GSA TODAY

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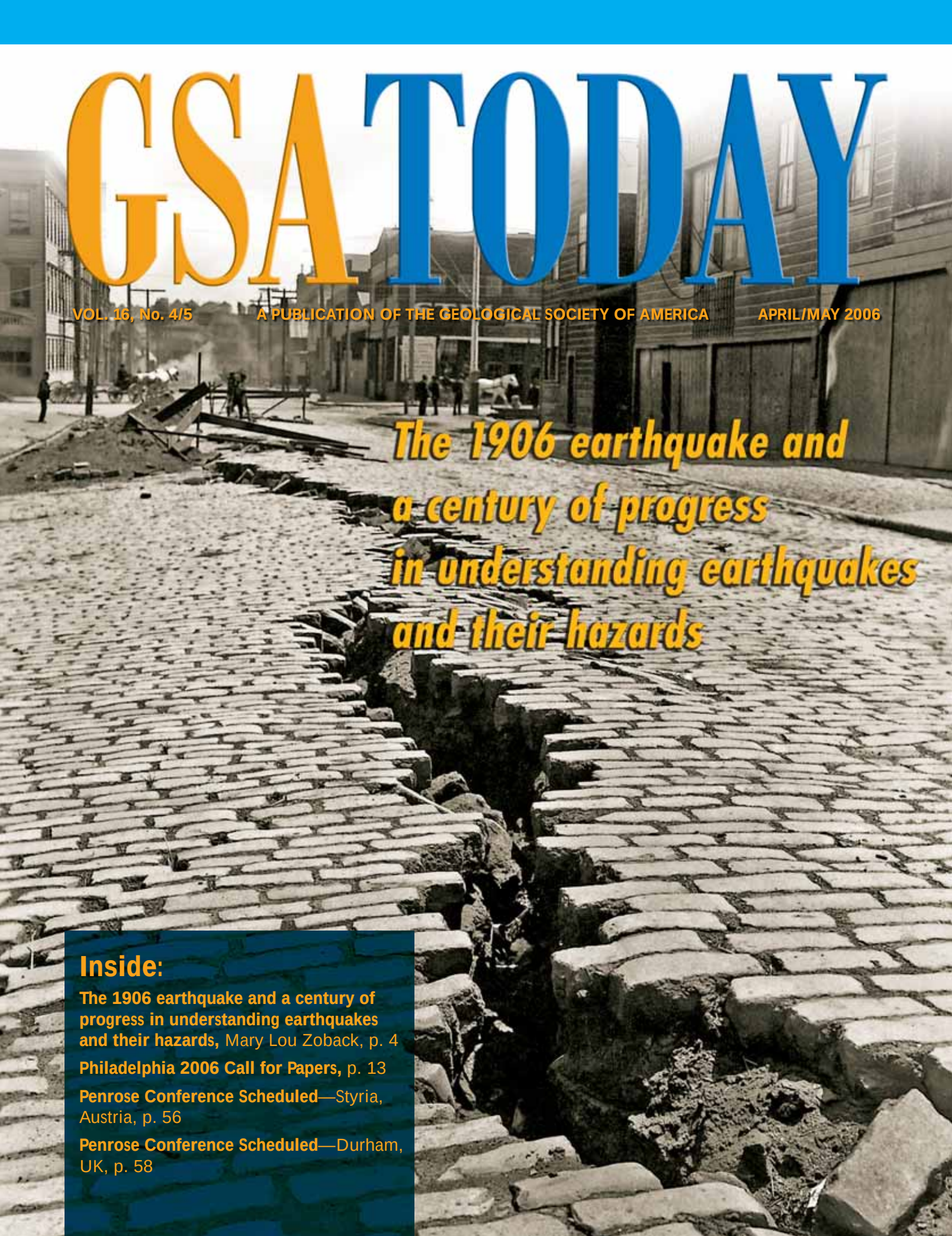
The 1906 earthquake and a century of progress in understanding earthquakes and their hazards



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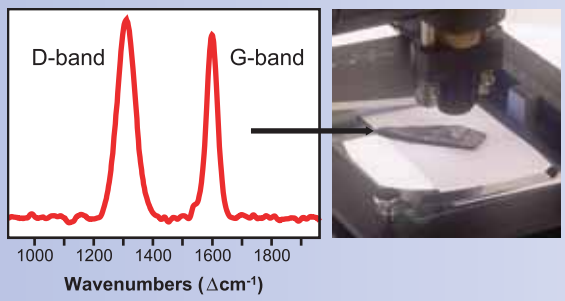

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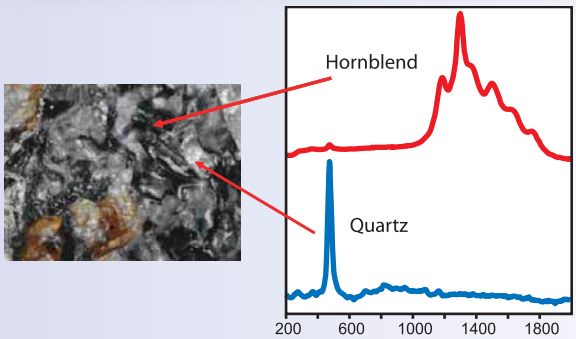

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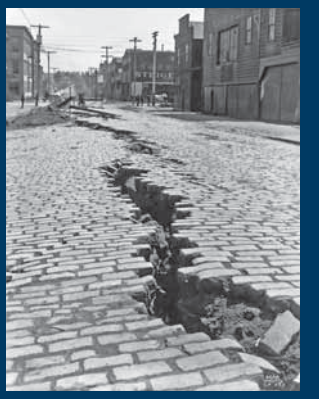

Cover: The 1906 San Francisco earthquake sparked massive damage in the city and surrounding areas, as illustrated by this crack running through a San Francisco street. Photo courtesy California Historical Society. See "The 1906 earthquake and a century of progress in understanding earthquakes and their hazards" by Mary Lou Zoback, p. 4–11.

GSA TODAY

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SCIENCE ARTICLE

The 1906 earthquake and a century of progress in understanding earthquakes and their hazards

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INTRODUCTION

At the turn of the century, San Francisco was the wealthiest and most important city on the Pacific Coast. With a population of 400,000, it was the eighth largest city in the country and the economic center of the West, largely the result of mining and railroad wealth. Then, in the early dawn of 18 April 1906, the city was rocked awake by a violent earthquake, which, together with the subsequent firestorm, reduced much of the city to ashes and ruins. The 1906 earthquake and subsequent fire remains one of the most devastating natural disasters this nation has known. At least 3000 people were killed, and in San Francisco alone, 225,000 out of the city's ~400,000 residents were left homeless (Hansen and Condon, 1989). While the 1906 earthquake marked a seminal event in the history of California, it can also be remembered as the birth of modern earthquake science in the United States. It was the first time that an earthquake was recognized and documented as the result of a recurring tectonic process of strain accumulation and release. Under the leadership of Professor Andrew Lawson, of the University of California (UC)–Berkeley, teams of scientists and engineers spread across the state, carefully collecting and documenting physical phenomena related to the quake. Their exhaustive data and thoughtful conclusions, published in landmark volumes two and four years after the earthquake, together with a complementary report published by the U.S. Geological Survey (USGS) in 1907, led to a number of new discoveries about the cause and effects of earthquakes. These discoveries underlie much of modern seismic hazard analysis.

Keywords: San Andreas fault, 1906 earthquake, elastic rebound, seismic hazard, strike-slip faulting.

EARLY EARTHQUAKE HISTORY

Our knowledge of the earliest historic earthquakes in the San Francisco Bay area comes from Spanish mission records, dating back to the founding of Mission Dolores in San Francisco in 1776. The Padres reported on earthquakes damaging their missions, but this record becomes spotty with secularization beginning in the 1830s. After the Gold Rush, numerous newspapers around the region provided excellent coverage.

The historical records indicate that the latter two-thirds of the nineteenth century was a period of intense seismic activity throughout the greater San Francisco Bay area (Fig. 1). In fact, 18 magnitude 6.0 or larger earthquakes occurred in the 70 years prior to 1906, averaging one about every four years (Bakun, 1999, 2000). Significant earthquakes in this period include a magnitude 6.8–7.4 earthquake on the San Francisco peninsula in 1838, probably on the San Andreas fault (Toppozada and Borchardt, 1998; Bakun, 1999); a magnitude 6.9–7.0 event on the Hayward fault in 1868 that killed more than 35 people across the region and caused significant damage both in East Bay towns and in San Francisco (Yu and Segall, 1996; Bakun, 1999); and a magnitude ~6.8 event north of Point Arena, possibly on the offshore portion of the San Andreas fault (Bakun, 2000).

Earthquakes seemed to be accepted as a nuisance but part of daily life in the region. On 12 December 1904, Andrew Lawson wrote in *The Daily Californian*, the UC–Berkeley newspaper, "History and records show that earthquakes in this locality have never been of a violent nature, as so far as I can judge from the nature of recent disturbances and from accounts of past occurrences there is not occasion for alarm at present" (*in* Fradkin, 2005, p. 25).

THE SHOCK RECORDED AROUND THE WORLD

At 5:12 a.m. on 18 April 1906, San Francisco residents were awakened variously by a strong jolt or a large roar. Stumbling from their beds, many were unable to stand as the floor and their buildings began to shake violently. Originating from an epicenter offshore from San Francisco, the earthquake ruptured the San Andreas fault in two directions, to the NW and SE, and strongly shook all of coastal northern California. Careful observers reported strong shaking lasting for 45–60 s. Many reliable observers also reported two strong pulses of shaking separated by 25–30 s (probably subevents of the large rupture). The earthquake was recorded on six local seismometers and on 90 stations around the world, part of a growing global seismic network. The next day, the *New York Times* featured on its front page a seismogram of the 1906 earthquake as recorded at the State Museum in Albany, New York.

The earthquake struck without warning. There was no unusual seismic activity noted in the days, weeks, and months preceding the 1906 earthquake (Gilbert, 1907, p. 16). However, astute local observers did report shaking believed to be related to a foreshock occurring ~30 s before the main shock (Bolt, 1968; Lomax, 2005).

Within minutes of the end of shaking, fires broke out around the city of San Francisco. As is reported in a number of recent books, ruptured water lines, unseasonably warm temperatures, and the use of explosives helped create and fuel a firestorm that raged for three days; intense winds were generated as air rushed in to feed the inferno, which burned with temperatures in excess of 2000 °F. When the fires were finally out, more than 28,000 buildings had been destroyed, with some estimates attributing 80%–85% of the damage in San Francisco to the fire.

WHEN THE SHAKING STOPPED—BIRTH OF MODERN EARTHQUAKE SCIENCE IN THE UNITED STATES

One of leading geologists of his time and a former chief geologist of the USGS, Grove Karl Gilbert was visiting UC–Berkeley in April 1906, studying the effects of hydraulic min-

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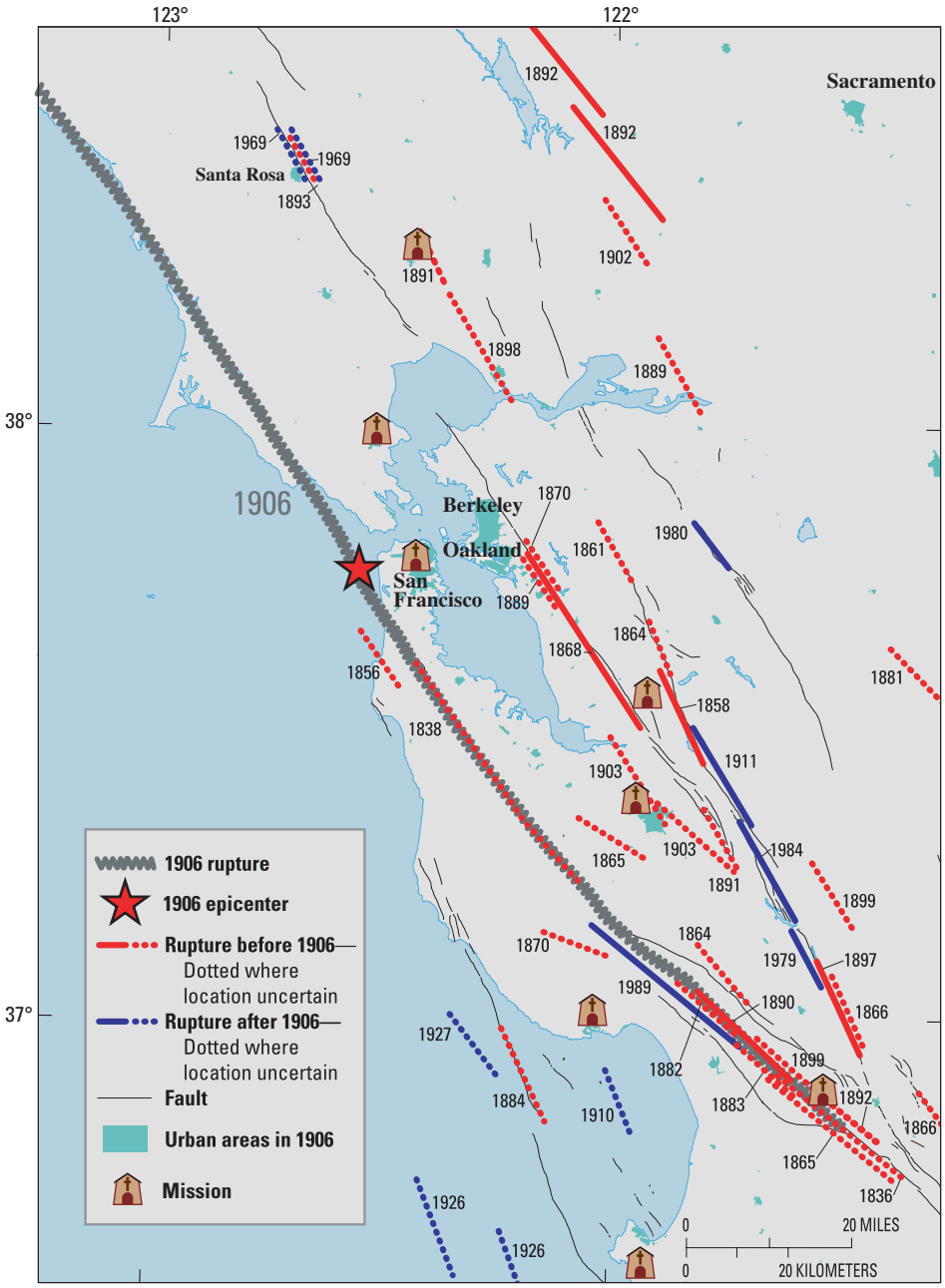

Figure 1. Rupture zones of moderate to large earthquakes (M ≥ 5.5?) in the San Francisco Bay region over the past 170 yr based on earthquake locations from Toppozada et al. (1981) and Bakun (1998). 1906 rupture shown by the bold black wavy line; epicenter by star (after Lomax, 2005). Rupture zones in red are for earthquakes prior to 1906; in blue for earthquakes after 1906. Solid lines—constrained rupture zones located from surface breaks, aftershock studies, or inferred by Bakun (1998) in an analysis of historic intensity data. Dotted rupture lines—drawn parallel to local fault trends, their position and lengths (scaled to magnitude) based on Bakun (1999).

ing on San Francisco Bay. His reaction to the quake was probably typical of that of a number of scientists and engineers in the area. "When, therefore, I was awakened in Berkeley on the eighteenth of April last by a tumult of motions and noises, it was with unalloyed pleasure that I became aware that a vigorous earthquake was in progress" (*in* Wallace, 1980, p. 41).

Three days after the earthquake, California Governor George C. Pardee appointed an eight-person Earthquake Investigation Commission in response to a request by Andrew Lawson. As requested by Lawson, the commission would work without pay, requiring only field expenses that were ultimately raised from the Carnegie Institution (who also published the final report). Lawson led the commission and oversaw the work of more than 25 geologists, seismologists, geodesists, biologists, and engineers, as well as some 300 others who contributed to the effort (Prentice, 1999).

The commission published a preliminary 17-page report on 31 May 1906. Their main report, *The Report of the State Earthquake Investigation Commission, volume I*, was edited by Lawson and published in 1908. It included the bulk of the geologic and morphological descriptions of the faulting, detailed reports on shaking intensity, as well as an impressive atlas of 40 oversized maps and folios. A second volume, edited by Henry Fielding Reid and published in 1910, focused on the seismological and mechanical aspects of the quake. Hereafter in this text, *The Report of the State Earthquake Investigation Commission* (both volumes: v. I, Lawson,

1908, and v. II, Reid, 1910; 643 pages total) will be referred to as the Commission Report, with the volume number noted as appropriate. The report is still available today in print and online (see references).

The commission was relentless in systematically reporting all manner of data about the earthquake. They included more than 310 photographs and numerous sketches capturing details of the surface rupture, offset culture features, and the nature and style of damage to buildings and other structures. In addition to documenting the earthquake, they also conducted simple laboratory experiments and mathematical analyses to help them understand some of their puzzling observations. In the end, their thoughtful interpretation of all these data, models, and analyses lead to a number of first-order discoveries about the earthquake and its effects.

Recognizing the San Andreas Fault as a Continuous Geologic Feature

The Commission Report (v. I) contains the first integrated description of the San Andreas fault. Small sections had previously been mapped and described (in 1895, Lawson had mapped and named a few miles of the fault on the San Francisco peninsula after the San Andreas Valley in which it was contained), but the earthquake rupture demonstrated the continuity of the structure. The location and morphology of the fault zone are described in detail and depicted on numerous large-scale maps along the ~220 km onshore portion of the surface rupture. One commission member, H.W. Fairbanks, continued mapping the San Andreas fault southeast of the 1906 rupture all the way to Southern California, southeast of San Bernardino, connecting the 1906 rupture to the same fault as the still relatively fresh rupture from the 1857 magnitude ~7.8 earthquake in Southern California. The Commission thus established the San Andreas fault as a continuous geologic structure extending for over 600 miles throughout much of California.

Establishing the Movement on the Fault as Strike-Slip

By documenting the offset of fences, roads, rows of trees, and other cultural features, the commission geologists reported commonly between 8 and 15 ft (and locally up to 21 ft) of horizontal slip during the earthquake. They also noted that the offsets north of the Golden Gate were generally greater than those to the south on the San Francisco peninsula. Gilbert (1907) reported associated vertical offsets that were "minor and of variable amount." The significance of this large horizontal offset remained problematic for decades. As Prentice (1999) noted, most scientists (including many of the contributors to the 1908 report) did not consider horizontal slip to be a geologically important mode of fault movement. This is not surprising because gravity provided an obvious source of vertical forces but there was no known source of large-scale horizontal forces until the theory of plate tectonics was established many decades later. Wallace (1949) was the first to suggest substantial (>120 km) right-lateral offset along the San Andreas fault. In a landmark paper, Hill and Dibblee (1953) suggested several hundred kilometers of right-lateral displacement of geologic units and also showed that older units were offset more than younger units.

Inferring Earthquake Recurrence from Evidence of Similar Past Movements

In addition to documenting the width of and offset along the rupture zone, commission geologists noted small-scale linear ridges and valleys lying within and striking parallel to the fault zone. Gilbert, in particular, grasped the significance of these topographic features, commenting, "It is easy to understand that the inception as well as the perpetuation of the ridges and valleys was due to faulting" (v. I, p. 33). He further noted that "the surface changes associated with the earthquake tended, within this belt, to increase the differentiation of the land into ridges and valleys," thus establishing the evidence for repeated recent earthquakes along the fault. These observations expanded on his conclusions of recurring earthquakes along the Wasatch fault zone in Utah based on repeated vertical offsets of Lake Bonneville shorelines (Gilbert, 1884) and provided the foundation for the modern field of tectonic geomorphology (Prentice, 1999).

In its summary section (v. I, p. 53), the Commission Report concluded, "The successive movements which in the past have given rise to the peculiar geomorphic features of the Rift … have with little question been attended in every case by an earthquake of greater or less violence. The earthquake of April 18, 1906, was due to a recurrence of movement along this line." (Note: Because the fault was often contained within a linear, well-defined 0.8–1.6-km-wide valley, the report commonly refers to the fault zone as the San Andreas Rift.) The commission members' attention to detail and confidence in the recurrence of such events led them to establish two small arrays "for measurement of future movements on the San Andreas fault" (v. I, p. 152).

Proposing the Elastic Rebound Theory and Basis for the "Earthquake Cycle"

One of the most profound findings from the commission investigation came from analysis of a relatively new and unexplored data set—distortion of the triangulation surveying network. J.F. Hayes and A.L. Baldwin of the U.S. Coast and Geodetic Survey resurveyed much of the northern California triangulation network in the 15 months after the earthquake. Their careful analysis (v. I, p. 114–145) documented evidence for displacements in both the 1868 Hayward fault earthquake and the 1906 quake. For 1906, they found that coseismic horizontal displacements were approximately parallel to the San Andreas fault, with points on opposite sides of the fault moving in opposite directions, consistent with the observed right-lateral offsets. They further concluded that the magnitude of the displacements decreased in a nonlinear fashion away from the fault, with the displacement decreasing most rapidly near the fault (Fig. 2).

H.F. Reid, in vol. II of the Commission Report, grasped the significance of the geodetic data on coseismic displacement as well as the evidence for distant pre-earthquake displacements. He inferred that the nearly instantaneous fault slip during the quake represented release, or "elastic rebound," of distant applied external elastic forces (Reid, 1910, p. 17) (Fig. 2). Reid went on to explore his theory with experiments in which he deformed, in shear, a layer of stiff jelly with a fault cut through it. He showed that shear displacements of the

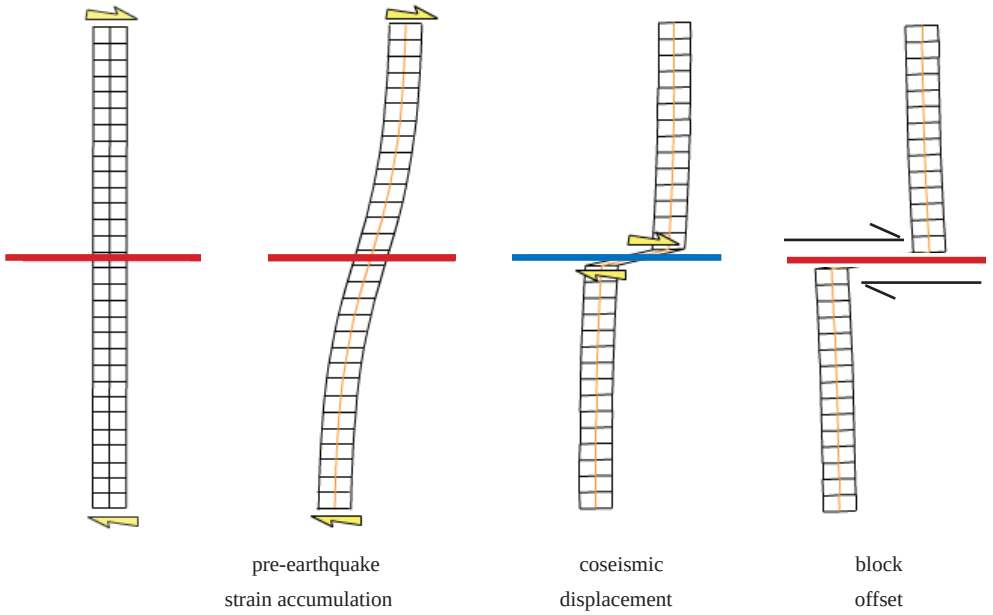

Figure 2. Elastic rebound hypothesis after Reid (1910). Fence indicates a line across the fault extending 100+ km on either side.

edge of the jelly block loaded the "fault," and when the fault was allowed to slip, the strain was relieved and the net result was block displacement.

No doubt influenced by Gilbert's and others' geomorphic evidence for repeated faulting, Reid envisioned the strain accumulation and release as a recurring process. He proposed the now famous "elastic rebound hypothesis" to explain the earthquake cycle—that earthquakes represent sudden release of elastic energy along a fault resulting from a long period of slow strain accumulation. This hypothesis is still accepted today, even though the basis for large-scale horizontal displacements wasn't established until the plate tectonic revolution more than 50 years later.

Correlating Shaking Intensity to Geology

The commission's attention to geologic and geomorphic phenomena was matched by their detailed descriptions of the damage caused by the earthquake. They documented the extent and style of damage to all manner of buildings, dams, pipelines, and other structures. In addition, they reported the distribution and direction of motion of damaged chimneys, broken-off headstones, and even the direction that milk sloshed out of pails. Through interviews and combing newspaper and personal accounts, they compiled damage and shaking reports for more than 600 sites, demonstrating strong shaking throughout nearly all of the northern California Coast Ranges and revealing that the earthquake was felt into southern Oregon and as far east as central Nevada. Their damage reports remain the largest set of seismic intensities ever compiled for a single earthquake and recently were utilized to construct a modern "Intensity ShakeMap" for the 1906 earthquake, which can be compared to maps made of shaking intensity based on measured values, such as for the 1989 Loma Prieta earthquake (Boatwright and Bundock, 2004).

The commission's first-order observation from the damage reports was, not surprisingly, that shaking intensity generally decayed with distance from the fault. However, a detailed examination of damage in San Francisco corroborated observations elsewhere and indicated a strong correlation between surface geology and shaking intensity. H.O. Woods (v. I) compiled a detailed (1:24,000) intensity map for San Francisco, defining five intensity zones to which he assigned approximate ground accelerations by comparison to a calibrated Japanese seismic intensity scale. This was an amazing accomplishment considering the earthquake damage had to be sorted out from the far more pervasive and devastating fire damage. Comparison of Woods' map with a geologic map of San Francisco compiled by Andrew Lawson revealed that "the amount of damage produced by the earthquake … depended chiefly on the geological character of the ground," that the "areas that suffered most severely were those upon filled ground," and "areas upon marshy ground showed destructive effects similar to artificial filled land" (v. I, p. 252).

To explore the observation that shaking intensity was stronger on soft ground than on rock at comparable distances from the fault, H.G. Rogers (v. I, p. 326–335) designed an ingenious set of experiments measuring the amplitude of shaking of sand in a vibrating box. Cognizant of possible scale and edge effects in such experiments, Rogers showed that at seismic frequencies, the amplitude of motion of soft, water-filled sediments is generally greater than that in surrounding rock. Using mathematical analysis to extend the application of these experiments, Reid (v. II, p. 54) correctly concluded that the response of basins depended on their size relative to the wavelength of the seismic waves and that in large basins, internal reflections could result in increased amplification. He further suggested that variations in amplitude within and

between large basins were related to "differences in the character and depth of the alluvium" (v. II, p. 56).

Relating Damage to Construction Style and Quality

The engineers on the commission, as well as those writing for the complementary USGS Bulletin (see Humphrey, 1907), quickly recognized several principles. The first was that well-constructed, tall steel frame buildings (generally commercial buildings built by private companies) performed quite well during the earthquake, particularly those with steel work that was well braced in the lower floors (Humphrey, 1907). A second principle was the "value of deep piling as a foundation structure in made land." Despite the stronger shaking intensity in soft soils, they noted that cable car tracks (underpinned by deep pilings) were often all that remained passable (and served as sidewalks) on many streets destroyed by liquefaction. Similarly, they reported that "first-class modern buildings" on made land "built upon deep piling and grillage formations were not imperiled by injuries to their walls or framework" (v. I, p. 235).

Those positive outcomes were tempered by the recognition that much of the building damage could be related to poor construction practices. The *Mining and Scientific Press*, in its 28 April 1906 edition (*in* Fradkin, 2005, p. 23), noted that "the amount of dishonest construction that escapes undetected in a big city is appalling and it is this that the earthquake, like a relentless inspector, exposes." Humphrey (1907) documented a number of faulty construction practices such as "collapse due to lack of tie between wall and frame" and "light wooden framing, insufficient bracing and poor mortar." Both reports noted numerous examples of the peril of unreinforced masonry as well as brick or stone building façades. Sadly, this same story of poor construction practices—resulting in catastrophic damage and collapse—has oft been repeated in a number of recent large urban earthquakes, even in countries with supposedly modern building codes.

STILL REAPING REWARDS FROM THE COMMISSION REPORT

Nearly one hundred years after its publication, the Commission Report remains a model for post-earthquake investigations. Because the diverse data sets were so complete and carefully documented, researchers continue to apply modern analysis techniques to learn from the 1906 earthquake.

Seismological Data

Modern seismology was in its infancy at the time of the 1906 earthquake. The first modern seismometers developed out of a collaboration of three British scientists (Ewing, Gray, and Milne) at the Imperial College in Tokyo, Japan, in the early 1880s (Dewey and Byerly, 1969). In 1887, astronomers brought the first two seismometers in the Western Hemisphere to the Bay Area to track earth movements that might introduce astronomical errors, and on 19 August of that year, the first local earthquake was recorded in the Bay Area (Fradkin, 2005). Most of the seismometers in operation locally at the time of the 1906 earthquake were duplex pendulum seismometers that were not sufficiently damped and almost immediately went off-scale (Reid, 1910). The only instrument that stayed on-scale, an Ewing three-component seismograph at Lick Observatory, produced the first-ever "strong motion" record of a large earthquake (Bolt, 1968). Fortunately, the commission reported station and instrument data as well as arrival times for the six local and 90 other stations that recorded the 1906 earthquake. They obtained 72 of these seismograms and reproduced them in the Commission Report, preserving them for future examination and analysis.

