

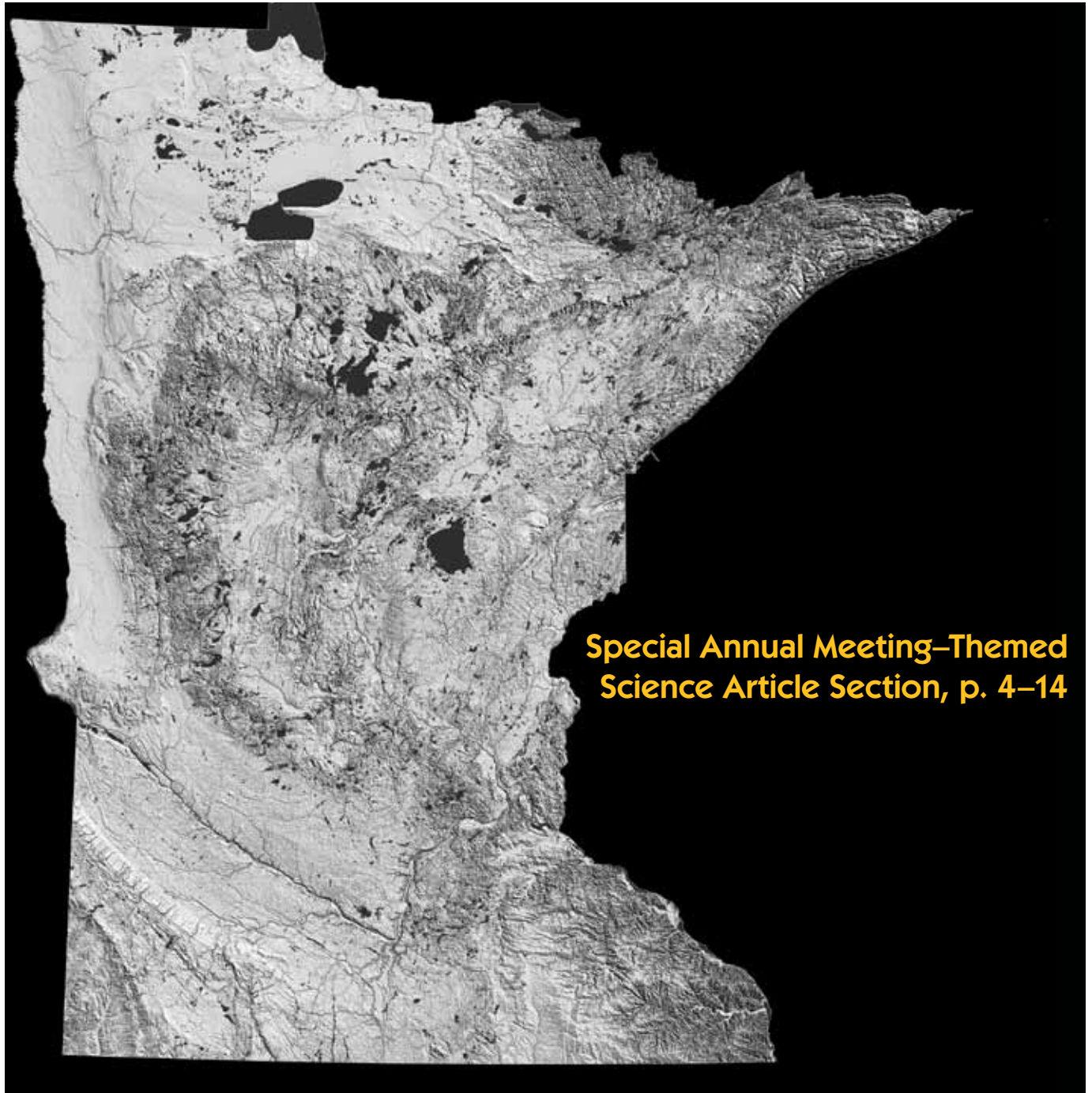
2011 GSA Annual Meeting & Exposition Issue!

# GSA TODAY

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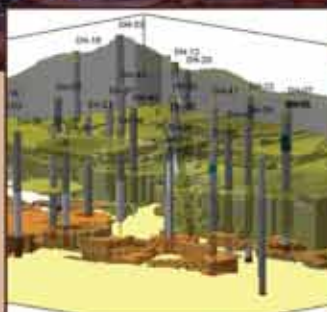
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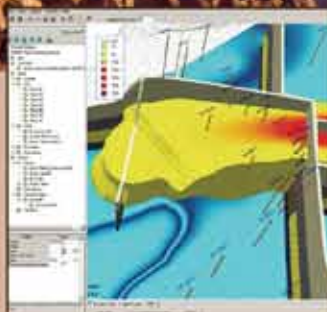


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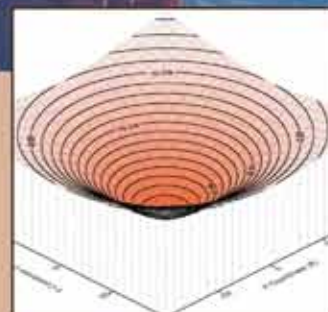


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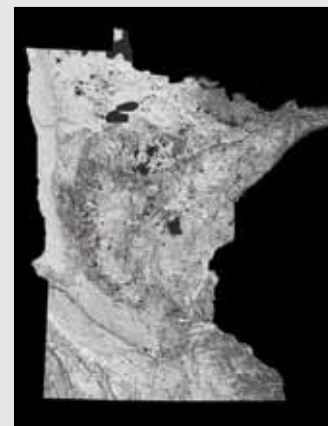
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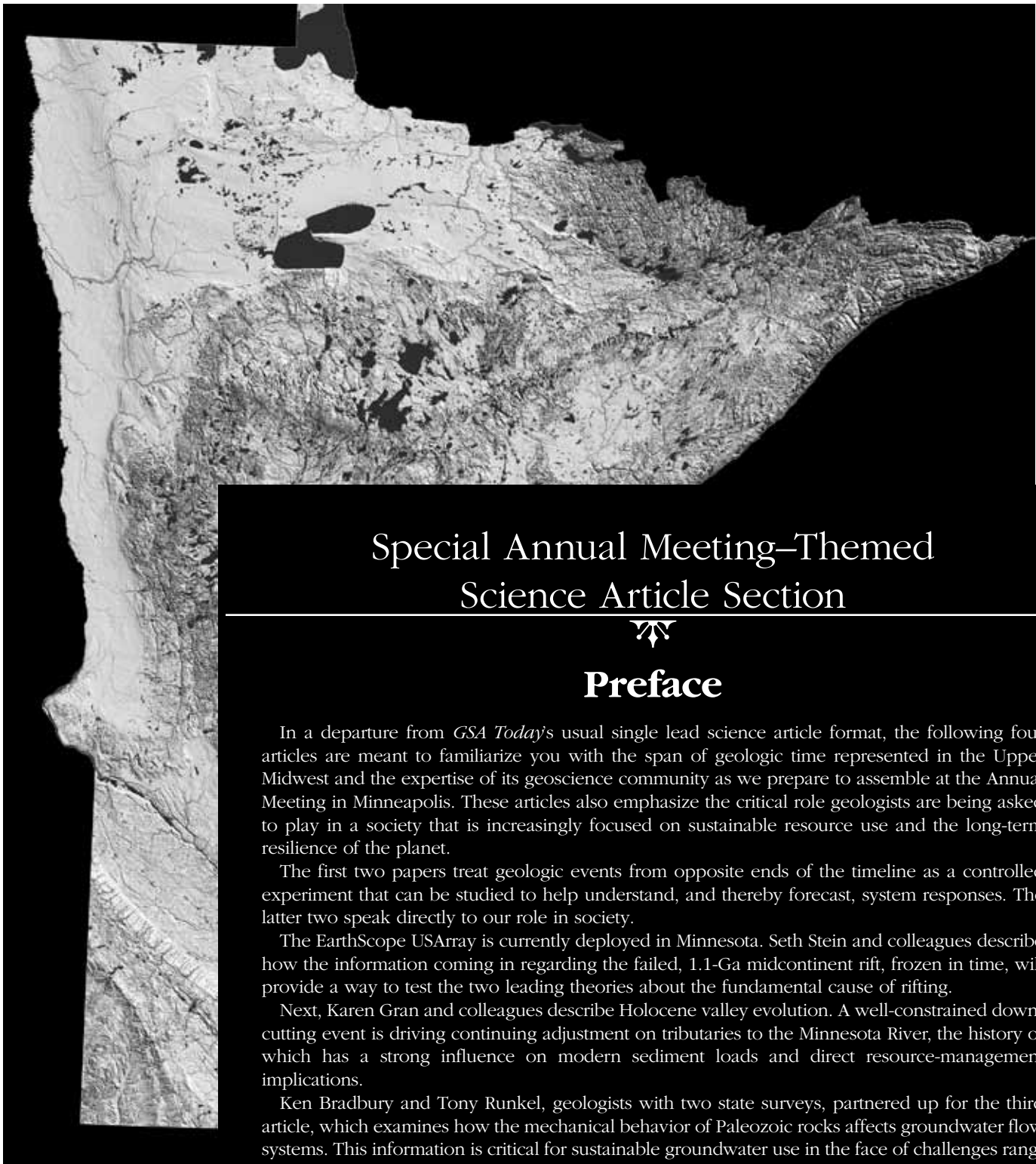
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## Special Annual Meeting–Themed Science Article Section



### Preface

In a departure from *GSA Today's* usual single lead science article format, the following four articles are meant to familiarize you with the span of geologic time represented in the Upper Midwest and the expertise of its geoscience community as we prepare to assemble at the Annual Meeting in Minneapolis. These articles also emphasize the critical role geologists are being asked to play in a society that is increasingly focused on sustainable resource use and the long-term resilience of the planet.

The first two papers treat geologic events from opposite ends of the timeline as a controlled experiment that can be studied to help understand, and thereby forecast, system responses. The latter two speak directly to our role in society.

The EarthScope USArray is currently deployed in Minnesota. Seth Stein and colleagues describe how the information coming in regarding the failed, 1.1-Ga midcontinent rift, frozen in time, will provide a way to test the two leading theories about the fundamental cause of rifting.

Next, Karen Gran and colleagues describe Holocene valley evolution. A well-constrained down-cutting event is driving continuing adjustment on tributaries to the Minnesota River, the history of which has a strong influence on modern sediment loads and direct resource-management implications.

Ken Bradbury and Tony Runkel, geologists with two state surveys, partnered up for the third article, which examines how the mechanical behavior of Paleozoic rocks affects groundwater flow systems. This information is critical for sustainable groundwater use in the face of challenges ranging from the presence of live viruses deep beneath Madison, Wisconsin, USA, to evolving cones of depression that change hydraulic gradients.

Finally, Cathy Manduca introduces readers to the process of producing an educated citizenry (and a well-prepared geoscience community) that understands the ways that Earth and society are linked. The article also illustrates the need to act collectively to share experiences, develop them into classroom activities, and accurately diagnose student challenges.

**Carrie Jennings**, Minnesota Geological Survey  
Vice Chair, 2011 Annual Meeting Organizing Committee

# Learning from failure: The SPREE Mid-Continent Rift Experiment

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Engineers have long realized that much can be learned about how complicated systems like aircraft or nuclear reactors really—as opposed to ideally—work by studying their failures. The same is likely to be true for the rifting phase of the Wilson cycle, in which continents drift apart to form new oceans that may grow to the size of the Atlantic and Pacific before closing and vanishing.

However, many continental rifts fail to develop into seafloor spreading centers. Such failed rifts become an important part of the fabric of the continents.

Rifting—successful or failed—shapes the continents and has crucial effects for society. It provides conditions for the deposition of hydrocarbons and other mineral resources. Moreover, some earthquakes within generally stable continents occur on failed rifts.

Despite its importance, much remains to be learned about how and why continental rifting occurs. Two end-member models have been discussed for many years (Sengor and Burke, 1978). In one, “active” rifting is a response to melting in the underlying asthenosphere or deeper mantle as a result of mantle plumes or shallower thermal or compositional anomalies, as commonly proposed for the East African Rift (Ebinger and Sleep, 1998). In the other, rifting is a “passive” response to stresses transmitted within the lithosphere, as appears to be the case along the Baikal Rift where the Amurian plate diverges from Eurasia (Calais et al., 2003). It is consequently unclear whether large-scale magmatism is a cause or effect of rifting, and the associated mantle dynamics remains unresolved. Similarly, the roles of shallow and deep crustal faults in the extension are debated.

Most of our knowledge about ancient rifting comes from studying continental rifting occurring today or passive continental margins remaining from successful rifts. An alternative is to study failed rifts preserved in continental interiors, such as

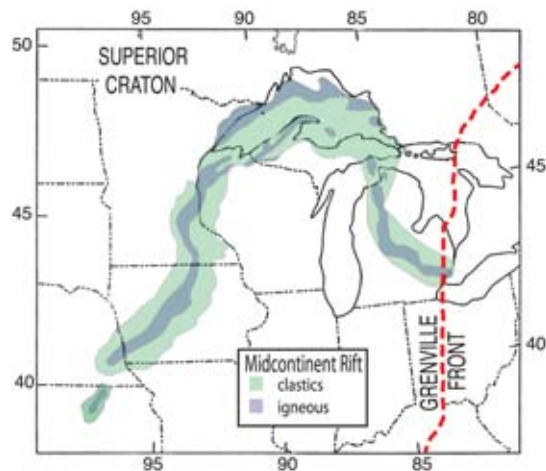


Figure 1. Location and general structure of the Midcontinent Rift.

North America’s Mid-Continent Rift System (Fig. 1). This system evolved at ca. 1.1 Ga during a rifting event recorded by volcanic, plutonic, and sedimentary rocks (Hinze et al., 1997).

The 2000-km-long Mid-Continent Rift System, which is comparable in length to the present East African and Baikal rifts, has two major arms meeting in the Lake Superior region. One extends southwestward at least as far as Kansas, and the other extends southeastward through Michigan. These arms are identified using the large gravity and magnetic anomalies resulting from dense and highly magnetic mafic igneous rocks. They are largely covered by Paleozoic sediments but outcrop near Lake Superior and can be followed further south in drill cores. Figure 1 thus shows the rift system’s minimum extent.

Active source seismic studies across Lake Superior (Cannon et al., 1989) show that the crust was thinned to about one-fourth of its original thickness by extension, the basin was filled with extrusive volcanics and sediments, and the lower crust was subsequently thickened by volcanic underplating. This rethickening process has now been identified elsewhere, as at the Baikal rift (Thybo and Nielson, 2009).

However, fundamental questions remain unresolved.

**First, how did it start?** Petrologic and geochemical models favor the formation of the Mid-Continent Rift System by active rifting over a mantle plume (Nicolson et al., 1997). In such scenarios, the two arms are analogous to today’s East African rift–Red Sea–Gulf of Aden system that is splitting Africa into three plates. The Nipigon volcanic region to the north might then have been a third arm. Testing this hypothesis is challenging because the extension is dated via the volcanism, making it difficult to establish relative chronology. Alternatively, many tectonic models view the rift as having formed as part of the

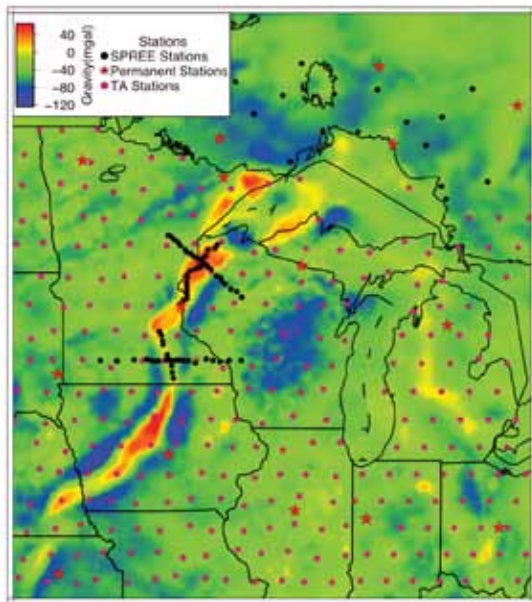


Figure 2. Gravity anomaly map of the Midcontinent Rift region, showing permanent, transportable array, and flexible array seismic stations being used in SPREE.



Figure 3. Emily Wolin and Jessica Lodewyk installing a SPREE station in northern Wisconsin.

Grenville orogeny, the series of 1.3–0.9 Ga tectonic events to the east associated with the assembly of Rodinia (Whitmeyer and Karlstrom, 2007). In such interpretations, northwest-directed convergence at the southern margin of Laurentia (North America) caused extension and magmatism to the northwest, including formation of the Mid-Continent Rift System. This scenario could be similar to the way the Baikal rift results from the Himalayan collision. If so, how did rifting occur? What controlled its geometry?

