER FOR ENVIRONMENTAL DYNAMICS (NCED) UNIVERSITY OF MINNESOTA

NCED has funding for several (3-6) positions for postdoctoral research associates in Synthesis of GEOSynth Dynamics. The Center’s research focus is channels and channel networks, with a strong emphasis on linking ecology and geomorphology.

The postdoctoral researchers hired under this announcement will form the nucleus of NCED’s Synthesis of GEOSynth Dynamics research. NCED research results into models and modeling algorithms. Quantitative proficiency and a taste for collaboration are required. Competitive research stipend, health and dental benefits, graduate student status, and/or PhD. A graduate degree in geology, civil engineering, biology, and/or ecology, especially with a modeling emphasis, is highly desirable.

Synthesis Group postdocs may be held at any NCED research institution: St. Anthony Falls Laboratory (University of Minnesota), University of California Berkeley, University of Wyoming, Massachusetts Institute of Technology, or Princeton University. Regardless of where each postdoc is based, activities of the Synthesis Group will be highly collaborative. All members of the Synthesis Group will maintain close contact with each other and all NCED researchers via regular meetings (weekly teleconferences).

Applicants should send a CV with names of three references to Rochelle Storfer, National Center for Earth Surface Dynamics, St. Anthony Falls Laboratory, 23 Third Ave S.E, Minneapolis, MN 55414.

The University of Minnesota is an equal opportunity employer and educator.

SENIOR LEVEL EXECUTIVE AMERICAN GEM SOCIETY LABORATORIES

American Gem Society Laboratories (www.agslab.com), known for its diamond Cut Grade and Cut Grade research, is currently looking for a senior level executive to implement growth plans, develop lab products and services, and maintain AGS diamond grading standards. Must have exceptional gemological knowledge and experience, BS in Business and/or 10-15 years of management experience in a related field. Excellent benefits. Drug Free Environment/EOE. Send resumes with salary history to: careergs@agslab.com or fax (702) 255-9861.

LECTURER/LAB MANAGER IN GEOLOGY

Bradley University

The Department of Geological Sciences in the School of the Environment at Bradley University invites applications for the position of Lecturer/ Lab Manager in Geology. This is a full-time position, with benefits, and is renewable annually, but it is not a tenure-track position. Primary duties include teaching one course per term, managing teaching laboratories and materials, developing curricula, and participating in the department’s outreach efforts. Applications are due by the end of the Fall semester of August 15, 2004.

The Department of Geological Sciences has the responsibility of providing introductory courses that fulfill several university science and general education requirements. Large numbers of non-science majors take these courses, with their associated laboratory classes, each requiring an assistant professor to teach two or three lecture sections per semester of physical geology, earth resources, or environmental science, coordinating laboratory and large lecture classes, supervising graduate teaching assistants, and assisting with departmental outreach efforts.

The position has a Ph.D. in earth sciences, or a related field. Preference will be given to candidates with prior teaching experience and a strong historical and geologic software packages. Nine-month starting salary will range from $8,000 to $15,000 depending on qualifications. Opportunities exist for collaboration in geoscience education research and summer teaching support.

Interested applicants should send a letter of application, curriculum vitae, statement of teaching philosophy, and the names and addresses of three persons who may be contacted as professional references to the Chair, Search Committee, Department of Geological Sciences, Room 340 Brackett Hall, Clemson University, Clemson, S.C. 29634-5919. Review of applications will begin on April 1, 2004, and continue until the position is filled.

Clemson University is an equal opportunity, affirmative action employer. Women and minority candidates are encouraged to apply.

BRADLEY UNIVERSITY TEMPORARY ASSISTANT PROFESSOR OR INSTRUCTOR IN GEOLOGY

The Department of Geological Sciences at Bradley University is seeking candidates for a Full-Time Assistant Professor or Instructor for a one year term beginning in August, 2004 for the 2004-2005 school year.