The 1906 earthquake is often referred to as having a "Richter magnitude" of 8.3 (Richter, 1958, p. 340). However, the Richter magnitude scale was developed for local earthquakes recorded on high-frequency seismometers. The preferred descriptor for large earthquakes rich in low frequencies is moment magnitude (M_W). This magnitude is directly proportional to energy release and can be obtained from analysis of broad-spectrum seismograms or from the product of the rupture area and average fault slip. Modern analyses suggest a M_W between 7.7 and 7.9 for the 1906 earthquake (Wald et al., 1993; Thatcher et al., 1997). Each unit step in M_W is equivalent to roughly a factor of 32 in energy release; thus, it would require roughly thirty 1989 M_W = 6.9 Loma Prieta earthquakes occurring simultaneously to equal the energy release of the 1906 event.

In 1969, Bruce Bolt interpreted some of the teleseismic records and the local observations contained in the Commission Report using modern techniques to show that the epicenter was most likely offshore of Daly City, rather than near Olema as Reid had concluded in 1910. (Reid had used crude estimates of seismic wave velocities and probably misidentified the phase that stopped clocks). Boore (1977) interpreted the "strong motion record" from Mount Hamilton and concluded an epicenter offshore in the Golden Gate region best matched that data. Recently, Lomax (2005) combined modern analysis using three-dimensional velocity models with a grid-search algorithm of possible locations (to account for the imprecision of the observations). His maximum likelihood solution was in the region offshore of the Golden Gate. Constraining the epicenter to fall on the mapped fault offshore yields a "best estimate hypocenter" of 37.75°, −122.55°, and a depth of 10 ± 2 km with a horizontal uncertainty of ±4 km (Fig. 1).

Inferred Fault Length and Slip

In 1975, Thatcher reanalyzed the original triangulation surveying records used in the Commission Report and determined variable amounts of slip at depth along the 1906 rupture averaging 4–5 m north of the Golden Gate and 2–3 m to the south. Using some previously unexamined regional geodetic networks, Thatcher et al. (1997) refined the slip distribution for 1906. They determined slip along 10-km patches along the San Andreas fault where data were available and interpolated slip values for the patches in between; the resulting pattern of slip is in good agreement with the measured surface offsets (Fig. 3). Significantly, they concluded that the rupture extended all the way to Cape Mendocino through the offshore segment of the San Andreas fault north of Point Arena, for a total rupture length of 477 km. In fact, they interpreted that some of the largest slip occurred at this northernmost end, but noted large uncertainties in that region. This northerly extension of the 1906 rupture is compatible with the seismic intensity distribution as well as reports of possible surface slip near Point Delgado.

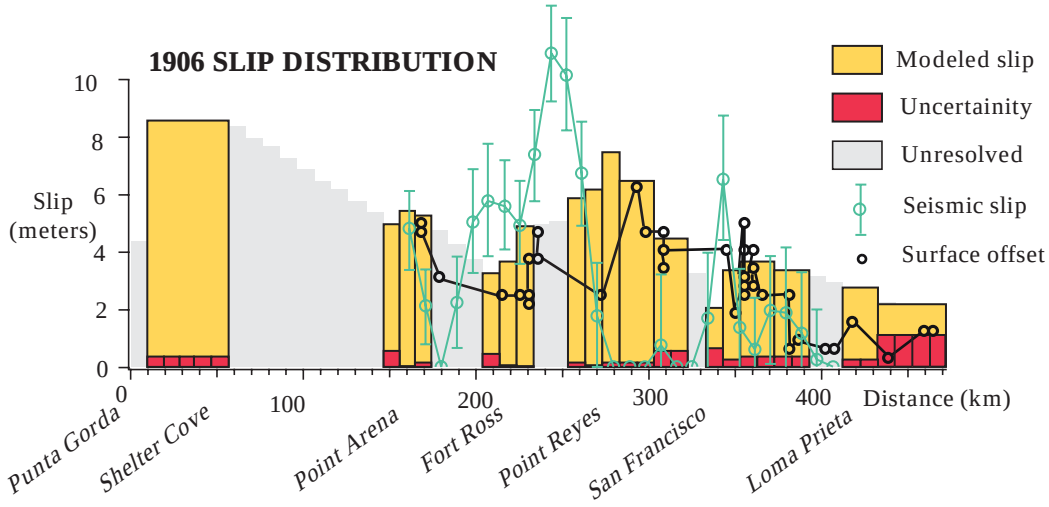

Figure 3. Comparison of slip distributions for the 1906 earthquake from surface offset measurements (Lawson, 1908), analysis of geodetic networks (Thatcher et al., 1997), and inversion of teleseismic data (Wald et al., 1993).

Also plotted in Figure 3 are the results of an inversion for fault slip by Wald et al. (1991, 1993) using the teleseisms from the Commission Report. There is a rather poor agreement between this seismic inversion and the geodetic inversion for slip. Recently, Song et al. (2005) suggested this discrepancy may be explained by a supershear rupture velocity, possibly as high as 5 km/s.

A CENTURY OF PROGRESS IN UNDERSTANDING EARTHQUAKES AND THEIR EFFECTS

The knowledge and understanding that came out of the study of the 1906 earthquake established several principles that underlie modern seismic hazard assessment:

- The earthquake was associated with a long, continuous "active" fault that exhibited ample evidence of past earthquakes with similar-style fault offsets.
- Earthquake occurrence was attributed to a cycle of long-term elastic strain accumulation and sudden release.
- Earthquake ground motion was found to generally decrease with distance from the fault and vary according to the character of near-surface materials as well as local structure, such as in large, deep basins.

Over the past century, new data and techniques have enabled us to quantify and refine these principles. Modern seismic networks accurately locate earthquakes to help identify active faults, while seismometers with wide dynamic range are recording, on-scale, both weak and strong ground motion. Modern analysis of the broadband seismic data are yielding key insights into the nature of the earthquake source as well as the parameters that most influence damaging shaking levels in earthquakes. For example, Wald et al. (1993) used modern earthquakes as analogs to model 1906 teleseismic data. They proposed a large asperity (source of strong seismic radiation) along the 1906 rupture to explain extremely high shaking intensity extending from the San Andreas fault into the town of Santa Rosa, 40 km from the fault and the site of the greatest 1906 earthquake damage per capita (Humphrey, 1907).

In the 1970s, the USGS pioneered advanced surveying techniques to establish the localization and rates of strain accumulation along the San Andreas fault system. Today, strain data are collected by many groups using global positioning satellite receivers accurate enough to resolve long-term horizontal strain accumulation rates of several centimeters per year within only a few months of continuous observations.

The pioneering papers of Clark et al. (1972), Bonilla (1973), Sieh (1978), and Swan et al. (1980) demonstrated that the timing of past earthquakes could be constrained by dating of disrupted soil layers exposed in trenches across active faults. These data establish "recurrence intervals" for surface-rupturing earthquakes (generally magnitude ~6.5 and greater). Dating of offset channels and other geomorphic features yield long-term slip rates on active faults averaged over thousands of years. In some cases, these geologic slip rates agree well with geodetically determined strain accumulation rates. In other cases, there are large discrepancies, suggesting changes in rates over time and/or possible clustering behavior.

Geologic, seismic, and geodetic data provide key inputs into the first step in assessing seismic hazard of a region—source characterization, in which the active faults are identified and the likely magnitude and mean recurrence intervals for earthquakes on them are determined. Earthquake probabilities, or forecasts, are then developed by applying statistical models of the earthquake cycle and summing over all possible earthquake sources within a prescribed region. The probability calculation can be done in a time-independent manner, assuming average long-term, average occurrence rates; or, it can be done in a time-dependent fashion, in which the position within the earthquake cycle on each fault is taken into account by including the time since the most recent event on the fault. The Working Group on California Earthquake Probabilities issued their first "earthquake forecast" in 1988 based on these principles. A current time-dependent earthquake forecast for the San Francisco Bay area, shown in Figure 4 (Working Group on California Earthquake Probabilities, 2003), indicates that at

least one damaging earthquake ($M_W \geq 6.7$) is nearly twice as likely as not to occur in the region over the next 30 years. This forecast integrates data on earthquake sources and strain loading in the Bay Area and allows for a range of earthquake sizes that rupture one or more identified segments of the major fault systems, as well as "background" earthquakes occurring off the main faults.

One of the most significant tectonic legacies of the 1906 earthquake was the "silencing" of seismicity throughout the San Francisco Bay region—undoubtedly a factor favoring the intense development and tenfold population increase of the region during the twentieth century. As previously noted, the relative seismic quiescence of the twentieth century is in marked contrast to the 70-year interval leading up to the 1906 earthquake (Fig. 1). The post-1906 suppression of seismicity on Bay Area faults is attributed to a "stress shadow" effect—the large slip on the San Andreas fault in 1906 reduced the Coulomb failure stress on all the surrounding parallel faults (Ellsworth et al., 1981; Harris and Simpson, 1998). The occurrence of moderate-sized earthquakes beginning in the late 1960s and including the 1989 Loma Prieta event suggests that the region has begun to emerge from the stress shadow as tectonic strain has reaccumulated slip to overcome the stress reductions. Uncertainty in the earthquake forecast (Fig. 4) reflects uncertainties in modeling the exact magnitude and duration of the stress shadow.

Modern seismic hazard assessments compute the expected earthquake shaking intensity levels within a region by integrat-

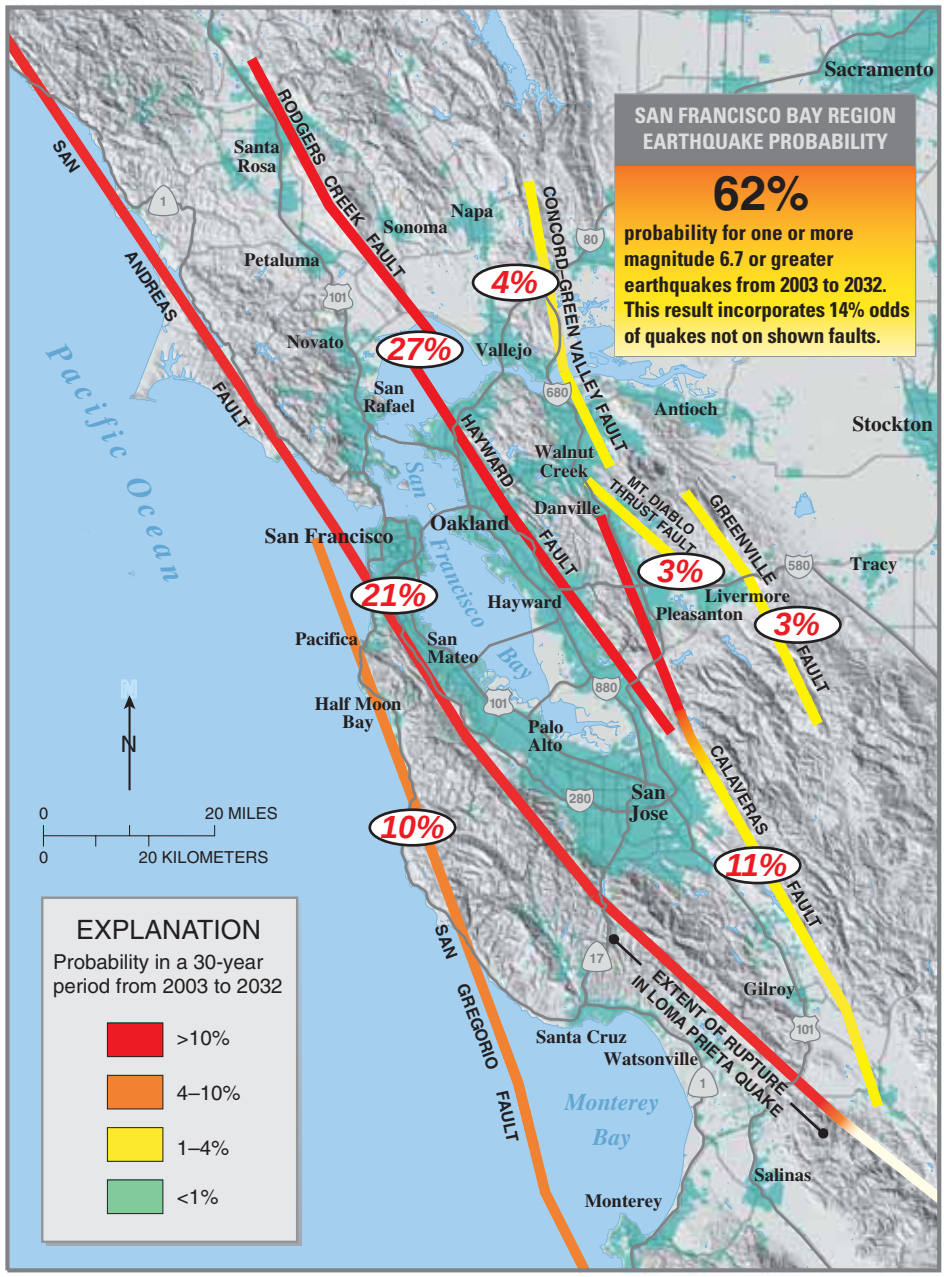

Figure 4. Probabilities (ovals) of one or more major ($M \geq 6.7$) earthquakes on San Francisco Bay region fault systems during the next 30 yr. Likelihood varies along the length of each fault. Color indicates the probability that each fault segment will rupture in a future quake (from Working Group on California Earthquake Probabilities, 2003).

ing the full distribution of earthquake sources and their likelihoods of occurrence. Ground motions are determined using seismic attenuation models (e.g., Boore et al., 1997) that quantify how shaking intensity decreases with distance from the fault. The nature of this relationship is a focus of on-going research as are other parameters noted in the Commission Report as influencing shaking intensity, such as the effects of local soil conditions and path effects, including amplification and trapping of seismic energy in basins.

CONCLUSIONS

It is important to remember the lessons from the 1906 earthquake and the myriad of other major urban earthquakes over the past century. These earthquakes are likely to occur without any warning. Furthermore, earthquakes do not kill people, buildings do. Even if we attain the elusive goal of short-term earthquake prediction, we are still faced with a huge inventory of existing structures and infrastructure, some of which are very vulnerable to damage and/or collapse in future earthquakes. For example, estimates suggest there will be between 150,000 and 160,000 uninhabitable households in the San Francisco Bay area following a repeat of the 1906 earthquake or a Hayward fault rupture (Association of Bay Area Governments, 2003). The situation is far worse in other parts of the world.

Earthquake forecasts alert the public to risk in high seismic hazard regions. Data from recent large earthquakes combined with advanced modeling techniques allow seismologists increasing sophistication in predicting ground motions of anticipated future quakes. Armed with the knowledge of likely ground motions, earth scientists can assist engineers in designing improved earthquake-resistant structures. We should also be working together to identify buildings and structures most at risk for severe damage and collapse in seismically vulnerable regions. Ultimately, scientists and engineers need to engage social scientists, policy makers, building owners, and the public to bring about effective seismic mitigation.

ACKNOWLEDGMENTS

Many thanks for thoughtful, helpful, and rapid reviews by Bill Ellsworth, David Schwartz, Gerry Ross, and Keith Howard.

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GSA Field Guides

Interior Western United States: GSA Field Guide 6

edited by Joel L. Pederson and Carol M. Dehler, 2005

The 2005 GSA Annual Meeting in Salt Lake City provided a large and diverse terrain for field trips—from the Basin and Range to the Rocky Mountains, from the Snake River Plain, across the Colorado Plateau, to the Mojave Desert. This volume contains 22 field trip articles. All combine the latest research with useful road logs to spectacular and often classic geologic settings. The regional tour has a core of structure and stratigraphy-paleontology contributions, and is rounded off with volcanic, glacial, lacustrine, fluvial geomorphology, neotectonic, geologic hazard, and geoarchaeology articles.

FLD006, 524 p., ISBN 0-8137-0006-X
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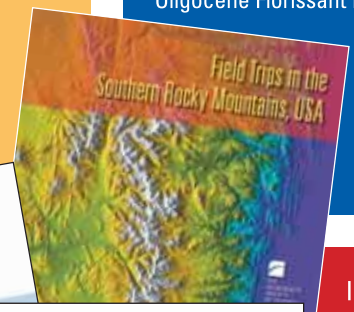

edited by Eric P. Nelson and Eric A. Erslev, 2004

The Front Range of the Rocky Mountains and the High Plains preserve an outstanding record of geological processes from Precambrian through Quaternary times. With energy and mineral resources, geological hazards, water issues, geoarchaeological sites, and famous dinosaur fossil sites, the Front Range and adjacent High Plains region provide ample opportunities for field trips focusing on our changing world. The chapters in this field guide all contain technical content as well as a field trip log describing field trip routes and stops. Of the 25 field trips offered at the 2004 GSA Annual Meeting, 14 are described in the guidebook, covering a wide variety of geoscience disciplines, with chapters on tectonics (Precambrian and Laramide), stratigraphy and paleoenvironments (e.g., early Paleozoic environments, Jurassic eolian environments, the K-T boundary, the famous Oligocene Florissant fossil beds), economic deposits (coal and molybdenum), geological hazards, and geoarchaeology.

FLD005, 234 p., ISBN 0-8137-0005-1
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Western Cordillera and Adjacent Areas

edited by Terry W. Swanson, 2003

This volume includes guides for 15 of the field trips held in conjunction with the 2003 GSA Annual Meeting in Seattle. Topics covered include Glacial Lake Missoula and the Clark Fork Ice Dam; the Sauk Sequence in western Utah; the geology of wine in Washington state; the Columbia River basalt and Yakima Fold Belt; Alpine glaciation of the North Cascades; and recent geoarchaeological discoveries in central Washington. Quaternary geology of Seattle, engineering geology in the central Columbia Valley, and the tephrostratigraphy and paleogeography of southern Puget Sound also are covered, as are trips to the central Cascade Range and the White River.

FLD004, 284 p. ISBN 0-8137-0004-3, softcover
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INQUA 2003 Field Guide Volume:

Quaternary Geology of the United States

edited by Don J. Easterbrook, 2003

Much of the landscape in the United States was shaped by climatic events during the Quaternary, especially the erosion and deposition in the Pleistocene. The wealth of Quaternary features found in the U.S. includes continental ice sheet glaciation, alpine glaciation, marine shorelines, marine deposits, faulting, tectonic uplift, effects of isostatic rebound, pluvial lakes, large-scale eolian deposits, the world's largest geothermal area, and much more. This volume contains 17 guides with contributions from 97 authors across the country, from Alaska and the west coast to New England, including much new, previously unpublished information. Each guide includes specific sites with interpretations of the features to be seen and discussions of critical issues.

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THE GEOLOGICAL SOCIETY OF AMERICA

The Pursuit of Science

PHILADELPHIA 2006

Building on a Foundation of Discovery

Recent responses to devastating natural disasters and escalating pressures on natural resources remind us of the need for the pursuit and distribution of objective, timely, and peer-reviewed scientific information. The 2006 GSA Annual Meeting will convene in Philadelphia and address this challenge under the theme of *The Pursuit of Science: Building on a Foundation of Discovery.*

The 2006 annual meeting will be an exciting and historic event that corresponds with the 300th birthday of Benjamin Franklin, one of the nation's most celebrated scientists and a visionary leader in the integration of science, public policy, and the open exchange of information. Philadelphia is widely known for its historic buildings and was the site of the signing of the Declaration of Independence, the Constitutional Congress, and the nation's first capital. Philadelphia was also the center of natural science in the colonies and the fledgling nation; many of the city's oldest museums, libraries, and scientific collections date from the era, and the efforts, of Benjamin Franklin. Today, the Philadelphia area supports over 100 museums, arboreta, and other scientific collections, including the Academy of Natural Sciences, the home of the first dinosaur skeleton discovered in the Americas; the first zoo in the western hemisphere; and the recently opened Fairmount Water Works Interpretive Center, a museum of watershed dynamics and history of the first modern municipal water-supply facility in the New World.

Many of North America's first geologists traveled regularly to Philadelphia to exchange information and share recent discoveries. Our 2006 annual meeting will carry on that tradition of the open exchange of scientific information and ideas through field trips, sessions, special symposia, and the public forum. Please engage in this information exchange and the excitement of discovery by submitting abstracts and encouraging your colleagues to submit abstracts by 11 July 2006.

We look forward to welcoming many thousands of you to the City of Brotherly (and Sisterly) Love.

Robert Giegengack and Fred Scatena, University of Pennsylvania

2006 Annual Meeting General Co-Chairs

Important Dates, Events & Deadlines

Registration Opens:	Early June
Space Request Deadline:	21 June
Abstract Deadline:	11 July
Standard Registration Deadline:	18 Sept.
Cancellation Deadline:	25 Sept.
Premeeting Field Trips:	TBD
Short Courses & Workshops:	Sat.–Sun., 21–22 Oct.
Presidential Address & Awards Ceremony:	Sat., 21 Oct., 7–9 p.m.
Welcoming Party & Exhibits Opening:	Sun., 22 Oct., 5:30–7:30 p.m.
Technical Program:	Sun.–Wed., 22–25 Oct.
Pardee Keynote Symposia:	Sun.–Wed., 22–25 Oct.
Private Alumni Receptions:	Mon., 23 Oct., 5:30 p.m.–1 a.m.
Group Alumni Reception:	Mon., 23 Oct., 7–9:30 p.m.
Exhibit Hall Hours:	Sun., 22 Oct., 5:30–7:30 p.m.
	Mon.–Tues., 23–24 Oct., 9 a.m.–5:30 p.m.
	Wed., 25 Oct., 9 a.m.–2 p.m.
Hot Topics:	Sun.–Wed., 22–25 Oct., 12:15–1:15 p.m.
Postmeeting Field Trips:	TBD

THE GEOLOGICAL SOCIETY OF AMERICA

Annual Meeting & Exposition

22–25 October 2006
Philadelphia, Pennsylvania

Image: Ben Franklin National Memorial at the Franklin Institute Science Museum. Photo by Rich Dunoff, courtesy of the Philadelphia Convention and Visitors Bureau. Delaware Bay, Appalachians, Long Island. Image courtesy of Earth Sciences and Image Analysis Laboratory, NASA Johnson Space Center. Mission: ISS006 Roll: E Frame: 35659, http://eol.jsc.nasa.gov.

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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. Erosion: Processes, Rates, and New Measuring Techniques

GSA Quaternary Geology and Geomorphology Division

Geomorphology; Quaternary Geology/Geomorphology

Frank Pazzaglia, Lehigh University, Bethlehem, Pa.; Paul Bierman, University of Vermont, Burlington, Vt.; Milan Pavich, U.S. Geological Survey, Reston, Va.; Dorothy Merritts, Franklin and Marshall College, Lancaster, Pa.

Synthetic view of the fundamental processes and rates of landscape erosion across wide temporal and spatial scales. Review of emerging techniques in measuring erosion and implications for landscape evolution, global sedimentary budgets, and human impacts.

P2. Evidence for Long-Term Survival of Microorganisms and Preservation of DNA

GSA Geobiology and Geomicrobiology Division

Geomicrobiology; Planetary Geology; Archaeological Geology

Tim K. Lowenstein, Binghamton University, Binghamton, N.Y.; Michael N. Timofeeff, Binghamton University, Binghamton, N.Y.; Brian A. Schubert, Binghamton University, Binghamton, N.Y.

Talks will present evidence for or against long-term survival of microorganisms and preservation of DNA in amber, ancient salt, subsurface rocks, deep sea sediments, glacial ice, permafrost, bones, and teeth.

P3. Geosciences and the Media: How Can We Better Communicate the Imperatives of Sustainability?

GSA Geology and Society Division; Critical Issues Caucus, Geology and Public Policy Committee; GSA Quaternary Geology and Geomorphology Division; GSA Engineering Geology Division; Association of Earth Science Editors

Geoscience Information/Communication; Public Policy; Environmental Geoscience

Paul H. Reitan, University at Buffalo, Buffalo, N.Y.; Susan W. Kieffer, University of Illinois, Urbana, Ill.; E-an Zen, University of Maryland, College Park, Md.; Allison R. Palmer, Institute for Cambrian Studies, Boulder, Colo.

Geoscientists have significant knowledge of hazards (volcanoes, earthquakes) and insidious creeping megacrises (soil, water, resources, climate). A sustainable future needs more effective cooperation with the media for successful communication and public education on these issues.

P4. Holocene Sea Level Change in North America: A Post-Katrina Assessment

GSA Quaternary Geology and Geomorphology Division; IGCP 495 (Quaternary Land-Ocean Interactions: Driving Mechanisms and Coastal Responses)

Quaternary Geology; Marine/Coastal Science; Neotectonics/Paleoseismology

Torbjörn E. Törnqvist, Tulane University, New Orleans, La.; Benjamin P. Horton, University of Pennsylvania, Philadelphia, Pa.

The concerns about sea-level rise and coastal responses are larger than ever in the post-Katrina world. This session, a contribution to IGCP 495, will address Holocene sea-level change in North America from a multidisciplinary perspective.

P5. Links between Geological Processes, Microbial Activities, and Evolution of Life

GSA International Division; GSA Geobiology and Geomicrobiology Division; GSA Geology and Society Division; GSA Structural Geology and Tectonics Division

Tectonics; Geomicrobiology; Geochemistry, Other

Yildirim Dilek, Miami University, Oxford, Ohio; Harald Furnes, University of Bergen, Bergen, Norway; Karlis Muehlenbachs, University of Alberta, Edmonton, Alberta

This session will explore the mode and/or nature of links between geological processes and microbial activities as recorded in the Precambrian through modern rocks and their implications for the origin/evolution of life on Earth and other planets.

P6. Natural and Anthropogenic Disasters: Earth and Health Scientists Working Together to Identify Potential Health Issues and Improve Outcomes

GSA Geology and Health Division

Environmental Geoscience; Public Policy

Geoffrey S. Plumlee, U.S. Geological Survey, Denver, Colo.; Gabriel Filippelli, Indiana University–Purdue University, Indianapolis, Ind.

Disasters, both natural and human-produced, put a large strain on public health resources. This session brings together earth scientists and public health experts to understand the links between causes, impacts, and health-related outcomes of disasters.

P7. Using Historical Photographs and Maps to Document Landscape Evolution and the Impacts of Changing Climate: A Celebration of the 96th Birthday of Bradford Washburn

Quaternary Geology; Geomorphology; Environmental Geoscience

Bruce Franklin Molnia, U.S. Geological Survey, Reston, Va.; Mike Sfraga, University of Alaska, Fairbanks, Alaska

This session in celebration of the 96th birthday of Bradford Washburn focuses on the use of historic photographs and maps to document landscape dynamics and evolution and to document Earth's response to human and natural forces.

P8. When One Planet Isn't Enough: Celebrating 25 Years of Solar System Exploration

GSA Planetary Geology Division

Planetary Geology

R. Aileen Yingst, University of Wisconsin, Green Bay, Wis.; Herbert Frey, National Aeronautics and Space Administration–Goddard Space Flight Center, Greenbelt, Md.; Louise Prockter, Applied Physics Lab, Laurel, Md.

The Planetary Geology Division is proud to be celebrating its 25th anniversary as a Division of the Geological Society of America. In this session, the Division presents a selection of important, influential, and exciting discoveries, results, or controversies in planetary geology in the past 25 years.

October in the northeastern United States: Fall colors in the Appalachians are readily visible throughout central Pennsylvania. True-color image taken 28 October 2004 by the Moderate Resolution Imaging Spectroradiometer (MODIS) on the National Aeronautics and Space Administration's *Aqua* satellite. Image courtesy Visible Earth, http://visibleearth.nasa.gov/view_rec.php?id=6742.

Topical and Discipline Sessions

ABSTRACTS DEADLINE: 11 JULY

TOPICAL SESSIONS

Below is a listing of all approved topical sessions. These sessions are topically focused with a mix of invited and volunteered papers. Sessions are designed to promote the exchange of interdisciplinary, state-of-the-art information. Papers can be submitted to a specific topical session, and you may choose up to three scientific categories. After each topical description below, the categories are identified as they appear on the abstract form. ***Please* submit only in the mode** (oral or poster) **and categories indicated in the description.** An abstract submitted in the incorrect mode will be transferred automatically to a discipline session.

Abstracts Deadline: 11 July

Please use the online electronic abstract form found on the GSA Web site, www.geosociety.org. An abstract submission fee will be charged. The fee is US$18 for all students and US$30 for all others. If you cannot submit your abstract electronically, contact Nancy Carlson, +1-303-357-1061, ncarlson@geosociety.org.

DISCIPLINE SESSIONS

From the list found on the electronic abstract form, you may choose up to three discipline categories you feel your abstract would best fit. Joint Technical Program Committee representatives organize the papers in sessions focused on disciplines (e.g., environmental geoscience, mineralogy).

T1. High Resolution Quaternary Records from Cave Environments

GSA Archaeological Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Hydrogeology Division; GSA Sedimentary Geology Division; Society for Vertebrate Paleontology; Paleontological Society; Geochemical Society; Karst Waters Institute

Archaeological Geology; Geochemistry, Other; Quaternary Geology

Bonnie A.B. Blackwell, Williams College, Williamstown, Mass.; Donald McFarlane, Claremont College, Claremont, Calif.

Caves are geological time capsules. When dated, they reveal detailed patterns of climatic, sedimentological, and hydrological changes, and botanical, faunal, and archaeological turnover. Contributions from all disciplines working in caves, rock shelters, or karst fissures welcomed. ORAL and POSTER

T2. Alluvial Geoarchaeology of Large River Valleys

GSA Archaeological Geology Division

Archaeological Geology; Geomorphology; Quaternary Geology

David L. Cremeens, GAI Consultants, Inc., Homestead, Pa.