**Second, how did rifting proceed?** How did the geometry and history of rifting differ between and along the two arms? Did the western arm have more extension and volcanism, as suggested by the gravity data, or does the difference reflect the rift's present depth? How did the microplate bordered by the rift arms (Chase and Gilmer, 1973; Hauser, 1996) evolve? How far southward do the arms extend and why? What controls the division of the rift into distinct segments? Are these structurally different? What was the sequence of extension, volcanism, and subsidence in each? How did crustal thinning followed by intrusion deepen the Moho?

**Third, why and how did it fail?** Was it unable to extend along strike to split the continent? Was it unable to sustain itself? Did changing far-field stresses as the Grenville orogeny progressed cause compression that slowed and stopped the extension and then inverted the normal faults, producing thrust faulting (Cannon, 1994)? Why is the western arm close to the surface, whereas the eastern arm is deeply buried within the Michigan Basin? Did the Michigan arm play a role in the later (600 Ma) formation of the Michigan Basin?

Resolving these questions will require a range of investigations using different techniques. Among these is EarthScope's USArray program, which uses recent advances in seismological instrumentation and analysis methods to study North America's deep crust and mantle. As part of Earthscope, we are conducting

a project named SPREE (Superior Province Rifting Earthscope Experiment).

SPREE uses Earthscope's broadband Flexarray seismometers in two ways (Fig. 2). One extends the Transportable Array, now moving across the U.S., into Canada, where the Mid-Continent Rift System follows or cuts the edge of the Archean Superior Craton. A second uses seismometers deployed along and across the rift in the U.S. (Fig. 3). Records of distant earthquakes will be analyzed to provide multiscale 3-D images of the structure of the crust and mantle beneath the rift system and its surroundings. The images will then show details of the transition from the Archean shield of northern Minnesota to the Mid-Continent Rift and then to the Proterozoic orogenic rocks of Wisconsin, and allow comparisons of the velocity structure to the gravity and magnetic anomalies.

The results should provide new constraints on the rifting event and its cessation. Although its thermal signature should be long gone, the role of the mantle could be reflected in velocity or density anomalies associated with melt depletion and seismic anisotropy. The depth extent of depleted mantle beneath the rift basalts will help constrain the mantle temperature structure at the time of rifting and the role of melting in the rifting. Velocity structure across the rift will constrain the across-strike extent of crustal and lithospheric thinning. The change in velocity structure across the rift's ends should give insight into what controlled its along-strike geometry. Because the rift system is currently seismically inactive, in contrast to some younger failed rifts like the Reelfoot Rift, comparison of seismic velocities may give insight as to how the crust "heals" mechanically.

These SPREE results will contribute to the emerging discipline of "comparative riftology" (Ziegler and Cloetingh, 2004), in which data from present, successful past, and failed rifts worldwide are being combined to give an integrated view of these complex processes.

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# Landscape evolution in south-central Minnesota and the role of geomorphic history on modern erosional processes

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## ABSTRACT

The Minnesota River Valley was carved during catastrophic drainage of glacial Lake Agassiz at the end of the late Pleistocene. The ensuing base-level drop on tributaries created knick-points that excavated deep valleys as they migrated upstream. A sediment budget compiled in one of these tributaries, the Le Sueur River, shows that these deep valleys are now the primary source of sediment to the Minnesota River. To compare modern sediment loads with pre-European settlement erosion rates, we analyzed incision history using fluvial terrace ages to constrain a valley incision model. Results indicate that even though

the dominant sediment sources are derived from natural sources (bluffs, ravines, and streambanks), erosion rates have increased substantially, due in part to pervasive changes in watershed hydrology.

## INTRODUCTION

The landscape of central Minnesota is young, having been extensively sculpted by the last glaciation. One of the biggest impacts on the post-glacial fluvial system in south-central Minnesota was the initial draining of glacial Lake Agassiz through its southern outlet, carving the Minnesota River Valley ca. 13,400 yr B.P. (Clayton and Moran, 1982; Matsch, 1983; Johnson et al., 1998). This event triggered knickpoints that continue to migrate upstream on tributaries, incising deep valleys and influencing modern erosional processes in the Minnesota River watershed (Gran et al., 2009).

The Minnesota River is impaired for turbidity and carries high suspended-sediment loads. It flows downstream to the Mississippi River and Lake Pepin (Fig. 1). Records from Lake Pepin show sedimentation rates are now an order of magnitude higher than pre-settlement rates (Engstrom et al., 2009), with 82%–92% of sediment derived from the Minnesota River (Kelley and Nater, 2000). A remarkable effort is underway to improve water quality in Lake Pepin and the Minnesota River, which ultimately requires understanding sediment loading at its source, in the primarily agricultural uplands and deeply incised tributary valleys. Here we explore how geomorphic history affects modern sediment loading in the Le Sueur River, a

tributary contributing a disproportionate suspended sediment load to the Minnesota River.

## VALLEY EVOLUTION IN THE LE SUEUR RIVER

The Le Sueur River offers a well-constrained example of landscape evolution in a low-gradient environment following rapid base-level fall. Before incision of the modern valley, glacial Lake Minnesota occupied much of the Le Sueur watershed (Fig. 1), smoothing topography and depositing 1–2 m of glaciolacustrine sediment (Jennings, 2010). The initial impulse, base-level fall of 65 m at the mouth, is well-timed to 13,400 yr B.P. (Clayton and Moran, 1982; Matsch, 1983). The knickpoint now lies 35–40 km upstream of the mouth, and hundreds of fluvial terraces record valley incision history (Gran et al., 2009). These are strath terraces carved into glacial till. Depositional ages on 19 terraces, ranging from 13,040 to 1540 yr B.P., were determined through optically stimulated luminescence and radiocarbon dating.

A one-dimensional numerical model was constructed to determine incision history. Two models were compared: detachment-limited (bedrock-based) and transport-limited (alluvial-based). Results show that the Le Sueur River is best modeled as a bedrock channel, with downstream coarsening playing a critical role in developing the modern long profile. Although incision rates over the lower 80 km decreased from 8 mm/yr to 1.3 mm/yr, two-dimensional modeling incorporating meandering and valley widening (Finnegan and Dietrich, 2011) shows that the slowing of incision was countered by an increase in valley area, leading to fairly steady sediment export through time. The average Holocene erosion rate, calculated from excavated volume below the highest terrace, is 75,000 Mg/yr, including 50,000 Mg/yr of silt and clay.

## MODERN SEDIMENT BUDGET

The upstream-migrating knick zone represents a geomorphic transition within the watershed affecting modern erosional processes. Within the knick zone, deep incision created high bluffs and steep ravines, while above the knick zone the landscape is dominated by low-gradient, primarily agricultural, fields. Valley incision is minor, with bluffs and ravines small or absent.

Paired gaging stations installed above and below the knick zone on three tributaries show sharp increases in total suspended solid (TSS) loads and yields within the knick zone. On the Maple River, the average upper gage TSS load from 2006–2009 was 7000 Mg/yr, increasing to 20,000 Mg/yr at the lower gage (Fig. 1), though drainage area increases by only 10%. Sediment yields increased from 8.7 to 22.5 Mg/km<sup>2</sup>/yr. Similar increases were observed on the Big Cobb (9.0 to 23.5 Mg/km<sup>2</sup>/yr) and Le Sueur Rivers (23.9 to 32.7 Mg/km<sup>2</sup>/yr) (Water Resources Center [WRC] and Minnesota Pollution Control Agency [MPCA], 2009; S. Matteson, 2010, personal commun.).

An annual- to decadal-scale sediment budget was assembled from direct monitoring, historical aerial photography, aerial LiDAR topography, terrestrial laser scanning, and geochemical sediment fingerprinting and compared with gaging records. All sediment volumes were converted into silt and clay fractions to compare with TSS loads. The modern budget indicates that the majority of sediment delivered to the mouth is derived from bluff erosion. Ravines and streambanks annually contribute

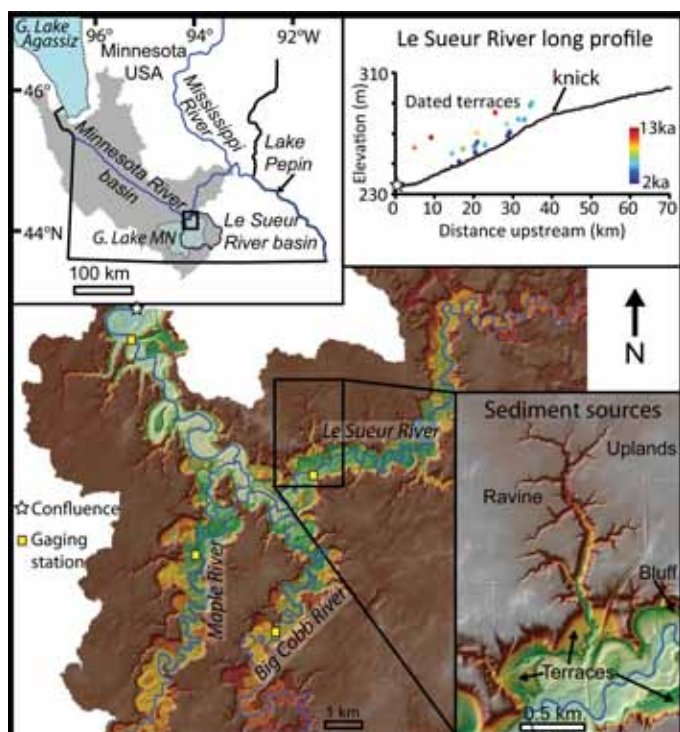


Figure 1. The Minnesota River Valley was carved by drainage of glacial Lake Agassiz (upper left), spawning knickpoints on tributaries like the Le Sueur River. There, the knick point has migrated 40 km upstream (upper right), forming hundreds of terraces in the process, and influencing major sediment sources (lower right).



~10% each, while uplands contribute ~20%. Streambank erosion includes a large volume from channel widening. The average TSS load from 2000–2010 is 225,000 Mg/yr (WRC and MPCA, 2009; S. Matteson, 2010, personal commun.), four to five times higher than Holocene-average loads.

## DISCUSSION AND CONCLUSIONS

Geomorphic history strongly influences modern erosional processes in the Minnesota River basin, with important implications for resource management. Most sediment currently comes not from agricultural fields, but from bluffs, ravines, and streambanks. This observation might lead to the assertion that excessive sediment loading in the Le Sueur is natural and not anthropogenic, but modern loads are four to five times higher than Holocene-average loads, and records downstream indicate that post-settlement sedimentation rates have increased tenfold in Lake Pepin (Engstrom et al., 2009). Although these erosional processes are natural, rates have increased due to human alterations in land cover and hydrology. Many areas in the upper Midwest have seen increases in erosion following agricultural development, and thick deposits of legacy sediment are common (e.g., Knox, 2001, 2006). In the Le Sueur, however, post-settlement alluvium is not as prevalent because the incising river lacks a geomorphic floodplain over much of the knick zone (Belmont, 2011). The sensitivity of the knick zone to erosion is an artifact of the geomorphic history of the watershed, which must be considered as management actions are taken to lower sediment delivery to the Minnesota River. This becomes increasingly important as mean annual precipitation and peak flows have been increasing in the Minnesota River basin (Novotny and Stefan, 2007), requiring a greater degree of resiliency within the watershed to combat hydrologic alterations.

## ACKNOWLEDGMENTS

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# Recent advances in the hydrostratigraphy of Paleozoic bedrock in the Midwestern United States

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Relatively undeformed Paleozoic bedrock forms the most widely used aquifers in Minnesota and Wisconsin (Fig. 1). Increasing demand for groundwater and concerns about contamination of deep aquifers have led to the need for a more comprehensive understanding of the hydrogeologic attributes of these strata than was deemed suitable just a few decades ago. Modern field techniques, coupled with advances in numerical modeling, are providing new insights into bedrock groundwater flow systems and redefinition of the classic divisions of the section into regional aquifers and aquitards. In Minnesota and Wisconsin, we commonly undertake borehole flowmeter logging, optical and acoustical borehole imaging, temperature profiling, short-interval packer testing, multi-level hydraulic head measurement, and dye tracing to evaluate the hydrogeology of bedrock formations. These techniques are widely available today but were beyond the reach of most field hydrogeologists only a few years ago.

Advances in our understanding of groundwater flow through fractures have been a critical outcome of recent hydrostratigraphic research. For example, clusters of bedding-parallel (subhorizontal) fractures that are commonly restricted to relatively discrete stratigraphic intervals can dominate flow systems (e.g., Muldoon et al., 2001; Runkel et al., 2006a; Tipping et al., 2006; Swanson et al., 2006). They are now documented not only in carbonate rock, but also in friable sandstone aquifers and in aquitards of greatly variable lithic properties (Eaton and Bradbury, 2003; Runkel et al., 2006b; Meyer et al., 2008). Although the distribution of bedding-perpendicular (subvertical) fractures remains poorly understood in comparison, integration of mechanical stratigraphy (the subdivision of rock into discrete intervals [mechanical units] according to the structures found in those intervals [Underwood et al., 2003]) with hydrostratigraphic data is leading us toward potentially significant advances in understanding vertical groundwater flow paths. Discrete stratigraphic intervals apparently resistant to the development of through-going vertical fractures appear to play a key role in limiting hydraulic connection between the major aquifers. Demonstration of stratigraphic control on fracture systems both parallel and perpendicular to bedding has provided us with better predictability in groundwater flow paths and velocities.

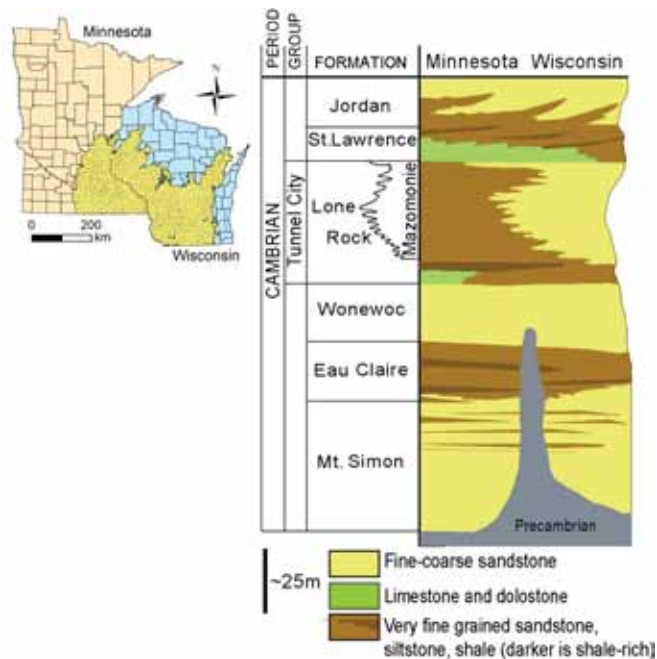


Figure 1. General distribution of the Cambrian-age units (stippled) and generalized Cambrian stratigraphic column in Minnesota and Wisconsin, USA. These rocks form several regionally important bedrock aquifers.

Research combining many of these techniques has provided new insights into aquitard properties, and the concept of aquitard integrity (Cherry et al., 2006). For example, the Cambrian St. Lawrence and Ordovician Platteville aquitards are now recognized as complex “hybrid” hydrogeologic units. These aquitards have well-developed conduit systems accommodating rapid horizontal flow analogous to karstic aquifers (e.g., Green et al., 2011). From a vertical perspective, under certain geologic conditions they appear to have only very limited integrity, and in other conditions appear to contain discrete intervals highly resistant to vertical flow. This aquitard research will also be highlighted as part of a Twin Cities Metro field trip associated with the 2011 annual meeting (Anderson et al., 2011).

Ongoing evaluation of the Cambrian Eau Claire Formation in southern Wisconsin provides an example of modern bedrock aquitard studies. The Eau Claire consists of generally fine-grained sandstones, siltstones, and mudstones (Aswasereelert et al., 2008) and lies stratigraphically between two important coarser-grained sandstone aquifers—the overlying Wonewoc Formation (Upper Cambrian) and underlying Mount Simon Formation (Middle Cambrian). This stratigraphic position has caused the Eau Claire Formation to be considered a major regional aquitard, yet

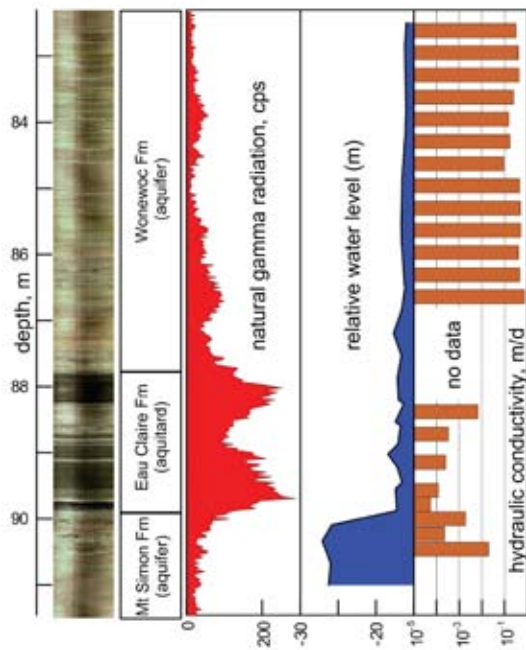


Figure 2. Hydrogeologic data across the Eau Claire aquitard. Optical borehole image (left) shows shaly facies. Relative water levels show head drop at base of aquitard. Horizontal hydraulic conductivity based on straddle-packer tests (no data collected between 87 and 88 m); cps—counts per second; m/d—meters per day.

historically the hydrogeologic characteristics of the Eau Claire Formation were confusing. Subsurface logs indicate that its thickness ranges from absent to >75 m, and parts of the formation yield significant amounts of water to wells. Recent evaluation of numerous downhole geophysical logs, especially gamma-ray logs, combined with studies of well cuttings and outcrop observations show that the Eau Claire Formation consists of five lithofacies ranging from fine-grained sandstone to shale (Aswasereelert et al., 2008), arranged as complexly stacked, discontinuous packages that form a heterogeneous and anisotropic aquitard. Two hydrogeologically critical components are low hydraulic conductivity mudstones and siltstones and high permeability sandstones.