Responsibilities: Serve as a full-time faculty member in the Department of Geological Sciences. Teach courses in introductory physical geology, introductory environmental science, or geology, is currently looking for a senior level executive

ENVIROMENTAL GIS POSITION

TEXAS CHRISTIAN UNIVERSITY

Texas Christian University (TCU) invites applications for a full-time, tenured or tenure-track position in Earth Resources GIS beginning August 2004. The appointment will be a tenure track position in the Department of Geography. The successful candidate will be expected to collaborate with the Remote Sensing and GIS and the Institute of Environmental Studies. Candidates must possess a strong background and track record in environmental and geoscience GIS applications. Responsibilities will include building upon an existing GIS/ Remote Sensing curriculum through development of introductory and advanced ArcGIS courses. Other teaching duties will reflect departmental needs, GIS background and scientific expertise of the individual. Candidates should demonstrate an equal commitment to both teaching and research. This is an opportunity-rich appointment; the candidate will be expected to foster cross-campus collaborations, and bridge the link between the university and a very active regional GIS community.

Applications should send a vita, statement of teaching and research interests, and contact information for three references to: R.N. Donovan, Chair, Department of Geography, Texas Christian University, Fort Worth, TX 76129. Review of applications will begin April 1 and continue until the position is filled. TCU is an AA/EEO employer and encourages a diversity of applicants.

Opportunities for Students

Graduate Assistant Funding, Wesleyan University, Middletown, CT. The Graduate School and Environmental Sciences announces a graduate assistantship for a Master's degree in Earth Sciences. We are committed to fulfilling the need for student research on broad range of topics in earth and environmental sciences. Areas of departmental expertise include earth-
surface processes, remote sensing, planetary geology, geochemistry, clastic sedimentology, paleoceanography, volcanology, structure, and tectonics. Graduates of our program have gone on to successful positions in Ph.D. programs, government agencies, and private industry. The successful applicant will receive 9-month stipend the first year and a 12-month stipend the second year, of not less $14,181 and $18,908 respectively. Interested candidates should contact: Dr. Suzanne O’Connell at (860) 685-2263, soconnell@wesleyan.edu. Application information is available at: http://www.wesleyan.edu/ees/graduateprogram.html.

Masters Graduate Assistantships. Eastern Kentucky University. The Dept. of Earth Sciences, Eastern Kentucky University (www.earthscience.eku.edu) has Teaching Assistantships available for the 2004-2005 academic year for Masters students. These assistantships offer 9 months of stipend support, generally for two academic years. Students must apply for graduate assistantships no later than 1 June 2004. Please contact Dr. Melissa Dieckmann, Director of Graduate Studies (859-622-1276; melissa.dieckmann@eku.edu) for further information. Our department offers individual instruction from a geology faculty of seven with research opportunities in geochemistry, hard rock petrography, karst hydrology, ocean science, sedimentation and stratigraphy, and tectonics. Our location in central Kentucky offers an excellent natural laboratory in the surrounding region and in surrounding states. EKU is an EEO/AA institution that values diversity in faculty, staff, and student body. In keeping with this commitment, our department welcomes applications from diverse candidates.

Masters Research Opportunity. Eastern Kentucky University. Dr. Walter S. Borowski has financial support available for Master’s thesis research at the Dept. of Earth Sciences, Eastern Kentucky University (www.earthscience.eku.edu). This research involves sulfur extractions from authigenic sulfide minerals residing in deep-sea sediments, and subsequent measurement of sulfur isotopic composition. Students will be supported for summer research contingent on their acceptance as a graduate assistant within the department. These assistantships offer 9 months of stipend support, generally for two academic years (please refer to the companion advertisement). Students must apply for graduate assistantships no later than 1 June 2004. Please contact Walter Borowski (859-622-1277; w.borowski@eku.edu) for further information. EKU is an EEO/AA institution that values diversity in faculty, staff, and student body. In keeping with this commitment, the department welcomes applications from diverse candidates.

The Yellow Springs Instruments Environmental PhD Fellowship. Wright State University is pleased to announce a new YSI Environmental Sciences PhD Fellowship. The Research Fellowship is for $25,000 with tuition and fee waivers. This prestigious award will be given to a highly qualified applicant accepted into the Environmental Sciences PhD Program at WSU. Students may apply with either a BS or MS degree from a relevant major (e.g., biology, chemistry, geology, physics, toxicology, environmental health sciences). The program provides a strong interdisciplinary focus both in the course work and dissertation research, with a focus on contaminant fate and effects in three areas of faculty expertise: environmental toxicology and chemistry, environmental stressors, and environmental geophysics and hydrogeology. Review of applications for the 2004-2005 Academic Year will begin in January, 2004, and continue until the position is filled. For more information on the curriculum, faculty research areas and application materials see http://www.wright.edu/academics/envsci.

GEOSCIENCE DIRECTORY

Books—Used & Rare
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