This session encourages contributions from scientists that have investigated archaeology sites in large river valley settings. Discussions of soil stratigraphy, correlation, paleoenvironmental reconstruction, post-occupation burial and alteration, and newer techniques and analyses are particularly encouraged. ORAL

T3. Reconstructing Landscape Contexts of Human Occupation Surrounding Wetlands

GSA Archaeological Geology Division; GSA Limnogeology Division; GSA Geology and Society Division

Archaeological Geology; Limnogeology; Quaternary Geology/Geomorphology

Catherine H. Yansa, Michigan State University, East Lansing, Mich.; Andrea K. Freeman, University of Calgary, Alberta

This session will provide examples of how valuable information about human activities in wetland and surrounding upland landscapes is obtained from the analysis of soils, sediments, and fossils from wetlands (lake, bog, marsh, and riparian). ORAL

T4. Marine Geoarchaeology: New Exploration of Sites from Coast to Shelf (Posters)

GSA Archaeological Geology Division

Archaeological Geology; Marine/Coastal Science; Quaternary Geology/Geomorphology

Jean-Daniel Stanley, Smithsonian Institution, Washington, D.C.; Eduard G. Reinhardt, McMaster University, Hamilton, Ontario

Marine geoarchaeology aims to understand human and environmental interactions during the Holocene in now-submerged settings. New techniques and applications in this new interdisciplinary field will present the latest research in the reconstruction of coastal and shelf settings. POSTER

T5. Archaeological and Geoarchaeological Records of Natural and Human-Induced Disasters

GSA Archaeological Geology Division

Archaeological Geology; Quaternary Geology/Geomorphology

Tina M. Niemi, University of Missouri, Kansas City, Mo.; Suzanne Leroy, University of Missouri, Kansas City, Mo.; L. Mark Raab, University of Missouri, Kansas City, Mo.

This session explores geologic and archaeological data, as well as historical records of catastrophic events and disasters in human history including earthquakes, volcanic eruptions, climate and environmental change, droughts, floods, and crises of cultural origin. ORAL and POSTER

T6. Geoarchaeology of Prehistoric Earthworks

GSA Archaeological Geology Division

Archaeological Geology; Quaternary Geology/Geomorphology

Rolfe D. Mandel, University of Kansas, Lawrence, Kans.

This session encourages contributions from researchers who have applied geoscientific methods, such as geophysics, remote sensing, soil stratigraphy, sedimentology, and micromorphological analyses, to the study of prehistoric earthworks, including mounds, mound-ridge complexes, canals, and moats. ORAL

T7. Coal Utilization in the 21st Century: Environmental Issues

GSA Coal Geology Division; GSA Geology and Society Division; Public Policy; GSA Geobiology and Geomicrobiology Division

Coal Geology; Environmental Geoscience; Public Policy

John Kiefer, GSA Geology and Society Division, Lexington, Ky.; James C. Hower, University of Kentucky, Lexington, Ky.; Stephen F. Greb, University of Kentucky, Lexington, Ky.; Cortland F. Eble, University of Kentucky, Lexington, Ky.

In this session, we will highlight research that looks at the ways coal geology influences the environment during mining, processing, and utilization. ORAL

T8. U.S. Energy Resources: Options, Scenarios, and Policy

GSA Coal Geology Division; Public Policy

Coal Geology; Environmental Geoscience; Economic Geology

Leslie F. Ruppert, U.S. Geological Survey, Reston, Va.; Brenda S. Pierce, U.S. Geological Survey, Reston, Va.

This session will examine costs and consequences of extracting and utilizing energy resources to fulfill demand scenarios. Talks will focus on choices among fuels, including natural gas, oil, heavy oil, hydrates, nuclear, geothermal, and renewables. ORAL

T9. "Ice House"/"Hothouse"—An Analysis of Late Paleozoic Floras and Their Response to Global Climate Change

GSA Coal Geology Division; The American Association of Stratigraphic Palynologists (AASP); Paleontological Society; Society for Sedimentary Geology (SEPM); GSA Geobiology and Geomicrobiology Division

Coal Geology; Paleontology/Paleobotany; Paleontology, Diversity, Extinction, Origination

Cortland Eble, University of Kentucky, Lexington, Ky.; Thomas D. Demchuk, ConocoPhillips; Hermann Pfefferkorn, University of Pennsylvania, Philadelphia, Pa.; Robert A. Gastaldo, Colby College, Waterville, Maine

This session will investigate the composition and dynamics of terrestrial vegetation during the Permian-Carboniferous ice age and attempt to resolve the scales and patterns of biotic turnover. ORAL

T10. Geotechnical Investigations: The Phase 1 Investigation in Karst Terrain

Engineering Geology; Environmental Geoscience; Geomorphology

Richard F. Dalton, New Jersey Geological Survey, Trenton, N.J.; William E. Kochanov, Pennsylvania Geological Survey, Middletown, Pa.

The role of geologists during the initial phases of construction and resource development requires a multidisciplinary approach in karst areas. Papers discussing current karst research, field techniques, and geotechnical engineering through case studies are encouraged. ORAL and POSTER

T11. Engineering Geology in the Northeastern United States

Master of Science in Applied Geoscience Graduate Program at the University of Pennsylvania

Engineering Geology; Hydrogeology; Environmental Geoscience

Craig R. Calabria, GeoSystems Consultants, Inc., Fort Washington, Pa.; Chad Freed, Widener University, Chester, Pa.

This engineering geology session will focus on northeastern United States engineering geology, hydrogeology, and environmental geology. Speakers are encouraged to present papers relating to groundwater–surface water hydrology, groundwater modeling, geomechanics, engineering geology, geochemistry, geotechnics, and geophysics. ORAL

T12. Fractured Rock Characterization in Applied Geology

GSA Engineering Geology Division; GSA Structural Geology and Tectonics Division; American Rock Mechanics Association

Engineering Geology; Structural Geology; Hydrogeology

William C. Haneberg, Haneberg Geoscience, Seattle, Wash.

Technological advances and case histories related to fractured rock characterization in engineering geology, hydrogeology, and resource geology. Digital outcrop characterization, subsurface data analysis and prediction, stochastic fracture simulation, and geomechanical models of fractured rocks. ORAL

T13. Mining as a Factor in Human Health

GSA Geology and Health Division; GSA Geology and Society Division

Environmental Geoscience; Coal Geology; Hydrogeology

Larry D. Woodfork, Consulting Geologist, Morgantown, W.Va.; E. Lynn Savage, Brooklyn College, City College of New York, Brooklyn, N.Y.

Mining and quarrying may impact human health through either occupational or environmental exposure to toxic substances released in this process or as a consequence of mine accidents. Resultant environmental degradation may also affect human health. ORAL

T14. Arsenic, Lead, and Mercury in Urban and Rural Watersheds

Public Policy; GSA Geology and Society Division

Environmental Geoscience; Geochemistry, Aqueous; Hydrogeology

Curtis L. Hollabaugh, University of West Georgia, Carrollton, Ga.; Randa R. Harris, University of West Georgia, Carrollton, Ga.

Arsenic, lead, and mercury are toxic substances that can be widespread and tend to accumulate in the biosphere. This session will cover the role of these elements in watersheds in both rural and urban settings. ORAL and POSTER

T15. Geochemical Modeling Applications in Ground Water Systems

International Association of GeoChemistry (IAGC); GSA Hydrogeology Division

Environmental Geoscience; Geochemistry, Aqueous; Hydrogeology

June E. Mirecki, U.S. Army Engineer Research and Development Center, Vicksburg, Miss.; Russell S. Harmon, Research Triangle Park, N.C.

Session focuses on the application of geochemical models to quantify major organic, inorganic, and isotopic reactions and rates that control groundwater quality. Models that simulate water-rock-microbe interactions in pristine and contaminated systems are encouraged. ORAL and POSTER

T16. The Effect of Diagenetic Factors Such as Organic Complexation, Microbial Activity, and Mineral Surface Sorption/Complexation on the Mobilization/ Sequestration of Uranium in Recent Sediments

Environmental Geoscience; Geochemistry, Organic; Geomicrobiology

Lenaye Bolanos, Stony Brook University, Stony Brook, N.Y.; Paul A. Northrup, Brooklyn National Laboritory, Upton, N.Y.

State of the art techniques are used to investigate the diagenetic processes affecting uranium in recent sediments. Sequestration and mobilization processes related to microbial activities, sorption, complexation, and precipitation will be addressed. ORAL and POSTER

T17. An Early Involvement of Undergraduates and K7–12 Students in Geological and Environmental Research (Posters)

GSA Geoscience Education Division

Environmental Geoscience; Geoscience Education; Geoscience Information/Communication

Nazrul I. Khandaker, York College of the City University of New York, Jamaica, N.Y.; Stanley Schleifer, York College of the City University of New York, Jamaica, N.Y.

This session is intended to provide hands-on and field-based geological and environmental information to the geoscience community and encourages undergraduates and high school students to give poster presentations covering topics ranging from purely geological to environmental. POSTER

T18. Collegiate Watershed Research Projects: Opportunities for Student Learning and Community Involvement

GSA Geoscience Education Division; Council on Undergraduate Research

Environmental Geoscience; Geoscience Education; Geochemistry, Aqueous

Kirsten M. Menking, Vassar College, Poughkeepsie, N.Y.; Brannon Andersen, Furman University, Greenville, S.C.

Session provides an opportunity for faculty and students engaged in collaborative interdisciplinary watershed studies to share ideas, strategies, best practices, and results from projects involving universities and community members in aquatic monitoring and stream restoration. POSTER

T19. Distribution of Arsenic and Related Metalloids in Surface and Ground Waters: Controls and Challenges

GSA Hydrogeology Division; GSA Geology and Health Division; GSA Geology and Society Division

Environmental Geoscience; Hydrogeology; Geochemistry, Aqueous

Kaye Savage, Vanderbilt University, Nashville, Tenn.; Andrea Foster, U.S. Geological Survey, Menlo Park, Calif.; Prosun Bhattacharya, Royal Institute of Technology (KTH), Stockholm, Sweden; Abhijit Mukherjee, University of Kentucky, Lexington, Ky.

We encourage studies of physical and biogeochemical processes controlling spatial and temporal heterogeneities in concentration and speciation of arsenic and related metalloids. Resulting challenges for public health and water supply management are also of interest. ORAL and POSTER

T20. The Occurrence, Bioavailability and Toxicity of Arsenic and Fluoride from Drinking Water—A Widespread Issue

GSA Geology and Health Division; GSA Geology and Society Division; Geochemical Society

Geology and Health

Michalann Harthill, U.S. Geological Survey, Reston, Va.; Achim Herrmann, Arizona State University, Tempe, Ariz.

Toxicity from arsenic or fluoride in drinking water, especially from groundwater sources, is affecting human populations on a global scale. Knowledge of the mechanisms of bioavailability may help in design of mitigation measures. ORAL

T21. Holocene Sequences of Environmental Disasters: The Terrestrial and Marine Palynological Records

American Association of Stratigraphic Palynologists (AASP)

Environmental Geoscience; Paleoclimatology/ Paleoceanography; Quaternary Geology/Geomorphology

Owen K. Davis, University of Arizona, Tucson, Ariz.

Natural disasters have occurred throughout recorded time and before. The geologic record of fires, droughts, earthquakes, tsunamis, and hurricanes has improved in the last decade through improved dating techniques and close-interval sampling. ORAL

T22. Sigma Gamma Epsilon Student Research (Posters)

Sigma Gamma Epsilon

Environmental Geoscience; Paleontology/Paleobotany; Quaternary Geology/Geomorphology

Richard L. Ford, Weber State University, Ogden, Utah; Charles Mankin, Oklahoma Geological Survey, Norman, Okla.; Donald Neal, East Carolina University, Greenville, N.C.

This poster session, sponsored by Sigma Gamma Epsilon, will showcase undergraduate and graduate student research in all areas of geoscience. POSTER

T23. Multidisciplinary Approaches to Geochemical Problems

Geochemistry, Aqueous; Geomicrobiology; Geoscience Information/Communication

Nancy Washton, Pennsylvania State University, University Park, Pa.; Karl T. Mueller, Pennsylvania State University, University Park, Pa.

Multidisciplinary geo/chemical/bio-science: How do we make our knowledge bases, experimental and computational techniques, and scientific philosophies accessible to a highly diverse group of scientists working on geochemical problems? ORAL and POSTER

T24. Innovations in Groundwater Vulnerability Assessment (Posters)

GSA Hydrogeology Division

Geochemistry, Aqueous; Hydrogeology; Remote Sensing/ Geographic Info System

Jason J. Gurdak, U.S. Geological Survey, Denver, Colo.; John E. McCray, Colorado School of Mines, Golden, Colo.

This session will explore recent advances in groundwater vulnerability assessment. Poster presentations on new techniques and applications of field-based and modeling studies to quantify nonpoint-source groundwater contamination and related uncertainty are encouraged. POSTER

T25. Water-Quality Issues in Sole-Source and Principal Aquifers in the United States

GSA Hydrogeology Division; National Ground Water Association

Geochemistry, Aqueous; Hydrogeology; Environmental Geoscience

Brian G. Katz, U.S. Geological Society, Tallahassee, Fla.; Michael J. Focazio, U.S. Geological Society, Reston, Va.

This session will focus on anthropogenic and natural factors that control water quality in sole-source and principal aquifers in the United States. We encourage presentations on innovative geochemical and hydrologic methods used to assess aquifer vulnerability. ORAL and POSTER

T26. Experimental Investigations into Hydrothermal Systems: Implications for Mass Transfer in the Earth's Crust

Geochemical Society; Society of Economic Geologists; Mineralogical Society of America

Geochemistry, Aqueous; Petrology, Experimental; Economic Geology

Brian Rusk, U.S. Geological Survey, Denver, Colo.; John Kaszuba, Los Alamos National Laboratory, Los Alamos, N.Mex.

Hydrothermal and geothermal systems redistribute enormous amounts of mass and energy in the crust. This session provides experimental insight into fluid-magma-rock interactions in a wide range of geologic environments in continental and oceanic crust. ORAL

T27. Better Living through Geochemistry: Fostering an Understanding of Terrestrial Paleoenvironments and Paleoclimates

GSA Sedimentology Division; Society for Sedimentary Geology; Geochemical Society

Geochemistry, Other; Paleontology, Biogeography/ Biostratigraphy; Sediments, Carbonates

Aisha H. Al-Suwaidi, University of Kansas, Lawrence, Kans.; Franciszek Hasiuk, University of Michigan, Ann Arbor, Mich.; Julie B. Retrum, University of Kansas, Lawrence, Kans.

This session will focus on applications of isotope and elemental geochemical techniques to explore the sedimentary and paleontological record of ancient terrestrial climates and environments. ORAL and POSTER

T28. An Appetite for Apatite: Conodont-Based Geological Investigations in the 21st Century

Paleontological Society; Pander Society; Geochemical Society

Geochemistry, Other; Paleontology/Paleobotany; Paleoclimatology/Paleoceanography

Jared R. Morrow, University of Northern Colorado, Greeley, Colo.; D. Jeffrey Over, State University of New York, Geneseo, N.Y.; Maya Elrick, University of New Mexico, Albuquerque, N.Mex.

Session highlights recent, increasingly innovative uses of conodont microfossils as a tool in a wide variety of geological applications, including geochemical, geochronologic, paleoceanographic, paleoclimatic, event stratigraphic, and paleotectonic studies. ORAL and POSTER

T29. The Use of Molecular Techniques to Assess Microbial Community Structure and Function in Aquifer Systems

GSA Geobiology and Geomicrobiology Division; GSA Hydrogeology Division

Geomicrobiology; Environmental Geoscience; Hydrogeology

Johanna V. Weiss, U.S. Geological Survey, Reston, Va.; Isabelle M. Cozzarelli, U.S. Geological Survey, Reston, Va.; Brian Mailloux, Barnard College, New York, N.C.

Direct measurements of the function and diversity of microorganisms are dramatically improving our understanding of geochemical cycling in aquifer systems. This session will examine the advantages, limitations, and application of available molecular techniques. ORAL and POSTER

T30. Quaternary Micropaleontology: Quantifying Environmental Change

Cushman Foundation; GSA Geobiology and Geomicrobiology Division

Geomicrobiology; Quaternary Geology/Geomorphology; Environmental Geoscience

Benjamin P. Horton, University of Pennsylvania, Philadelphia, Pa.; Robin J. Edwards, Trinity College Dublin, Dublin, Ireland

Microfossil assemblages provide a means of reconstructing and quantifying high profile issues such as climate and sea-level change, the frequency of hurricanes and tsunami, and environmental acidification. ORAL and POSTER

T31. Geomorphology and Hydrology of Montane Tropical Streams

GSA Quaternary Geology and Geomorphology Division; GSA Hydrogeology Division

Geomorphology; Hydrogeology; Environmental Geoscience

Fred N. Scatena, University of Pennsylvania, Philadelphia, Pa.; Fred L. Ogden, University of Wyoming, Laramie, Wyo.

Streams draining tropical montane catchments are important sources of water and hydropower, and play major roles in global sediment and biogeochemical budgets. This session focuses on geomorphology, ecohydrology, sediments dynamics, and management of these systems. ORAL and POSTER

T32. Linking Sediment Dynamics and Geomorphology in Tidal Marshes and Estuaries

GSA Sedimentary Geology Division

Geomorphology; Marine/Coastal Science; Sediments, Clastic

Christopher Sommerfield, University of Delaware, Lewes, Del.; Raymond Torres, University of South Carolina, Columbia, S.C.

This session focuses on sediment dynamics, the evolution of estuarine landscapes and seascapes, and the linkages between process and morphology. Spatial and temporal scales of interest range from bedform to drainage network development. ORAL and POSTER

T33. The Impact of Climate Change on Hydrologic and Geomorphic Processes in the Arctic and Subarctic

GSA Quaternary Geology and Geomorphology Division

Geomorphology; Paleoclimatology/Paleoceanography

Joan Ramage, Lehigh University, Bethlehem, Pa.; Rose McKenney, Pacific Lutheran University, Tacoma, Wash.

High-latitude rapid temperature increases may lead to irreversible shifts in hydrogeomorphic regime resulting in significant environmental and human impacts. We seek observations or predictions of climatic impacts on processes and responses in high latitudes. ORAL and POSTER

T34. Erosion: Processes, Rates, and New Measuring Techniques (Posters)

GSA Quaternary Geology and Geomorphology Division

Geomorphology; Quaternary Geology/Geomorphology

Frank Pazzaglia, Lehigh University, Bethlehem, Pa.; Paul Bierman, University of Vermont, Burlington, Vt.; Milan Pavich, U.S. Geological Survey, Reston, Va.; Dorothy Merritts, Franklin and Marshall College, Lancaster, Pa.

Synthetic view of the fundamental processes and rates of landscape erosion across wide temporal and spatial scales. Review of emerging techniques in measuring erosion and implications for landscape evolution, global sedimentary budgets, and human impacts. POSTER

T35. Watershed-Based Approaches to River Restoration

GSA Quaternary Geology and Geomorphology Division; GSA Engineering Geology Division

Geomorphology; Quaternary Geology/Geomorphology; Engineering Geology

Sara L. Rathburn, Colorado State University, Fort Collins, Colo.; Karin Boyd, Applied Geomorphology Inc., Bozeman, Mont.

This session emphasizes river restoration through manipulation of watershed-scale processes at broad temporal and spatial scales. Restoration approaches that accommodate natural variability of rivers to enhance ecological integrity will be highlighted. ORAL

T36. Surficial Processes at the Hyperarid Limit: Current Research in the Atacama Desert, Chile

GSA Geobiology and Geomicrobiology Division

Geomorphology; Sediments, Clastic; Geomicrobiology

Jason A. Rech, Miami University, Oxford, Ohio; Ronald G. Amundson, University of California, Berkeley, Calif.

This session focuses on the quantification of surficial processes and landforms in the Atacama Desert and the use of these features to interpret environmental change on Earth and Mars. ORAL and POSTER

T37. Fluids at Plate Boundaries: Agents of Mechanical and Chemical Processes

GSA Hydrogeology Division; GSA Structural Geology and Tectonics Division

Geophysics/Tectonophysics/Seismology; Structural Geology; Tectonics

Demian Saffer, The Pennsylvania State University, University Park, Pa.; Jim Evans, Utah State University, Logan, Utah; Glenn Spinelli, New Mexico Institute of Mining & Technology, Socorro, N.Mex.

Fluids at plate boundaries influence deformation behavior, as well as global thermal, solute, and mass budgets. Presentations will include field, laboratory, and theoretical studies that provide quantitative insight into fluid-assisted mechanical and chemical processes. ORAL and POSTER

T38. Earthquakes and Effects on Health

GSA Geology and Health Division; GSA Geology and Society Division; GSA Engineering Geology Division

Geophysics/Tectonophysics/Seismology; Tectonics; Environmental Geoscience

Constantin Cranganu, Brooklyn College, Brooklyn, N.Y.

The recent Pakistan earthquake illustrated health problems of remote areas including habitat and hospital destruction, reduced retrieval of buried survivors, impaired rescue aid due to isolation, and greater health hazards than in urban areas. ORAL

T39. Innovative Watershed-Based Approaches for Integrating Research and Education

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education; Environmental Geoscience; Hydrogeology

Joseph R. Graney, Binghamton University, Binghamton, N.Y.; Michele Hluchy, Alfred University, Alfred, N.Y.

Watershed-scale studies are ideal for demonstrating biogeochemical complexity from research and education perspectives.

GSA Trivia Night

Come along and test your knowledge of geoscience trivia at this evening of fun. Over 100 questions will have you racking your brain and testing your skills!

Register a team or join a mixed team. Meet new people, share your knowledge, and have a great evening in Philadelphia. Winning teams will be awarded fabulous prizes and the prestige of being GSA Trivia Night winners!

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This session will provide overviews of watershed-based activities from urban and rural locations in pristine and polluted environments. ORAL

T40. Geohazards—Teachable Moments for Students and the Public: An Illustrated Community Discussion (Posters)

National Association of Geoscience Teachers; GSA Geoscience Education Division; GSA Geology and Society Division; Public Policy; GSA Engineering Geology Division

Geoscience Education; Environmental Geoscience; Public Policy

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

Natural and human-caused geohazards impact humanity on local, national, and international scales. This session will explore opportunities to inform students and the public about the importance and relevance of geology in light of these events. POSTER

T41. Using Large Experiments and Programs for Education and Outreach: Examples from EarthScope, the Joint Oceanographic Institutions, and Others

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education; Geoscience Information/ Communication; Public Policy

John E. DeLaughter, Washington, D.C.; Leslie Peart, Joint Oceanographic Institutions, Washington, D.C.

This session will focus on special issues inherent to education and outreach in large experiments and programs with particular emphasis on developing and maintaining a high level of public interest and interaction. ORAL

T42. Visualization in the Geosciences

GSA Geoscience Education Division; National Association of Geoscience Teachers; GSA Engineering Geology Division

Geoscience Education; Geoscience Information/ Communication

Sarah Titus, University of Wisconsin, Madison, Wis.; Eric Horsman, University of Wisconsin, Madison, Wis.; Cathryn Manduca, Carleton College, Northfield, Minn.

New tools are revolutionizing how geoscientists collect, display, and interact with data. Cognitive science is shedding new light on the development of spatial cognitive skills. We encourage papers that address geoscience visualization from both perspectives. ORAL and POSTER

T43. Addressing Present and Future Energy, Mineral, and Water Issues in the Classroom: The Need to Prepare Both Educated Citizens and Geoscientists

National Association of Geoscience Teachers; GSA Geoscience Education Division; GSA Geology and Society Division

Geoscience Education; Geoscience Information/ Communication

Andrew M. Buddington, Spokane Community College, Spokane, Wash.; Eric S. Cheney, University of Washington, Seattle, Wash.

This session will address energy and resource issues in geoscience education. We seek best practices at the classroom, curriculum, and public levels. Possible examples include lab exercises, resource courses, informal education activities, and experiential learning. ORAL

T44. Beyond the Content: Teaching Scientific and Citizenship Skills in the Geosciences (Posters)

National Association of Geoscience Teachers; GSA Geoscience Education Division

Geoscience Education; Geoscience Information/ Communication

Erin Campbell-Stone, University of Wyoming, Laramie, Wyo.; James D. Myers, University of Wyoming, Laramie, Wyo.

Scientific and citizenship literacy help students to succeed academically and to apply their knowledge to society as an active participant. This session seeks ideas and best practices in addressing the students' literacy needs within geoscience courses. POSTER

T45. Service Learning and Community Service in Earth Science Courses: Community Involvement in Earth Science Education

National Association of Geoscience Teachers; GSA Geoscience Education Division

Geoscience Education; Geoscience Information/ Communication; Environmental Geoscience

Suzanne O'Connell, Wesleyan University, Middletown, Conn.

Service learning joins theory with practice and action for academic credit. Community service has a less academic focus. In both, students develop citizenship skills, apply learning to real life projects, and strengthen community relationships. ORAL and POSTER

T46. Teaching Hydrogeology in the 21st Century

GSA Hydrogeology Division; National Association of Geoscience Teachers; GSA Education Division

Geoscience Education; Hydrogeology

Martin F. Helmke, West Chester University, West Chester, Pa.; Barbara J. Tewksbury, Hamilton College, Clinton, N.Y.

We encourage abstracts that showcase effective methods of teaching hydrogeology in the classroom, laboratory, and field. This session will also present outcomes from the 2005 workshop Teaching Hydrogeology in the 21st Century (http://serc.carleton.edu/NAGTWorkshops/hydrogeo/index.html). ORAL and POSTER

T47. Learning from Disaster: Using Natural Disasters to Teach Geoscience Concepts, Spatial Understanding, and Temporal Scale

GSA Geoscience Education Division; GSA Engineering Geology Division

Geoscience Education; Quaternary Geology and Geomorphology; Sediments, Clastic

James H. Kirby, University of South Florida, Tampa, Fla.

Using recent disasters as a starting point to discuss natural causes of catastrophic events, their spatial relationships with the planet, and temporal context of occurrence creates a unique learning environment for students in grades 5–12. ORAL

T48. Geology in the National Parks: Research, Mapping, and Resource Management

National Park Service; GSA Geology and Society Division

Geoscience Education

Bruce A. Heise, National Park Service, Lakewood, Colo.; Timothy B. Connors, Denver, Colo.; Jim Wood, National Park Service, Denver, Colo.

This session addresses the role of geoscience in the National Parks. Presentations are encouraged on geologic research, geologic mapping, paleontology, coastal geology, glacier studies, and resource management in National Parks, monuments, seashores, and historic sites. ORAL and POSTER

T49. Building New and Rebuilding Defunct College and University Geoscience Programs for the 21st Century: Challenges and Opportunities, Successes and Failures (Posters)

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education

Kurt A. Shoemaker, Shawnee State University, Portsmouth, Ohio; Jeffrey A. Bauer, Shawnee State University, Portsmouth, Ohio

Focuses on the challenges of launching new or extensively rebuilding existing but weakened undergraduate (major and minor) and graduate-level geoscience programs. Contributions encouraged from departments which are actively building or have successfully launched new programs. POSTER

T50. Effective Online Strategies for Teaching Geoscience at a Distance

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education

Laura A. Guertin, Penn State Delaware County, Media, Pa.; Tanya Furman, Pennsylvania State University, University Park, Pa.

Technology enables geoscience content to be delivered through online lectures and virtual fieldtrips to students unable to access a geoscience course. This session will share effective strategies to provide geoscience instruction in an online environment. ORAL and POSTER

T51. G–K12 (Graduate–K–12) Education: Improving Understanding of Geologic Concepts at All Levels (Posters)

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education

N.J. McMillan, New Mexico State University, Las Cruces, N.Mex.; Dave Mayo, California State University, Los Angeles, Calif.

Participants and principal investigators of National Science Foundation–funded G–K12 partnerships between universities and K–12 schools will share the challenges and benefits of sustained interactions between geoscience graduate students, K–12 teachers, and K–12 students. POSTER

T52. Preparing Future K–12 Teachers of Earth Science

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education

Heather L. Petcovic, Western Michigan University, Kalamazoo, Mich.; Elizabeth Nagy-Shadman, California State University, Northridge, Calif.; Michael J. Passow, White Plains Middle School, White Plains, N.Y.

How do we ensure that prospective K–12 teachers have a meaningful understanding of the geosciences? This session considers effective methods, courses, curricula, technology, and field programs that enhance the geoscience content knowledge of future teachers. ORAL and POSTER

T53. Teaching Instrumentation to Geoscience Students: Course Design, Objectives, and Presentations

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education

Elizabeth J. Catlos, Oklahoma State University, Stillwater, Okla.; George Morgan, University of Oklahoma, Norman, Okla.

Geoscience-related instrumentation courses (electron microprobe, scanning electron microscopy, X-ray diffraction, ion microprobe) are becoming increasingly important for students at all levels. We encourage presentations from faculty who teach these courses and incorporate equipment into their existing curriculum and from students. ORAL and POSTER

T54. Translating Earth: Conceptions Research in Earth Science Education

GSA Geoscience Education Division; National Association of Geoscience Teachers

Geoscience Education

Julie C. Libarkin, Ohio University, Athens, Ohio

This session will bring together researchers to discuss the latest findings in conceptions and conceptual change research in the geological sciences, as well as implications of this research for teaching geology. ORAL and POSTER

T55. Successes in Professional Development of Earth Science Teachers: Courses, Workshops, Partnerships, and Professional Development Opportunities that Work

National Association of Geoscience Teachers; GSA Geoscience Education Division

Geoscience Education

Nathalie N. Brandes, Montgomery College, Conroe, Tex.; Eric L. Cohen, Moriches, N.Y.

This session features successful programs that enhance K–12 earth science education through teacher education/enhancement programs that focus on any or all of the following: content knowledge, field experience, effective teaching strategies, and exemplary classroom/teacher resources. ORAL

T56. Successful Strategies for Recruiting and Retaining Undergraduate Geoscience Majors

National Association of Geoscience Teachers; GSA Geoscience Education Division

Geoscience Education

Barbara Tewksbury, Hamilton College, Clinton, N.Y.; Carolyn Eyles, McMaster University, Hamilton, Ontario; R. Heather Macdonald, College of William and Mary, Williamsburg, Va.