A key part of modern aquitard hydrogeology is the integration of multi-level hydraulic head measurements into hydrostratigraphic analysis. In south-central Wisconsin, regional groundwater withdrawals from the confined Mount Simon aquifer have created a regional cone of depression. As a result, vertical hydraulic gradients are downward: The elevation of the shallow water table can be many feet above water levels in deep wells. Careful measurement of this hydraulic gradient through the Eau Claire Formation has shown that the major head loss occurs near the very bottom of the formation, where >12 m of head drop corresponds to an interval of <3 m of shale and siltstone identified by borehole geophysical logs and cuttings (Fig. 2). This same interval shows very low hydraulic conductivity in short-interval straddle-packer tests. Collectively, these data lead to the conclusion that the Eau Claire aquitard, as opposed to the Eau Claire Formation, is only a few meters thick and is discontinuous, ranging from absent to ~9 m thick across the study area. Regional groundwater modeling has

demonstrated that this relatively thin unit exerts a major control on regional groundwater flow in the ~300-m-thick bedrock aquifer system and that it is critical in protecting deep wells from contamination.

Combining these hydrogeologic techniques with recent advances in water quality measurements provides new insights into aquifer vulnerability. For example, ongoing work has documented the presence of human enteric viruses in deep wells in Madison, Wisconsin, USA (Borchardt et al., 2007; Bradbury et al., 2010). These viruses originate near the land surface, and their presence in deep wells suggests a very rapid transport path. Movement through cross-connecting wells is one such pathway, but transport along fractures or windows in aquitards are also possibilities. Ultimately, understanding of the mode(s) of transport of the virus and other contaminants is dependent on the level of understanding of the hydrostratigraphy.

Current studies link these new hydrostratigraphic advances to water sustainability issues at a variety of scales. A recent Twin Cities metro-wide (southeastern Minnesota, USA) compilation depicting the 3-D distribution of hydrochemical facies, including contamination zones, interpreted within the context of a well-developed hydrostratigraphic framework, provides important new bases for decision making as the region grapples with resource sustainability. These are exciting times for hydrogeologists interested in bedrock groundwater flow systems in the Midwest, as we learn that rocks long considered “layer-cake” aquifers and aquitards contain fascinating complexity.

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# Improving undergraduate geoscience education

## —A community endeavor

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### ABSTRACT

Undergraduate geoscience education is centrally important to all geoscientists. We improve when we share our insights and successes, build on our collective experiences, and work together to find the most important, durable ideas. Such intentional reflection on geoscience education is becoming an important part of the work of the geoscience community facilitated by professional societies, professional development opportunities, and online resources.

### WORKING TOGETHER TO IMPROVE TEACHING

Teaching is more than hard work. Teaching, like surgery, is a difficult, creative practice informed by research and improved through experience. Effective teaching requires knowledge of the subject, knowledge of educational methods, and skill in the classroom, the lab, and in utilizing office hours. Teaching can be accurately described as the work of guiding and promoting learning—the challenging part is that the learning itself must be done by the student. Thus, the teacher, like a coach, must develop experiences for the students that allow them to progress while diagnosing the students' specific challenges in learning and continuously adapting to their response to instruction. Because faculty often work with groups of more than 100 students at a time, they must respond in aggregate to the needs of each individual. And, of course, it is not easy to observe students learning, so teachers must devise mechanisms for deducing how this learning is proceeding. At the

end of the day, the teacher is asked to ascertain each student's state of knowledge and assign a grade, further complicating the relationship between the student and the teacher. No wonder faculty find teaching to be both a source of inspiration and pleasure and of frustration.

All geoscientists understand the importance of undergraduate geoscience education. It is our opportunity to reach out to the world and improve society's understanding of Earth—the ways that it impacts people and the ways that people impact it. It is also an integral piece of the development of new geoscience professionals, those who will take our places in the geoscience workforce as we know it, and those who will fill new, as yet unimagined, jobs that will emerge as our large population strives to live successfully on the planet. How then as a community do we maximize our ability to do the important work of educating?

As scientists, we routinely address our challenges collectively. The communication, discussion, and synthesis of ideas at the community scale is one of the hallmarks of science. The work of individual researchers or research projects is informed by the community's collective prior work, and its results are fed back into and used by this community as it moves forward in addressing the problems at hand. The need for a similar community-scale approach in education has been widely discussed (PKAL, 2002, 2006) and underpins the current program design of the National Science Foundation's "Transforming Undergraduate Education in STEM" solicitation (NSF 10-544).

In the past decade, the geosciences have made substantial progress in developing a community-scale approach to addressing the challenges of undergraduate geoscience education (Manduca, 2008). The Geological Society of America meetings, like the meetings of other professional geoscience societies,

play an important role in supporting this work. This year, as in the past, the program will be full of opportunities to learn about teaching, both in the traditional sense of working with undergraduate students and preparing future teachers, but also in the more general sense of bringing new understanding to the public through writing, public speaking, or participation in policy discussions. The meeting will also provide opportunities to meet new people whose work in research or education enhances our own ability to do this educational work.

Professional societies and their journals are the traditional mechanisms that we use to move information and knowledge through our community. Complementing these traditional mechanisms, the geosciences have pioneered an array of opportunities for sharing information about teaching, discussing and synthesizing our teaching experience, and learning from one another. These include the “On the Cutting Edge” program for faculty professional development (Macdonald et al., 2004) and its associated website (<http://serc.carleton.edu/NAGTWorkshops/index.html>; Manduca et al., 2010); the “Teach the Earth” portal (<http://serc.carleton.edu/teachearth/index.html>), which provides integrated access to information and products developed by individuals, departments, and projects across our community; and the “Starting Point” (<http://serc.carleton.edu/introgeo/index.html>) and “Pedagogies in Action” (<http://serc.carleton.edu/sp/index.html>) websites which describe teaching methods and provide examples of their use within the geosciences and beyond.

Roughly one-third of geoscience faculty in the United States now make use of these opportunities to learn about how their colleagues teach a particular topic, to find new ideas or materials, or to seek information that will help support changes in their teaching approach to a more student-centered and interactive style (McLaughlin and Iverson, 2009). In addition, workshop participants and website users report that these opportunities give them new inspiration and new confidence to change their teaching. For them, the hard work of being an excellent teacher is made easier by capitalizing on the experiences of their colleagues. They are learning from one another and collectively improving geoscience teaching. As a result, new ideas are moving out of individual classrooms and spreading across the nation.

### **COLLABORATING TO UNDERSTAND LEARNING**

How do we know these ideas are improvements? As scientists, we are well-trained to be suspicious of our results and to think critically about our claims and the data that support them. This is no less true in education. How do we know that our students are achieving the desired learning? That new materials or methods are working as designed or desired? Not only do individual faculty members seek these answers in their daily work in the classroom, institutions are increasingly calling on geoscience departments to assess the learning taking place in their programs. These questions are hard to answer and take time to address thoroughly—precious time. Robust analysis can require techniques from educational research, cognitive science, and social science that are foreign to most of us.

Again, a community approach is helping us. A new cadre of geoscience education researchers is pursuing research on teaching and learning in the geosciences. Faculty can learn about

this work, as well as relevant developments in educational research and cognitive science through professional development opportunities like the recent journal club on temporal learning offered by the On the Cutting Edge professional development program. (Look for papers associated with the upcoming GSA Annual Meeting session “Time, Events, and Places: Understanding Temporal and Spatial Learning in Geoscience Education” [T167].) They can also participate in community-wide research projects testing the effectiveness of teaching methods (e.g., McConnell et al., 2006) and exploring new approaches to improving learning (e.g., McConnell, 2011). Assessing the learning taking place in an individual classroom or by an individual student is a central aspect of teaching and will remain an important skill for every instructor; however, by working together, we can collectively test our methods and materials.

### **BEYOND THE INDIVIDUAL FACULTY MEMBER OR COURSE**

While the individual faculty member and his or her effort in teaching is critical, there is more to strong undergraduate geoscience education. The department as a whole offers programs of study including both course work and other co-curricular learning experiences, and it is at the department level that a culture develops that can support learning, mentoring, and advising. Increasingly interdisciplinary programs that bring geoscience together with other sciences or social sciences are an important part of our educational work. Developing strong programs, strong departments, and strong interdisciplinary collaborations are also challenging tasks for which learning from the experience of other geoscientists can be valuable. To this end, GSA, The National Association of Geoscience Teachers (NAGT), the American Geophysical Union (AGU), and the American Geological Institute (AGI) have sponsored the Building Strong Geoscience Departments program (<http://serc.carleton.edu/departments>). This program brings together workshops, sessions at professional society meetings (including GSA), and a website to support sharing and discussion of the challenges departments face. The program complements and makes use of the ongoing efforts at AGI to describe the state of geoscience education and the geoscience workforce.

Like science, geoscience education is a community endeavor. We can be most effective if we share our insights and successes, build on our collective experiences, and work together to find the most important, durable ideas. Just as every mountain belt has a unique history, each academic department is unique—but geoscientists long ago discovered the power and fun of working together to understand them. The GSA meeting in Minneapolis will provide an opportunity for all of us to learn from each other about teaching.

### **ACKNOWLEDGMENTS**

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# GEOLOGIC PAST

## Highlighting Articles from Past Issues of *GSA Bulletin*

### “Better Get the Garbage Before it Gets You”

Luna B. Leopold, *GSA Bulletin*, June 1973

The last time GSA met in Minneapolis, Minnesota, USA, was November 1972. Luna B. Leopold was outgoing GSA president and delivered his address to meeting participants on “River Channel Change with Time” (published in *GSA Bulletin* in 1973 [v. 84, no. 6, p. 1845–1860]). Leopold’s talk focused on Watts Branch, “a small tributary of the Potomac River, north of Washington, D.C.” He notes that he chose this river and its small basin because it had been the spot where, years earlier, he had taken his children on picnics and to play catch. Over time, he writes, suburban growth resulted in a basin filled with “muddy trash heaps” and “the little stream ... littered with bricks, concrete, trash, plastic bottles, and old tires.” To counteract such adverse effects, Leopold calls for “observations [to be] made on

the ground” to augment flow records and water-quality determinations. “Geologists,” he writes, “more so than most people, know how the natural world operates and what beauty lies in these mechanisms of nature. If some of the beauty of undisturbed processes is to exist within the reach of cities, the present practices of planning, design, and construction must include some geologic knowledge.”

Leopold’s article includes a song, “Better get the garbage before it gets you,” (lyrics written by him, set to a traditional tune). Find it and the entire 1972 presidential address article at <http://gsabulletin.gsapubs.org/content/84/6/1845.full.pdf> (open access).

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JUNEAU ICEFIELD RESEARCH PROGRAM  
JIRP  
ALUMNI RECEPTION  
Mon., 10 Oct., 6:00pm  
McCormick and Schmick's Restaurant  
800 Nicollet Mall, Suite 100, Minneapolis, MN

Don't miss GSA technical session #138  
honoring Dr. Maynard Miller

www.  
JUNEAUICEFIELD.COM

FACEBOOK:  
JUNEAU ICEFIELD RESEARCH PROGRAM (JIRP)

PHOTO BY CATHY CONNOR

# ARCHEAN to ANTHROPOCENE

*the past is the key to the future*



## PRESIDENTIAL ADDRESS & AWARDS CEREMONY

Minneapolis Convention Center, Ballroom A  
Sun., 9 Oct., 6:30–8:30 p.m.

*Sponsored in part by Newmont Mining Corporation*

Please join us Sunday evening when GSA President John W. Geissman gives his Presidential Address, “The importance of the global professoriate in the geosciences—the students we are teaching, and learn from, today may represent the last great hope.” Following this address, the citations and responses for the 2011 recipients of the Penrose Medal, the Arthur L. Day Medal, the Young Scientist Award (Donath Medal), the President’s Medal of the Geological Society of America, the GSA Public Service Award Medal, the Bromery Award for the Minorities, the GSA Distinguished Service Award, the Subaru Outstanding Woman in Science Awardee, and the American Geological Institute (AGI) Medal in Memory of Ian Campbell will be presented. The John C. Frye Environmental Geology Awardee, the GSA Division awardees, the GSA/ExxonMobil Field Camp Excellence Award, and the newly elected GSA Fellows will also be announced. A reception will immediately follow the ceremony.



### AWARD RECIPIENTS



Paul F. Hoffman



Susan L. Brantley



Jasper A. Vrugt



Scott F. Burns



A. Wesley Ward



Richard C. Berg



Brendan Murphy



Naomi E. Levin



Harrison H. Schmitt

#### PENROSE MEDAL

**Paul F. Hoffman**, Harvard University (Professor Emeritus)

#### ARTHUR L. DAY MEDAL

**Susan L. Brantley**, Pennsylvania State University

#### YOUNG SCIENTIST AWARD (DONATH MEDAL)

**Jasper A. Vrugt**, University of California at Irvine

#### GSA PUBLIC SERVICE AWARD

**Scott F. Burns**, Portland State University

#### RANDOLPH W. “BILL” AND CECILE T. BROMERY AWARD FOR THE MINORITIES

**A. Wesley Ward**, U.S. Geological Survey (scientist emeritus)

#### GSA DISTINGUISHED SERVICE AWARD

**Richard C. Berg**, Illinois State Geological Survey  
**Brendan Murphy**, Saint Francis Xavier University

#### SUBARU OUTSTANDING WOMAN IN SCIENCE AWARD



*Sponsored by Subaru of America Inc.*

**Naomi E. Levin**, Johns Hopkins University

PRESIDENT’S MEDAL OF  
THE GEOLOGICAL SOCIETY OF AMERICA  
To be determined

#### AGI MEDAL IN MEMORY OF IAN CAMPBELL

**Harrison H. Schmitt**, *Apollo 17* astronaut and geologist;  
former U.S. senator; aerospace and earth science consultant



# ARCHEAN to ANTHROPOCENE

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## 2011 GSA GOLD MEDAL LECTURES

Minneapolis Convention Center, Room 101FG

Mon., 10 Oct., 1:30–3:30 p.m.

Please join us for the third annual GSA Gold Medal Lectures, a special public event hosted by GSA to honor its awardees. Audience questions are encouraged. GSA President John W. Geissman will chair the program.

Penrose Medalist **Paul F. Hoffman**, professor emeritus from Harvard University, will reflect on “How Adolescent Earth Made Continents but Messed up the Carbon Cycle.”

Day Medalist **Susan L. Brantley**, professor at Pennsylvania State University, will take a look “Back to the Future as a Geochemist.”

Donath Medalist **Jasper A. Vrugt**, assistant professor at the University of California at Irvine, will lecture on the theme “Lost between Two Shores.”

*No reservations, tickets, or invitations required!*



Minneapolis Convention Center, Lobby B

Pause in the bustle of the Annual Meeting to visit the digital Hall of Fame and acknowledge your well-deserving and hard-working colleagues, mentors, and students.

This year, the Hall of Fame honors:

- ★ Current and past GSA Medals & Awards recipients;
- ★ Current and past recipients of the AGI Medal in Memory of Ian Campbell;
- ★ Current and past awardees from GSA's Divisions;
- ★ GSA Fellows and Honorary Fellows;
- ★ 50-year and 25-year members;
- ★ Associated Society award recipients; and
- ★ Top-ranked graduate student research grant recipients.



New day and time!

### *GSA Awards & Welcome Reception*

Minneapolis Convention Center,  
Ballroom B  
Sunday, 9 Oct., 8:30–9:30 p.m.

Please join us *Sunday* evening for the GSA Awards & Welcoming Reception immediately following the Presidential Address & Awards Ceremony. Mingle with current and past GSA awardees, GSA Fellows, and GSA's Executive Committee. Enjoy snacks and a complimentary beverage while you catch up with your friends, colleagues, and students—a great way to kick off the meeting!