Few departments can thrive without making conscious efforts to recruit and retain students. We encourage abstracts that showcase creative and successful strategies for recruitment and retention that can be adapted for use in other departments. ORAL

T57. We Can Do Better: Alternatives to the Same Old Lab-Lecture Format in the College Classroom

National Association of Geoscience Teachers; GSA Geoscience Education Division

Geoscience Education

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

Many educators find that traditional science classrooms do a poor job of promoting learning. Speakers in this session will describe innovative alternative pedagogies, activities, and scheduling that are exciting and promote student learning. ORAL and POSTER

T58. Geology of Parks and Public Lands: Effective and Innovative Informal Earth Science Education for the Masses

National Park Service; Bureau of Land Management; Association of Earth Science Editors

Geoscience Information/Communication; Geoscience Education

Marion Malinowski, Bureau of Land Management, Lakewood, Colo.; Jim F. Wood, National Park Service, Lakewood, Colo.; Melanie Ransmeier, National Park Service, Denver, Colo.; Monica Gaiswinkler Easton, Ministry of Northern Development and Mines, Sudbury, Ontario

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

T59. Geoscience Information: Keys to Discovery

Geoscience Information Society

Geoscience Information/Communication; Public Policy; Geoscience Education

Patricia B. Yocum, University of Michigan, Ann Arbor, Mich.

Discovery in science depends on information made publicly available. This session provides opportunity for the geoscience community to discuss scientific information—how it is created, distributed, organized, accessed, and used. ORAL and POSTER

T60. Geoscience Advocacy and Communicating with the Public

GSA Geology and Society Division; GSA Geoscience Education Division

Geoscience Information/Communication; Public Policy; Geoscience Education

Linda Rowan, American Geological Institute, Alexandria, Va.; Sarah Andrews, Sonoma State University, Sebastopol, Calif.

Resources, hazards, and the teaching of science are major societal and policy issues. Examples of successful geoscience advocacy and effective communication of geoscience to the public will highlight the essential role of geoscientists in society. ORAL

T61. Geology and America's Early Wars

GSA History of Geology Division; National Park Service; GSA Engineering Geology Division; History of the Earth Sciences Society (HESS); GSA Archaeological Geology Division, GSA Quaternary and Geomorphology Division; GSA Geology and Society Divsion

History of Geology; Engineering Geology; Archaeological Geology

Bob Higgins, Education and Outreach Branch, Geologic Resources Division, National Park Service, Denver, Colo.; William R. Brice, University of Pittsburgh, Johnstown, Pa.; Judy Ehlen, Fredericksburg, Va.

Geology plays a critical role in every military venture. This session will examine how the American geologic setting, including geomorphology, hydrology, and resources influenced the course of the Revolutionary and Civil wars and other conflicts. ORAL

T62. Transcendental Geology: Henry David Thoreau and Nineteenth-Century Science

GSA History of Geology Division; History of the Earth Sciences Society (HESS)

History of Geology; Geomorphology; Marine/Coastal Science

Jon D. Inners, Pennsylvania Geological Survey, Camp Hill, Pa.; Kristen Hand, Pennsylvania Geological Survey, Middletown, Pa.

This session focuses on the scientific interests and geological observations of the American "poet-naturalist" Henry David Thoreau. We welcome submissions on the landscape of Concord, Thoreau's excursions, and his family's connection to the graphite trade. ORAL

T63. From the Scientific Revolution to the Enlightenment: Emergence of Modern Geology and Evolutionary Thought from the 16th–18th Century

GSA History of Geology Division; Paleontological Society, History of the Earth Sciences Society

History of Geology; Paleontology, Diversity, Extinction, Origination; Public Policy

Gary D. Rosenberg, Indiana University–Purdue University, Indianapolis, Ind.; William C. Parcell, Wichita State University, Wichita, Kans.

This session will explore discoveries made about nature and the momentous social changes of the 16th–18th centuries, which influenced the growing realization that Earth and life upon it have a long history of evolution. ORAL

T64. History of Geology: 100 Years of Wissahickon Interpretation

GSA History of Geology Division; Structural Geology Division; Association for Women Geoscientists; History of the Earth Sciences Society (HESS)

History of Geology; Petrology, Metamorphic; Structural Geology

Sally Newcomb, retired, Silver Spring, Md.; Maria Luisa Crawford, Bryn Mawr College, Bryn Mawr, Pa.

The Wissahickon Formation that underlies Philadelphia has been an enigma from the first time it was described to the present. This session will trace the history of geological ideas that have been applied to it. ORAL

T65. Detection of Voids, Tunnels, and Collapse Features

GSA Hydrogeology Division; GSA Geophysics Division; Karst Waters Institute; GSA Engineering Geology Division

Hydrogeology; Engineering Geology; Geophysics/Tectonophysics/Seismology

Todd Halihan, Oklahoma State University, Stillwater, Okla.; J.E. Nyquist, Temple University, Philadelphia, Pa.

The detection of voids and collapse structures, including karst features, mine shafts, and archaeology sites, is important for many problems in geology. This session evaluates applications of innovative techniques for characterization of these features. ORAL and POSTER

T66. Emerging and Innovative Approaches to Groundwater Modeling

GSA Hydrogeology Division; National Ground Water Association

Hydrogeology; Environmental Geoscience; Geochemistry, Aqueous

Abe Springer, Northern Arizona University, Flagstaff, Ariz.; Linda Zhang, University of Michigan, Ann Arbor, Mich.

The evolution and widespread application of groundwater models has led to innovative approaches in modeling. The session will explore these innovative approaches in development, application, effective parameter determination, uncertainty of models, or other topics. ORAL and POSTER

T67. Flow and Transport in Aquitard-Aquifer Systems

GSA Hydrogeology Division

Hydrogeology; Environmental Geoscience; Engineering Geology

Hongbin Zhan, Texas A&M University, College Station, Tex.

This session solicits new theoretical and field studies on flow and transport in aquitard-aquifer systems and new methods of aquitard characterization using hydrogeological, hydrogeophysical, and hydrogeochemical methods. ORAL and POSTER

T68. Gradients at Hydrologic Interfaces as Indicators of Key Earth-Surface ("Critical-Zone") Processes

GSA Hydrogeology Division; GSA Geobiology and Geomicrobiology Division; GSA Limnogeology Division

Hydrogeology; Environmental Geoscience; Geochemistry, Aqueous

David A. Stonestrom, U.S. Geological Survey, Menlo Park, Calif.; Michelle A. Walvoord, U.S. Geological Survey, Lakewood, Colo.

Chemical and physical gradients at hydrologic interfaces provide information about processes that can sustain or threaten life. Key processes include weathering, nutrient cycling, regulation of natural water supplies, and transport of contaminants. ORAL and POSTER

T69. Groundwater Availability and its Sustainability within Regional Aquifer Systems

GSA Hydrogeology Division; GSA Geology and Society Division

Hydrogeology; Environmental Geoscience

William M. Alley, U.S. Geological Survey, San Diego, Calif.; Kevin F. Dennehy, U.S. Geological Survey, Reston, Va.

Groundwater monitoring and assessment to address issues of the long-term sustainability of aquifer systems at the regional scale, including storage depletion, water-quality impacts, land subsidence, and streamflow depletion. ORAL and POSTER

T70. Groundwater Flow and Contaminant Fate, Transport, and Remediation in Fractured Soil, Sediment, and Rock

GSA Hydrogeology Division

Hydrogeology; Environmental Geoscience; Geochemistry, Aqueous

Larry D. McKay, University of Tennessee, Knoxville, Tenn.; Ying Fan Reinfelder, Rutgers University, Piscataway, N.J.

This session encourages abstracts on field, lab, and modeling investigations or informative case histories on the subject of groundwater flow and contaminant fate, transport, or remediation in fractured soil, sediment, and rock. ORAL and POSTER

T71. Groundwater's Role in the Survival of Threatened and Endangered Ecosystems

GSA Hydrogeology Division

Hydrogeology; Environmental Geoscience

F. Edwin Harvey, University of Nebraska, Lincoln, Neb.; Donald I. Siegel, Syracuse University, Syracuse, N.Y.

Many of Earth's ecosystems contain fauna and flora that are threatened or endangered. Some of these systems depend on groundwater for their survival. Thus, understanding groundwater's role is critical to making informed management decisions. ORAL and POSTER

T72. Heat as a Natural Tracer in Hydrologic Systems: Current Understanding, Innovation and Application

GSA Hydrogeology Division

Hydrogeology; Environmental Geoscience

Laura K. Lautz, State University of New York College of Environmental Science and Forestry, Syracuse, N.Y.; Jeffrey M. McKenzie, Ohio State University, Columbus, Ohio

Temperature can be used as a reliable, cost-effective tracer to quantify water movement through hydrologic systems. We encourage presentations on innovative field and modeling applications highlighting the use of temperature measurements to understand hydrologic systems. ORAL

T73. Nonpoint Source Pollution: Sources, Processes, Prediction, and Solutions

GSA Hydrogeology Division; GSA Geology and Society Division

Hydrogeology; Environmental Geoscience

William W. Simpkins, Iowa State University, Ames, Iowa; Carolyn G. Olson, U.S. Department of Agriculture, Washington, D.C.

Are we making progress in understanding and reducing nonpoint source (NPS) pollution? We seek papers identifying sources of and processes that produce NPS pollution, models for prediction of concentrations and total maximum daily loads, and solutions to NPS pollution. ORAL and POSTER

T74. Pharmaceuticals and Other Emerging Contaminants in the Environment—Transport, Fate, and Effects

GSA Hydrogeology Division

Hydrogeology; Environmental Geoscience

Douglas J. Schnoebelen, U.S. Geological Survey, Iowa City, Iowa; Dana W. Kolpin, U.S. Geological Survey, Iowa City, Iowa

The study of pharmaceuticals and other emerging contaminants is advancing to include the transport, fate, and effects of these compounds in the environment. This session provides a state-of-the-science overview for this exciting research area. ORAL and POSTER

T75. Chemical and Hydrological Interactions in the Evolution and Control of Coal and Metal Mine Drainage

GSA Hydrogeology Division; Geochemical Society: GSA Coal Geology Division

Hydrogeology; Geochemistry, Aqueous

Charles A. Cravotta, Pennsylvania Water Sciences Center, New Cumberland, Pa.; Joseph J. Donovan, West Virginia University, Morgantown, W.Va.; Keith B.C. Brady, Department of Environmental Protection, Harrisburg, Pa.

This session emphasizes the chemistry and hydrology of coal or metal mine drainage. Papers are solicited on aqueous chemical processes in mine settings and prediction and evolution of mine-water chemistry, innovative treatment, and long-term environmental effects. ORAL and POSTER

T76. Detecting and Characterizing Fluxes of Water and Dissolved Constituents across the Groundwater–Surface Water Interface

GSA Hydrogeology Division; GSA Limnogeology Division

Hydrogeology; Geochemistry, Aqueous; Limnogeology

Brewster Conant, University of Waterloo, Waterloo, Ontario; Donald Rosenberry, U.S. Geological Survey, Denver, Colo.

Session examines preferential flow paths and areas of exchange between groundwater and surface water across the sediment-water interface of streams, lakes, and wetlands and the processes controlling water fluxes, mass fluxes, and biogeochemical reactions. ORAL and POSTER

T77. Epikarst to Conduits: Quantitative Methods Applied to Monitoring and Modeling of Karst Aquifers

GSA Hydrogeology Division; Karst Waters Institute

Hydrogeology; Geochemistry, Aqueous; Environmental Geoscience

Ralph K. Davis, University Arkansas, Fayetteville, Ark.; Dorothy Vesper, West Virginia University, Morgantown, W.Va.

This session explores state-of-the-art monitoring and modeling systems that provide quantifiable data and results on which effective policy and management decisions about development and contaminant fate and transport in complex karst aquifers are based. ORAL and POSTER

T78. Geochemical and Hydrologic Linkages between Shallow and Deep Groundwaters

GSA Hydrogeology Division; GSA Geobiology and Geomicrobiology Division

Hydrogeology; Geochemistry, Aqueous; Environmental Geoscience

Laura Rademacher, University of the Pacific, Stockton, Calif.; Jennifer C. McIntosh, Johns Hopkins University, Baltimore, Md.

We welcome catchment- to basinal-scale hydrogeochemical studies linking shallow aquifer/soil waters to deep groundwaters over varying timescales, particularly isotopic tracers of fluid/solute transport, water-rock-microbial interactions, and effects of climate change on aquifer systems. ORAL

T79. Groundwater Age Dating: Current Issues and Applications

GSA Hydrogeology Division

Hydrogeology; Geochemistry, Aqueous; Environmental Geoscience

Andrew G. Hunt, U.S. Geological Survey, Denver, Colo.; Jean Moran, Lawrence Livermore National Laboratory, Livermore, Calif.; Andrew H. Manning, U.S. Geological Survey, Denver, Colo.

This session will provide a forum to present recent studies, both applied and theoretical, involving the measurement and modeling of groundwater residence time on all time scales. ORAL and POSTER

T80. Impact of Past Glaciations on Present-Day Subsurface Water Resources: Geochemical, Hydrogeological, and Modeling Studies

GSA Hydrogeology Division

Hydrogeology; Geochemistry, Aqueous; Quaternary Geology

Jennifer C. McIntosh, Johns Hopkins University, Baltimore, Md.; Victor Bense, Indiana University, Bloomington, Ind.

Continental glaciations altered regional-scale fluid flow and solute transport in underlying aquifer systems. This session focuses on geochemical and hydrologic evidence for ice sheet–permafrost–aquifer interactions and residence times of meltwaters. Field and modeling studies encouraged. ORAL and POSTER

T81. Physical, Chemical, and Biological Controls on Remediation of Chlorinated Solvents in Fractured Rock

GSA Hydrogeology Division; GSA Geobiology and Geomicrobiology Division

Hydrogeology; Geochemistry, Aqueous; Geomicrobiology

Allen M. Shapiro, U.S. Geological Survey, Reston, Va.; Francis H. Chapelle, U.S. Geological Survey, Columbia, S.C.

This session is designed to review the current state of characterizing fractured rock sites subject to contamination with chlorinated solvents and to review available remediation technologies in such formations. ORAL and POSTER

T82. Reactions at Mineral-Water Interfaces: The Role of Solute Adsorption on Contaminant Co-Adsorption, Mineral Dissolution, and Colloid Behavior

GSA Hydrogeology Division

Hydrogeology; Geochemistry, Aqueous; Environmental Geoscience

John J. Lenhart, The Ohio State University, Columbus, Ohio; Daniel E. Giammar, Washington University in St. Louis, Saint Louis, Mo.

This session highlights advances in understanding how solute adsorption influences contaminant co-adsorption, mineral dissolution, and colloid behavior. Experimental, spectroscopic, and theoretical approaches are used to elucidate reaction mechanisms in both natural and model systems. ORAL and POSTER

T83. Salinization Processes and Problems in Coastal and Inland Aquifers

GSA Hydrogeology Division

Hydrogeology; Geochemistry, Aqueous; Marine/Coastal Science

Jeffrey S. Hanor, Louisiana State University, Baton Rouge, La.; Ann Mulligan, Woods Hole Oceanographic Institution, Woods Hole, Mass.

Field and modeling studies of the sources of salinity and causes of salinization of coastal and inland groundwater resources. The hydrogeology, geochemistry, and management of aquifer salinization. ORAL and POSTER

T84. Novel Applications of Tracers to Characterize and Distinguish Multiple Transport Phenomena at Various Scales

GSA Hydrogeology Division

Hydrogeology; Geochemistry, Other; Environmental Geoscience

William E. Sanford, Colorado State University, Fort Collins, Colo.; Craig E. Divine, ARCADIS, Highlands Ranch, Colo.

Papers will show creative tracer tests such as separating the effects of diffusion and sorption, estimating mass transfer rate, multiple tracers, nanoparticles, low detection limits, and complementary characterization methods (e.g., geophysics). ORAL and POSTER

T85. New Approaches to Understanding the Cycling of Water in Urban Landscapes

GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division

Hydrogeology; Geomorphology

Claire Welty, University of Maryland–Baltimore County, Baltimore, Md.; Andrew J. Miller, University of Maryland–Baltimore County, Baltimore, Md.

This session explores the impact of urban development on hydrologic response, sediment yield, and landform evolution. Contributions are encouraged on new tools for quantifying the urban water cycle at high-resolution space and time scales. ORAL and POSTER

T86. Peatland Patterns and Hydrological Processes: From the Subarctic to the Subtropics

GSA Hydrogeology Division

Hydrogeology; Geomorphology; Limnogeology

Judson W. Harvey, U.S. Geological Survey, Reston, Va.; Andrew Reeve, University of Maine, Orono, Maine

The goal is to bring together hydrologists from disparate research areas to encourage comparisons and new insights about evolution, function, and future changes in peatland ecosystems. ORAL and POSTER

T87. Stream-Hyporheic Interactions: Hydrology, Geochemistry, and Biology

GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geobiology and Geomicrobiology Division

Hydrogeology; Geomorphology; Geochemistry, Aqueous

Eric W. Peterson, Illinois State University, Normal, Ill.; Meinhard Bayani Cardenas, New Mexico Institute of Mining and Technology, Socorro, N.Mex.

An interdisciplinary session designed to expose and synthesize our understanding of the hyporheic zone, focusing on geomorphologic, hydrologic, and biogeochemical studies exploring linkages across scale and process. ORAL and POSTER

T88. Innovative Sensors, Technologies, and Strategies for Performance Monitoring of Waste Disposal Facilities and Remediation Approaches

GSA Hydrogeology Division; GSA Geophysics Division

Hydrogeology; Geophysics/Tectonophysics/Seismology; Environmental Geoscience

Thomas J. Nicholson, U.S. Nuclear Regulatory Commission, Rockville, Md.; Roelof Jan Versteeg, Idaho National Laboratory, Idaho Falls, Idaho; John W. Lane, U.S. Geological Survey, Storrs, Conn.

This session will showcase innovative sensors, technologies, and strategies being used to monitor the performance of waste disposal facilities and various remediation approaches for isolating or mitigating groundwater contaminant plumes. ORAL and POSTER

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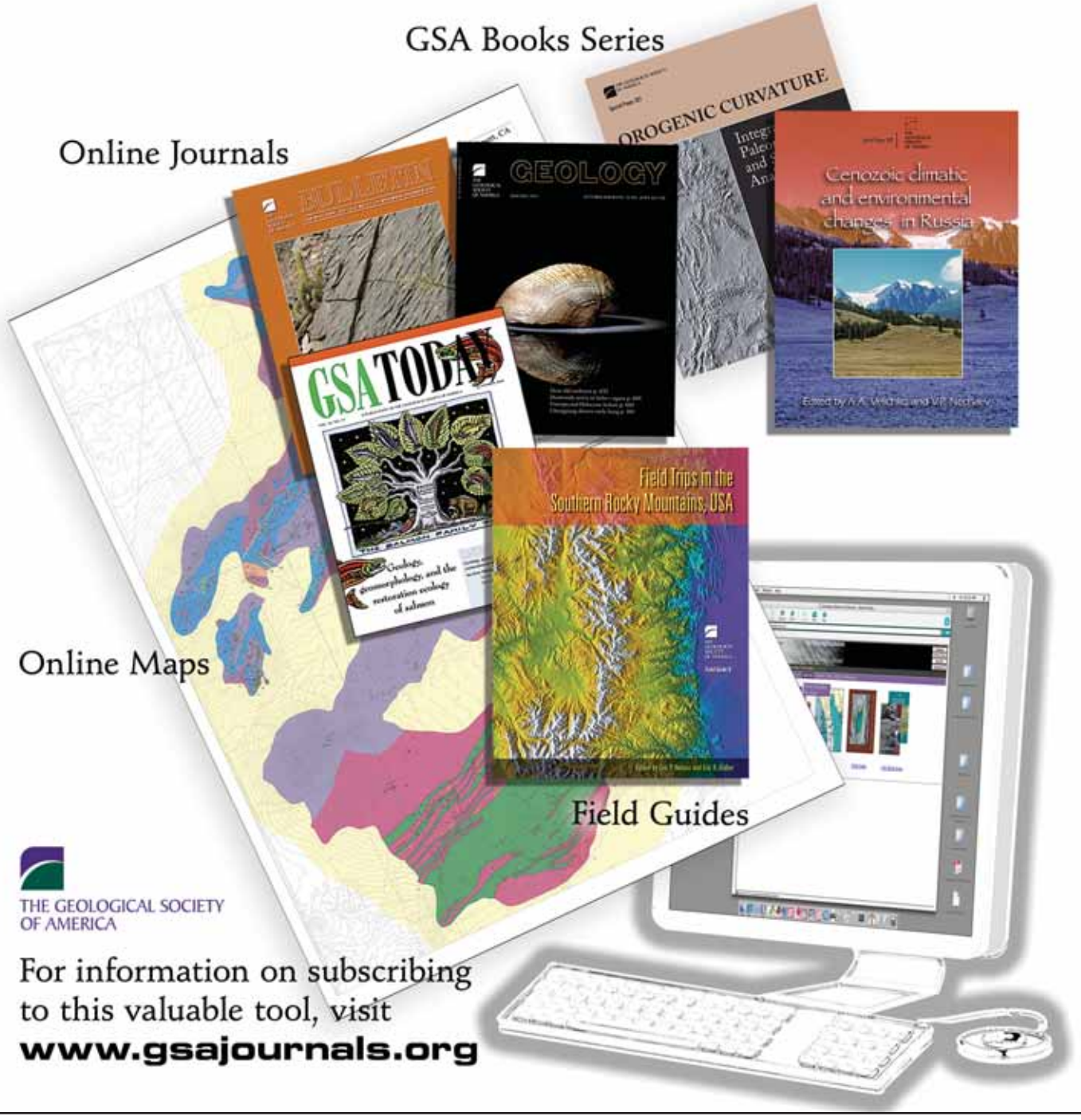

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T89. Revolutionizing Hydrologic Systems Observations: Data Needs to Ensure Groundwater Availability

GSA Hydrogeology Division; National Ground Water Association, GSA Geology and Society Division

Hydrogeology; Geoscience Information/Communication; Public Policy

Vicki J. Kretsinger Grabert, Luhdorff and Scalmanini, Woodland, Calif.; Beverly L. Herzog, Illinois State Geological Survey, Champaign, Ill.

This session highlights the global need to revolutionize hydrologic systems observations to achieve sustainable resources goals and provide decision makers with the data needed to better assess and manage groundwater resources. ORAL and POSTER

T90. Three-Dimensional Geological Mapping for Groundwater Applications

GSA Hydrogeology Division; GSA Geology and Society Division; GSA Quaternary Geology and Geomorphology Division

Hydrogeology; Quaternary Geology/Geomorphology; Engineering Geology

Hazen A.J. Russell, Geological Survey of Canada, Ottawa, Ontario; Richard C. Berg, Illinois State Geological Survey, Champaign, Ill.; L. Harvey Thorleifson, University of Minnesota, St. Paul, Minn.

This session will highlight case studies or techniques of data collection, management, and integration leading to the construction and visualization of three-dimensional geological models with particular emphasis on hydrogeological applications. ORAL

T91. GPS and InSAR in Groundwater Investigations

GSA Hydrogeology Division

Hydrogeology; Remote Sensing/Geographic Info System; Environmental Geoscience

Thomas J. Burbey, Virginia Tech, Blacksburg, Va.; John Bell, University of Nevada, Reno, Nev.

This session will explore new and innovative uses of both global positioning systems (GPS) and interferometric aperture radar techniques (InSAR) in groundwater investigations and aquifer characterization. ORAL and POSTER

T92. Innovations in Characterizing Physical and Chemical Heterogeneity in Sedimentary Aquifers

GSA Hydrogeology Division

Hydrogeology; Sediments, Clastic

Richelle M. Allen-King, State University of New York, Buffalo, N.Y.; Robert W. Ritzi, Wright State University, Dayton, Ohio

This session will feature various approaches to capture aquifer heterogeneity in sedimentary systems with a goal to improve solute transport prediction. Approaches of interest include experimental and field quantification, geophysical characterization, and sedimentary architecture modeling. ORAL and POSTER

T93. Recent Advances in Groundwater Solute Transport Modeling: Alternatives to the Classical Advection-Dispersion Model

GSA Hydrogeology Division

Hydrogeology

Gaisheng Liu, University of Oklahoma, Norman, Okla.; Chunmiao Zheng, University of Alabama, Tuscaloosa, Ala.; Steven M. Gorelick, Stanford University, Stanford, Calif.

This session focuses on the latest progress on groundwater solute transport modeling with emphasis on theoretically sound and practically useful alternatives to the classical advection-dispersion theory. ORAL and POSTER

T94. The Spatial and Temporal Variability of Groundwater Recharge

GSA Hydrogeology Division

Hydrogeology

Weston R. Dripps, Furman University, Greenville, S.C.; Kenneth Bradbury, Wisconsin Geological & Natural History Survey, Madison, Wis.

This session seeks papers that develop and/or apply field and/or modeling techniques for quantifying the spatial and temporal variability and distribution of groundwater recharge. ORAL and POSTER

T95. Dating and Environmental Interpretation of Lake, Loess, and Marine Sediment Sequences using Paleomagnetism and Rock Magnetism

GSA Limnogeology Division

Limnogeology; Paleoclimatology/Paleoceanography; Quaternary Geology

John A. Peck, University of Akron, Akron, Ohio; John W. King, University of Rhode Island, Narragansett, R.I.

This session combines rock magnetic studies of environmental change from lake, loess, and marine sediments with paleomagnetic studies that provide robust chronologies for these sediment sequences on time scales from secular variation to reversals. ORAL and POSTER

Holtwood Gorge, Susquehanna River, Pennsylvania. Photo courtesy of Frank J. Pazzaglia.

T96. Neogene and Quaternary Biological Paleolimnology: In Memory of J. Platt Bradbury

GSA Limnogeology Division

Limnogeology; Paleoclimatology/Paleoceanography; Quaternary Geology

Scott W. Starratt, U.S. Geological Survey, Menlo Park, Calif.

During his career, Platt Bradbury pioneered techniques in biochronology and paleoenvironmental analysis of late Cenozoic lake sediments from around the world. Papers on all aspects of lacustrine analysis, particularly those using biological proxies, are welcomed. ORAL and POSTER

T97. Core Analysis of Lake Sediments (Posters)

GSA Limnogeology Division; ExxonMobil

Limnogeology

Elizabeth H. Gierlowski-Kordesch, Ohio University, Athens, Ohio; Peter A. Drzewiecki, Eastern Connecticut State University, Willimantic, Conn.; Kevin Bohacs, ExxonMobil Upstream Research Co., Houston, Tex.

Core analysis and comparison of modern lake sediments and fossil lake rock sequences will shed light on sedimentation processes as well as preservation potential of fossils and structures through time and space. POSTER

T98. Identifying Our Most Vulnerable Shorelines: Science and Policy

GSA Geology and Society Division

Marine/Coastal Science; Public Policy; Quaternary Geology/Geomorphology

Robert S. Young, Western Carolina University, Cullowhee, N.C.; David M. Bush, University of West Georgia, Carrollton, Ga.

This session will focus on how scientists can objectively determine which of this nation's shorelines are the most vulnerable, and how a long-term retreat from these shorelines might be initiated. ORAL and POSTER

T99. Utilization of Benthic Mapping Data in Estuarine and Coastal Environments: An Integration of Pure and Applied Research

Marine/Coastal Science; Remote Sensing/Geographic Info System; Geophysics/Tectonophysics/Seismology

John A. Madsen, University of Delaware, Newark, Del.; Bartholomew D. Wilson, Delaware Coastal Program, Dover, Del.

Benthic maps are a necessity for decision makers involved in management decisions affecting coastal and estuarine resources. Utilizing the best methodologies and datasets for mapping greatly increases the validity of these essential bottom maps. ORAL

T100. Whet Your Apatite: Advances in Research of Natural and Biological Apatite

Mineralogical Society of America

Mineralogy/Crystallography; Geochemistry, Other; Paleontology, Paleoecology/Taphonomy

Doreena Patrick, University of Pennsylvania, Philadelphia, Pa.; H. Catherine W. Skinner, Yale University Medical School, New Haven, Conn.; John Rakovan, Miami University, Oxford, Ohio.

Biogenic apatite composition reflects conditions during fossilization and acts as a "flight recorder" for events occurring in the environment. Paleontologists, mineralogists, and others interested in bioapatite research will benefit from this body of knowledge. ORAL

T101. Petrologic Mineralogy—The Study of Minerals in Context: In Honor of Charles V. Guidotti

Mineralogical Society of America

Mineralogy/Crystallography; Petrology, Metamorphic; Geochemistry, Other

Edward S. Grew, University of Maine, Orono, Maine; M. Darby Dyar, Mount Holyoke College, South Hadley, Mass.; Darrell Henry, Louisiana State University, Baton Rouge, La.

Charles Guidotti maintained that minerals are chemical systems that should be studied in context. This session focuses on crystallography, mineral physics, and phase relationships in the study of minerals and their relevance to geologic processes. ORAL and POSTER

T102. Atmosphere–Ice Sheet–Ocean Interactions: Modern Observations and Historical Interpretations

Paleoclimatology/Paleoceanography; Marine/Coastal Science; Environmental Geoscience

Stefanie Brachfeld, Montclair State University, Upper Montclair, N.J.; Amy Leventer, Colgate University, Hamilton, N.Y.

This session examines recent ice shelf collapse and links to dynamic modern glacial systems, and marine and terrestrial records of past ice sheet, and ice shelf advances and retreats. ORAL

T103. The Terrestrial Eocene-Oligocene Boundary Revisited: A Comparison of Multi-Proxy Records of Paleoenvironmental and Paleoclimatic Change

Paleontological Society

Paleoclimatology/Paleoceanography; Paleontology, Biogeography/Biostratigraphy; Stratigraphy

Dennis Terry, Temple University, Philadelphia, Pa.; Emmett Evanoff, University of Colorado, Boulder, Colo.

New data is challenging the hypothesis of cooling and drying across the terrestrial Eocene-Oligocene boundary. This session provides a forum to present new data and to compare multiple-proxy records of terrestrial paleoclimatic and paleoenvironmental change. ORAL

T104. History of Study of Environmental Impacts on Health

GSA Geology and Health Division; GSA History of Geology Division; History of the Earth Sciences Society (HESS)

Paleoclimatology/Paleoceanography; Sediments, Carbonates; Sediments, Clastic

Gerald M. Friedman, Northeastern Science Foundation, Troy, N.Y.

Recorded history of ancient life is nontraditional: fossils, skeletons, portrayals on ancient monuments, stelae, pottery, sculptures. Modern studies of more available evidence are often part of other disciplines, including paleontology, paleopathology, anthropology, archaeology, etc. ORAL

T105. Paleosols, Proxies, and Paleoenvironments

Paleoclimatology/Paleoceanography; Sediments, Clastic; Geochemistry, Other

Nathan D. Sheldon, Royal Holloway University of London, Egham, Surrey, UK; Neil J. Tabor, Southern Methodist University, Dallas, Tex.

Paleosols formed at the interface of Earth's lithosphere, biosphere, and atmosphere and therefore have potential to offer unique paleoclimatic/paleoenvironmental proxies. This session will focus on new proxies and applications of existing ones to paleoclimatic and paleoenvironmental problems. ORAL

T106. Devonian–Early Carboniferous Climate Change: Glacial Deposits and Proxy Records

Society for Sedimentary Geology (SEPM)

Paleoclimatology/Paleoceanography; Stratigraphy; Paleontology/Paleobotany

Peter Isaacson, University of Idaho, Moscow, Idaho; Thomas Algeo, University of Cincinnati, Cincinnati, Ohio

Intended for glacial geologists, paleoclimate modelers, sedimentary geochemists, sequence stratigraphers, paleobotanists, and paleontologists studying problems related to climate change during the Devonian and Early Carboniferous, with a special focus on events around the Devonian-Carboniferous boundary. ORAL and POSTER

T107. The EARTHTIME Project

Paleontological Society

Paleontology, Biogeography/Biostratigraphy; Paleontology/Paleobotany

Samuel A. Bowring, Massachusetts Institute of Technology, Cambridge, Mass.; Douglas H. Erwin, Smithsonian Institution, Washington D.C.

EARTHTIME is an international, community-based scientific initiative aimed at sequencing earth history through the integration of geochronology, stratigraphy, and paleontology to resolve the rates of geological and evolutionary processes. ORAL

T108. Stratigraphic Palynology: Applications to Geologic Problems

American Association of Stratigraphic Palynologists

Paleontology, Biogeography/Biostratigraphy; Stratigraphy

Douglas J. Nichols, U.S. Geological Society, Denver, Colo.; Robert A. Cushman, Loma Linda University, Loma Linda, Calif.

This session will explore recent techniques and developments in the application of palynology to solving geologic problems in stratigraphy and basin analysis. ORAL

T109. Mass Extinctions: New Approaches Analyzing Process Links between Land and Sea

Paleontological Society; GSA Geobiology and Geomicrobiology Division

Paleontology, Diversity, Extinction, Origination; Paleoclimatology/Paleoceanography; Geochemistry, Other

David J. Bottjer, University of Southern California, Los Angeles, Calif.; Peter D. Ward, University of Washington, Seattle, Wash.

This session will highlight newly developed analyses that explore mass extinction processes that affect both marine and terrestrial environments, including how extinction in one might cause extinction in the other. ORAL

T110. Magnetostratigraphy of Critical Intervals in Earth History: Contributions to Geochronology, Geobiology, Paleogeography, and Global Change

GSA Geophysics Division; GSA Sedimentary Geology Division; GSA Geobiology and Geomicrobiology Division; Society for Sedimentary Geology (SEPM)

Paleontology, Diversity, Extinction, Origination; Paleontology, Biogeography/Biostratigraphy; Geophysics/Tectonophysics/Seismology

Timothy D. Raub, Yale University, New Haven, Conn.; Adam C. Maloof, Princeton University, Princeton, N.J.

This session solicits new magnetostratigraphies, critical reviews of global datasets, and fundamental studies into the paleomagnetic character of sedimentary materials, especially addressing floral and faunal correlation, extinction, and radiation, and recent and ancient biogeochemical cycling. ORAL and POSTER

T111. The Late Cretaceous–Early Tertiary Interval in the Atlantic Coastal Plain

Paleontological Society

Paleontology, Diversity, Extinction, Origination; Paleontology, Paleoecology/Taphonomy; Stratigraphy

William B. Gallagher, New Jersey State Museum, Trenton, N.J.; Kenneth J. Lacovara, Drexel University, Philadelphia, Pa.

This session will summarize recent research on the paleontology and biostratigraphy of the Late Cretaceous–early Tertiary stratigraphic sequence in the Atlantic Coastal Plain of North America, focusing on the record around the K-T boundary. ORAL

T112. Extinction, Dwarfing, and the Lilliput Effect

Paleontological Society

Paleontology, Diversity, Extinction, Origination; Paleontology, Phylogenetic/Morphological Patterns; Paleontology, Biogeography/Biostratigraphy

Richard J. Twitchett, University of Plymouth, Plymouth, UK; Bridget S. Wade, Rutgers, The State University of New Jersey, New Brunswick, N.J.

This session explores and discusses the dwarfing of organisms during Phanerozoic extinction events, commonly known as the "Lilliput Effect." Presentation addressing issues of taxonomy, morphometrics, and paleoecology surrounding this phenomenon are welcome. ORAL and POSTER

T113. Applied Reef Coral Paleoecology

Paleontological Society

Paleontology, Paleoecology/Taphonomy; Paleontology, Biogeography/Biostratigraphy; Marine/Coastal Science

Benjamin J. Greenstein, Cornell College, Mount Vernon, Iowa

This session assembles researchers engaged in various aspects of reef coral community paleoecology. Research results will be presented in the context of their application to ecological disturbances facing modern reef coral communities. ORAL

T114. The Dynamic Reef and Shelly Communities of the Paleozoic: A Tribute to the Research Career of Paul Copper

Paleontological Society

Paleontology, Paleoecology/Taphonomy; Paleontology, Diversity, Extinction, Origination; Paleontology, Biogeography/Biostratigraphy

Leif Tapanila, Idaho State University, Pocatello, Idaho; Jisuo Jin, University of Western Ontario, London, Ontario

A session highlighting the environmental and evolutionary changes that helped define the Paleozoic Era as a time of innovation and complexity for shallow marine benthic communities. ORAL and POSTER

T115. Fossil Behavior: In Honor of Adolf Seilacher

Paleontological Society

Paleontology, Paleoecology/Taphonomy; Paleontology, Phylogenetic/Morphological Patterns; Paleontology, Diversity, Extinction, Origination

A.A. Ekdale, University of Utah, Salt Lake City, Utah; Richard G. Bromley, Copenhagen University, Denmark

The fossil record of animal behavior as represented by the wide spectrum of trace fossils ranging from the Precambrian to the present. ORAL and POSTER

T116. Trilobite Paleobiology and Evolution: In Honor of Brian Chatterton

Paleontological Society

Paleontology, Phylogenetic/Morphological Patterns; Paleontology, Diversity, Extinction, Origination; Paleontology, Paleoecology/Taphonomy

Brenda R. Hunda, Cincinnati Museum Center, Cincinnati, Ohio; Mark Webster, University of Chicago, Chicago, Ill.

Trilobites as major contributors to the Paleozoic record: Paleobiologic and phylogenetic investigations, and their role in patterns of diversity and evolution. ORAL

T117. Life on Late Devonian Continents—Organisms and Ecosystems in Transition: In Honor of James Richard "Dick" Beerbower

Paleontological Society

Paleontology/Paleobotany; Paleontology, Diversity, Extinction, Origination; Paleoclimatology/Paleoceanography

Edward B. Daeschler, Academy of Natural Sciences, Philadelphia, Pa.; Walter L. Cressler, West Chester University, West Chester, Pa.

This session will take a multidisciplinary approach toward integrating data on the biotic and physical conditions of Late Devonian floodplains where evolutionary changes among plants and animals dramatically expanded early continental ecosystems. ORAL

T118. Biotic Response to Global Environmental Change: Analogs for the Future of Life on Earth

Paleontological Society

Paleontology/Paleobotany; Paleontology, Paleoecology/Taphonomy; Paleontology, Diversity, Extinction, Origination

Margaret L. Fraiser, University of Wisconsin, Milwaukee, Wis.

Effects of atmospheric and oceanic changes on microbial, macroinvertebrate, and vertebrate life in the terrestrial and marine realms that could represent analogs for the future of life on Earth if CO_2 levels continue to rise. ORAL

T119. Crustal Melt Flow in Orogenic Belts: Integrated Field, Microstructural, Geochemical, and Geochronological Analysis of Migmatites and Associated Granites

Mineralogical Society of America

Petrology, Igneous; Structural Geology; Geochemistry, Other

Paul B. Tomascak, State University of New York, Oswego, N.Y.; Gary S. Solar, State University of New York College, Buffalo, N.Y.

Combination of structure, petrology, geochemistry, and geochronology on migmatites and granites is required to understand synchronous metamorphism, deformation, melting, and magma migration. This session focuses on data integration to understand the links among these processes. ORAL and POSTER

T120. Minerals, Melts, Fluids, and the Evolution of Mountain Belts: A Tribute to Maria Luisa Crawford

Mineralogical Society of America

Petrology, Metamorphic; Structural Geology; Mineralogy/Crystallography

Jinny Sisson, Rice University, Houston, Tex.; Alice L. Hoersch, La Salle University, Philadelphia, Pa.

Maria Luisa Crawford's deeply insightful research combines mapping, mineralogic-petrogenic studies, and fluid inclusion data to comprehend mountain belt evolution. We encourage those inspired by her work to submit papers on these subjects in her honor. ORAL and POSTER

T121. Impact Craters: Structures, Drilling, Ages, and Geophysics

GSA Planetary Geology Division; International Continental Scientific Drilling Program (ICDP); GSA Geophysics Division; GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division

Planetary Geology; Structural Geology; Geophysics/Tectonophysics/Seismology

Christian Koeberl, University of Vienna, Vienna, Austria; Jared R. Morrow, University of Northern Colorado, Greeley, Colo.

This session highlights recent advancements in understanding the structural development, geochronologic and stratigraphic dating, geophysical characteristics, and numerical modeling of terrestrial impact craters, including key data provided by ongoing interdisciplinary and international crater-drilling projects. ORAL and POSTER

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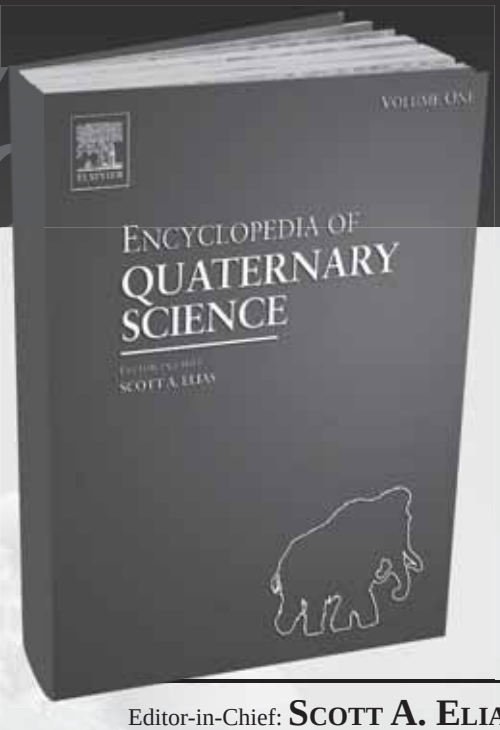

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T122. Asteroids, Meteorites, and the Early History of the Solar System—G.K. Gilbert Award Session

GSA Planetary Geology Division

Planetary Geology

Thomas R. Watters, Smithsonian Institution, Washington, D.C.; Harry Y. McSween, University of Tennessee, Knoxville, Tenn.

This session, dedicated to reflectance spectroscopy studies of asteroids and meteorites, honors Michael J. Gaffey, winner of the Planetary Geology Division's G.K. Gilbert Award for Outstanding Achievement. The recipient will give a keynote talk. ORAL

T123. Geology, Health, and Public Policy

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

Public Policy; Environmental Geoscience

David W. Mogk, Montana State University, Bozeman, Mont.; Monica E. Gowan, Mayo Clinic, Rochester, Minn.

The geosciences are increasingly important in their application to human health issues. This session will explore the interfaces between the earth system, impacts on human health, and ensuing local, national, and international public policy. ORAL and POSTER

T124. Forensic Geoscience from the Classroom to the Courtroom

GSA Geoscience Education Division

Public Policy; Geoscience Education; Environmental Geoscience

Elisa Bergslien, Buffalo State College, Buffalo, N.Y.

A forum for those with investigative experience and classroom experience to share realistic information about the applications of fundamental geoscience to forensic investigation, including environmental forensics. Use of analytical research techniques, including X-Ray diffraction, Raman spectroscopy, and ground penetrating radar. ORAL and POSTER

T125. Keys to Opportunities with the National Park Service

National Park Service

Public Policy; Geoscience Information/Communication; Geoscience Education

Judy Geniac, National Park Service, Denver, Colo.

Examples of helping parks with research, partnerships, projects, and volunteer and paid positions. Discover geoscience opportunities for professors, students, retirees, organizations, universities, and companies. Discuss possible partnerships, opportunities, and ways to improve cooperative efforts. ORAL

T126. Conservation and Management of Geoheritage Resources

GSA Geology and Society Division; GSA International Division; National Park Service; Public Policy

Public Policy; Geoscience Information/Communication

Robert D. Higgins, National Park Service, Denver, Colo.; Maurice J. Terman, Falls Church, Va.

This session will explore examples of managing geologic heritage resources and sites through regional, national, and international programs whose goals are in accordance with conservation and public enjoyment. ORAL

T127. Scales of Instability in Tropical Environments

American Association of Stratigraphic Palynologists

Quaternary Geology; Environmental Geoscience; Paleontology, Paleoecology/Taphonomy

Christopher O. Hunt, Queen's University of Belfast, UK

This session deals with the geological evidence for the changeability and dynamism of tropical environments, over a variety of time scales, from catastrophic individual storms lasting a few hours to slow changes over millions of years. ORAL

T128. Sources, Transport, Storage, and Delivery of Sediment in the Chesapeake Bay Watershed

GSA Quaternary Geology and Geomorphology Division

Quaternary Geology/Geomorphology; Geomorphology

Allen C. Gellis, U.S. Geological Survey, Baltimore, Md.; Dorothy Merritts, Franklin and Marshall College, Lancaster, Pa.

Understanding the sources, storage, and transport of sediment in the Chesapeake Bay watershed is critical to improving habitat. This session encourages presentations on studies that have examined sediment processes in Chesapeake Bay watersheds. ORAL and POSTER

T129. Geologic Mapping: Innovations and Interoperability (Posters)

GSA Geology and Society Division; GSA Quaternary Geology and Geomorphology Division; GSA Hydrogeology Division; GSA Structural Geology and Tectonics Division

Quaternary Geology/Geomorphology; Hydrogeology; Geoscience Information/Communication

Richard C. Berg, Illinois State Geological Survey, Champaign, Ill.; David R. Soller, U.S. Geological Survey, Reston, Va.; Peter T. Lyttle, U.S. Geological Survey, Reston, Va.; Thomas Berg, Ohio Geological Survey, Columbus, Ohio; Harvey Thorleifson, University of Minnesota, St. Paul, Minn.; Hazen Russell, Geological Survey of Canada, Ottawa, Ontario

This session will highlight innovations in geological mapping by showing new mapping, strategies for managing data, new methods for map publishing and Web accessibility, and how digital procedures have advanced the effectiveness of geological mapping. POSTER

T130. Geologic Mapping and Minerals Exploration Using Remote Sensing Data

GSA Geophysics Division

Remote Sensing/Geographic Info System; Economic Geology

John C. Mars, U.S. Geological Survey, Reston, Va.

This session will investigate new methods and effectiveness of using hyperspectral and multispectral data in geologic mapping and mineral exploration. ORAL

T131. Using Geographic Information Systems to Explore Geology and Health Relationships (Posters)

GSA Geology and Health Division

Remote Sensing/Geographic Info System; Environmental Geoscience

John Maclachlan, McMaster University, Hamilton, Ontario; David Mogk, Montana State University, Bozeman, Mont.

Geographic information systems have allowed for the further exploration and visualization of spatial relationships of health and geologic variables. This session will allow researchers to showcase these relationships. POSTER

T132. A Visual Showcase for Diverse GIS Applications: A Cornucopia of Case Studies

GSA Geoscience Education Division

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

Richard B. Schultz, Elmhurst College, Elmhurst, Ill.; Mark R. Hafen, University of South Florida, Tampa, Fla.

This interdisciplinary session, emphasizing the diverse applications of geographic information systems (GIS), showcases broad applications for GIS and creates an awareness of the infusion of spatial concepts across the geosciences from the perspective of both professional and academics. ORAL

T133. Late Permian–Early Triassic Earth

Paleontological Society

Sediments, Carbonates; Geochemistry, Other; Paleontology, Biogeography/Biostratigraphy

Ezat Heydari, Jackson State University, Jackson, Miss.; Thomas C. Wynn, Lock Haven University, Lock Haven, Pa.

We request contributions related to the tectonics, volcanism, mantle disturbances, geochemistry, paleoceanography, paleontology, exotic sedimentary features, extraterrestrial events, and mineralogy to better understand events that affected Earth during the Late Permian to Early Triassic. ORAL and POSTER

T134. Back to the Future of Sedimentary Geology: Student Research in Sedimentary Geology (Posters)

GSA Sedimentary Geology Division

Sediments, Carbonates; Sediments, Clastic; Stratigraphy

Daniel Larsen, University of Memphis, Memphis, Tenn.

This session will feature undergraduate and graduate student research in sedimentary geology. Awards will be given for the best research papers at the graduate and undergraduate levels. POSTER

T135. Forensic Geology

GSA Geology and Health Division; GSA Geology and Society Division

Sediments, Clastic; Geomorphology; Geochemistry, Other

Nehru E. Cherukupalli, City University of New York, Brooklyn, N.Y.

Application of geology to criminal and other investigations of fossil and modern evidence based on minerals, rocks, soils, dust, disturbed stratigraphy, sedimentology, etc., using field methods, polarized light microscopy, and other investigative laboratory techniques. ORAL and POSTER

T136. River Generated Hyperpycnal Events and Resulted Deposits in Modern and Ancient Environments

Sediments, Clastic; Marine/Coastal Science; Stratigraphy

Cornel Olariu, University of Texas, Austin, Tex.; Piret Plink Björklund, Göteborg University, Göteborg, Sweden

We are looking for results of studies in flume experiments, modern environments, or ancient deposits related to hyperpycnal flows. The aim of the session is to improve sedimentological criteria to recognize ancient river-generated hyperpycnal deposits. ORAL

T137. Epicontinental Seas in the Geological Record: The Limitations of the Uniformitarian Paradigm

Sediments, Clastic; Sediments, Carbonates; Paleoclimatology/Paleoceanography

Peter A. Allison, Imperial College, London, UK; Martin R. Wells, Imperial College, London, UK; Brian R. Pratt, University of Saskatchewan, Saskatoon, Saskatchewan

This multidisciplinary session will involve paleontologists, geochemists, sedimentologists, and ocean-atmospheric modelers and will extend our appreciation of the behavior of ancient epicontinental seas. ORAL

T138. Using Detrital Zircon Geochronology to Answer Geologic Questions We Formerly Could Not Ask

GSA Sedimentary Geology Division; Society for Sedimentary Geology

Sediments, Clastic; Stratigraphy; Tectonics

Michael Pope, Washington State University, Pullman, Wash.; Paul Link, Idaho State University, Pocatello, Idaho

This session will provide a forum to discuss novel uses of detrital zircon geochronology to address a variety of geologic questions including provenance, sediment transport, and the tectonic evolution of mountain belts, which were not previously addressed. ORAL and POSTER

T139. Changes in Ocean and Atmospheric Redox State and the Evolution of Life

Paleontological Society; GSA Geobiology and Geomicrobiology Division

Stratigraphy; Geochemistry, Organic; Geomicrobiology

Ganqing Jiang, University of Nevada, Las Vegas, Nev.; Andrey Bekker, Carnegie Institution of Washington, Washington, D.C.

This session will bridge a gap between specialists using various tools to constrain the redox state of modern, Phanerozoic, and Precambrian ocean and atmosphere. Studies that examine elemental, isotopic, and mineralogical redox indicators are welcome. ORAL and POSTER

T140. U.S. Atlantic and Gulf Margin Sequences and Hydrostratigraphy

Stratigraphy; Hydrogeology; Marine/Coastal Science

Peter J. Sugarman, New Jersey Geological Survey, Trenton, N.J.; Kenneth Miller, Rutgers University, Piscataway, N.J.

We encourage presentations that relate U.S. Atlantic and Gulf coastal plain sequence, processes of sea-level, tectonics, and climate changes, and their relationships to aquifers, confining units, and water resources. ORAL and POSTER

T141. Spatial and Temporal Heterogeneity of Hypoxic-Anoxic Conditions in Mid-Cretaceous Deposits of the Tethyan Realm: Characterization and Paleoenvironmental Implications (Posters)

GSA Sedimentary Geology Division; Society for Sedimentary Geology (SEPM); GSA Geobiology and Geomicrobiology Division

Stratigraphy; Paleoclimatology/Paleoceanography; Geomicrobiology

Florentin J. Maurrasse, Florida International University, Miami, Fla.; Ricardo Barragan-Manzo, Universidad Nacional Autónoma de México (UNAM), Mexico City, México

Comparison of Mid-Cretaceous deposits at sites in Colombia, NE México, the Atlantic Ocean and Europe in order to characterize spatial and temporal heterogeneity of hypoxic-anoxic deposits in the different areas, and assess their paleoceanographic implications. POSTER

T142. Terrestrial Impact Breccias

GSA Planetary Geology Division; GSA Sedimentary Geology Division

Stratigraphy; Planetary Geology; Sediments, Clastic

David T. King Jr, Auburn University, Auburn, Ala.; Kevin Evans, Missouri State University, Springfield, Mo.

Impact breccias can be deposited or emplaced in a variety of settings by a wide range of impact-related processes. This session will explore proximal to distal impact ejecta, crater-filling breccias, and other impact-related breccias. ORAL and POSTER

T143. Outcrop Studies: Fundamental to Lithofacies and Reservoir Characterization

GSA Sedimentary Geology Division; American Association of Petroleum Geologists

Stratigraphy; Sediments, Clastic; Sediments, Carbonates

Ernest A. Mancini, University of Alabama, Tuscaloosa, Ala.; Jim Blankenship, American Association of Petroleum Geologists, Tulsa, Okla.; William C. Parcell, Wichita State University, Wichita, Kans.

This session is designed to provide a forum for stratigraphers, sedimentologists, and petroleum geologists to discuss the importance of detailed outcrop studies to understand the variations in the internal fabric of strata, lithofacies, and reservoirs. ORAL

T144. Deformation in Sedimentary Rocks: A Tribute to Richard H. Groshong Jr.

GSA Structural Geology and Tectonics Division

Structural Geology; Tectonics

David A. Ferrill, Southwest Research Institute, San Antonio, Tex.

As a tribute to Richard H. Groshong, Jr., this session brings together diverse researchers to review progress, discuss recent advances, and frame future challenges in the understanding of low-temperature deformation processes in sedimentary rocks. ORAL

T145. Unraveling Tectonics: The Power behind Balanced Cross Sections and Kinematic Reconstructions

GSA Structural Geology and Tectonics Division

Structural Geology; Tectonics; Geophysics/Tectonophysics/Seismology

Nadine McQuarrie, Princeton University, Princeton, N.J.; Delores Robinson, University of Alabama, Tuscaloosa, Ala.

Balanced cross sections and kinematic reconstructions extract deformational histories from tectonic environments. Combined with age constraints, they have the potential to estimate geologic rates. This cross-disciplinary session explores the challenge of quantifying magnitudes of deformation. ORAL and POSTER

T146. Geoinformatics: Data to Knowledge about the Evolution of Continents

GSA Geophysics Division

Tectonics; Geophysics/Tectonophysics/Seismology; Petrology, Igneous

G. Randy Keller, University of Texas, El Paso, Tex.; A.K. Sinha, Virginia Tech, Blacksburg, Va.

One major challenge we face is to fully understand continental evolution. This session will present examples of scientific results obtained through high levels of integration between diverse fields and the approaches that facilitated this integration. ORAL and POSTER

T147. National Science Foundation Continental Dynamics Field Laboratories: 20 Years On

Tectonics; Geophysics/Tectonophysics/Seismology; Structural Geology

Lincoln S. Hollister, Princeton University, Princeton, N.J.; G. Randy Keller, University of Texas, El Paso, Tex.

This session features new geologic insights gained from multidisciplinary, field-based projects funded by the National Science Foundation Continental Dynamics Program that began in 1985. Most projects combined deep lithospheric probing techniques with focused geologic and geochemical studies.

T148. Intraplate Earthquakes: Advances in Understanding Their Causes and the Hazard Posed by Them

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

Tectonics; Geophysics/Tectonophysics/Seismology; Neotectonics/Paleoseismology

Eugene Schweig, U.S. Geological Survey, Memphis, Tenn.; Pradeep Talwani, University of South Carolina, Columbia, S.C.

This session will present the latest advances in understanding the causes, rates of occurrence, and hazard posed by intraplate earthquakes in North America and worldwide. ORAL and POSTER

T149. Modern to Precambrian Subduction Systems: Convergent Margin Behavior and Evolution over Geologic Time

GSA International Division; GSA Structural Geology and Tectonics Division; GSA Geophysics Division; GSA Sedimentary Geology Division; Integrated Ocean Drilling Program, MARGINS

Tectonics; Petrology, Metamorphic; Petrology, Igneous

Yildirim Dilek, Miami University, Oxford, Ohio; Mark Cloos, University of Texas, Austin, Tex.

This session is aimed at bringing together a diverse group of scientists working on modern-ancient convergent margins to evaluate our understanding of their evolution via material-heat transport, tectonic deformation, and seismogenesis at plate interfaces. ORAL

T150. Understanding Mountain Belts from Basin-Fill: Multidisciplinary Approaches to the Detrital Record of Orogenic Evolution

Tectonics; Stratigraphy; Sediments, Clastic

Andrea Fildani, ChevronTexaco, San Ramon, Calif.; Tim Cope, DePauw University, Greencastle, Ind.; Amy Weislogel, Stanford University, Stanford, Calif.

This session features integrated case studies of provenance evolution in sedimentary basins as a tracer of orogen evolution and/or plateau uplift, and novel efforts to apply cutting-edge technology to the detrital record of orogenic events. ORAL and POSTER

T151. Orogenesis in the Northwestern Appalachians

Tectonics; Structural Geology; Stratigraphy

Paul A. Washington, University of Louisiana, Monroe, La.

Recent discoveries have challenged the accepted nature and timing of Taconic through Acadian events. This session will explore the nature and timing of orogenic events within the northwestern half of the northern and maritime Appalachians. ORAL

T152. Spreading the Message: New Developments in the Presentation and Visualization of 3D and 4D Geological Data and Processes

GSA Structural Geology and Tectonics Division; GSA Geoscience Education Division

Tectonics; Structural Geology; Geoscience Education

Steven J. Whitmeyer, James Madison University, Harrisonburg, Va.; Steve Reynolds, Arizona State University, Tempe, Ariz.; Ken McCaffrey, University of Durham, Durham, UK; Jonathan Imber, University of Durham, Durham, UK

This session will focus on presentation techniques that effectively illustrate three-dimensional and four-dimensional geologic data and processes, with the goal of stimulating discussion on promising new approaches to visualization that can target a broad audience. ORAL and POSTER

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Determine if your paper would fit neatly under one of the topical sessions. If it doesn't, please submit your abstract for inclusion in the general discipline sessions. The available choices are as follows:

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Paleontology, Phylogenetic/Morphological Patterns
Petrology, Experimental
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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.

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GSA provides the following equipment in each Technical Session room at no charge to speaker:

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- 1 LCD projector
- 1 screen
- 1 laser pointer
- 1 lectern/podium with light and microphone
- 1 wired lavaliere microphone

Overhead projectors and multiple screens are no longer part of the standard set-up; however, they are available for an additional fee. Slide projectors are not available. More information on this will be included in the speaker guide, which will be posted to www.geosociety.org in September.

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).

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- 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 oral abstracts.***
- This limitation does not apply to, nor does it include, *invited* contributions to keynote symposia or topical sessions.
- This limitation is lifted for second abstracts submitted to Geology Education or to a Public Policy discipline and is also lifted if the paper is submitted as a Woman/Minority abstract. One of the two volunteered papers must be a poster submission.

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.

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link students around the world to life-changing experiences through involvement with GSA.

Join the GSA network of members serving on campuses everywhere. Our 500+ fantastic volunteers introduce students to the advantages and opportunities available through GSA that will make a difference throughout their geoscience careers. Campus reps are a source of information, inspiration, and a valuable voice of experience to students in their professional development.