# ARCHEAN to ANTHROPOCENE

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## SPECIAL EVENTS



Minneapolis, Minnesota, skyline at night. Photo by Greg Benz, <http://carbonsilver.com/blog>.

### ANNUAL *Geoscience Educators Reception*

Minneapolis Convention Center, Seasons  
Sat., 8 Oct., 5–7 p.m.

GSA's Committee on Education, the National Association of Geoscience Teachers (NAGT), GSA's Geoscience Education Division, "On the Cutting Edge," the IRIS Consortium, the American Geological Institute (AGI), and UNAVCO invite geoscience educators at all levels to this reception for networking and sharing ideas with other geoscience community members interested in education.

*Appetizers and cash bar provided.*

Teach in a community or junior college?

### *GSA Welcome Reception for Two-Year Geoscience Faculty*

Minneapolis Convention Center, Seasons  
Sat., 8 Oct., 4–5 p.m.

(just before the main education reception)

### *P* **All Students Invited!** *resident's Student Breakfast Reception*

Sponsored by

**ExxonMobil**

Hosted by GSA



Minneapolis Convention Center, Ballroom B  
Sunday, 9 Oct., 7–8:30 a.m.

GSA President John W. Geissman invites all students registered for the meeting to attend a free breakfast buffet sponsored by ExxonMobil Corporation. John and members of GSA leadership, along with ExxonMobil staff members, will be on hand to answer questions and address student issues.

Each student registered for the meeting will receive a complimentary ticket for the breakfast buffet. This is one of the most popular events at the meeting for students, and with good reason! Take this opportunity to network with fellow students, meet the officers of GSA, and recognize fellow student award recipients!

## THIRD ANNUAL

## PHOTO EXHIBITION

Your colleagues will share their best geologic images at the GSA Photo Exhibition.

*Supported in part by EarthSystems Imaging and Terranes LLC.*



**Categories:** Regional geology, abstract images, geologic processes past and present, and iconic landscapes.

**Questions** may be directed to:

Ellen Bishop, [paleobishop@gmail.com](mailto:paleobishop@gmail.com);

Marli Miller, [millerm@uoregon.edu](mailto:millerm@uoregon.edu); and/or

Steve Weaver, [sweaver@coloradocollege.edu](mailto:sweaver@coloradocollege.edu).

This contest is open only to GSA members and members of GSA's Associated Societies.

*Be there to help  
decide which  
images earn top  
honors!*

Iconic Landscapes: Allison Pluda, Lower Falls, Yellowstone

# ARCHEAN to ANTHROPOCENE

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## SPECIAL EVENTS

### GSA Luchtime Lecture Series

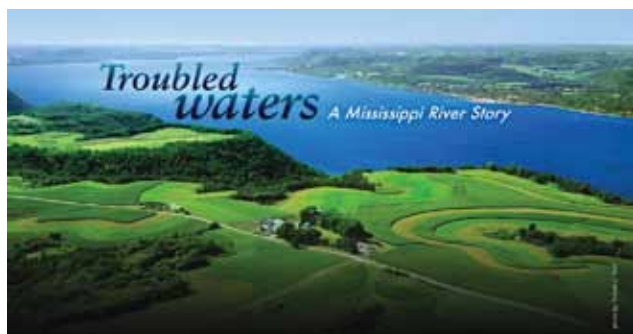


**The Anthropocene: A Geological Perspective**  
Minneapolis Convention Center, Room 101DE  
Sunday, 9 Oct., 12:15–1:15 p.m.

Over the past decade, the term “Anthropocene” has moved from a catch phrase for the scientific community to a cover story in the popular press. While both the scientific community and the public continue to recognize evidence of human-driven changes to Earth’s systems, the International Committee on Stratigraphy is grappling with what it would mean to officially recognize the Anthropocene as a geologic time period. What does this mean for geologists? How can geologists, with our unique spatial and temporal perspective, contribute to the dialog and the events we see happening around us?

Please join us for this lively participatory discussion of *The Anthropocene: A Geological Perspective*.

Moderator: Jonathan Foley, Director, Institute on the Environment and University of Minnesota. Panelists include: Stanley Finney, Chair, International Commission on Stratigraphy and California State University at Long Beach.



**Troubled Waters: A Mississippi River Story**  
Minneapolis Convention Center, Room 101DE  
Sunday, 9 Oct., 4–5 p.m. (film showing); Q&A session: 5–5:30 p.m.

This film, by Bell Museum Productions, traces the development of America’s beautiful heartland and its effect on the legendary Mississippi River. Through beautiful photography and inspiring narrative, the film offers solutions to the river’s troubles through fresh ideas and concrete solutions.

Please join Barb Coffin, Coordinator of Public Programs and Executive Producer of Bell Museum Productions, for a screening and discussion of this thought-provoking film. Coffin will be joined by local geologists who appear in the documentary, discussing their research approaches to untangling natural from anthropogenic agents of change to one of the world’s great rivers.

### Events & Deadlines

## CALENDAR

**Early registration deadline:**

Tues., 6 Sept.

**Housing deadline:**

Tues., 6 Sept.

**Registration cancellation deadline:**

Mon., 12 Sept.

**Pre-Meeting Field Trips:**

Tues.–Sat., 4–8 Oct.

**Short Courses & Workshops:**

Fri.–Sun., 7–9 Oct.

### NEW TIMES!

**Exhibits Opening:**

Sun., 9 Oct., 2–6:30 p.m.

**Presidential Address & Awards Ceremony:**

Sun., 9 Oct., 6:30–8:30 p.m.

**Awards & Welcoming Reception:**

Sun., 9 Oct., 8:30–9:30 p.m.

### TECHNICAL PROGRAM

**Oral Sessions:**

Sun.–Wed., 9–12 Oct.

**Poster Sessions**

(posters are to be hung all day; authors present a.m. or p.m.):  
Sun.–Wed., 9–12 Oct.

### EXHIBIT HALL HOURS

Sun., 9 Oct., 2–6:30 p.m.

Mon.–Tues., 10–11 Oct.,  
9 a.m.–6 p.m.

Wed., 12 Oct., 9 a.m.–2 p.m.

**Lunchtime Lectures:**

Sun.–Wed., 9–12 Oct.,  
12:15–1:15 p.m.

**Private Alumni Receptions:**

Mon., 10 Oct.; evening times vary

**Group Alumni Reception:**

Mon., 10 Oct., 7–9:30 p.m.

**Post-Meeting Field Trips:**

Thurs.–Sat., 13–15 Oct.

# ARCHEAN to ANTHROPOCENE

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*SPECIAL  
EVENTS*



## Subaru Outdoor Life Lecture

### *No Horizon Is So Far*

**Ann Bancroft, Polar Explorer**

Minneapolis Convention Center  
Monday, 10 Oct., 6–7 p.m.

Ann Bancroft's polar expeditions have not only conquered rigorous tests of teamwork and leadership, they also have taken advantage of opportunities to shatter stereotypes about women. Bancroft is the first woman in history known to have crossed the ice to the North and South Poles. In 1986, Bancroft dog-sledded 1,000 miles (1,600 km) from the Northwest Territories in Canada to the North Pole as the only female member of the Steger International Polar Expedition. In 1993, she led the American Women's Expedition to the South Pole, a four-woman, 67-day skiing expedition of 660 miles (1,060 km). In February 2001, Bancroft and Liv Arnesen from Norway became the first team of women to ski across Antarctica's landmass.

 **SUBARU** Sponsored by Subaru of America Inc.



Ann Bancroft, Polar Explorer



### *Diversity in the Geosciences Social Reception*

Hilton, Marquette Ballroom VI  
Tues., 11 Oct, 5:30–7:30 p.m.

GSA's Diversity in the Geosciences Committee, along with the NSF's Opportunities for Enhancing Diversity in the Geosciences, would like to invite you to this relaxed forum for socializing, sharing ideas, and meeting other geoscience community members interested in diversity issues.

*Appetizers and cash bar provided.*



## GREEN SPACE

### 5K RUN



Mon., 10 Oct., 6:30 a.m.  
COST: \$20.

Come enjoy your Monday morning run around Loring Park with GSA friends!

The Green Space 5K Run starts at the Minneapolis Convention Center at 6:30 a.m. A t-shirt and post-race refreshments are included with the entry fee.

**Register online when registering for the meeting.**

# ARCHEAN to ANTHROPOCENE

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## SPECIAL SESSIONS

*Five special sessions will extend and enhance opportunities for diverse learning and presentation modes within the technical program. Each four-hour session will be structured by the individual organizers to best fit their purpose.*

### **Crossing the Digital Divide: Availability of Geoscience Knowledge for Resolving Environmental and Societal Challenges**

*Cosponsors: American Association of State Geologists; British Geological Survey; U.S. Geological Survey; and these GSA Divisions: Environmental and Engineering Geology; Geoinformatics; Geology and Society; Hydrogeology*

**Organizers:** A. Keith Turner, Colorado School of Mines; D.A. Keefer, Illinois State Geological Survey; Holger Kessler, British Geological Survey

This session addresses the entire digital geoscience data collection, management, and dissemination process, including making and maintaining digital data resources, digital tools for 3-D and 4-D geologic modeling, associated process modeling, visualization, and options for collaborative Web-enabled outreach. Experiences with process modeling for hydrogeologic investigations have led the USGS, the British Geological Survey, and the Illinois Geological Survey to adopt an integrated holistic Earth-modeling approach, supported by digital data management, visualization, and dissemination tools, and to focus on development of linked-process models across a range of earth- and social-science processes.

### **GSA Geophysics Division 40th Anniversary Special Session**

*Cosponsor: GSA Geophysics Division*

**Organizers:** Walter Mooney, USGS; G. Randy Keller, University of Oklahoma; Kevin Mickus, Missouri State University; Audrey Huerta, Central Washington University

This session celebrates the 40th anniversary of GSA's Geophysics Division. Geophysical studies of lithospheric structure, composition, and evolution—from the near surface to the lithospheric-asthenospheric boundary—have made giant leaps during the past decades. We will highlight the major scientific discoveries concerning the lithosphere, from top to bottom, with invited keynote presentations of past George P. Woollard (Geophysics Division) award winners. The last talk will be given by the 2011 George P. Woollard award winner.

### **Planetary Geology Division 30th Anniversary—Then and Now: The Past 30 Years of Solar System Exploration**

*Cosponsor: GSA Planetary Geology Division*

**Organizers:** Simon A. Kattenhorn, University of Idaho; David Williams, Arizona State University

This retrospective on the major advances in understanding the geologic histories of planets and moons over the past 30 years celebrates the 30th anniversary of GSA's Planetary Geology Division. We will describe the history of solar system exploration, with emphasis on characterizing planetary surfaces and on unraveling the geologic processes and histories that have resulted in the astounding geologic diversity of our solar system.

### **The Past Yucca Mountain Project—Advancing Science and Technology for the Future: Was It Worth the Cost?**

**Organizers:** Richard R. Parizek, The Pennsylvania State University; Claudia M. Newbury, U.S. DOE (retired); Ardyth M. Simmons, Los Alamos National Laboratory

Regulatory requirements for a nuclear waste repository at Yucca Mountain, Nevada, USA, anticipated that characterization of the natural system and calculations of future performance would use established methodologies and technologies, but these were not always sufficient for the time scales and level of detail required. During the life of the program (1988–2010), ~1.1 billion dollars was spent on scientific and technical investigations across a wide range of disciplines. This symposium reviews the innovative work of the program investigators and the transfer of those methodologies and technologies to the wider scientific community. It also asks the question: Was it worth the price?

### **Water and Sediment Dynamics in Agricultural Landscapes: Towards Prediction of Watershed Sediment Yield**

*Cosponsors: Soil Science Society of America; and these GSA Divisions: Environmental and Engineering Geology; Geoinformatics; Geology and Society; Geophysics; Hydrogeology; Quaternary Geology and Geomorphology*

**Organizers:** Patrick Belmont, Utah State University; Karen B. Gran, University of Minnesota; Carrie E. Jennings, University of Minnesota

This session brings together a diverse group of geographers, geomorphologists, hydrologists, soil scientists, and agricultural scientists to evaluate approaches for predicting water and sediment yield in agricultural landscapes.

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## PARDEE KEYNOTE SYMPOSIA



Minneapolis, Minnesota, skyline at night. Photo by Greg Benz, <http://carbonsilver.com/blog>.



Joseph T. Pardee

These unique interdisciplinary sessions cover issues on the leading edge of a scientific discipline or area of public policy and address broad, fundamental issues in the geosciences. Selection is on a competitive basis, all speakers are invited, and all sessions will take place at the Minneapolis Convention Center.

- P1. **The Frontiers of Quaternary Geochronology: Extension or Overextension of Dating Methods for Quaternary Geology and Geomorphology?:** Sun., 9 Oct., 8 a.m.–noon.
- P2. **Honoring British Geologist Arthur Holmes (1890–1965) for Contributions to Geochronology, Plate Tectonics, and the Origin of Granite:** Sun., 9 Oct., 1:30–5:30 p.m.
- P3. **Exploration of the Deep Biosphere:** Mon., 10 Oct., 8 a.m.–noon.
- P4. **Rare Earth Elements and Critical Minerals for a Sustainable and Secure Future:** Mon., 10 Oct., 1:30–5:30 p.m.
- P5. **The EarthScope Program: Recent Results and Future Projects:** Tues., 11 Oct., 8 a.m.–noon
- P6. **Prairie Ice Streams:** Tues., 11 Oct., 1:30–5:30 p.m.
- P7. **Earth's Early Atmosphere and Surface Environment:** Wed., 12 Oct., 8 a.m.–noon
- P8. **Global Water Sustainability:** Wed., 12 Oct., 1:30–5:30 p.m.

## Want to work in the geosciences? Looking for qualified geoscience employees?



THE  
GEOLOGICAL  
SOCIETY  
OF AMERICA

### Visit the GSA Employment Service Center!

Minneapolis Convention Center,  
Exhibit Hall C  
Mon., 10 Oct., 8 a.m.–5 p.m.  
Tues., 11 Oct., 8 a.m.–noon

Please schedule your interviews online prior to the meeting. On-site scheduling will not be available, but please stop by to view our job postings.

**Cost:** It's **FREE** for all GSA members to post an online profile. Employer fees start at US\$300.

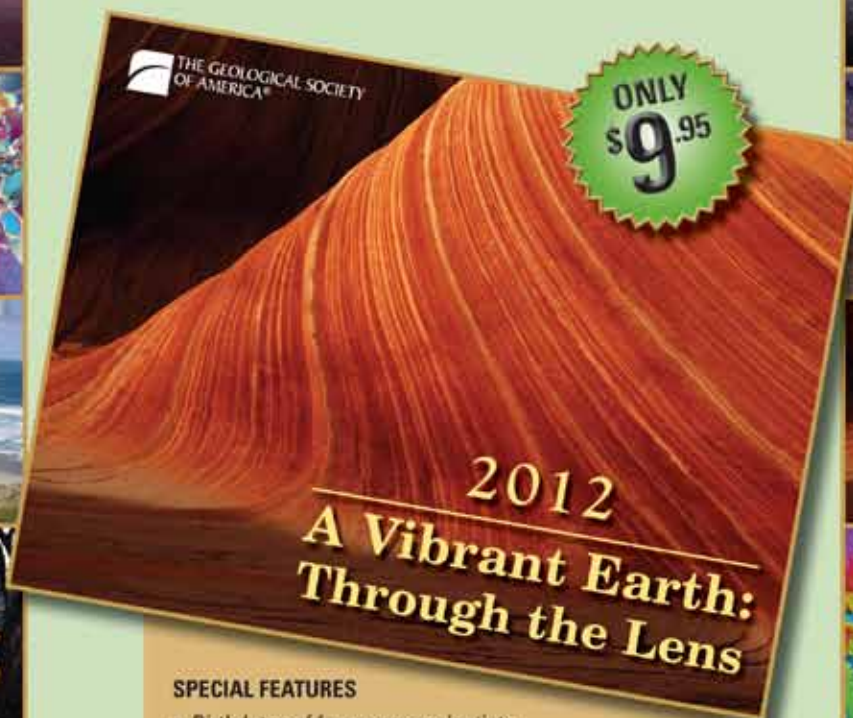
[www.geosociety.org/Employment\\_Service/](http://www.geosociety.org/Employment_Service/).

# 2012 Calendar

## A Vibrant Earth: Through the Lens, 2012

This 12-month calendar features colorful images of all scales, from aerial views to photomicrographs. Photographs were selected from award-winning submissions to the 2010 GSA Annual Meeting Photo Exhibition in Denver, Colorado. Showcasing stunning photographs of Bonita Bend on the Green River, Utah; Sand Fly Bay, South Island, New Zealand; an orbicular rhyolite from Madagascar; sunrise over Merrick Butte, Arizona; and many other landscapes captured by cameras and through microscopes, this useful calendar will spruce up your office or home.