Check **www.geosociety.org/members/campus.htm** to see if your school has a representative. If not, contact Christa Stratton, cstratton@geosociety.org, +1.303.357.1093, for information or to volunteer!

Watch *GSA Today* and *GSA Connection* for details on the Campus Rep Appreciation Breakfast at the Annual Meeting in Philadelphia, 22–25 October 2006.

Campus Reps Are Winners!

Fifteen GSA Campus Reps took part in the member recruitment campaign between 1 October and 31 December 2005. GSA wishes to publicly acknowledge their vital contribution to the health and well-being of the Society. These able spokespeople are building the future of GSA.

An **Honorable Mention** Goes To All Participants:

Thomas B. Anderson	Sonoma State University	Rohnert Park, Calif.
Gail Ashley	Rutgers University	Piscataway, N.J.
Phyllis Camilleri	Austin Peay State University	Clarksville, Tenn.
John Creasy	Bates College	Lewiston, Maine
J. Warner Cribb	Middle Tennessee State University	Murfreesboro, Tenn.
Grenville Draper	Florida International University	Miami, Fla.
Peter Eichhubl	Texas A&M University	Corpus Christi, Tex.
Carolyn Eyles	McMaster University	Hamilton, Ontario, Canada
Garry Hayes	Modesto Junior College	Modesto, Calif.
Paul Kelso	Lake Superior State University	Sault Sainte Marie, Mich.
Helen Lang	West Virginia University	Morgantown, W.Va.
Lynn Marquez	Millersville University	Millersville, Pa.
Virginia Peterson	Grand Valley State University	Allendale, Mich.
Donna Whitney	University of Minnesota	Minneapolis, Minn.
Andrew Wulff	Western Kentucky University	Glasgow, Ky.

Top Recruiters

Donna Whitney from the University of Minnesota in Minneapolis finished in first place with nine new Student Members enrolled and two Member renewals.

John Creasy from Bates College, Lewiston, Maine, finished a close second with eight new students enrolled.

Peter Eichhubl from the Texas A&M campus in Corpus Christi finished third with five new Members enrolled.

These top recruiters will receive gift certificates good toward any GSA product or service.

Congratulations and thank you!

In addition, each new Member enrolled as a part of this membership drive was entered into a drawing for a free Apple iPod. The lucky winner was **Brandon C. Jackson** from Austin Peay State University in Clarksville, Tenn. His campus rep is Phyllis Camilleri.

STUDENTS: Apply for Travel Grants Today!

The GSA Foundation has made US$4,500 in grants available 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 Section Web sites listed below or contact the Section secretary directly.

Cordilleran	www.geosociety.org/sectdiv/cord/ The Cordilleran Section will not be offering student travel grants to the annual meeting this year.
Rocky Mountain	www.geosociety.org/sectdiv/rockymtn/ Kenneth E. Kolm +1-303-231-9115 ext.110 kkolm@bbl-inc.com
North-Central	www.geosociety.org/sectdiv/northc/ John P. Szabo +1-330-972-7630 jpszabo@uakron.edu
Northeastern	www.geosociety.org/sectdiv/northe/ Stephen G. Pollock +1-207-780-5353 pollock@usm.maine.edu
South-Central	www.geosociety.org/sectdiv/southc/ Matthew W. Totten +1-913-532-6101 mtotten@ksu.edu
Southeastern	www.geosociety.org/sectdiv/southe/ Donald W. Neal +1-252-328-4392 neald@mail.ecu.edu

Future GSA Annual Meetings

2007	Denver (October 28–31)
2008*	TBD
2009	Portland, Ore. (October 18–21)
2010	Denver (October 31–November 3)
2011	Minneapolis (October 9–12)

* Joint meeting with American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America.

The Pursuit of Science

PHILADELPHIA 2006

Exhibitors Provide It All!

Do you have a product to sell?

A new service to unveil?

A school or program to promote?

The GSA Annual Meeting Exhibit Hall showcases more than 200 organizations offering the latest in scientific instrumentation; field supplies and gear; computer software/hardware; geological publications; laboratory services; gems, minerals, and fossils; and information on earth science programs at various institutions.

Find out more about our current 2006 exhibitors by visiting our Web site at www.geosociety.org/meetings/2006/. Exhibitors reach more than 6,300 influential and key decision makers from the geoscience community, meeting face-to-face with attendees and developing new customers, increasing sales, and educating potential new customers on products and services. Exhibit with us in 2006—it will be a successful and rewarding experience for everyone!

Building on a Foundation of Discovery

For more information on becoming an exhibitor, contact Cindy Harig with GSA Exhibits Management Services
+1-303-914-0695
or cindy@qbsoffice.com.

Welcoming Party and Exhibit Hall Hours

Our Welcoming Party kicks off the GSA Annual Meeting in the Exhibit Hall on Sunday, 22 Oct., 5:30–7:30 p.m. This event provides exposure to 6,000+ attendees with no conflicting events!

Exhibits are also open Mon.–Tues., 23–24 Oct., 9 a.m.–5:30 p.m., and Wed., 25 Oct., 9 a.m.–2 p.m.

Philadelphia 2006 Field Trips

A true-color view of the northeastern United States, taken from the National Aeronautics and Space Administration's Multi-angle Imaging SpectroRadiometer (MISR). Larger cities, including Philadelphia, are visible. Image courtesy Earth Observatory, http://earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=15289.

History, geology, and society converge to make the field trips for the 2006 Geological Society of America meeting in Philadelphia a unique and memorable experience for participants. Over 30 trips have been proposed, ranging from an exploration of Appalachian geology, structure, petrology, and geomorphology exposed along the great transverse rivers corridors, to the history of geology and science, archaeology, and paleontology, to environmental geology, geologic resources, engineering geology, coastal geology, hydrology/hydrogeology, and geologic education. Several of the trips have been proposed in the context of topical sessions, giving the participants "a meeting within a meeting" feel. There is an almost equal distribution of pre- and postmeeting offerings as well as several one- or half-day trips during the meeting. All trips begin and end in Philadelphia unless otherwise stated. Remember that cheaper airfares to Philadelphia are commonly associated with a Saturday night stay, which is pertinent particularly to many of the premeeting trips. The following list is tentative and subject to change. Details and a firm field trip listing will be available when meeting registration begins in June.

The field trip chair for the Philadelphia meeting is Frank J. Pazzaglia, Dept. of Earth and Environmental Sciences, Lehigh University, 31 Williams, Bethlehem, PA 18015, USA, fjp3@lehigh.edu, +1-610-758-3667. For more information regarding these trips, please contact him or the individual field trip leaders.

PREMEETING

Along-Strike Changes in the Architecture of a Fold-Thrust Belt: An Example from the Hudson Valley, New York
Thurs.–Sun., 19–21 Oct. Kurtis C. Burmeister, University of Pacific, Stockton, Calif., +1-209-946-2398, kburmeister@pacific.edu; Steve Marshak.

Behind the Scenes at the American Philosophical Society, the Library Company, and the Academy of Natural Sciences: Research Collections in the History of Geology and Paleontology
Fri., 20 Oct. Sponsored by *GSA History of Geology Division*. Gary Rosenberg, Indiana University–Purdue University, Indianapolis, Ind., +1-317-274-7468, grosenbe@iupui.edu; Sally Newcomb.

Buried Holocene Streams and Legacy Sediment: Late Pleistocene to Historical Changes in Stream Form and Process and Implications for Stream Restoration, Mid-Atlantic Piedmont Region
Sat., 21 Oct. Dorothy Merritts, Franklin and Marshall College, Lancaster, Pa., +1-717-291-4398, dorothy.merritts@fandm.edu; Robert Walter; Ward Oberholtzer.

Coastal Hydrology and Processes of Atlantic Barrier Islands
Sat., 21 Oct. Rip Kirby, University of South Florida, Tampa, Fla., +1-850-217-1616, jkirby@mail.usf.edu.

Effects of Metasomatism and Fusion of Host Rock on the Chemistry of Early Jurassic Palisades Diabase in the Newark Basin
Sat., 21 Oct. Alan Benimoff, City University of New York, College of Staten Island, Staten Island, N.Y., +1-718-982-2835, benimoff@mailcsi.cuny.edu; John Puffer.

Journey into Anthracite
Sat., 21 Oct. Aaron R. Frantz, Cambridge, Mass., +1-610-293-0450, frantzar@cdm.com; Ed Simpson; Dale Freudenberger.

Lacustrine Cyclicity and the Triassic-Jurassic Transition
Fri.–Sat., 20–21 Oct. Cosponsored by *GSA Sedimentary Division; GSA Limnogeology Division*. Paul Olsen, Lamont-Doherty Earth Observatory, New York, N.Y., +1-845-365-8491, polsen@ldeo.columbia.edu; Jessica Whiteside.

Late Pleistocene to Modern Lacustrine Processes and Paleoclimatic History in the Finger Lakes, New York
Fri.–Sat., 20–21 Oct. Cosponsored by *GSA Sedimentary Division; GSA Limnogeology Division*. John Halfman, Hobart and William Smith College, Geneva, N.Y., +1-315-781-3918, halfman@hws.edu; Tara Curtin; Neil Laird; Pete Knuepfer.

New Insights to An Old Fold-Thrust Belt
Fri.–Sat., 20–21 Oct. Steven Wojtal, Oberlin College, Oberlin, Ohio, +1-440-775-8352, steven.wojtal@oberlin.edu; Patricia Campbell; Tom Anderson.

Plant Paleoecology and Geology of the Southern Anthracite Field, Pennsylvania
Fri., 20 Oct., Hermann Pfefferkorn, University of Pennsylvania, Philadelphia, Pa., +1-215-898-5156, hpfeffer@sas.upenn.edu; Rudy Slingerland; William Kochanov.

Prehistoric and Urban Landscapes of the Middle Atlantic Region: Geoarchaeological Perspectives
Sat., 21 Oct. Sponsored by *GSA Archaeological Geology Division*. Joseph Schuldenrein, Geoarchaeology Research Associates, Riverdale, N.Y., +1-718-601-3861, geoarch@aol.com.

Refining the Metamorphic and Tectonic History of the Southeastern Pennsylvania Piedmont: Recent Results from Monazite and Zircon Geochronology and Accessory-Phase Thermometry
Thurs.–Fri., 19–20 Oct. Joe Pyle, Rensselaer Polytechnic Institute, Troy, N.Y., +1-518-276-4899, pylej@rpi.edu; Hal Bosbyshell; Gale Balckmer.

Rivers, Glaciers, Landscape Evolution, and Active Tectonics of the Central Appalachians, Pennsylvania and Maryland
Wed.–Sat., 18–21 Oct. Cosponsored by *GSA Quaternary Geology and Geomorphology Division*. Frank Pazzaglia, Lehigh University, Bethlehem, Pa., +1-610-758-3667, fjp3@lehigh.edu; Duane Braun; Noel Potter; Dru Germanoski; Milan Pavich; Paul Bierman; Dorothy Merritts; Allen Gellis. Begins in Washington D.C. Participants will be advised on arrival options.

Rodinian Collisional and Escape Tectonics in the Hudson Highlands, New York
Thurs.–Sat., 19–21 Oct. Cosponsored by *Highlands Environment Research Institute*. Alexander Gates, Rutgers State University, Newark, N.J., +1-973-353-5034, agates@andromeda.rutgers.edu; David Valentino; Mathew Gorring.

Stratigraphy and Paleontology of the Chesapeake Group
Wed.–Sat., 18–21 Oct. Luack Ward, Virginia Natural History Museum, Martinsville, Va., +1-276-666-8628, lwward@vmnh.net; Alton C. Dooley Jr.

Stratigraphy of the Cambrian and Lower Ordovician Carbonates of the Kittatinny Supergroup, Northwestern New Jersey: Special Attention to the Nature and Timing of Silica Diagenesis and the Origin of Nodular Cherts
Fri.–Sat., 20–21 Oct. Philip C. LaPorta, City University of New York and LaPorta Associates, Warwick, N.Y., +1-845-986-7733, plaporta@laportageol.com; Margaret Brewer; Scott Minchak.

Taconic Orogeny in the Susquehanna Shelf and Foreland
Fri.–Sat., 20–21 Oct. Don Wise, University of Massachusetts, Amherst, Mass., +1-413-545-0482, dwise@geo.umass.edu; Bob Ganis.

Tectonic History of the Blue Ridge, North-Central Virginia
Thurs.–Sat., 19–21 Oct. Christopher (Chuck) Bailey, College of William and Mary, Williamsburg, Va., +1-757-221-2445, cmbail@wm.edu; Scott Southworth; Richard Tollo.

The Great Centralia Mine Fire—Then and Now
Sat., 21 Oct. Glenn Stracher, East Georgia College, Swainsboro, Ga., +1-478-289-2073, stracher@ega.edu; Melissa Nolter; Daniel H. Vice; Janet L. Stracher.

Two Classic Structural Exposures in Central Pennsylvania
Fri.–Sat., 20–21 Oct. Richard Nickelsen, Bucknell University, Lewisburg, Pa., +1-570-577-1146, nickelsn@bucknell.edu; Mary Beth Gray.

DURING THE MEETING

135 Million Years of History in Southwestern Philadelphia
Sunday, 22 Oct. Raymond A. Scheinfeld, Weston Solutions Inc., West Chester, Pa., +1-215-841-2019, ray.scheinfeld@westonsolutions.com.

Bicycle Tour of the Geology and Hydrology of Philadelphia
Tues., 24 Oct., Raymond A. Scheinfeld, Weston Solutions, West Chester, Pa., +1-215-841-2019, ray.scheinfeld@westonsolutions.com.

Erosion and the Hickory Run Boulder Field—1st Annual Kirk Bryan Field Seminar
Tues., 24 Oct. Cosponsored by *GSA Quaternary Geology and Geomorphology Division*. Frank Pazzaglia, Lehigh University, Bethlehem, Pa., +1-610-758-3667, fjp3@lehigh.edu; Paul Nierman; Milan Pavich; Dorothy Merritts.

Geology of Delaware Water Gap, New Jersey–Pennsylvania
Wed., 25 Oct. Jack Epstein, U.S. Geological Survey, Reston, Va., +1-703-648-6944, jepstein@usgs.gov; Tim Connors; Denise Cooke-Bauer; Rab Cika.

Philadelphia Urban Hydrology—A Tour of the Fairmont Water Works
Wed., 25 Oct. Laura Toran, Temple University, Philadelphia, Pa., +1-215-204-2352, ltoran@temple.edu; Chris Crockett.

POSTMEETING

A Tour of the Peach Bottom Slate—Once the Best Building Slate in the World
Thurs., 26 Oct. Jeri Jones, Jones Geological Services, Spring Grove, Pa., +1-717-225-3744, jlj276@aol.com; Mary Ann Schlegel; Charles Scharnberger; Donald Robinson.

Arsenic in Groundwater in the Newark Basin
Thurs., 26 Oct. Mike Serfes, New Jersey Geological Survey, Trenton, N.J., +1-609-984-6587, mike.serfes@dep.state.nj.us; Steve Spayd; Paul Olsen.

Central Appalachian Transect along the Potomac River Corridor

Thurs.–Fri., 26–27 Oct. Scott Southworth, U.S. Geological Survey, Reston, Va., +1-703-648-6385, ssouthwo@usgs.gov; Robert Wintsch; Michael Kunk.

Environmental Issues Associated with Sulfide Occurrences in Pennsylvania
Thurs.–Fri., 26–27 Oct. Ryan Mathur, Juniata College, Huntingdon, Pa., +1-814-641-3725, mathur@juniata.edu; David P. Gold; Arnold Doden; Larry Mutti.

From the K-T to the Coast: Paleontology, Stratigraphy, and Coastal Sedimentation from the Late Cretaceous through the Quaternary, Southern New Jersey
Thurs., 26 Oct. William Gallagher, New Jersey State Museum, Trenton, N.J., +1-609-292-6330, william.gallagher@sos.state.nj.us; Ken Lacovara.

Geologic, Hydrogeologic, and Biogeochemical Controls on Natural and Enhanced Degradation of Industrial Solvents in Fractured Rocks
Thurs., 26 Oct., Dan Goode, U.S. Geological Survey, Harrisburg, Pa., +1-717-571-8783, djgoode@usgs.gov; Claire Tiedeman.

History and Geology of Gettysburg National Battlefield
Thurs., 26 Oct. Roger Cuffey, Pennsylvania State University, Pennsylvania, Pa., +1-814-865-1293, cuffey@ems.psu.edu; Jon Inners.

Karst and Environmental Hydrology in Central Pennsylvania
Wed.–Sat., 25–28 Oct. Richard Parizek, Pennsylvania State University, Pennsylvania, Pa., +1-814-865-3012, parizek@ems.psu.edu. This trip will start in State College and end in Philadelphia. Participants must arrange their transportation to State College accordingly.

Paleontology and Paleoenvironments of the Upper Devonian Catskill Formation in North Central Pennsylvania
Thurs.–Fri., 26–27 Oct. Ted Daeschler, Academy of Natural Science, Philadelphia, Pa., +1-215-299-1133, daeschler@acnatsci.org; Walt Cressler.

Prehistoric Quarries and Early Mines in the New York–New Jersey–Pennsylvania Tri-State Metropolitan Area
Thurs.–Sat., 26–28 Oct. Sponsored by *GSA Archaeological Geology Division.* Philip C. LaPorta, City University of New York and LaPorta Associates, Warwick, N.Y., +1-845-986-7733, plaporta@laportageol.com; Margaret Brewer; Scott Minchak.

GSA Mentor Programs

at the 2006 GSA Annual Meeting in Philadelphia

Looking for a job—now or in the future?

Plan to Attend the Careers Roundtable Discussions Mentor Program

Join this group of mentors for one-on-one career advice, networking opportunities, and job-market perspectives. They represent a broad range of geoscience-related professions, including academics, industry, and government agencies. This FREE come-and-go event is open to everyone. **Registration not required.** Sun., 22 Oct., 10:30 a.m.–noon, Pennsylvania Convention Center, room location TBA. For more information, contact Karlon Blythe, kblythe@geosociety.org.

Attention Students Pursuing a Hydrogeology Career Path—This Mann Mentor Program is for You!

The Mann Mentors in Applied Hydrogeology Program underwrites the cost for up to 25 students to attend the distinguished Hydrogeology Division Luncheon and Awards Presentation. That's right—no cost to students. **Eligible students are those who have: (1) checked the box on their membership application indicating their professional interest in hydrology/hydrogeology, AND (2) registered for the Annual Meeting by 18 September 2006.** The lucky recipients of these tickets will have the chance to meet with some of the nation's most distinguished hydrogeologists. FREE tickets will be awarded to the first 25 students who respond to an **e-mail invitation**, based on the eligibility criteria above. **Registration required.** Date and location TBA. For more information, contact Karlon Blythe, kblythe@geosociety.org.

Students: Check Out the GEOLOGY IN GOVERNMENT Mentor Program!

A **FREE lunch** for undergraduate and graduate students will be held at GSA's Philadelphia meeting. This popular annual event will feature a select panel of mentors representing various government agencies. Mentors will invite questions from the students, offer advice about preparing for a career, and comment on the prospects for current and future job opportunities within their agencies. Mon., 23 Oct. 2006, 11:30 a.m.–1:30 p.m., location TBA. **Registration not required.** Every student registered for the Annual Meeting will receive a ticket to this event along with their badge; however, attendance is limited, so arrive early! For more information, contact Karlon Blythe, kblythe@geosociety.org.

Philadelphia 2006 Short Courses

GSA-SPONSORED SHORT COURSES

Early Registration Deadline: 18 September 2006

Registration information and course descriptions will be published in the June *GSA Today*. For additional information, contact Karlon Blythe, kblythe@geosociety.org. (CEU—Continuing education credit.)

Beyond the Content: Teaching Scientific and Citizenship Literacy in the Geosciences
Sat., 21 Oct. (full day). Cosponsored by *GSA Geoscience Education Division*. Erin Campbell-Stone and James D. Myers, University of Wyoming. Fee: US$200. CEU: 0.8.

Using GPS Data to Study Crustal Deformation, Earthquakes, and Volcanism: A Workshop for College Faculty
Sun., 22 Oct. (morning only). Cosponsored by *GSA Geoscience Education Division*. Susan C. Eriksson and Becca Walker, UNAVCO, Boulder, Colo. Fee: US$270. CEU: 0.4.

Digital Terrain Modeling
Sat., 21 Oct. (full day). Cosponsored by *GSA Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division*. William C. Haneberg, Haneberg Geoscience, Seattle, Wash. Fee: US$240. CEU: 0.8.

Earthquakes—A One-Day Workshop for College and University Faculty
Sat., 21 Oct. (full day). Cosponsored by *GSA Geoscience Education Division*. Michael Hubenthal, Incorporated Research Institutions for Seismology (IRIS) Consortium, Washington, D.C. Fee: US$15. CEU: 0.8.

Scientific Inquiry in the K–16 Classroom: What Every Scientist Should Know about Effective Science Education
Sat., 21 Oct. (morning only). Cosponsored by *GSA Geoscience Education Division; ReSciPE Project; National Academies Forum (NAF) Geoscience Education*. Sandra Laursen, Cooperative Institute for Research in Environmental Sciences (CIRES) Outreach, Boulder, Colo. Fee: US$145. CEU: 0.4.

Using EarthEdOnline: Online Delivery System for Data Rich Inquiry Education
Sat., 21 Oct. (full day). Cosponsored by *GSA Geoscience Education Division*. William A. Prothero Jr., Santa Barbara, Calif. Fee: US$200. CEU: 0.8.

Education Research: An In-Depth Look at Qualitative Methods
Sat., 21 Oct. (afternoon only). Cosponsored by *GSA Geoscience Education Division*. Julie Sexton, Golden, Colo. Fee: US$200. CEU: 0.4.

Using Online Igneous Geochemical Databases for Research and Teaching
Sat., 21 Oct. (afternoon only). Cosponsored by *GSA Geoscience Education Division*. J. Douglas Walker, University of Kansas, Lawrence, Kans.; Kerstin Lehnert, Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y.; Kent Ratajeski, University of West Georgia, Carrollton, Ga. Fee: US$215. CEU: 0.4.

OTHER COURSES

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

Core Analysis of Lake Sediments

Sat., 21 Oct. GSA Limnogeology Division Workshop. Core analysis and comparison of modern lake sediments and fossil lake rock sequences will shed light on sedimentation processes, climatic effects, and the preservation potential of fossils and structures through time and space. Please bring posters and/or cores describing your lake sediments. Posters can also be submitted for the poster session held during the annual meeting. Sponsored by ExxonMobil. For more information, contact Elizabeth Gierlowski-Kordesch, gierlows@ohio.edu.

Sequence Stratigraphy for Graduate Students

Fri.–Sat., 20–21 Oct., 8 a.m.–5 p.m. This free two-day short course is designed to teach graduate students the principles, concepts, and methods of sequence stratigraphy. Sequence stratigraphy is a methodology that uses stratal surfaces to subdivide the stratigraphic record. This methodology allows the identification of coeval facies, documents the time-transgressive nature of classic lithostratigraphic units, and provides geoscientists with an additional way to analyze and subdivide the stratigraphic record. Using exercises that utilize outcrop, core, well-log, and seismic data, the course provides a hands-on experience to learning sequence stratigraphy. The exercises include classic case studies from which many sequence stratigraphic concepts were originally developed. Instructors: Art Donovan, Ph.D. (Colorado School of Mines), BP (British Petroleum); Kirt Campion, Ph.D., ExxonMobil Upstream Research Co. Limit: 40. No fee. Preregistration required. For information or to register, please contact art.donovan@bp.com.

Philadelphia 2006 K–12 Program

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

Join us for the
Geoscience Educators' Social Reception

Saturday, 21 Oct. 2006, 5:30 p.m.

Look for the K–12 Education Short Course listings in the June *GSA Today*. Questions? Contact Karlon Blythe, kblythe@geosociety.org, or Chris McLelland, cmclelland@geosociety.org.

Philadelphia 2006 Registration Information

Standard Registration Deadline: 18 September
Cancellation Deadline: 25 September

Further registration information will be available in the June *GSA Today* and at www.geosociety.org in early June. Online registration and information regarding Subaru-sponsored grants for Pennsylvania-based graduate students and two-year college faculty also will be available in early June.

REGISTRATION FEES

	STANDARD	ONSITE/ LATE
	JUNE–18 SEPT.	AFTER 18 SEPT.
Prof. Member—Full Meeting	US$305	US$390
Prof. Member—1 Day	US$199	US$215
Prof. Member >70—Full Meeting	US$250	US$330
Prof. Member >70—1 Day	US$145	US$160
Prof. Nonmember—Full Meeting	US$395	US$485
Prof. Nonmember—1 Day	US$235	US$250
Student Member—Full Meeting	US$95	US$130
Student Member—1 Day	US$65	US$70
Student Nonmember—Full Meeting	US$125	US$160
Student Nonmember—1 Day	US$80	US$85
K–12 Professional—Full Meeting	US$40	US$45
Field Trip or Short Course Only	US$40	US$40
Guest or Spouse	US$80	US$85

GSA will provide each meeting registrant (field trip or short course only and guest or spouse registrants excluded) with a copy of the *Abstracts with Programs* on CD-ROM. The 2006 Section Meeting Abstracts are also included on the CD.

LODGING

Philadelphia offers high-quality, affordable hotel rooms for meeting attendees. GSA has booked rooms at six hotels, offering special convention rates starting at US$139 a night. The co-headquarter hotels are the Lowes Philadelphia Hotel and the Philadelphia Marriott. Most activities will take place at the Pennsylvania Convention Center and the two headquarter hotels. Additional housing information will be included in the June *GSA Today* as well as on the GSA Meeting Web site, www.geosociety.org/meetings/2006/, beginning in June.

STUDENT TRAVEL FUND

You can make a difference!

Help make it more affordable for students to attend the annual meeting by contributing to the Student Travel Fund via your annual meeting registration form. Your donation can make it possible for students to attend the 2006 GSA Annual Meeting in Philadelphia. 100% of the contributions received will go to help fund student travel. To get the fund started off on the right foot, GSA and the GSA Foundation are happy to contribute US$1,000 each.

GUESTS INVITED!

Make plans now to participate in the guest program at the GSA Annual Meeting in Philadelphia, and get ready to be pampered! GSA extends a warm welcome to all spouses, family members, and friends to register for our guest program.

The guest or spouse registration fee of US$80 (US$85 after 18 Sept.) per person is for nongeologist 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 *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 a Visitor Badge allowing them to attend a specific presentation.

GUEST HOSPITALITY SUITE HOURS

Sun.–Wed., 22–25 Oct. 2006, 8 a.m.–5:30 p.m.

Registration for the Guest Program begins in June.
Look for the June *GSA Today* or register online at www.geosociety.org.

Graduate School Information Forum

EXHIBIT HALL

Sun., 22 Oct., 8 a.m.–7:30 p.m.
Mon.–Wed., 23–25 Oct., 8 a.m.–5:30 p.m.

Take full advantage of promoting your school to over 1,500 students at the upcoming GSA Annual Meeting and Exposition in Philadelphia, Pennsylvania. Meet face-to-face with prospective students in a relaxed, informal setting.

The Graduate School Information Forum (GSIF) will be located in the Exhibit Hall between the exhibits and the poster session displays. The forum will be open Sunday, 8 a.m.–7:30 p.m. This coincides with the Welcoming Party in the Exhibit Hall on Sunday evening. The hours for Mon.–Wed. are 8 a.m.–5:30 p.m.

Because the GSIF will be opened Sun.–Wed., you may choose to participate for one day up to all four days. Space is limited, and Sunday and Monday will be the first to sell out. 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 reservation form), the 2006 Annual Meeting Program, and in e-mail links to the GSA Web site so prospective students may schedule appointments prior to the Annual Meeting.

For more information, contact Kevin Ricker, +1-303-357-1090, kricker@geosociety.org.

EMPLOYMENT

SERVICE CENTER

GSA will again offer its popular Employment Service Center (ESC) at this year's Annual Meeting in Philadelphia. This service matches employers with job seekers for onsite interviews, message exchange, and more.

Last year, 315 interviews were conducted with over 130 registered applicants for applied, government, and academic positions in the geosciences.

Register early for the best exposure in the ESC Web-based database, which is accessible by participating employers.

For more information, go to **www.geosociety.org/Employment_Service/** or email **employmentservice@geosociety.org**.

ATTENTION STUDENTS!

Would you like to attend the 2006 GSA Annual Meeting & Exposition in Philadelphia but feel that there is no way to afford it?

Think again—become a Student Volunteer.
You will receive
FREE registration by volunteering 10 hours.
FREE *Abstracts with Programs* volume by volunteering 15 hours.

ALSO, volunteers receive a stipend of $25 for every 5 hours that are volunteered. (Optional partial food stipend available.)

For more information, contact Mollie VanOtterloo, GSA Meetings Coordinator, mvanotterloo@geosociety.org, +1-303-357-1060.

ROCK STARS

Andrew Cowper Lawson (1861–1952): How a Boy from Canada Became a Legendary Professor of Geology at Berkeley

Gerard V. Middleton, *School of Geography and Earth Sciences, McMaster University, Hamilton, Ontario L8S 4K1, Canada; mailing address: 90 St. Margaret's Road, Ancaster, Ontario L9G 2K9, Canada*

Figure 1. Lawson aged 20, the age at which he first took a course in geology from William Dawson at McGill (Geological Survey of Canada photo 201995).

Born in Scotland, Andrew Cowper Lawson came to Hamilton, Ontario, when he was six years old, graduated from the University of Toronto in 1883, worked for the Geological Survey of Canada, gained his doctorate at Johns Hopkins in 1888, and moved to California in 1890.