CAL2012, 9.5" x 12.5" calendar | \$9.95 (sorry, no additional discount)



### SPECIAL FEATURES

- Birthdates of famous geoscientists
- Dates of many noteworthy eruptions and earthquakes
- Upcoming GSA meeting dates
- Brief descriptions of moments in geoscience history

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[www.geosociety.org](http://www.geosociety.org)

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## TRAVEL & TRANSPORTATION

### AIR TRAVEL

If you haven't made airline reservations yet, discounts may still be available through Delta Airlines. For more information, please go to [www.geosociety.org/meetings/2011/travel.htm](http://www.geosociety.org/meetings/2011/travel.htm).

### TRANSPORTATION OPTIONS TO/FROM MSP

The Minneapolis–St. Paul International Airport (MSP; [www.mspairport.com](http://www.mspairport.com)) is ~15 miles southeast of downtown Minneapolis. The Terminal 1–Lindbergh ground transportation booth on Level T (tram level) is staffed seven days a week from 7 a.m. to 11:30 p.m. to provide information, directions, and other assistance to travelers.

### Light Rail

**+1-612-373-3333; [metrotransit.org](http://metrotransit.org)**

Light Rail Transit (LRT) trains stop at both terminals and connect travelers to 17 other destinations, including downtown Minneapolis. Trains run every 10–15 minutes during the day, with a lighter schedule at night, and range in price between US\$1.75 and US\$2.25. The ride to downtown Minneapolis takes ~25 minutes. Go to [metrotransit.org](http://metrotransit.org) for a complete light rail schedule, station location, fare breakdown, and map. All light rail stations are fully accessible.

### Taxis

**Terminal 1–Lindbergh:** Taxi service is accessible via the Tram Level (Level T). Signs will direct you one level up to the taxi starter booth, where airport staff can assist you in obtaining a taxi.

**Terminal 2–Humphrey:** Taxi service is located on the ground level of the purple parking ramp, directly across from the terminal building.

**Fares** average US\$37–US\$47 to downtown Minneapolis (up to US\$2.50/mile + US\$4 airport access fee).



Segways; photo used with permission from Meet Minneapolis.



Twinkle Bus, Nicollet Mall, Jonathan Canaday. Photo used with permission from Meet Minneapolis.

### Bus Service

**+1-612-373-3333**

City bus service (Route 54; [metrotransit.org](http://metrotransit.org)) picks up and drops off outside the Terminal 1–Lindbergh Transit Center on Level 1 of the blue and red parking ramps. From the Lindbergh Terminal, access the Transit Center via the tram on Level T or via the Concourse Connector between concourses C and G. There is no bus pick up at Terminal 2–Humphrey; passengers must take light rail transit (free between terminals) to the Lindbergh Terminal to access city buses.

### Shuttle Service

**[www.supershuttle.com/en/MSPAairportShuttleMinneapolis.html](http://www.supershuttle.com/en/MSPAairportShuttleMinneapolis.html)**

SuperShuttle offers shared ride service to and from the airport. Shuttles operate daily, serving all downtown hotels to/from the airport for US\$16 each way or US\$28 round-trip (save US\$12 on the round-trip by using discount code **J855J** when reserving). Use J855J to also save US\$5 each way on private sedan/SUV trips to and from the airport. Advance reservations are highly recommended. The SuperShuttle ticket counter is in the **Terminal 1–Lindbergh** ground transport center, accessible via the terminal's Tram Level. Follow the signs to the appropriate escalator or elevator up. Travelers arriving at **Terminal 2–Humphrey** can call for pick up at the Super Shuttle kiosk in the ground transport center, located on Level 1 of the purple parking ramp across from the terminal building.

### Car Rental

**Terminal 1–Lindbergh:** Rental car counters are located on the second and third levels between the blue and red parking ramps, which can be reached via tram.

**Terminal 2–Humphrey:** Rental car counters are located in the ground transport center on the ground level of the purple parking ramp, directly across from the terminal building.

**Enterprise Rent-a-Car,** [www.enterprise.com](http://www.enterprise.com), +1-800-593-0505: Save 5% when you make your reservation online under "Business Rentals." The Enterprise Business Rental Program number is **1299A11**, and GSA's pin is "GEO."



## **GEOSCIENCE CAREERS AT SHELL. LET'S BUILD A BETTER ENERGY FUTURE.**



When it comes to technical excellence, Shell's reputation is world class. Our innovative technology is a way of life – driven by talented geoscientists, engineers and technicians who help keep us at the forefront of our industry. At the heart of this culture is our structured approach to technical skills management and professional development that provide employees with access to an unparalleled range of technical roles, training opportunities and global careers.

As part of our commitment to innovation and development, Shell is a proud sponsor of the 2011 GSA Annual Meeting, including the Women in Geology Mentor Program, Educational Short Courses and Poster Sessions.

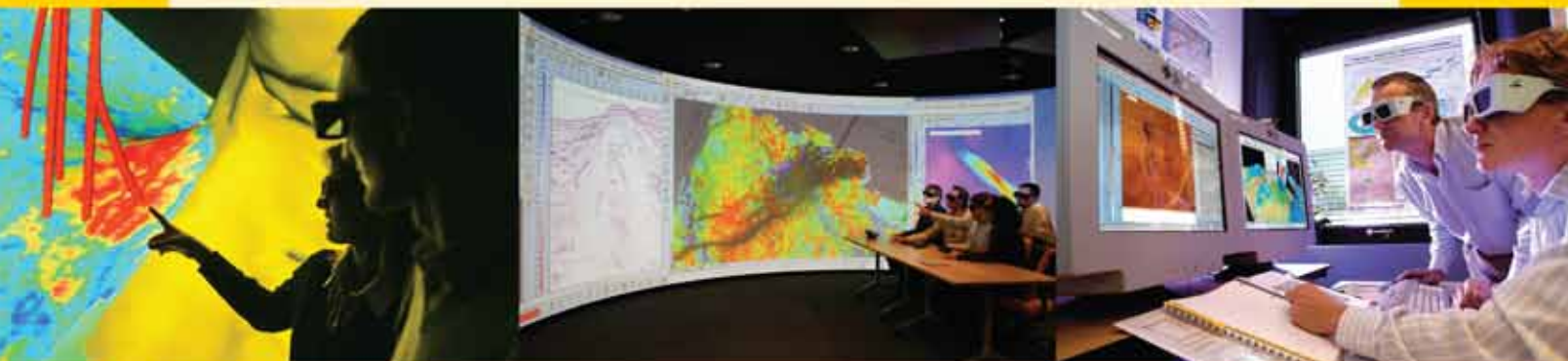
Can you apply a creative mind to some of the world's biggest energy challenges?

To learn more and apply, **visit [www.shell.us/careers](http://www.shell.us/careers) or speak with us in person at the GSA Annual Meeting in Minneapolis** (booth #1110 adjacent to the poster areas).

Follow us on LinkedIn, Facebook and Twitter @ShellCareers.



**BE PART OF THE SOLUTION.**



*Shell is an equal opportunity employer.*

# ARCHEAN to ANTHROPOCENE

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## HOUSING

*How can we help you once the deadline has passed?*

### MAKING YOUR RESERVATION

We will continue to assist you in making a reservation but cannot guarantee that group rates will still be available. Reservations may be made via ONE of the following methods:

**Internet:** [www.geosociety.org/meetings/2011/](http://www.geosociety.org/meetings/2011/)

**Fax:** +1-612-767-8201

**Telephone:** +1-888-947-2233 (domestic) or +1-612-767-8200; Mon.–Fri., 9 a.m.–3 p.m. CST; please have credit card and arrival/departure dates ready.

**Questions only:** Send an e-mail to [housing@meetminneapolis.com](mailto:housing@meetminneapolis.com) (refer to the GSA Annual Meeting in your subject line).

### MODIFY/CANCEL YOUR RESERVATION

**On or before 29 September:** Cancellation and changes to name, stay dates, address, or special requests can be made online at [www.geosociety.org/meetings/2011/](http://www.geosociety.org/meetings/2011/), or contact the Meet Minneapolis Housing Bureau.

**After 29 September:** All changes and cancellations must be made directly with the assigned hotel. Please DO NOT contact the hotel directly until after 29 Sept.

Cancellation requests received after **6 Sept.** will be subject to a US\$25 cancellation fee. Cancellations made within 72 hours of the scheduled arrival date are subject to a fee equal to one night's room rate plus tax. These fees will be charged to the credit card used to make the reservation. Early departures are subject to penalty fees set by the hotel. A charge of first night's room and tax will be applied and/or forfeited if you do not cancel or do not arrive (no show).

### ROOM SHARING

Use the GSA Travel & Housing Bulletin Board at [http://rock.geosociety.org/forumstudenttravel/forum\\_topics.asp?FID=36](http://rock.geosociety.org/forumstudenttravel/forum_topics.asp?FID=36) to share housing and/or carpool. You can also use this service to make arrangements to meet up with your colleagues.

### Association for Women Geoscientists

[www.awg.org](http://www.awg.org)



The AWG Foundation supports  
AWG programs:

Scholarships | Geoscientists-in-the-Parks  
Travel Awards | Distinguished Lecturers  
Educator of the Year Award  
Girl Scout Activities | Brunton Award  
Science & Engineering Fairs  
Student Awards | Field Trips | Job Web

Join us for one of the many exciting AWG  
events at GSA in Minneapolis, MN

- \* Women in Geology Mentor Event  
Sunday October 9th at 5:00 PM
- \* AWG Breakfast and Awards Ceremony  
Monday October 10th at 6:30 AM
- \* Issues Facing Women Chairs, Deans & Academic Leaders
- \* AWG Booth, exhibit hall #744  
Sunday October 9th to Wednesday October 12th

AWG activities at the  
2011 GSA Annual Meeting are  
sponsored by ExxonMobil

**ExxonMobil**



25th Anniversary  
SAGEEP

SAGEEP 2012

Making Waves: Geophysical Innovations  
for a Thirsty World

March 25-29, 2012

Tucson, Arizona USA

Hilton Tucson El Conquistador

Call for Sessions/Abstracts announced soon at  
[www.eegs.org/SAGEEP](http://www.eegs.org/SAGEEP)

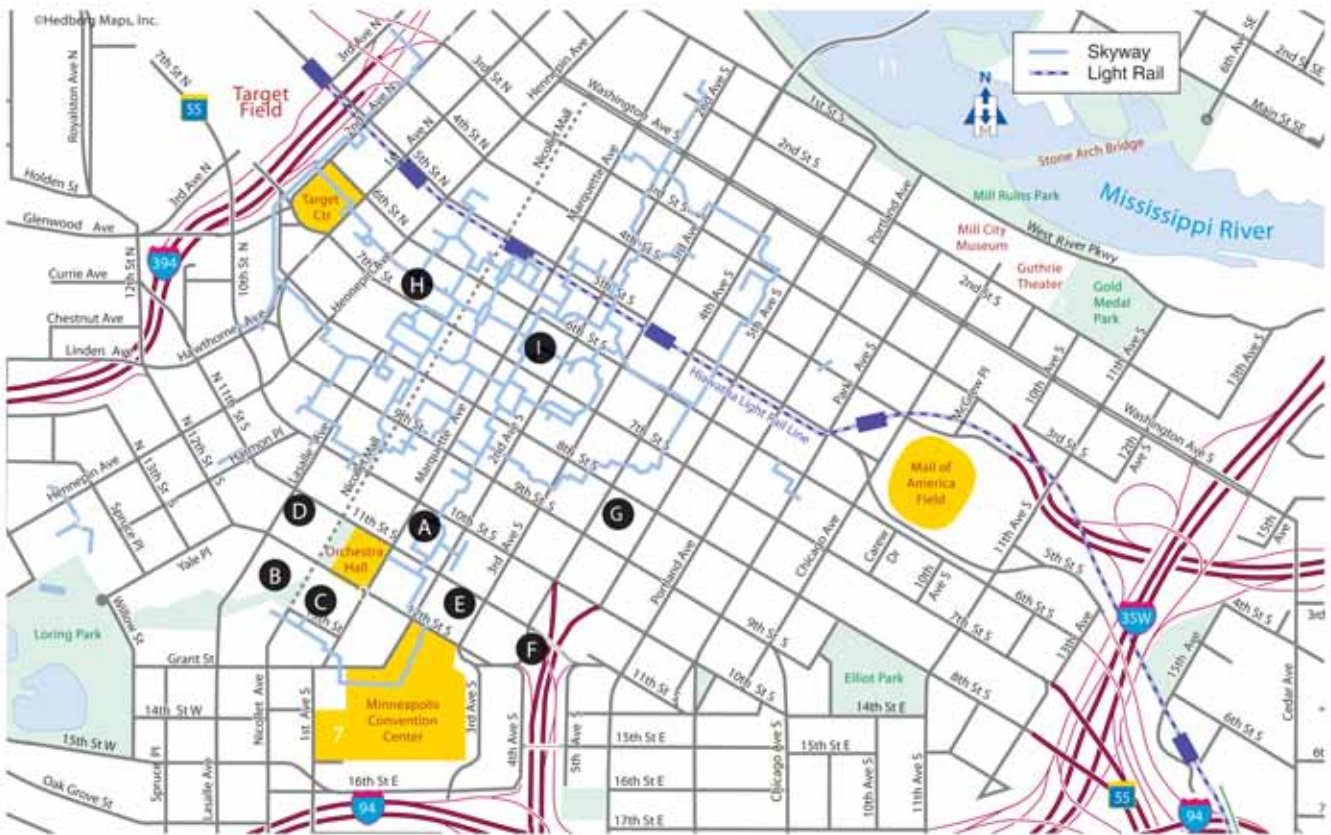


Save the Dates: March 25-29, 2012

# ARCHEAN to ANTHROPOCENE

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## MINNEAPOLIS STREET & HOTEL MAP



### GSA Room Block Hotels:

		<b>Single</b>	<b>Double</b>	<b>Triple</b>	<b>Quad</b>
(A)	Hilton Minneapolis - HQ	189.00	189.00	209.00	229.00
(B)	Hyatt Regency - Co-HQ	189.00	189.00	214.00	239.00
(C)	Millennium Hotel	175.00	175.00	190.00	205.00
(D)	DoubleTree Guest Suites	158.00	158.00	173.00	188.00
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(F)	Hilton Garden Inn*	136.00	136.00	151.00	166.00
(G)	Best Western Normandy Inn*	139.00	139.00	154.00	169.00
(H)	Marriott City Center Hotel*	167.00	167.00	182.00	197.00
(I)	Crowne Plaza Northstar*	162.00	162.00	172.00	182.00

A 13.40% state and city tax will be added to the room rate. Taxes are subject to change. Rates are in U.S. dollars.  
 \*Complimentary Internet access in guest rooms.



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## GSA EXHIBITOR LISTING BY CATEGORY

(as of September press deadline)

### Exhibit Hall Hours:

Sun., 9 Oct., 2 p.m.–6:30 p.m.

Mon.–Tues., 10–11 Oct.,

9 a.m.–6 p.m.

Wed., 12 Oct., 9 a.m.–2 p.m.

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National Earth Science Teachers

Association

National Ground Water Association

Paleontological Society

SEPM (Society for Sedimentary

Geology)

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### Publications, Maps, Films

Cambridge University Press

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### State Surveys

Illinois State Geological Survey

### Universities/Schools

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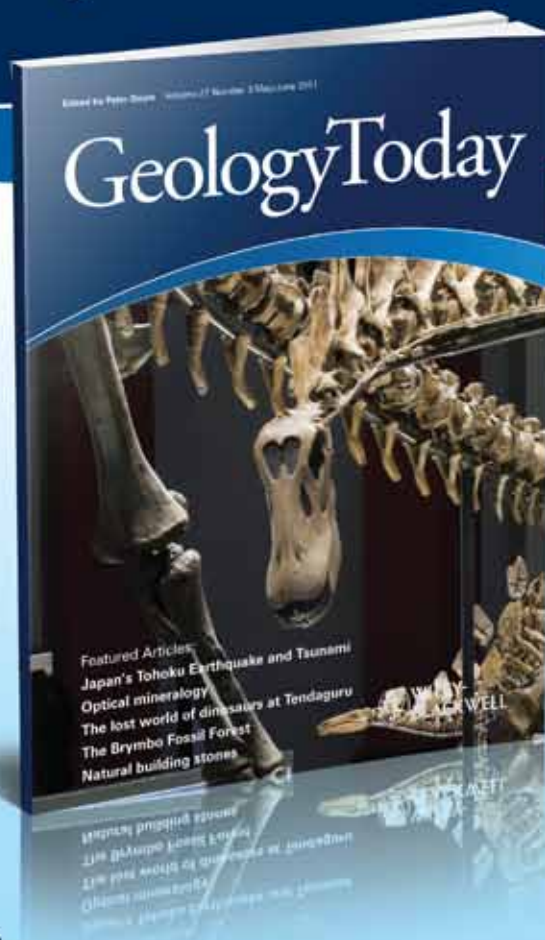
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## GRADUATE SCHOOL INFORMATION FORUM

Sun., 9 Oct., 8 a.m.–6:30 p.m. ♦ Mon.–Wed., 10–12 Oct., 8 a.m.–6 p.m.