His father was William Lawson, born in Kirkaldy, Scotland, a seaman whose health was ruined in a shipwreck in 1865. His mother was Jessie Kerr, a name she took after her adoption by her maternal grandparents. William and Jessie were married in 1860, and Andrew was their first child, born in Anstruther, Scotland, on 21 July 1861. The family, including Andrew's brother and two sisters, emigrated to Canada in 1866 and settled in Hamilton, where William was employed in a shipyard. He retired in 1873 because of his health. Six more children were born in Canada.

Andrew attended the Hamilton Collegiate Institute (HCI), one of a small number of superior high schools that offered a classics-based education. After her husband's retirement, Jessie managed to support the family by writing short stories, which she sold to magazines in Scotland and Canada under a variety of pen-names, and Andrew and his sister, Katherine, had to take over many of the tasks and responsibilities that would normally have been assumed by their parents. One of Andrew's brothers, James, showed artistic talent, which was encouraged (and subsidized) by his headmaster at HCI, George Dickson, who was an amateur geologist. In 1879, James left for Europe, where he became a well-known artist, changing his name to Kerr-Lawson in order to avoid confusion with another artist with a similar name. The family moved to Toronto in 1881.

While at school, Andrew delivered newspapers, including the *Hamilton Spectator*, which is still the local newspaper. After graduating from HCI "with great distinction," he worked part time as a reporter for that newspaper. In his last year at HCI (1879–1880), Andrew studied chemistry with Joseph Winthrop Spencer, a geologist later known for his work on the Great Lakes. Dickson and Spencer probably made him aware of geology, but when he enrolled in the University of Toronto, it was to study classics, not science. In the summer of 1881, he was offered a job as a legal reporter in Montreal. He accepted, and in the fall of 1881 took courses at McGill University in geology (from William Dawson), mineralogy, and medicine (from William Osler). He soon discovered he was too squeamish for medicine and not inclined to pursue a career in journalism. Instead, in 1882, he worked as a field assistant in the western prairies with Robert Bell of the Geological Survey of Canada (GSC), then based in Montreal. He described this experience in detail much later in his life: he enjoyed the exploration but seems to have learned little geology from Bell.

The following summer, Lawson and J.W. Tyrrell (a topographer) began mapping the Precambrian of the Lake of the Woods region, nominally under Bell's supervision, but working largely by themselves. Returning to the University of Toronto, Lawson graduated in 1883 with a gold medal for excellence in classics, mathematics, modern languages, and natural science. He then worked full-time for the GSC, in charge of the Precambrian mapping he had begun the year before, while studying geology part time at Toronto (M.A., 1885). This work continued during the summers, even after he began graduate studies in geology at Johns Hopkins University. Perhaps E.J. Chapman, then Professor of Geology at Toronto, had suggested that he go to Hopkins to learn the new polarizing microscope techniques from George Williams. Lawson's doctorate was awarded in 1888. He was the first of many GSC geologists to have their doctoral studies supported while they remained employees of the GSC. In 1888 he obtained leave to travel to the International Congress of Geology in London in 1888, followed by field excursions in Scandinavia, France, Germany and Italy. He returned to the GSC, but resigned in 1890 to become a consultant in Vancouver, British Columbia, and spent the summer prospecting for coal. In November, he moved to the University of California at Berkeley and remained there for the rest of his long life.

Lawson was known for his field studies of the Precambrian rocks of western Ontario, and Minnesota (1891). In 1885–1888, he established that the old granitic rocks, known as Laurentian,

were intrusive into metamorphic and volcanic rocks (Keewatin), and so were younger than them rather than older as previously thought. Lawson thought the intrusive granites were remobilized older crust and continued to call both Laurentian. His ideas were published promptly by the GSC in 1885 (Lake of the Woods Report) and again in 1887–1888 (Rainy Lake). His observation that the Laurentian granites were intruded into the Keewatin was soon accepted, but his interpretation of the stratigraphy of the Keewatin and its associated metasediments (called Coutchiching by Lawson in 1887) remained controversial for almost a hundred years. In 1911, he returned to Ontario and recognized a further stratigraphic unit (Seine) and two periods of intrusion, which he called Laurentian and Algoman. The stratigraphic controversy continued, and was resolved only partially by the application of way-up techniques, unknown to Lawson in the 1880s. It finally ended in the 1980s, with the application of refined age dating and recognition that the Superior Province contains many structurally juxtaposed terranes.

At Berkeley, Lawson began teaching a seminar for graduate students, as well as a field course, both innovations in America. With help from his students, he began detailed geological mapping of coastal California, and established *The Bulletin of the Department of Geology*. After the 1906 earthquake, he supervised the production of volume 1 of *The Report of the State Earthquake Investigation Commission* (1908), and established a laboratory at Berkeley that became a famous center for earthquake studies. He was one of the founders of the Seismological Society of America. He also served as a consultant on mining and engineering projects, including the Golden Gate Bridge.

Lawson had strong views on the methodology of the earth sciences (including the importance of field studies). Philosophically, he rejected his Presbyterian upbringing and was a positivist but held near-mystical views about nature, which he generally expressed in poetry (see Vaughan's 1970 biography). A rather private, reserved man, he was also a forceful teacher who had many famous pupils. A ruthless critic, he was rarely persuaded to alter his own opinions. His personality earned him the nickname "The King" at Berkeley. He served as department chair on several occasions for a total of 20 years and was Dean of the College of Mining at Berkeley from 1915 to 1918.

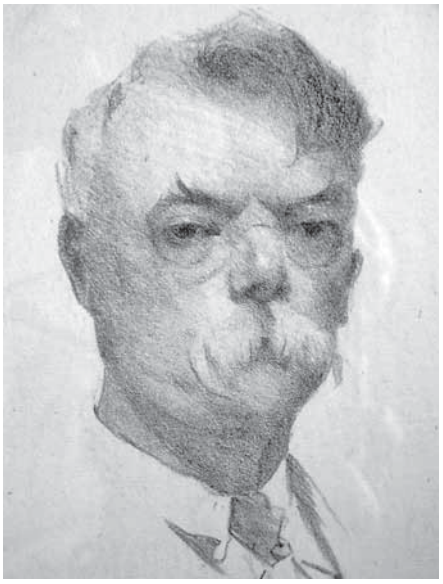

Figure 2. Portrait by his younger brother, James Kerr-Lawson. A characteristic pose, which nicely illustrates why he was called "the King."

ACKNOWLEDGMENTS

I thank Angus Kerr-Lawson, emeritus professor of mathematics at University of Waterloo, for help with family history. Angus is the grandson of Lawson's brother Edward (a writer) and provided the sketch of Lawson by his brother, reproduced as Figure 2. The Rock Star editorial committee assisting during the preparation of this article consisted of R. Ginsburg (chair), R. Dott, Jr., P. von Bitter, and J. Winterer.

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"Rock Stars" is produced by the GSA History of Geology Division. Editorial Committee: Kennard Bork, Robert Dott Jr., Robert Ginsburg, Gerard Middleton, Peter von Bitter, and E.L. (Jerry) Winterer.

The Kerry Kelts Research Awards of the Limnogeology Division

The application process for the Kerry Kelts Research Awards of the Limnogeology Division is now open. These awards are named in honor of Kerry Kelts, a visionary limnogeologist and inspiring teacher. Up to three awards of US$300 each for use in research related to limnogeology, limnology, and paleolimnology are available. Application for this award is simple and consists of a summary of the proposed research, its significance, and how the award will be used (five-page maximum). Please send your summary in PDF format along with your name and associated information to the chair of the Limnogeology Division, Thomas C. Johnson, tcj@d.umn.edu. **Application Deadline: 10 August 2006.** Awards will be announced at the Limnogeology Division Business Meeting and Reception at the 2006 GSA Annual Meeting in Philadelphia in October.

We hope to increase the amount of the awards in succeeding years. If you are interested in supporting this awards program, please send your donations, designated for the Kerry Kelts Research Awards of the Limnogeology Division, to GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA.

Call for Nominations:

Fifteenth Annual Biggs Award

for Excellence in Earth Science Teaching for Beginning Professors

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 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 2006 Biggs Earth Science Teaching Award are posted at www.geosociety.org/aboutus/awards/biggs.htm. Or, contact Diane Lorenz-Olsen, +1.303.357.1028, awards@geosociety.org. Nominations must be received by **9 June 2006.**

Mail nomination packets to:
Diane Lorenz-Olsen
Program Officer, Grants, Awards, and Recognition
Geological Society of America
3300 Penrose Place, P.O. Box 9140
Boulder, CO 80301-9140, USA

STUDENTS—Meet Your Career Mentor!

Plan now to attend a Shlemon Mentor Program in Applied Geoscience and/or a Mann Mentor Program in Applied Hydrogeology at your 2006 Section Meeting to chat one-on-one with practicing geoscientists. These volunteers will answer your questions and share insights on how to get a job after graduation. When programs are scheduled for multiple days, each day's program will offer a different set of mentors.

FREE lunches will be served (students only) at the **Shlemon Mentor Programs**. Students will receive a free lunch ticket with their registration badge to attend each Shlemon Program. However, space is limited: first come, first served.

FREE pizza suppers will be served (students only) at the **Mann Mentor Programs**. Students will receive a free pizza supper ticket with their registration badge to attend the Mann Program. The Mann Program is geared toward careers in hydrogeology or hydrology. Whether you've already decided to head down the hydro career path or whether you just would like to know more about these career options, this meeting is for you! However, space is limited: first come, first served.

More than 500 students and 100 mentors participated in the 2005 programs and provided very positive feedback regarding the experience. See the October 2005 issue of *GSA Today* or go to **www.geosociety.org/science/** to learn more.

Mentor Programs for the 2006 Section Meetings

FOR PROGRAM LOCATIONS, ASK AT THE ON-SITE GSA REGISTRATION DESK.

NORTH-CENTRAL SECTION MEETING
Student Center, University of Akron, Akron, Ohio
Shlemon Mentor Program Luncheons:
Thurs.–Fri., 20–21 April, 11:30 a.m.–1 p.m.
Mann Mentors in Applied Hydrogeology Program:
Thurs., 20 April, 5–6:30 p.m.

CORDILLERAN SECTION MEETING
University of Alaska, Anchorage, Alaska
Shlemon Mentor Program Luncheons:
Mon.–Tues., 8–9 May, 11:30 a.m.–1 p.m.

ROCKY MOUNTAIN SECTION MEETING
Western State College, Gunnison, Colorado
Shlemon Mentor Program Luncheons:
Wed.–Thurs., 17–18 May, 11:30 a.m.–1 p.m.
Mann Mentors in Applied Hydrogeology Program:
Wed., 17 May, 5–6:30 p.m.

For more information contact kblythe@geosociety.org

2006 GSA Section Meetings

NORTH-CENTRAL SECTION

20–21 April 2006
Student Center, University of Akron, Akron, Ohio
Information: John Szabo, Dept. of Geology, University of Akron, Akron, OH 44325-4101, +1-330-972-8039, jpszabo@uakron.edu

CORDILLERAN SECTION

(Joint Meeting with PSAAPG and SPE-A)
8–10 May 2006
University of Alaska, Anchorage, Alaska
See the January 2006 issue of *GSA Today* for more information.

ROCKY MOUNTAIN SECTION

17–19 May 2006
Western State College, Gunnison, Colorado
Early Registration Deadline: 17 April 2006
Information: Rob Fillmore, Western State College, Dept. of Natural and Environmental Sciences, Gunnison, CO 81231-0001, +1-970-943-2650, rfillmore@western.edu

EARTHCACHING

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Earthcaching is GSA's earth science spin on the GPS game, geocaching.

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Donna L. Russell, *Director of Operations*

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

GSA Foundation—Frequently Asked Questions

A LITTLE HISTORY

The GSA Foundation was incorporated in December 1980 as a non-profit 501(c)(3) corporation. The Foundation's first project was raising US$3.8 million for the Decade of North American Geology Project. In the 1990s, the Foundation raised over US$10 million for the Second Century Fund, supporting research grants, Institute for Environmental Education, Sage, the building expansion and other projects.

The Foundation currently has 82 funds: 29 for research, 48 restricted, four planned giving programs, and the Greatest Needs Fund, which is unrestricted.

Q What is the legal relationship of the Foundation to the Society?

A The Foundation is a separately governed nonprofit 501(c)(3) corporation.

Q Who administers the Foundation?

A The Foundation is managed by its Board of Trustees, which consists of a maximum of 20 members, each of whom can serve up to two consecutive five-year terms. The Foundation's Executive Committee consists of the board chair and vice chair, the Foundation president, and up to two trustees at large to be selected by the chair and president. Day-to-day activities are conducted at GSA Headquarters in Boulder by the Foundation's president, the director of operations, and one part-time foundation assistant.

The Foundation's current Board of Trustees are Robert D. Hatcher, Chair; David E Dunn, Vice Chair; Farouk El-Baz; P. Geoffrey Feiss; Thomas D. Fouch; Susan M. Landon; Elaine Padovani; Robert H. Rutford; George C. Sharp; Virginia B. Sisson; H. Catherine W. Skinner; and Lee J. Suttner.

Q How are the Trustees selected, and what role do they play in fund-raising and development?

A Trustees are selected from a list of nominations put forth by current Board members and approved by GSA Council. Trustees are expected to identify and cultivate potential donors, and be ambassadors, policy makers, compliance officers, and advocates for the Foundation. They are also expected to make an annual contribution at a level of personal ability.

Q Who determines the fund-raising priorities of the Foundation?

A GSA's executive director, working with GSA's Council and Executive Committee, provides the Foundation a non-prioritized list of funding needs semi-annually.

Q What are the total contributions the Foundation has raised?

A Contributions over the past five years averaged US$742,000 in support of GSA programs and projects. Gifts so far for fiscal year 2006 (July–December 2005) total US$639,773.

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☐ $2,500 ☐ $1,000 ☐ $500 Other: $_____.
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☐ Please send a copy of *GeoTales* ☐ volume I ☐ or volume II
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Q What percentage of the GSA membership contributes to the Foundation?

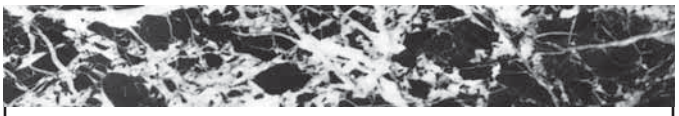
A Since a check-off system for contributions to the Foundation was added to GSA's dues renewal statement three years ago, an average of over 25% of the membership has given to the Foundation annually. Although there is no standard percentage for members who contribute to their professional society's foundations, most fund-raisers say that an organization is doing very well if at least 10% of its membership contributes annually.

Q Do other geoscience professional societies provide support like this to run their foundations?

A Other geoscience societies generally cover the majority of the costs of their foundation's expenses. For several of the societies, the leaders and employees of the societies are also the foundation employees, thereby lessening the actual "apparent" operating expense of their foundation. But this practice is discouraged by the Council of Better Business Bureaus and American Institute of Philanthropy because the fiduciary responsibility of a foundation should be legally separate from the mother society so that donor interests are preserved.

Q Where can I learn more about the Foundation and programs I might wish to support?

A Read more about the Foundation on its Web site, www.geosociety.org/gsaf/, or call Donna Russell, director of operations, at 1-880-472-1988 ext. 1054.



In Memory of John C. Maxwell

GSA FOUNDATION ESTABLISHES ONE-TIME RESEARCH GRANT AWARD

John C. Maxwell, a former GSA President and Foundation Trustee, passed away on 24 January 2006 in Austin, Texas.

The GSA Foundation has established a Memorial Fund in his memory. The proceeds of this fund will be used for a special one-time award to be given out by the GSA Committee on Research Grants next spring.

If you would like to be a part of this tribute to John Maxwell, please send your contribution to the GSA Foundation, P.O. Box 9140, Boulder, CO 80301-9140, USA, noting on the check "In Memory of John C. Maxwell."

You may also give online via the Foundation's secure Web page, https://rock.geosociety.org/donate/donate.asp, selecting Memorial Fund from the drop-down menu.

Most memorable early geologic experience:

Missing just one question on a freshman geology quiz—by calling glacially transported boulders "erotic boulders."

—Kenneth W. Ciriacks

PENROSE CONFERENCE SCHEDULED

Chronostratigraphy: Beyond the Global Standard Stratotype and Point

3–9 June 2006

Schloss Seggau, Styria, Austria

Conveners:

William A. Berggren, *Department of Geology, Rutgers University, Piscataway, New Jersey 08854, USA, wberggren@whoi.edu*

John A. Van Couvering, *The Micropaleontology Project, Inc., 256 Fifth Avenue, New York, New York 10001, USA, vanc@micropress.org*

Werner Piller, *Department of Geology, University of Graz, Heinrichstrasse 26, A8010 Graz, Austria, werner.piller@uni-graz.at*

Jan A. Zalesiewicz, *Geology Department, University of Leicester, University Road, Leicester LE1 7RH, UK, jaz1@leicester.ac.uk*

Brian McGowran, *School of Earth and Environmental Sciences, University of Adelaide, Mawson Building DP 313, Adelaide SA 5005, Australia, brian.mcgowran@adelaide.edu.au*

INTRODUCTION

With the imminent completion of the international campaign to define boundaries in the geological time scale at fixed physical points in stratotype sections, rather than in conceptual terms, this is an appropriate time to discuss the opportunities and problems in a radically changed science. Not only have our primary landmarks, the chronostratigraphic boundaries, emerged into new clarity because of this development, but the tools of correlating the landmarks have also improved very substantially in recent years. We will evaluate the new limits of chronostratigraphy and consider how much of its philosophy, terminology, and practice should be changed to take advantage of the increased potential for accuracy in theories of earth history.

DESCRIPTION

The fossil record, which gave original meaning to the geological time scale and which is still gaining in effectiveness as the primary control in earth history, has been joined in modern times by other means of chronostratigraphic correlation: regional or global changes in stable isotope ratios of carbon, oxygen, strontium, neodymium, and other elements; the global imprint of changes in Earth's magnetic field; astronomically forced cycles in sedimentation, sea level, and climate; and identification of the worldwide effects of cataclysmic events, both external (meteorite impact) and internal (mass volcanism, seafloor methane hydrate dissociation)—among others. Dating—directly measuring the age of rocks—also continues to improve, providing an independent control over assumed time-correlations of stratigraphic features.

The establishment of a Global Standard Stratotype and Point (GSSP) or "Golden Spike" as a physical, rather than conceptual, definition for each worldwide chronostratigraphic boundary has now given improved correlation techniques something solid to work on. What is emerging is a multithreaded earth history of unparalleled detail and temporal resolution, allowing regional or worldwide reconstructions of trends in biodiversity and global biomass, oceanic and atmospheric composition, or volcanic flux, for example, as well as links between events at Earth's surface and in the deep mantle and in the wider solar system. Crucially, the greatly increased temporal resolution can enable realistic constraints to be placed on models of cause and effect in earth processes. This integrated earth history is indispensable to the location and exploitation of earth resources and is equally of growing importance in providing a context for past environmental change, fundamental to the prediction of changes today and in the future.

Given the ever-growing complexity of these stratigraphic studies, the vast size and scope of the databases now being assembled, and the multidisciplinary nature of current studies, we urgently need to reexamine the basics of our classification of time, rock, and events. These classifications have roots going back a century or more, when our perceptual tools were far less acute. Specialists in the disparate disciplines, working together, will reexamine and, where necessary, suggest means to reshape the nature of stratigraphical classification in the future.

OUTLINE

Discussions will be organized into topic sessions dealing with specific issues.

1. Chronostratigraphy today—Where do we stand?: status of marine and terrestrial stratigraphies, calibrated geohistorical models, and time scales.
2. Chronostratigraphy today—Unresolved issues: status of Quaternary, Precambrian, and "problem boundaries."
3. Chronostratigraphy today—New applications: sequence stratigraphy, interactive Internet-based time scales.
4. Chronostratigraphy tomorrow—Where are we going?: potential for better resolution; the detection of high frequency global processes; the debate over dualistic terminology.
5. Chronostratigraphy tomorrow—How do we get there?: improving on the GSSP; updating and revising the guidelines.
6. Chronostratigraphy tomorrow—The view ahead: new tools and trends.

Venue, Travel, and Estimated Costs

The conference will be held at Schloss Seggau, a twelfth-century castle built on Roman foundations, in the foothills of the Eastern Alps of Styria (southern Austria) near the historic cultural center of Graz.

Sat., 3 June, will be the travel reception day; departure is Fri., 9 June. Direct flights to Graz from Vienna are provided by Austrian Airlines; from Frankfurt, Munich, and Düsseldorf by Lufthansa; from Zurich by Swissair; and from Paris by Styrian Airways. Rail should be booked via Graz to the local town of Leibnitz. Connections to the Schloss will be arranged.

A one-day geological field trip to the Neogene basin of southern Styria, a wine tasting session in the Schloss Seggau wine cellars with an exploratory tour of the castle, and a baroque concert are included in the program.

The cost per person, listed below, includes meals and all events. Prices are in Euros (€).

- Single room (category 1): €677—11 rooms available
- Single room (category 2): €545—4 rooms available
- Double room (category 1): €499—12 rooms available
- Double room (category 2): €491—20 rooms available

Registrants with Special Needs

GSA is committed to making Penrose Conferences accessible to all. Aside from the field trip, participants with disabilities can be readily accommodated. Vegetarian and restricted diets will be available. If you require special arrangements, please contact Mollie VanOtterloo, mvanotterloo@geosociety.org.

For additional information on this trip, please visit www.geosociety.org/penrose/06-chronostratigraphy.htm.

PENROSE CONFERENCE SCHEDULED

Unlocking Three-Dimensional Earth Systems—Harnessing New Digital Technologies to Revolutionize Multi-Scale Geologic Models

17–21 September 2006

e-Science Research Institute and Department of Earth Sciences, University of Durham, UK

Conveners:

Ken McCaffrey, *Reactivation Research Group, Department of Earth Sciences, University of Durham, South Road, Durham DH1 3LE, UK, +44-0-191-334-2300, k.j.w.mccaffrey@durham.ac.uk*

Jonathan Imber, *Reactivation Research Group, Department of Earth Sciences, University of Durham, South Road, Durham DH1 3LE, UK, +44-0-191-334-2300, jonathan.imber@durham.ac.uk*

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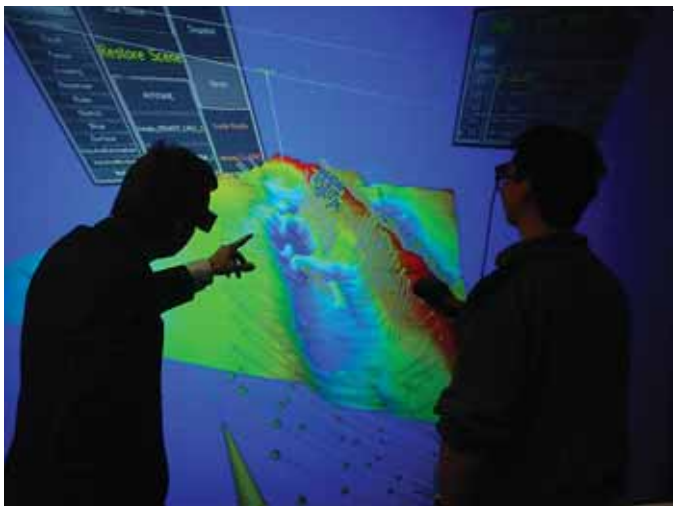
Bob Holdsworth, *Reactivation Research Group, Department of Earth Sciences, University of Durham, South Road, Durham DH1 3LE, UK, +44-0-191-334-2300, r.e.holdsworth@durham.ac.uk*

John Howell, *Centre for Integrated Petroleum Technology, University of Bergen, Allegaten 41, Bergen N-5007, Norway, +47-55-58-3391, john.howell@geo.uib.no*

Tim Wawrzyniec, *LiDAR Laboratory, Department of Earth and Planetary Sciences, Northrop Hall, University of New Mexico, Albuquerque, New Mexico 87131-0000, USA, +1-505-277-2740, tfw@unm.edu*



DESCRIPTION AND OBJECTIVES

Geoscientists understand that their subject is inherently spatial and temporal in nature. Advances in geochronologic and chronostratigraphic methods have improved our temporal understanding of earth systems markedly. However, we have yet to fully utilize the three-dimensional (3D) geospatial datasets that have recently become available to industrial and academic geoscientists. These range from high-resolution 3D seismic volumes, which provide an unprecedented level of information on subsurface geological architectures, to data from laser scanners, LiDAR, and digital geological mapping/surveying techniques that capture macro- to mega-scale surface information rapidly and accurately. Put simply, the ability to collect, visualize, and analyze spatially accurate surface and subsurface datasets in three dimensions provides geoscientists with new opportunities to capture and interpret true 3D geological architectures at a range of scales. This development represents as great a paradigm shift for the geosciences as William Smith's seminal geological map of 1815. The September 2006 Penrose Conference brings together researchers from a range of countries, academic institutions, and private sector organizations to focus on how 3D technologies are opening up new research opportunities. Application of these technologies to three critical areas of the earth sciences will be discussed:

- Spatial analysis and scaling properties of geological architectures and processes;
- Quantification and visualization of uncertainty in geological data and interpretations;
- Calibration and validation of predictive Earth models.

OUTLINE AND PROGRAM

The conference will include a one-day field trip and workshop, followed by three and a half days of oral and poster presentations and discussions. All participants are expected to contribute a poster or oral presentation and should arrive in Durham by the evening of 16 Sept. 2006.

17 Sept.: Field Trip and Workshop

To set the scene for the conference and to stimulate discussion on our three main themes, we have arranged a half-day field trip to visit spectacular exposures of deformed Permian sandstones on the Northumberland Coast, a one hour drive north of Durham. Participants will collect data from these outcrops using such diverse methods as terrestrial laser scanning, digital surveying, and traditional pen-and-paper techniques. After lunch at a traditional northeast "chippy," we'll return to Durham to analyze the data and address a range of questions:

- What are the uncertainties associated with each of the datasets—and how can we quantify these uncertainties?
- How can we take full advantage of the spatial information contained within the digital datasets—and how do our new interpretations compare with traditional geometric analyses?
- How much "soft" information—derived from our geological intuition or gut feeling—is lost when analyzing digital datasets?

18–21 Sept.: Presentations and Discussions

Days 2–4 will be broken up into morning keynote speeches and afternoon poster sessions. However, rather than feature the traditional paper-based presentations, we encourage participants to show their data "live" on desktop 3D screens, which will be provided. In addition, there will be an opportunity to present selected datasets in a fully immersive environment ("HIVE"). We welcome contributions based around the following themes:

- Day 2—Virtual outcrops and 3D geological maps: surface-based digital mapping and survey methods; LiDAR and terrestrial laser scanning; getting the most out of 3D visualization—theory and human factors.
- Day 3—Two-and-a-half– to 4D geospatial modeling: uses 3D datasets to calibrate numerical modeling results; mapping and quantifying uncertainty in geological models; problems and challenges in developing software for (auto-) interpretation and (auto-) model building; tracking the spatial evolution in earth systems (4D Earth models).
- Day 4—New approaches to 3D geospatial analysis: extending geospatial tools into the third dimension; opportunities to understand the 3D scaling of geological architectures.

  A round-up panel discussion will finish each day. One evening will be set aside for graduate students to meet industry participants. This will be an opportunity to exchange ideas for research collaboration, for students to meet prospective employers, and for industry participants to meet the next generation of earth scientists.
- Day 5—Synthesis and future research directions.

Venue

Visualization facilities are available at the conference venue in the brand new Durham e-Science Research Institute and adjacent Department of Earth Sciences. In complete contrast, participants will stay in historic Durham Castle, situated opposite Durham Cathedral within a World Heritage Site. Durham is situated on the main London-Scotland rail and motorway routes, making it easily accessible from the Heathrow and Gatwick airports. Alternatively, participants can take a connecting flight to either Newcastle or Durham–Tees Valley Airport, both of which are located within ~25 miles of Durham City.

DEADLINES

28 April 2006—Deadline for Applications

Geoscientists interested in exploring the opportunities offered by digital technologies to developing new research in the fields identified in this article are encouraged to apply. Please send a letter of intent to Jonathan Imber that includes a brief statement of interests, the relevance of the applicant's recent work to the themes of the meeting, the subject of the proposed presentation, and contact details. Digital presentations that include "live" data are particularly encouraged. Please advise your software requirements in your letter of application and, if appropriate, state why your dataset should be considered for presentation in a "HIVE." **Invitations will be e-mailed to participants at the end of May 2006.** Where appropriate, the conveners will notify participants if their data has been selected for viewing in the HIVE.

31 August 2006—Deadline for "Live" Data

Participants must ensure that all "live" data they intend to present at the conference are transferred to Durham by this date.

Software Availability

We support the following software packages, which will be made available for participants to display "live" data: 2D/3DMove; ArcGIS; GeoFrame IESX; GeoProbe; GOCAD; Inside Reality; Paraview; Petrel; SeisWorks; Trimble Geomatics Office; RiSCAN PRO; TrapTester; and VolView. Participants who wish to use other software should arrange to bring their own laptops to the meeting, which can be plugged into the 3D displays.

Registration Fee

The estimated registration fee of US$900 will cover lodging, all meals, and the field trip, but will not cover transportation to and from the meeting site. Graduate students are especially encouraged to apply. We anticipate that the student registration fee will be approximately half of the full rate.

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 Lisa Smith, lsmith@geosociety.org.

Related Web Sites

Department of Earth Sciences, Durham University: www.dur.ac.uk/earth.sciences.

Reactivation Research Group: www.dur.ac.uk/react.res/RRG_web/; www.dur.ac.uk/react.res/RRG_web/Durham_Penrose.pdf.

Durham Centre for Terrestrial Laser Scanning: www.dur.ac.uk/earth.sciences/facilities/cetls/.

Centre for Integrated Petroleum Research, Bergen: www.uib.no/cipr/.