Minneapolis Convention Center, Exhibit Hall C

**Searching for the right graduate school?** Meet with representatives from across the nation at the Graduate School Information Forum. Participating schools (as of press time) are listed below. For an up-to-the-minute list, go to <http://rock.geosociety.org/gsif/gsif.aspx>.

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East Carolina Univ., Geological Sciences	♦	♦		
Geological Education Services	♦	♦		
Indiana State Univ., Geology Program	♦	♦		
Iowa State Univ., Geological & Atmospheric Sciences	♦	♦		
Juneau Icefield Research Program, Earth Sciences		♦	♦	
Louisiana State Univ., Geology & Geophysics	♦			
Miami Univ., Geology	♦	♦		
Michigan Tech Univ., Geo. Eng. & Sciences	♦	♦		
Missouri State Univ., Geosciences	♦	♦		
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Montana State Univ.–Bozeman, Earth Sciences		♦	♦	
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Univ. of Idaho	♦	♦		
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Univ. of Minnesota–Duluth	♦	♦		
Univ. of Nebraska–Lincoln, Earth & Atmospheric Sciences	♦			
Univ. of North Carolina–Charlotte, Geography & Earth Sciences	♦	♦		
Univ. of Oklahoma School of Geology & Geophysics	♦	♦	♦	
Univ. of Southern California, Earth Sciences	♦	♦	♦	♦
Univ. of South Florida College of Marine Sciences	♦	♦		
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Univ. of Wisconsin–Madison, Geoscience	♦	♦	♦	♦
Univ. of Wisconsin–Milwaukee, Geosciences	♦	♦		
Utah State Univ., Geology	♦	♦		
Vanderbilt Univ.	♦	♦		
Virginia Tech, Geosciences	♦	♦	♦	
Western Michigan Univ. Geosciences	♦	♦		
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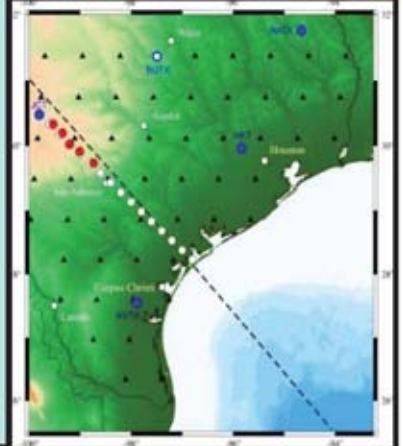
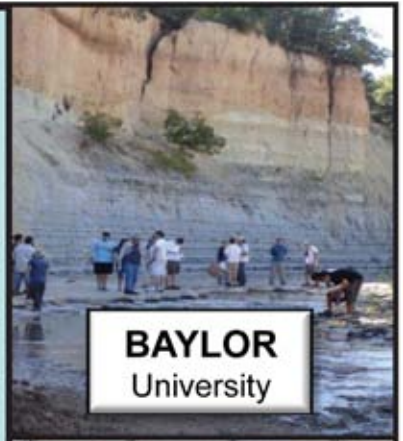
## Revising the Precambrian Time Scale

The Subcommittee on Precambrian Stratigraphy of the International Commission on Stratigraphy plans to replace the GSSAs on the ICS International Chronostratigraphic Chart with GSSPs. The chart is at [www.stratigraphy.org](http://www.stratigraphy.org). A GSSP (global stratotype section and point) now defines the Ediacaran Period; the Cryogenian Period and the Archean-Proterozoic boundary are under consideration. GSSPs will not coincide with the rounded numbers of the GSSAs, resulting in revisions, perhaps significant.

**This project will be presented in Theme Session T46 (Application of New Stratigraphic Tools to Precambrian and Igneous Rocks: Challenges and Solutions), and discussed at length in a "Friends of the Precambrian" meeting at GSA Minneapolis.**

All members of the Precambrian community are invited. Working groups to develop GSSP proposals for the eras and periods will be established at the 34<sup>th</sup> International Geological Congress in Brisbane, Australia in 2012. The activities at GSA Minneapolis serve to give advance notice to the Precambrian community, to initiate discussions within the community, to recruit participants to the project, and to initiate planning for the 34<sup>th</sup> IGC.

Baylor Geology in Waco, TX offers M.S and Ph.D. research in a variety of subjects and in outstanding teaching and research facilities. We are interviewing for two new faculty positions in (1) mineralogy and petrology, and (2) applied geophysics. Please visit our booth #524 in the exhibits area at the 2011 GSA meeting in Minneapolis, MN, or visit our website at: <http://www.baylor.edu/Geology/>



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## MENTOR PROGRAM SCHEDULE

### WOMEN IN GEOLOGY

Hilton, Symphony Ballroom 1  
Sun., 9 Oct., 5–6:30 p.m.



*Sponsored by Subaru of America Inc.  
and supported by Shell, the Association for*

*Women Geoscientists (AWG) and EnPro Assessment Corp.*

This informal reception begins with remarks from a few key women speakers addressing issues faced by women in geology, followed by time for networking, sharing ideas, and getting to know other women geoscientists and geosciences educators. This year's speakers include Naomi Levin (GSA's Subaru Outstanding Woman in Science awardee), Alicia Kahn (from Chevron), and Susan van der Lee (of Northwestern University), along with our moderator, AWG president Heidi Hof-fower. *Appetizers provided.*

### GEOLOGY IN GOVERNMENT

Minneapolis Convention Center, Ballroom A  
Mon., 10 Oct., 11:30 a.m.–1 p.m.



*Sponsored by the GSA Foundation*

This popular program, supported by the GSA Foundation, features a FREE lunch for undergraduate and graduate students with a panel of mentors representing a variety of government agencies, including the Wisconsin Geological Survey, NASA, NSF, NPS, USGS, Forest Service, and the Bureau of Land Management. These mentors will answer questions, offer advice about preparing for a career in government, and comment on the prospects for current and future job opportunities with their agencies. This year's luncheon will include a GeoCorps™ America information desk. *Space is limited for this event, so please try to arrive early.*

### STUDENT NETWORKING LUNCHEON

Minneapolis Convention Center, Ballroom B  
Mon., 10 Oct., 11:30 a.m.–1 p.m.

This luncheon, supported by industry donations and organized by the YES Network (young or early career earth scientists), GSA, and AGI, features a FREE lunch for undergraduate and graduate students with an exciting opportunity to network with more than 40 geoscience professionals. They will answer questions, offer advice about career plans, and comment on job opportunities within their fields. Preregistration is necessary, and you must bring your luncheon ticket to be admitted. Learn more at [www.networkyes.org/index.php/meetings/gsa\\_2011/](http://www.networkyes.org/index.php/meetings/gsa_2011/).

### GEOLOGY IN INDUSTRY

Minneapolis Convention Center, Ballroom A  
Tues., 11 Oct., 11:30 a.m.–1 p.m.



*Sponsored by Chevron, Alpha Natural Resources,  
ExxonMobil, Barr Engineering, and the Society of Economic  
Geologists through the GSA Foundation*

This program, which features a FREE lunch for undergraduate and graduate students, brings together a panel of mentors representing Chevron, Alpha Natural Resources, ExxonMobil, Barr Engineering, and the Society of Economic Geologists. These mentors will answer questions, offer advice about preparing for a career in industry, and comment on the prospects for current and future job opportunities with their companies. *Space is limited for this event, so please try to arrive early.*

Full program descriptions are available at  
[www.geosociety.org/mentors/](http://www.geosociety.org/mentors/). Questions? Contact  
Jennifer Nocerino, [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).



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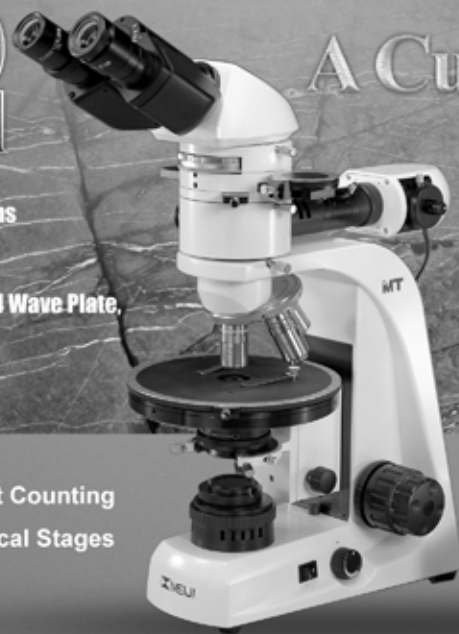
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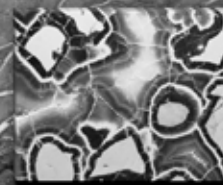
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## GSA FIELD TRIPS



The University of Minnesota's research vessel *Blue Heron* plies the waters of the North American Great Lakes; photo courtesy Brett Groehler. See Field Trip 414.

One of the best things about going to a new area (GSA hasn't had an annual meeting in Minneapolis since 1972) is having the chance to see new places and take part in some fascinating field excursions. It's not too late to sign up for a field trip, but space is filling up quickly, so register soon.

Learn more at

[www.geosociety.org/meetings/2011/fieldTrips.htm](http://www.geosociety.org/meetings/2011/fieldTrips.htm).

## Create Your Own Annual Meeting Schedule

Welcome to the **GSA Online Personal Scheduler**, located at:

<http://gsa.confex.com/gsa/2011AM/scheduler/index.epl>.

Here you can search or browse events scheduled for the meeting, including exhibits you want to visit or a presentation you don't want to miss. You can create your own schedule of events, check it for conflicts, record notes, and download it to your smart phone or Personal Digital Assistant (PDA). If you download to PDA, please wait until the day before travel to ensure you have the latest updates. You can even create your own memo to be used as a personal reminder.

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Closing date: 29 September 2011.

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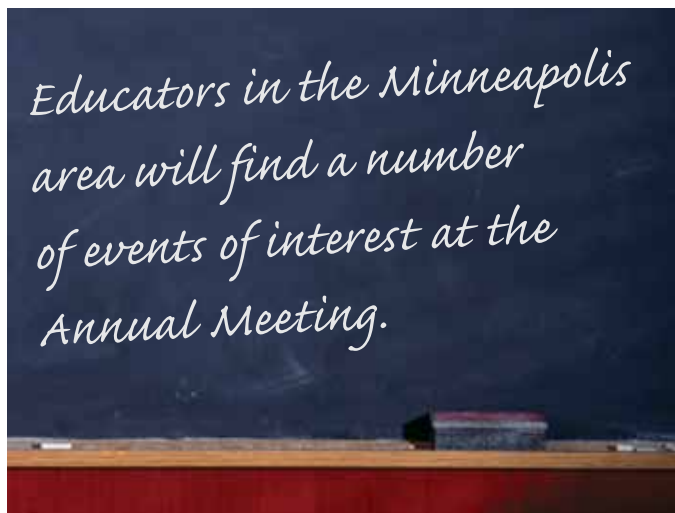
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## K-12 EDUCATION EVENTS



*Educators in the Minneapolis area will find a number of events of interest at the Annual Meeting.*

### GEOSCIENCE EDUCATORS SOCIAL RECEPTION

Minneapolis Convention Center, Seasons

Sat., 8 Oct., 5–7 p.m.; see p. 18.

Meet geoscience educators at all levels at this informal reception. *Appetizers and cash bar provided.*

### SHORT COURSES FOR K-12 TEACHERS

#### 518. Education Research I: Conducting Qualitative

**Geoscience Education Research.** Sat., 8 Oct.,

8 a.m.–noon. US\$60; includes lunch. CEU: 0.4.

#### 519A. Teaching Students How to Learn.

Sat., 8 Oct., 8 a.m.–noon. US\$35 for one course—or, get two-for-one!—US\$35 for combined courses (519C or 519D); includes lunch. CEU: 0.4.

#### 519B. Teaching Climate Science with Active Learning

**Strategies.** Sat., 8 Oct., 8 a.m.–noon. US\$35 for one course—or, get two-for-one!—US\$35 for combined courses (519C or 519D); includes lunch. CEU: 0.4.

#### 519C. Retooling Your Geosciences Class: Strategies to Assess Learning and Improve Student Success.

Sat., 8 Oct., 1–5 p.m. US\$35 for one course—or,

get two-for-one!—US\$35 for combined courses

(519A or 519B); includes lunch. CEU: 0.4.

#### 519D. Teaching with Google Earth.

Sat., 8 Oct., 1–5 p.m. US\$35 for one course—or, get two-for-one!—US\$35 for

combined courses (519A or 519B); includes lunch.

CEU: 0.4.

#### 523. Education Research II: Conducting Quantitative

**Geoscience Education Research.** Sat., 8 Oct., 1–5 p.m.

US\$60; includes lunch. CEU: 0.4.

#### 529. Hands-on, Inquiry-Based Activities in Earth Sciences: Workshop for Middle- and High-School Teachers.

Sun., 9 Oct., 8 a.m.–5 p.m. US\$20; includes

continental breakfast and lunch. CEU: 0.9.

### FIELD TRIPS FOR K-12 TEACHERS

#### 403. An Excursion to the Classic Bedrock Localities of Northern Minnesota with a Focus on Teaching and Learning in the Field.

Thurs.–Fri., 6–7 Oct. US\$245; includes breakfast, lunch, dinner, refreshments, and one overnight stay. Check in at 7:30 a.m. Cosponsor: *National Association of Geoscience Teachers*. Leaders: Karl R. Wirth, Macalester College; Dexter Perkins; Alison Stokes.

#### 405. Pedagogical Strategies for Introductory Geology Field Trips through an Examination of the

**Mississippi River Valley in the Twin Cities.** Fri., 7 Oct.

US\$75; includes lunch and refreshments. Check in at 7:30 a.m. Cosponsor: *National Association of Geoscience Teachers*. Leaders: Kate S. Pound, St. Cloud State Univ.; Karen M. Campbell; Lee Schmitt.

#### 406. 3.5 Billion Years of Geologic History: A Teachers' Guide to the Rocks of Southern Minnesota.

Fri.–Sat., 7–8 Oct. US\$215; includes breakfast, lunch, dinner, refreshments, and one overnight stay. Check in at 7:30 a.m. Cosponsor: *GSA Geoscience Education Division*. Leader: Sadredin C. Moosavi, Univ. of Massachusetts.

Learn more at [www.geosociety.org/meetings/2011/](http://www.geosociety.org/meetings/2011/).



### Paleontological Society Distinguished Lecturers

The PS will cover up to \$400 towards travel for a speaker to visit your department. Host institutions are responsible for on-site expenses (meals and lodging). For more details, see <http://www.paleosoc.org/speakerseries.html>

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Jon Karr  
jkarr@duke.edu  
919-660-7418



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LAB WEBSITE: [www.biology.duke.edu/jackson/devil/](http://www.biology.duke.edu/jackson/devil/)

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## GSA Short Courses



### *Don't Forget to Sign up for a GSA Short Course!*

**Put your best foot forward—use the time right before the meeting to earn continuing education credits (CEUs).** All short courses offer CEUs, and most are low or no cost.

**Short courses fill up quickly—early registration is recommended,** but if you missed the 6 Sept. deadline, you may still be able to sign up for a class (for an additional US\$30). Learn more at [www.geosociety.org/meetings/2011/courses.htm](http://www.geosociety.org/meetings/2011/courses.htm).

**Questions?** Contact Jennifer Nocerino, [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).



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## REGISTRATION

[www.geosociety.org/meetings/2011/reg.htm](http://www.geosociety.org/meetings/2011/reg.htm)

**Early registration deadline:** 6 September



**Deadline to register by mail or fax:** 6 October  
(online registration will be available throughout the meeting)

The Geological Society of America  
P.O. Box 9140  
Boulder, CO 80301-9140, USA  
Phone: Option 3, at +1-303-357-1000 or +1-888-443-4472  
(in the U.S.) and +1-800-472-1988 (outside the U.S.)  
Fax: +1-303-357-1071

Registration by phone, mail, or fax, will not be available after 6 October. *Please register online or in person* at the Minneapolis Convention Center, Lobby B. When you register, don't forget to sign up for guest tours (details on page 42), special events, and other ticketed functions. You can also sign up to receive text message alerts during the meeting (on the last page of the online registration system or when you register in person).

### Registration Desk Hours

Saturday, 8 Oct.: 7 a.m.–6 p.m.  
Sunday, 9 Oct.: 6:30 a.m.–8 p.m.  
Monday–Tuesday, 10–11 Oct.: 7 a.m.–4:30 p.m.  
Wednesday, 12 Oct.: 7–11 a.m.

**BADGES:** If you registered in advance of the meeting, please pick up your badge onsite at the *Annual Meeting Advanced Registration Desk* in Lobby B of the Minneapolis Convention Center.