University of New Mexico LiDAR Laboratory: http://epswww.unm.edu/facstaff/tfw/index.htm.

Durham Castle: www.durhamcastle.com.

Panel Seeks Community Input

The Geological Society of America (GSA), through its Geology and Public Policy Committee (GPPC), requests input from GSA members for a position statement on global climate change, specifically related to human impacts on climate, the importance of climate change research, and the need for climate change policy to take into account results of peer-reviewed earth science.

GPPC panel members: Sally Benson, Lawrence Berkeley National Laboratory; Thure Cerling, University of Utah; Judith Curry, Georgia Institute of Technology; Yehouda Enzel, Hebrew University; Mickey Glantz, National Center for Atmospheric Research; and Lynn Soreghan, University of Oklahoma. Mark Peters, Argonne National Laboratory, and Jim Finley, Telesto Solutions, Inc., both members of the GPPC, are also participating in the panel. Mark Peters is the panel chair and corresponding member.

Presented here are some key points the panel is considering during the preparation of the position statement. We encourage the community to send comments and suggestions on the points below or additional points that should be considered during the preparation of the statement. Please e-mail your comments and suggestions to Mark Peters at mtpeters@anl.gov, preferably before 15 April 2006.

Background

The panel has been given the task of drafting a position statement on global climate change, for approval by the GPPC and GSA Council. The document will include (1) a brief statement elucidating the crux of the argument, (2) background information justifying the brief statement, and (3) an implementation plan (how GSA, GSA members, and others may use the position statement).

The panel is carefully examining the position statements on climate change of other societies (e.g., American Geophysical Union [AGU], American Chemical Society). These statements do an excellent job of stating facts and conclusions from the peer-reviewed literature and include the importance of science in the practical solutions of mitigation, technological advancement, and adaptation. Earth science will be essential to all three solutions.

The panel is considering a position statement that broadly supports scientific research related to climate change, incorporating the important perspective of geologic time (deep time) that is an integral component of many geological subdisciplines. The statement will also emphasize the urgency of developing and implementing mitigation and adaptation measures, many of which are rooted in the geosciences. Many earth science disciplines contribute to this complex scientific issue: sedimentary geology, Quaternary geology, geochemistry, and paleontology, climatology, oceanography, and atmospheric physics and chemistry. The understanding of natural variations in climate over geologic time provides boundary conditions for evaluating human impacts on climate and for producing more reliable predictions of future climate change. In addition, knowledge of active geologic processes provides invaluable insight toward a better understanding and improved monitoring of anthropogenic climate change as well as how to adapt to the consequences of climate change. The panel is emphasizing geological perspectives on predicting and addressing the impacts of climate change, regardless of cause.

Climate change policy needs to incorporate an earth science perspective. Earth science provides important perspectives related to the climate change issue, appropriate mitigation strategies, and future alternative sources of energy (e.g., carbon sequestration, potential impacts of a hydrogen-based economy). Significant research remains to be done to address the uncertainties and assess potential future impacts of climate change policy, as well as to develop the appropriate mitigation strategies, assess long-term resource potential, formulate sustainable sources of energy for the future, and adapt to changes in fundamental Earth environmental conditions (e.g., rising sea level, droughts in some areas, and increased precipitation in others).

As policy makers address the issue of climate change, the science community needs to provide peer-reviewed science as a basis for policy decisions. The peer-review system is the best approach for scientists to provide objective information critical to the development of viable, effective policy. The heart of the argument for peer-reviewed science is that although the mainstream of the scientific community believes global warming is a real threat, the peer-review process will ensure development of the correct interpretation of global climate change.

Justification

A position statement outlining earth science perspectives and GSA's position related to the impact of human activities on climate, the importance of climate change research, and the need to educate policy makers about objective science is an important initiative for GSA. The GSA position statement will complement existing statements by other societies and provide the essential, cross-disciplinary perspective the GSA membership brings to the issue (e.g., sedimentary geology, Quaternary geology, geochemistry, paleontology).

Implementation Plan

We hope that such a document, backed by the authority of the GSA, will be used by scientists to inform policy makers of the evolving issues related to global climate change. An additional goal of the position statement is to serve as the basis for GSA members to communicate to the general public the importance of geological research and publication in the global climate change dialogue. For these objectives to be effective, the background or justification section of the document should contain major conclusions of peer-reviewed research, as in the AGU's 2003 position statement, *Human Impacts on Climate.* The implementation plan should also include how GSA ensures the statement is put to use. This could include identification of federal, international, and other programs that should be supported financially; it may include programs in the National Science Foundation, the National Aeronautics and Space Administration, the National Center for Atmospheric Research, the U.S. Geological Survey–Department of the Interior, the Department of Energy, and the Intergovernmental Panel on Climate Change.

Call for Papers

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Geosphere science editor: G. Randy Keller, University of Texas at El Paso.

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- aims to evolve with technological advances.

For more information on *Geosphere* see www.geosociety.org/pubs/geosphere/.

ANNOUNCEMENTS

MEETINGS CALENDAR

2006

11–12 May	Geoinformatics 2006, Reston, Virginia, USA. **Information:** www.geongrid.org/geoinformatics2006/.
23–26 May	2006 Joint Assembly, a partnership between AGU, GS, MB, MSA, and SEG, Baltimore, Maryland, USA. **Information:** www.agu.org/meetings/ja06/.
13–16 June	5th European Congress on Regional Geoscientific Cartography and Information Systems, Barcelona, Spain. **Information:** www.icc.es/econgeo2006.
24–27 July	Western Pacific Geophysical Meeting, Beijing, China. **Information:** www.agu.org/meetings/wp06/.
27–31 August	3rd International Symposium on Isotopomers (ISI 2006), San Diego, California, USA. **Information:** http://isi2006.ucsd.edu/.
4–8 September	6th Annual Meeting of the European Meteorological Society in part and partner with the 6th European Conference on Applied Climatology, Ljubljana, Slovenia. **Information:** http://meetings.copernicus.org/ems2006/.
13–16 September	Archaeological Sciences of the Americas Symposium. Topics of interest to GSA Members include geoarchaeology, chronometry, and human-environment interaction. Abstracts due 1 May 2006. **Information:** http://asas06.ltc.arizona.edu/.
15–22 September	23rd Annual Meeting, The Society for Organic Petrology, Beijing, China. **Information:** e-mail: tsop2006@mail.edu.cn or go to www.tsop.org.

2007

5–9 March	Second Alexander von Humboldt International Conference on the role of geophysics in natural disaster prevention, Lima, Peru. **Information:** http://www.pages.unibe.ch/calendar/2007/2nd_AvH_Circular1.pdf.
13–17 May	Coastal Sediments 2007, New Orleans, Louisiana, USA. **Information:** www.asce.org/conferences/cs07/index.cfm.

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

About People

GSA Fellow **Brian G. Katz** has been awarded the John Hem Excellence in Science and Engineering Award. This award was bestowed at the National Ground Water Association Meeting on 15 December 2005 by the Association of Ground Water Scientists and Engineers. Katz was cited for his significant advances in the understanding of contaminant movement and groundwater flow patterns in complex karst aquifer systems.

ERRATUM

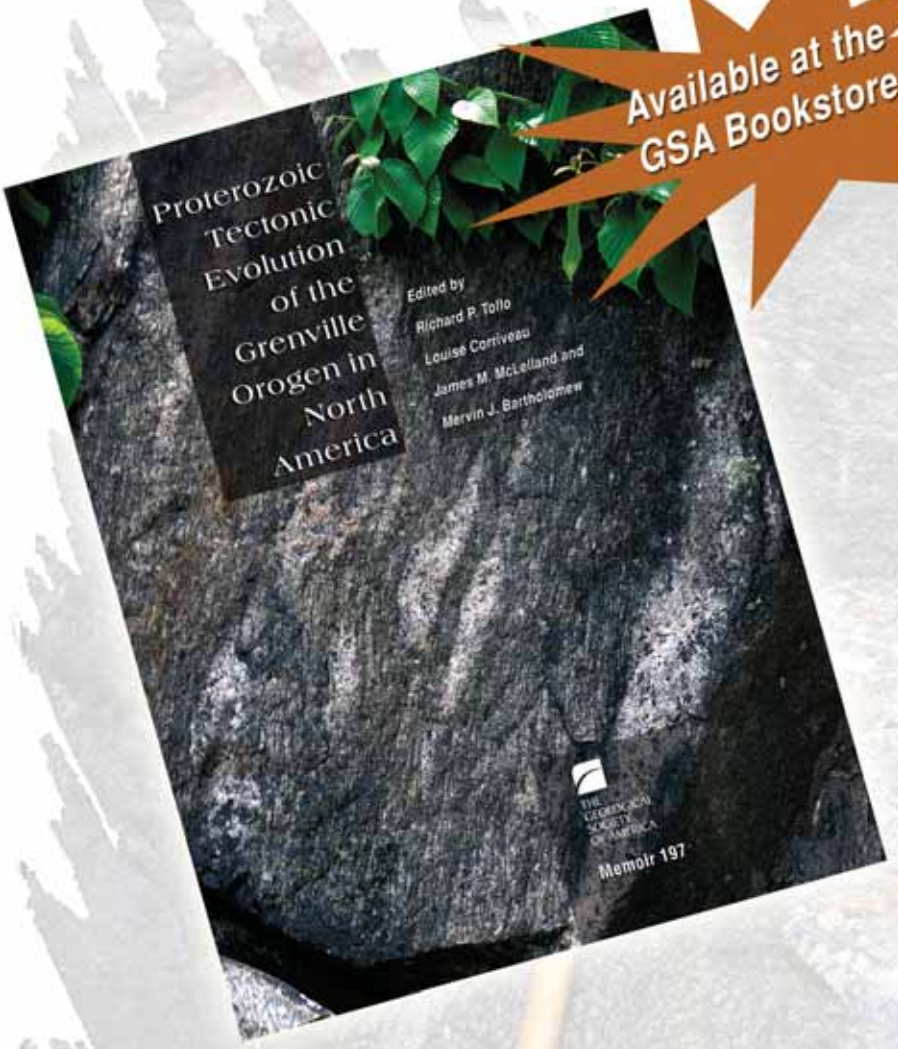
In the "In Memoriam" section of the March 2006 issue of *GSA Today* (p. 27), **Richard E. Ernst** was erroneously listed as deceased. Dr. Ernst is very much alive and is operating his own consulting business, Ernst Geosciences, in Ottawa, Ontario. GSA greatly regrets the error.

Philmont Scout Ranch Volunteer Program

Cimarron, New Mexico

Sponsored by the Rocky Mountain Association of Geologists

Volunteer for one-week back country management opportunities at French Henry mining camp, Baldy Town, or Cyphers Mine. The 2006 program begins Sun., 11 June; the last week starts Sun., 6 August. For more information and to sign up, contact Ed Warner, P.O. Box 480046, Denver, CO 80248-0046, USA, +1-720-904-0560, ewarn@ix.netcom.com.



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Proterozoic Tectonic Evolution of the Grenville Orogen in North America

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and Mervin J. Bartholomew

The geological evolution of the Grenville orogenic belt represents one of the most widespread episodes of crustal modification in Earth's history. The 39 papers in this volume offer a system-wide perspective on rocks and processes of the Mesoproterozoic Grenville orogen and Appalachian inliers and include many multidisciplinary studies presenting results from integrated petrologic, geochemical, and geochronologic investigations. The volume includes contributions concerning the Grenvillian geology of Canada, the United States, and Mexico, focusing on both the tectonic evolution of the orogen and on innovative approaches to deciphering the igneous, metamorphic, structural, and metallogenic history of Mesoproterozoic assembly and Neoproterozoic rifting. The timing and regional correlation of events and processes is emphasized in order to bridge knowledge gaps within the orogen and to better understand the geodynamic framework.

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Managing Drought and Water Scarcity in Vulnerable Environments: Creating a Roadmap for Change in the United States

18–20 September 2006 • Boulder, Colorado, USA

Drought-related impacts can be expected to increase in intensity in the twenty-first century as human population increases and land uses change. To evaluate current drought-related problems and anticipate future issues, GSA and its partners announce a participatory conference to be held 18–20 September 2006 near Boulder, Colorado, USA. While broad in scope, the meeting will focus on identifying successful strategies for drought and water scarcity management and on developing a clear and decisive action plan.

The goals of this meeting are to create an integrated, interactive, future-oriented forum for understanding and improving our management of drought and water scarcity in the United States and to stimulate national debate through the publication and wide distribution of a science- and policy-based discussion document.

Drought is a normal part of climate for virtually all regions of the United States. Recent episodes have highlighted the increasing vulnerability of all regions to drought-induced water shortages. In the face of mounting pressure on finite water supplies from expanding and shifting population, urbanization, and environmental degradation, it is imperative for the United States to consider a paradigm shift to a risk-based approach to drought management. The threat of climate change and potential increases in the frequency, severity, and duration of drought episodes is further exacerbating water management issues and conflicts among users.

This meeting is designed to promote collaboration between the policy and science communities. Through a combination of plenary and invited talks, interactive roundtable and breakout group discussions, and poster presentations of case studies and innovative research and outreach efforts, participants will derive key lessons learned from national and relevant international experience and current policies and practices (e.g., factors involved in decision making, facilitators and barriers to implementing action, and treatment of underlying causes versus symptoms).

Active participation of meeting attendees is sought in preparing recommendations for the roadmap for change.

Key lessons learned will form the basis of a scientifically informed roadmap for implementing necessary changes in policy and practice to ensure adequate water resources for future generations. Active participation of meeting attendees is also sought in deriving and evaluating these key science and policy lessons and in preparing recommendations for the roadmap for change. The resulting document will be concise, impartial, informative, useful for congressional visits, letter-writing campaigns, and other efforts to accomplish policy changes. It will also address additional research and funding needs.

Presented by
Geological Society of America
American Meteorological Society
American Water Resources Association
American Water Works Association
Colorado State University
Desert Research Institute
Ecological Society of America
Groundwater Foundation
National Center for Atmospheric Research
National Drought Mitigation Center
National Ground Water Association
National Oceanic and Atmospheric Administration
National Water Research Institute
National Institutes for Water Resources
Natural Hazards Center
Society for Range Management
Soil Science Society of America
U.S. Army Corps of Engineers
U.S. Geological Survey–Water Resources Division
Western Rural Development Center
Western Water Assessment

Poster presentations on case studies and innovative research and outreach efforts are invited on the following topics:

- Interactions among the physical and ecological environment and human behavior and institutions;
- Relationships between humans and the water environment as population pressures, urbanization, and quality-of-life expectations increase demands on already-strained water resources;
- Improved monitoring, innovative interrogation of historical records, and new approaches to the prediction of drought intensity, frequency, and duration;
- Economic aspects of drought (historical, contemporary, and potential future impacts);
- Ecological impacts of drought and extreme hydrological events, including quantitative impacts on biota/floral and faunal assemblages, and indicators of ecosystem alteration;
- Impact of global climate change on management of drought and water scarcity;
- Risk-based approaches, including probabilistic risk assessment, for assessing multiple uncertain future drought scenarios such as climate change–induced drought;

- Development of drought and water scarcity indicators;
- Enhanced prediction, monitoring, impact assessment, and policy development;
- Public policy approaches (social, economic, political, etc.), including past successes and failures, for managing and mitigating the impact of present and future drought;
- Improved insights into individual and corporate human decision making and behavior before, during, and after a drought;
- Qualitative and quantitative measures of confidence in drought analyses supporting public policy decision making;
- Facilitating communication, collaboration, and cooperation of social and natural scientists, resource managers, and policy makers; and
- The impact of community involvement in drought mitigation.

Registration and Abstract Submission

To encourage interaction among participants, registration will be limited to 250 people. **Abstracts may be submitted 1 April 2006 through 26 June 2006**. See www.geosociety.org/meetings/06drought/ for details, including abstract submission, registration, and lodging. For more information or if you have any questions, please contact Deborah Nelson, +1-303-357-1014, dnelson@geosociety.org.

The Colorado River Delta. Image taken 8 September 2000 by the Spaceborne Thermal Emission and Reflection Radiometer (ASTER) from the National Aeronautics and Space Administration's (NASA) Terra spacecraft. NASA image courtesy http://earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=4732.

GSA Today Online Forum

The *GSA Today* Online Forum is made up of comments and replies to *GSA Today* science articles that exceed the 350-word print limit.

This month's Online Forum features an exchange between H.F. Garner and M. Clark et al. regarding Clark et al.'s September 2005 *GSA Today* science article, "The non-equilibrium landscape of the Sierra Nevada, California."

To read these and other comments and replies related to *GSA Today* articles, go to www.gsajournals.org, choose "Online Journals," then click on "Online Forum" and select "GSA Today: Comments and Replies."

GSA Special Papers

Collisional Delamination in New Guinea: The Geotectonics of Subducting Slab Breakoff

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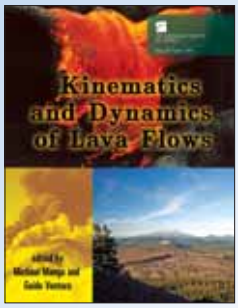

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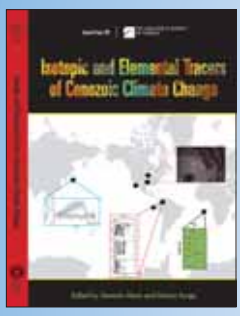

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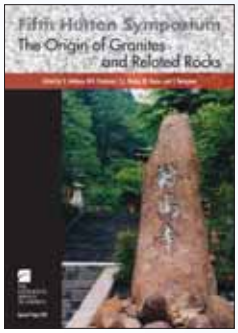

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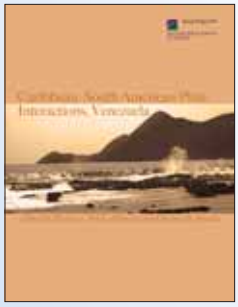

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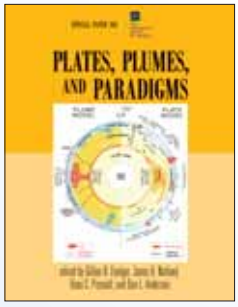

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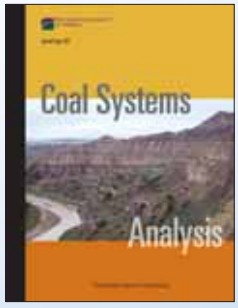

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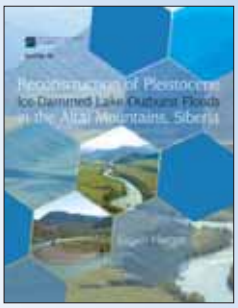

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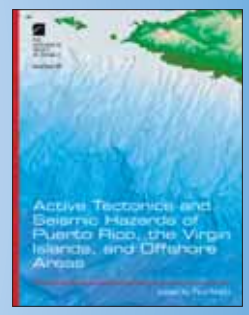

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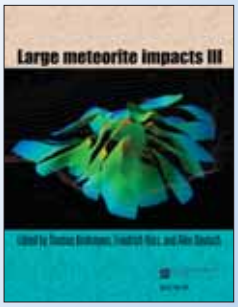

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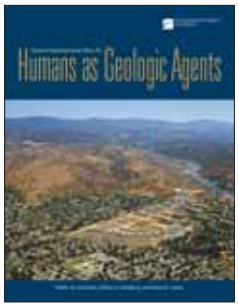

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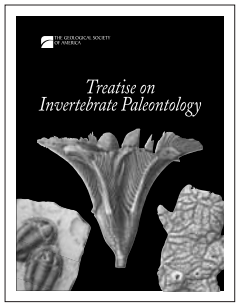

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edited by Roger L. Kaesler, with coordinating author, Monique Feist, leading a team of international specialists

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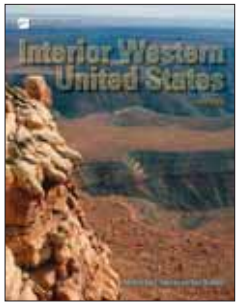

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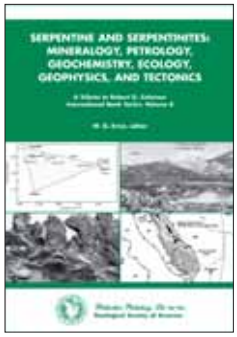

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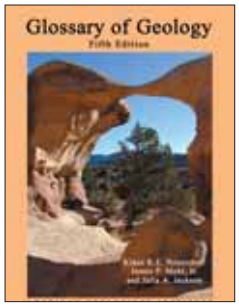

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The Department of Geology at Whitman College invites applications for a one-semester sabbatical replacement position as a Visiting Assistant Professor of Geology beginning January of 2007. It is likely that the position will be extended for the 2007–2008 academic year. A Ph.D. or ABD is required by the time of appointment. Applicants should have demonstrated expertise in teaching and the ability to teach courses in Historical Geology and Geographic Information Systems (GIS). Two courses plus labs per semester. Whitman College is a highly selective liberal arts college located at the foot of the Blue Mountains, midway between the Cascades and the Rockies. Please submit a letter of application, curriculum vita, evidence of teaching excellence, and three letters of reference to: Chair of the Geology Search Committee, Department of Geology, Whitman College, 345 Boyer Avenue, Walla Walla, WA 99362. **Deadline for applications is 15 May 2006**. Applicants who would enrich the diversity of the campus community are strongly encouraged to apply and to address how they can contribute to that diversity. For more information about Whitman College see: http://www.whitman.edu.

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To apply for this position, go to http://mtsujobs.mtsu.edu and follow the instructions on how to complete an application, attach documents, and submit materials online. If you have questions regarding the application process, please contact Dr. Hilary Stallings at +1-615-898-5986; queries about the position should be directed to Dr. Clay Harris, search committee chair, at cdharris@mtsu.edu or +1-615-904-8019. Review of applications will continue until the position is filled. Rank and salary commensurate with education and experience. Proof of U.S. citizenship OR eligibility for U.S. employment will be required prior to employment (Immigration Control Act of 1986). Clearly Act crime statistics for MTSU available at http://police.mtsu.edu/crime_statistics.htm. EO/AA employer.

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Geologist. We seek applicants at the Assistant or Associate Professor level for a position in geology. Specialty may vary (e.g., Neotectonics, Sedimentology, Geochemistry), but we encourage individuals who have expertise in GIS/ Remote Sensing to apply. Area establishments with active collaborative research include the Civil, Architectural and Environmental Departments on campus, U.S. Geological Survey, Department of Natural Resources, Fort Leonard Wood and other agencies. Any questions regarding the position should be directed to the chair of the search committee, Dr. John P. Hogan (jhogan@umr.edu).

Geophysicist. We seek applicants at any level with any specialization within the general field of Geophysics, (Petroleum Geophysics, Solid Earth, Environmental, Applied) to augment our existing research programs. Any questions regarding the positions should be directed to the chair of the search committee, Dr. David Wronkiewicz (wronk@umr.edu).

A Ph.D. is required at the time of employment. Applications must include a letter describing interests and possible contributions to our programs, curriculum vita, statements of teaching and research goals, and the names and contact information of three referees. Review of applications will begin 15 April 2006. All applications are ensured a full review until the position is filled.

Please send application to: Human Resource Services, Reference Number 00031149 (Geologist), Reference Number 00030182 (Geophysicist), University of Missouri-Rolla, 113 University Center East, 1870 Miner Circle, Rolla, MO 65409-1050

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Call for Applications and Nominations
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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, submit a letter of nomination and the individual's written permission and CV. Send nominations and applications to Jon Olsen, Director of Publications, GSA, P.O. Box 9140, Boulder, CO 80301, jolsen@geosociety.org, by 1 September 2006. Questions regarding the positions also may be directed to Mr. Olsen.

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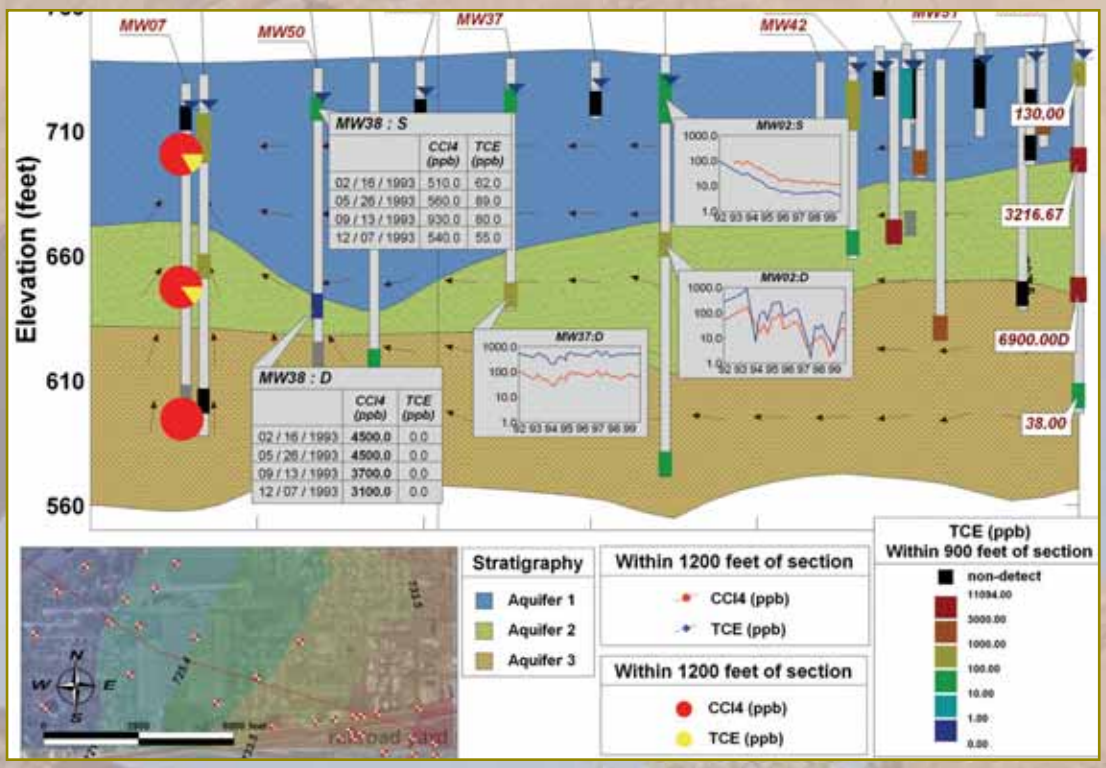

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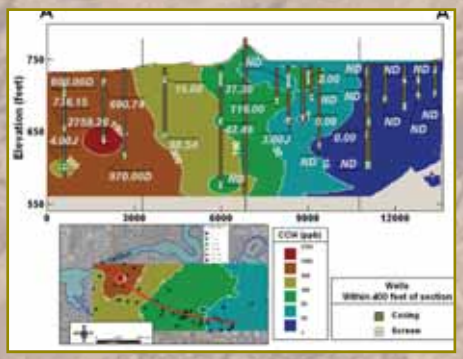

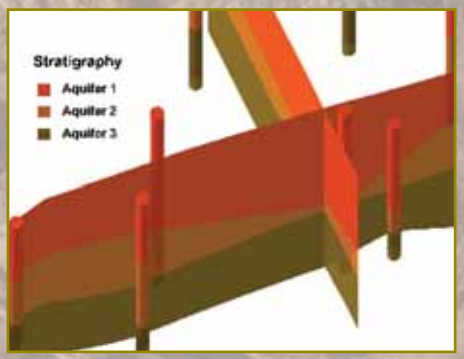

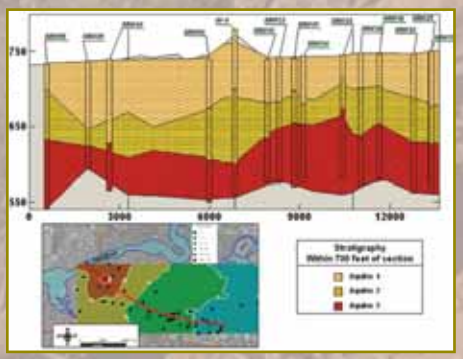

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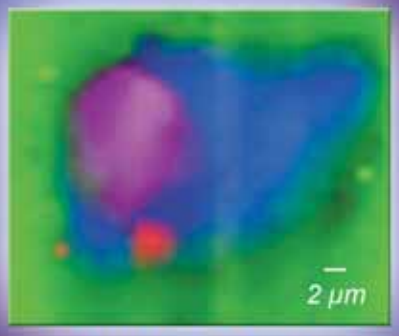

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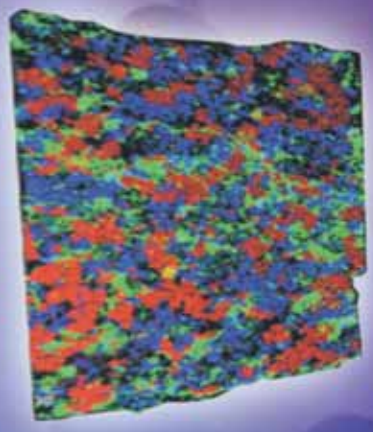

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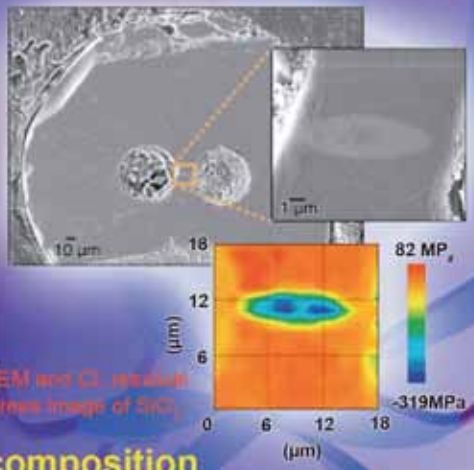

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