Attendees (field trip or short course only & guest or spouse registrants excluded) will receive a free electronic copy (CD-ROM) of the *Abstracts with Programs* (which includes the 2011 Section Meeting abstracts). The *Abstracts with Programs* book may be purchased when you register and will be provided when you pick up your badge.



### Accessibility for Registrants with Special Needs

GSA is committed to making the annual meeting accessible to all people interested in attending. If you need auxiliary aids or service because of a disability, check the appropriate box on the registration form. If you have suggestions or need further information, contact William Cox, [wcox@geosociety.org](mailto:wcox@geosociety.org), +1-303-357-1013.



Glacial Lake Duluth strandline, Carlton County, Minnesota; photo courtesy Andy Breckenridge.



Autumn view over Wausawanagin Bay on Lake Superior near the Canadian border; Pigeon Point is in the distance and Isle Royale is on the horizon; photo courtesy Jim Miller.



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## GUEST PROGRAM

### GUEST HOSPITALITY SUITE

Sun.–Wed., 9–12 Oct., 8 a.m.–5:30 p.m.

GSA looks forward to welcoming all our guests from near and far! The Guest Hospitality Suite includes complimentary seminars, light food and beverages throughout the day, a welcome gift, and the President's guest breakfast, and will be staffed by a hostess who can assist you with questions regarding restaurants, activities, and attractions, as well as offer general information about Minneapolis.

As a registered guest, you are welcome to attend your companion's technical session(s), and you will also have admittance to the exhibit hall. In addition, you have the opportunity to sign up for professional field trips (additional fees apply) or attend open lectures.

### President's Guest Breakfast



#### **Note new day and time:**

Tuesday, 11 Oct., 8–8:45 a.m.

#### **Consider this your invitation...**

GSA's president and executive director are looking forward to meeting you during this complimentary breakfast just for those registered as guests at the meeting.

### Guest Seminars



Walker Sculpture Garden; courtesy Meet Minneapolis.

SUNDAY, 9–10 a.m.

#### **MEET MINNEAPOLIS**

Presented by the Minneapolis Convention & Visitors Bureau.  
*Arts and adventure: That's what awaits you in Minneapolis.*

MONDAY, 10–11 a.m.

#### **GIFTS FROM THE NORTH STAR**

Presented by J.B. Eckert, local actor and historian.  
*An insightful look into how Minnesota and its people have shaped the world.*

TUESDAY, 9–10 a.m.

#### **PHOTO AND MEMORY CELEBRATION**

Presented by Beth Gibson Lilja, Creative Memories Photo Solutions Specialist.  
*Your life, your story, your way.*

WEDNESDAY, 9–10 a.m.

#### **BOUNTY FROM THE ORCHARDS (MINNESOTA LANDSCAPE ARBORETUM)**

Presented by the Minnesota Landscape Arboretum.  
*A flavorful gathering with abundance from the earth.*

## CHILDCARE

Minneapolis Convention Center, Room 210AB



Your children will enjoy the meeting as much as you enjoy the convenience of onsite childcare during the GSA Annual Meeting and Exposition. Children enrolled in the program will participate in games, story time, arts and crafts, and other fun-filled activities for each age group.

KiddieCorp has provided high-quality programs to children at conventions, trade shows, and corporate events throughout the United States and Canada since 1986; GSA has worked with KiddieCorp since 2005.

Sat., 8 Oct., 7 a.m.–6 p.m.

Sun., 9 Oct., 7 a.m.–7:30 p.m.

Mon.–Wed., 10–12 Oct., 7 a.m.–6 p.m.

**Age range:** Six months to 12 years

**Cost:** US\$7 per hour per child; two-hour minimum

**Deadline:** 9 September; minimum enrollments are required

Register at [www.kiddiecorp.com/gsakids.htm](http://www.kiddiecorp.com/gsakids.htm)

**For more information,** contact GSA's meetings department at [meetings@geosociety.org](mailto:meetings@geosociety.org).

*Childcare services are a contractual agreement between each individual and the childcare company. GSA assumes no responsibility for the services rendered.*

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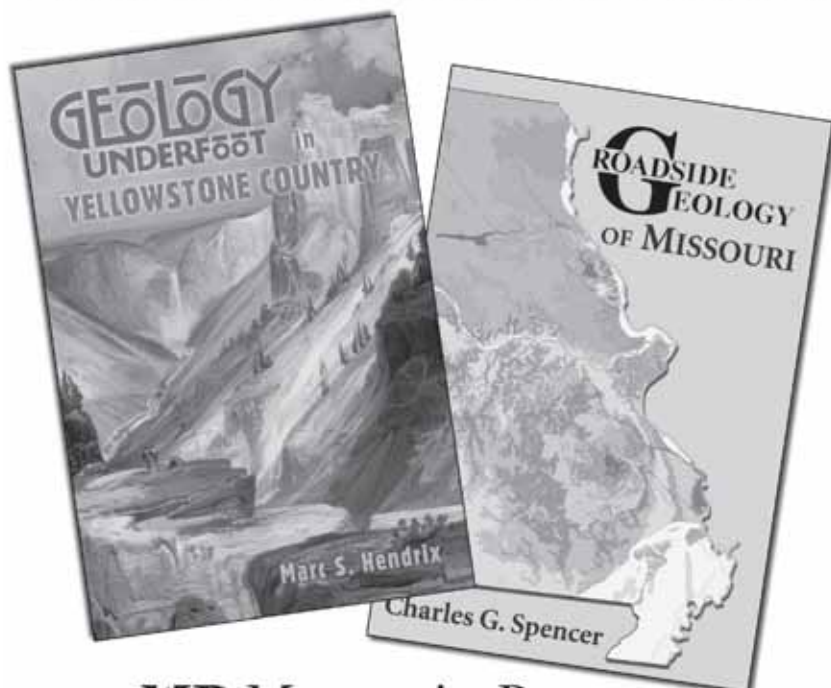
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## TOURS

All Annual Meeting attendees and guests are welcome to register for the following tours, running Sun.–Wed., 9–12 October. The prices for these tours cover transportation, professional tour guide fees, admission, and gratuities. Tours may be canceled if minimum attendance is not met, so please register early. We also recommend that you periodically check the meeting website, [www.geosociety.org/meetings/2011/](http://www.geosociety.org/meetings/2011/), for updates and news about these tours.

### SUNDAY

#### 101. Guthrie Theater Backstage Tour and Minnesota History Center with Lunch

10:30 a.m.–3:30 p.m. US\$64; minimum 25 people.

This tour begins at the Guthrie Theater, located in the historic Mills District on the banks of the Mississippi River in downtown Minneapolis. The original Guthrie Theater opened on 7 May 1963 with a production of *Hamlet*, directed by Sir Tyrone Guthrie, the theater's founder. While the Guthrie Theater's mission and artistic excellence have remained constant, this updated 250,000-square-foot theater center was inaugurated in June 2006. Our behind-the-scenes tour of the new Guthrie Theater promises to excite and surprise you. Discover the stunning and expanded features of the state-of-the-art facility, designed by French architect Jean Nouvel, and view unique building highlights and key architectural elements. We will also visit rehearsal rooms, workshops, dressing rooms, and the backstage area and learn about the underworld of stage elevators and trap doors. Next we'll head to Saint Paul to visit the Minnesota History Center. An interactive museum with both permanent and changing exhibits, the Minnesota History Center hosts concerts, lectures, family days, and other special events. The building is also home to the Minnesota Historical Society library and archives, a research destination for schoolchildren, family historians, and academics. While at the museum, we'll have lunch at Café Minnesota. The Café offers self-service dining, with a full grill and entrée, deli, and dessert stations. The food is exceptional!

#### 102. Aamodt's Apple Festival

1:30–5 p.m. US\$35; minimum 25 people.

For three generations, the Aamodt family has nurtured the finest apples. You're invited to turn back the time to 1948 when the orchard was first planted and sample the good life on this picturesque farm. At Aamodt's Apple Festival, you'll enjoy sweet and juicy Honeycrisp apples—a seasonal treat! You can also try the famous cider donuts, apple brats, and fresh apple cider. Jump on a hay wagon ride, explore the hay bale maze, visit the goat farm, and buy fresh apples. Aamodt's is also the only apple orchard in Minnesota with a vineyard. Taste award-winning local wines, grown and produced on site.

### MONDAY

#### 103. Twin Cities Highlights Tour

1:30–4:30 p.m. US\$30; minimum 25 people.

Get ready to experience a sampling of what makes the Twin Cities—Minneapolis and St. Paul—so fantastic! The culture, attractions, restaurants, shops, entertainment, and recreational opportunities in Minneapolis are unsurpassed in the Midwest. First, we'll take in a view of the Minneapolis skyline. The contemporary skyscrapers, with their dazzling variety of colors, shapes, and sizes, herald the city's dynamic growth and vibrant, thriving lifestyle. We will explore Nicollet Mall, the Skyway network, the Minneapolis Sculpture Garden, the Milwaukee Depot and Train Shed, Orchestra Hall, the television home of Mary Tyler Moore, and St. Anthony Falls, the city's birthplace. Minnesota's oldest tourist attraction is Minnehaha Falls, where the 22-mile Minnehaha Creek, which flows from Lake Minnetonka through the western suburbs of Minneapolis and into the city, meets the Mississippi River. The 53-foot falls were immortalized in Henry Wadsworth Longfellow's *Song of Hiawatha* and are visited by thousands of tourists and locals every year. Saint Paul—Minnesota's capital city—is a contrast of old-world charm, with magnificent Victorian and art deco reminders of the past situated among sleek, modern skyscrapers. We will explore Rice Park, Ordway Center for the Performing Arts, Landmark Center, the Children's Museum, Mickey's Diner, the Fitzgerald Theater, the Minnesota History Center, and the Minnesota State Capitol. We'll also visit the magnificent Cathedral of Saint Paul, the fourth largest cathedral in the United States. Built in the classical Renaissance style, the cathedral dome is modeled after St. Peter's Basilica. We'll also drive along Summit Avenue, one of the longest stretches of virtually uninterrupted Victorian architecture in the United States. This monumental boulevard of homes, churches, synagogues, and schools would not have been uncommon in the nineteenth century, but in most American cities, these thoroughfares have completely lost their character to progress. Some homes to note along the way are the James J. Hill House, the former home of F. Scott Fitzgerald, and the Governor's Mansion.

### TUESDAY

#### 104. Stillwater—Birthplace of Minnesota

10:15 a.m.–4:15 p.m. US\$59; minimum 25 people.

Located on the St. Croix River, Stillwater is Minnesota's oldest town, the birthplace of the Minnesota Territory in 1849. Stillwater is steeped in history, architectural gems, and beautiful natural surroundings. For more than 50 years, lumbermen dominated the St. Croix River with camps, mills, log rafts, and steamboats—making Stillwater the Queen City of the river. The hills of Stillwater provided escape from the industrial and commercial riverfront, and this is where the lumbermen, bankers, riverboat men, and mill workers built their homes. The diversity of the population created diversity in home architecture:

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Queen Anne, Greek Revival, Second Empire, Stick Style, Shingle Style, Neoclassicism, Bungalow, Italianate, Craftsman, and Prairie. During the motorcoach tour, our guide will provide anecdotes and stories to illuminate the lives of the enchanting river town's immigrants and entrepreneurs. Mansions built by wealthy lumber barons, beautiful old churches on the "Street of Spires," and landmarks on the National Register of Historic Places will all be pointed out along the way. Next, we'll board a replica of an 1890s paddlewheel riverboat to enjoy the scenic St. Croix River. A delicious buffet lunch will be served on board. After lunch, you'll be able to visit the shops on Stillwater's historic streets. Discover original works of art, jewelry, pottery, eclectic gifts/crafts, books, gourmet utensils, wine, clothing, home furnishings, and antiques.

## WEDNESDAY

### 105. **Gangster Tour**

1:30–4:30 p.m. US\$39; minimum 25 people.

Baby Face Nelson, Machine Gun Kelly, Kid Caan, Ma Barker—these are names that Americans, especially Minnesotans (St. Paulites in particular) became all too familiar with during prohibition. Alvin "Creepy" Karpis once said, "If you were looking for a guy you had not seen in a few months, you usually thought of two places: Prison or St. Paul." During the prohibition era, things were not always what they seemed—St. Paul was more than a quiet, picturesque river town! We'll see the spot where Dillinger had a shoot-out with St. Paul police, pass the former most-exclusive speakeasy in the area, and visit the Landmark Center, the site of the famous gangster trials (J. Edgar Hoover personally escorted public enemy no. 1 Karpis through the doors for his trial). The restored federal courts building still commands respect. Originally conceived as a post office, custom house, and courthouse, the building eventually became the headquarters for all federal offices in the upper Midwest. This grand edifice has been honored with numerous awards for its architectural genius. Next, we'll visit the Wabasha Street Caves. The caves were dug in the early 1800s out of a layer of rock known as St. Peter Sandstone. The sand that forms this rock was the beach of a warm inland sea over 400 million years ago. During our cold Minnesota winters, it is reassuring to see this remnant of a tropical Minnesota. In the 1800s, a mushroom-growing business was established in the caves, then a nightclub and restaurant opened in the 1930s; if you listen carefully, you can still hear the music of the Dorsey Brothers, Cab Calloway, and others. The caves even include a "Gangster Gallery" of some of its more notorious past visitors. Also while in St. Paul, our guide will provide commentary on Rice Park, Ordway Center for the Performing Arts, Children's Museum, Mickey's Diner, and the Fitzgerald Theater, home to Garrison Keillor's *Prairie Home Companion*.

## NOTICE of Council Meeting

2011 GSA Annual Meeting

Hilton Minneapolis, 1001 Marquette Ave.,  
Minneapolis, Minnesota, USA

Sat., 8 Oct., 8 a.m.–noon

Wed., 12 Oct., 8 a.m.–noon



Meetings of the GSA Council are open to Fellows, members, and associates of the Society, who may attend as observers, except during executive sessions. Only councilors and officers may speak to agenda items, except by invitation of the chair.

## Attention GeoCorps™ America Alumni and Current Participants!

### GeoCorps Alumni Reception

Hilton, Grand Ballroom A  
Mon., 10 Oct., 5–6:30 p.m.



### GeoCorps™ America Booths

GSA is seeking GeoCorps alumni to volunteer at the GeoCorps booths at the Annual Meeting. See the GeoCorps website, [www.geosociety.org/geocorps/](http://www.geosociety.org/geocorps/), or contact Matt Dawson at [mdawson@geosociety.org](mailto:mdawson@geosociety.org) for details.

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## TAKE YOUR MEETING TO THE NEXT LEVEL WITH WEB 2.0

[www.geosociety.org/meetings/2011/fusion.htm](http://www.geosociety.org/meetings/2011/fusion.htm)

You'll find several ways to get involved in the meeting and network with your peers—before, during, and after your trip—through a variety of Web 2.0/social media innovations. Adding social media to your meeting experience gives you a greater sense of its broader impacts and can also bring the meeting before a wider audience by including geoscientists around the world who aren't able to attend.

### GSA's Meeting Bulletin Board

Here you'll have a chance to contact other meeting attendees and talk about whatever you want, whenever you want. Meet new people, coordinate your schedules, plan activities, or start a science discussion forum. You can even save money by sharing travel and lodging expenses. Information entered to this bulletin board is secure and only accessible by login. Go to [http://rock.geosociety.org/forumstudenttravel/forum\\_topics.asp?FID=36](http://rock.geosociety.org/forumstudenttravel/forum_topics.asp?FID=36) to get started.

### GSA is @geosociety on Twitter

GSA has a community of more than 2,600 followers on Twitter—a global audience that includes geoscientists, academics, students, institutions, agencies, and geoscience companies. Get regular meeting updates by following @geosociety (and GSA's followers!) on Twitter.

#### What is Twitter?

Twitter, originally developed as a short messaging service, much like cell-phone texting, is now considered an essential "microblogging" tool. It helps get your 140-character reports (and links) out to people who *want* this information—people who have elected to "follow" your tweets or search your subject hashtag.

#### What are Hashtags?

Hashtags are words or phrases (without spaces) preceded by the # symbol, which allows them to become searchable, much like keywords or metadata. Typical hashtags used by GSA include #geoscience and #citizenscience. This year's meeting hashtag is #GSAMinn.

#### Join Our Twitter Roll

Tweeting from the meeting? If so, add your Twitter ID to our Twitter Roll at [www.geosociety.org/meetings/2011/fusion.htm](http://www.geosociety.org/meetings/2011/fusion.htm). Tweet with the #GSAMinn hashtag to create a rolling Twitter narrative and stretch the meeting's virtual boundaries.

### Blog Roll

Are you planning to blog about the meeting? Please add your blog to our blog roll at [www.geosociety.org/meetings/2011/fusion.htm](http://www.geosociety.org/meetings/2011/fusion.htm). Your posts will be monitored by GSA newsroom staff and added to our annual meeting news coverage Web page.

### Facebook

GSA's Facebook page has more than 7,350 fans. Look for meeting updates and meeting-related blog posts at [www.facebook.com/pages/Geological-Society-of-America/67821277078](http://www.facebook.com/pages/Geological-Society-of-America/67821277078).



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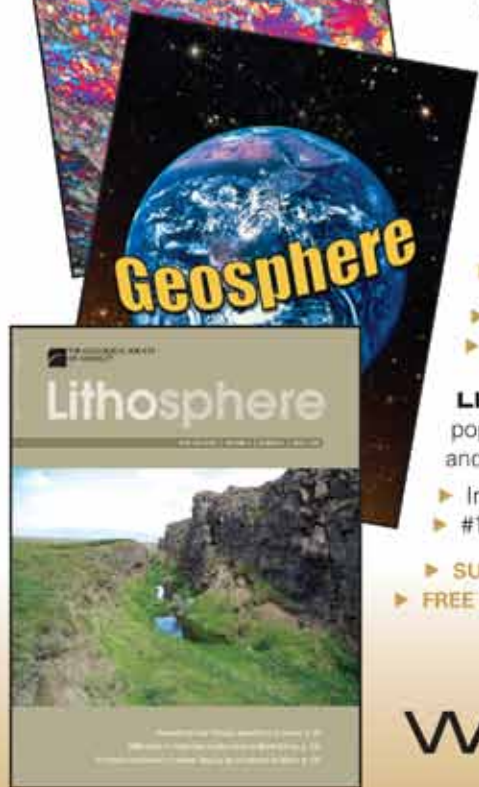
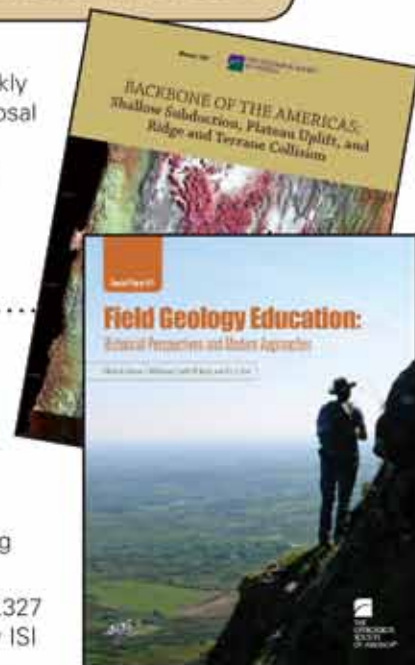
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**We highly recommend** that all speakers visit the speaker ready room for an opportunity to run through their presentations and get comfortable with the equipment. Technicians will be on-hand to offer assistance.

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**Acceptable file types:** PowerPoint (.ppt or .pps), Microsoft Word (.doc), or PDF (.pdf). If your graphics or video clips are not embedded in your presentation, please be sure that you bring them as well.

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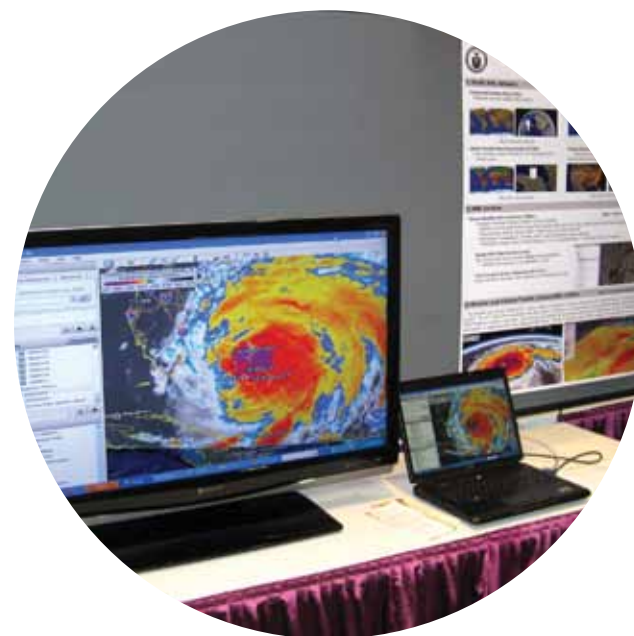
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# GSA Foundation Update

Donna L. Russell, Director of Operations

## Come Visit the GSA Foundation Booth in Minneapolis

If you will be attending the October 2011 GSA Annual Meeting in Minneapolis, Minnesota, USA, please stop by the Foundation Booth in the GSA Headquarters Services area of the Convention Center.

### At the Foundation Booth you will be able to:

- Participate in the Foundation's 12th Silent Auction
- Donate your gold jewelry or coins to our "Gold for Gold" program
- Learn about GSA Programs supported by the Foundation
- Meet the Foundation Trustees and Foundation staff
- Make a donation to your favorite Foundation fund
- Penrose Circle donors (gifts of \$500+) can pick up a "token of appreciation"

As you can see, we have a lot going on in the Foundation Booth and we hope to see you there!

## Support for GSA Programs

Your support of the Foundation's Greatest Needs Fund enables the Foundation to continue to provide the critical support needed for many of GSA's important programs and projects. In the past few years we have used funding from the **Greatest Needs Fund** to support:

- GeoCorps™ America interns
- GSA Public Service Award
- Geology in Industry Mentor Program
- Geology in Government Mentor Program
- GSA's Annual Meeting
- Minority Scholarships
- Outstanding Earth Science Teacher Awards
- Congressional Science Fellow
- Matching Student Travel Grants for the Sections
- Research Grants
- Travel Grants (International & Domestic)

Your contributions to the Greatest Needs Fund will help us to support these programs and many more. Please use the coupon below for your donation, or go to the Foundation's website—[gsafweb.org](http://gsafweb.org)—and make your donation there. Thanks, as always, for your contributions to the Foundation and GSA.



### Most memorable early geologic experience:

Doing geology in the African bush, in the 1960s, and running into large animals with tusks and teeth that caused me to move very fast out of their way, when not dodging African killer bees!

—John F. Schroder



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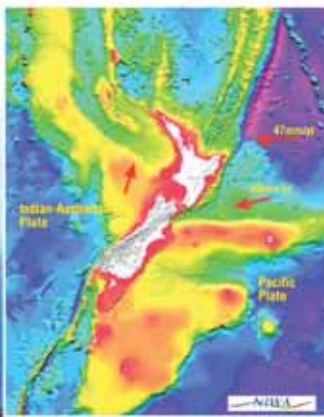


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# GSA Position Statement DRAFT

## SUPPORTING PLANETARY EXPLORATION

**Position Statement:** The Geological Society of America (GSA) supports planetary exploration to advance research concerning the evolution of Earth; to deepen and expand human understanding of our place in the universe; to reinforce science, technology, engineering and math (STEM) education and effective training of the next generation of scientists; to increase U.S. competitiveness in science and technology development; and to enhance the quality of life through technological innovation.

**Purpose:** This position statement (1) summarizes the relevance and benefits of planetary exploration to national and international leadership in science and technology research, development, and education; (2) describes workforce development and the key role that geoscientists play in both historical and future exploration missions through continued civilian exploration programs; and (3) provides recommendations for policy decisions related to the importance of science support for both U.S. and international collaborative space exploration missions to the Moon and to other solar system bodies beyond Earth.

### RATIONALE

Early planetary exploration missions (including the first human explorations on the Moon) were initially designed as demonstrations of technology development and global leadership in space. While science was a tertiary objective, the underlying science was inherently geologic and geophysical in nature. Through 50 years of space exploration, planetary exploration missions have supported a growing population of planetary scientists along with an increasing appeal to students, especially those in geology classes. Over this time, the U.S. and other nations have launched many successful exploration missions to planets, moons, comets, and other objects throughout the solar system, including returning samples of solar wind particles, asteroids, and comets to Earth. Today, planetary missions are designed to collect data to better understand the history and workings of the entire solar system, to gain insight into the formation and evolution of Earth and the other planets, to understand how life began on Earth, and to determine whether extraterrestrial habitable environments and life forms exist (or ever did exist) elsewhere in the solar system or beyond.

To support these missions, planetary scientists engage in both terrestrial field studies and Earth observation to examine geologic features and processes that are common on other planets, such as impact structures, volcanic constructs, tectonic structures, and glacial and fluvial deposits and landforms. Geochemical studies include investigations of extraterrestrial materials now on Earth, including lunar samples, tens of thousands of meteorites, cosmic dust particles, and, most recently, particles returned from comets and asteroids. It is clear that planetary exploration has successfully stimulated research across diverse geoscience topics and disciplines.

While most of the U.S. electorate know of and take pride in space program accomplishments, few reflect on or know about the fundamental scientific research conducted during exploration and the importance of geoscientists in determining new

knowledge that bears directly on our understanding of the Earth's formation as well as that of other objects throughout the solar system. It is a natural extension of the basic goals of GSA to expand geosystems knowledge to encompass our solar system as well as the many planets now being discovered around other stars.

### PUBLIC POLICY ASPECTS

Exploration of other planets in the solar system requires major national and international initiatives, significant funding levels, and long timelines for mission planning and collaborative research. For scientists, the funding cycle is much shorter than typical mission cycles, and in particular, graduate student and career-development timelines are much shorter than mission timeframes. Therefore, the growth and continued development of a robust workforce capable of conducting complex space missions and analyzing the scientific data returned from such missions does not depend on individual missions as much as it depends upon a consistent, sustained program that educates and develops planetary scientists. Public expenditures and investments are often controversial, yet planetary exploration has a proven record of benefits that include stimulation of the general economy through public and corporate investment, educational investment in STEM, and technology spin-offs to industry.

The GSA membership includes many geoscientists who count planetary science studies as part of their research portfolio or who have entered the geosciences because of inspiration from the Apollo missions and spacecraft exploration of other planets. The involvement of GSA members in planetary exploration supports collaborative research and stewardship of extraterrestrial bodies like the Moon, the planets and their satellites, near-Earth objects, and other small bodies throughout the solar system. With the realization that planetary exploration requires significant levels of government funding, GSA should support planetary exploration through informed advocacy in focused, responsible, and collaborative ways.

### RECOMMENDATIONS

The Geological Society of America recommends the following:

- Informed public advocacy of continued government investment in planetary exploration missions. Support for planetary studies, of necessity, requires large expenditures at local, state, national, and international levels.
- Increased interactions between the geoscience community and all elected government officials and lawmakers, managers, and scientists at all space agencies (e.g., NASA, ESA, etc.), as well as higher education institutions (especially those with planetary sciences in their curricula), space grant consortia, K–12 educators, and, most importantly, the general public. Planetary exploration and research require scientific literacy, intellectual support, and thoughtful dialogs with policy makers.

- Expansion of public programs that utilize space exploration results to maintain science and technology growth. Most of the world populace does not appreciate how planetary exploration has stimulated advances in numerous fields of study and supported the development of new technologies and economic growth across a broad portfolio (e.g., imaging systems, geographic information systems, new materials).
- Expansion of education programs using examples and results from planetary missions. The integration of all basic sciences (i.e., chemistry, physics) into planetary research endeavors is essential to the scientific literacy of the populace, and a major emphasis should be placed on engaging the STEM student population.

### OPPORTUNITIES FOR GSA AND GSA MEMBERS TO HELP IMPLEMENT RECOMMENDATIONS

To facilitate implementations of the goals of the position statement, The Geological Society of America recommends that its members take the following actions:

- *Become informed about opportunities to meet with elected officials at all levels; tell them about the importance of sustained support by space-faring nations for exploration missions and the analysis of scientific data obtained from planetary exploration efforts.* Elected government officials need to hear from their constituents that continued support is essential for the maintenance of a healthy planetary exploration program with specific information regarding planetary exploration initiatives. Highlight the broad scientific value derived from planetary exploration, and emphasize the need for consistent funding levels to sustain long-term exploration efforts. Letters, phone calls, and emails to representatives make a difference, particularly when they come from constituencies not in proximity to a major space facility.
- *Encourage all scientists to take more active roles in various governmental agencies and in interactions with Congress.* Not every GSA member can be a congressional liaison, but everyone can take an active role in participating in various governmental efforts at local, state, and federal levels. In particular, planetary scientists should get involved in whatever aspect of government might interest you, and watch for any opportunity to highlight the broad scientific value derived from planetary exploration.
- *Look for any opportunity to share the results of planetary exploration.* The GSA community represents a very special intellectual medium through which the science knowledge of all people can be expanded. GSA members can play a pivotal role in communicating both the scientific and educational benefits derived from space exploration missions to the worldwide populace, including to elected officials. Members are encouraged to take advantage of all venues of communication regarding what has been learned during five decades of planetary exploration. Both in the classroom and in public forums, GSA members can be proactive in emphasizing how results from planetary exploration have contributed to science in general and the geosciences in particular and

how this exploration has provided exciting new media for education. GSA members should consider including planetary exploration subjects in their public lectures, in talks given to K–12 school classrooms, as well as within undergraduate or graduate level science courses, particularly any subject related to the geosciences.

- *Be prepared to explain how technological spinoffs derived from planetary exploration are a part of modern life.* For example, spacecraft camera design has stimulated many developments in charge coupled devices (CCDs), the basis for practically every modern imaging device, whether used in a pocket camera, a smart phone, or security systems. The scientific and technological advancement of a nation is often greatly benefited by developments used to support various aspects of planetary exploration.

### POSITION STATEMENT PANEL MEMBERS

**James Zimelman, Chair**, Smithsonian Institution  
 Philippe Claeys, Vrije Universiteit Brussel  
 Cynthia Evans, NASA Johnson Space Center  
 Jack Farmer, Arizona State University  
 Herbert Frey, NASA Goddard Space Flight Center  
 Lawrence Taylor, University of Tennessee, Knoxville

### REFERENCES AND RESOURCES

- **National Aeronautics and Space Administration**, [www.nasa.gov](http://www.nasa.gov). For information specific to planetary exploration, see either [www.nasa.gov/topics/moonmars/index.html](http://www.nasa.gov/topics/moonmars/index.html), or [www.nasa.gov/topics/solarsystem/index.html](http://www.nasa.gov/topics/solarsystem/index.html).
- **European Space Agency**, [www.esa.int/esaCP/](http://www.esa.int/esaCP/).
- **Planetary Science Decadal Survey**, [http://sites.nationalacademies.org/SSB/CurrentProjects/ssb\\_052412](http://sites.nationalacademies.org/SSB/CurrentProjects/ssb_052412). Results of a recent survey of planetary scientists for plans for the next ten years.
- **NASA Planetary Photojournal**, <http://photojournal.jpl.nasa.gov/index.html>. Site to access images and explanatory text for publicly released planetary data.
- **Chronology of Lunar and Planetary Exploration**, <http://nssdc.gsfc.nasa.gov/planetary/chrono.html>.
- **NASA Spinoffs**: [www.sti.nasa.gov/tto/](http://www.sti.nasa.gov/tto/) or [www.thespaceplace.com/nasa/spinoffs.html](http://www.thespaceplace.com/nasa/spinoffs.html).

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# NORTHEASTERN

47th Annual Meeting of the Northeastern  
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Hartford, Connecticut, USA

18–20 March 2012



The skyline of Hartford, Connecticut, USA, as seen from across the Connecticut River. Author I. Elipongo. This is a file from the Wikimedia Commons.

## *200 Years of Geology in the Northeast*

### LOCATION

Hartford is one of the oldest cities in the United States and is in the final stages of a development project that has revitalized the downtown and renewed the city's connection to the Connecticut River. The city is built on Mesozoic rocks of the Hartford rift basin and is a short drive from Long Island Sound, metamorphic rocks of the eastern and western uplands, and sediments of Glacial Lake Hitchcock. The meeting will be held at the Hartford Marriott Downtown, which opened in 2005 and is in walking distance of parks along the Connecticut River, the Connecticut Science Center, the Wadsworth Atheneum Museum of Art, and a wide range of restaurants and eateries.

### CALL FOR PAPERS

**Abstract deadline:** 13 December 2011

Please submit your abstract online at [www.geosociety.org/sections/ne/2012mtg/](http://www.geosociety.org/sections/ne/2012mtg/). An abstract submission fee of US\$10 for students and US\$15 for all others will be charged. If you cannot submit an abstract online, please contact Linda Battan, +1-303-357-1018, lbattan@geosociety.org. Symposia and Theme Sessions are listed below; we also welcome abstract submission to discipline sessions.

### Symposia

1. **Modern and Ancient Orogenic Belts.** Tim Byrne, Univ. of Connecticut, tim.byrne@uconn.edu; Yu-Chang Chan, Academia Sinica, yuchang@earth.sinica.edu.tw; Clark Burchfiel, Massachusetts Institute of Technology, bcburch@mit.edu.
2. **New Advances in the Stratigraphic Record and Chronology of Pleistocene Glacial/Interglacial Events in the Southeastern Laurentide Ice Sheet Region.** Byron D. Stone, U.S. Geological Survey, bdstone@usgs.gov; Janet R. Stone, U.S. Geological Survey, jrstone@usgs.gov.
3. **The CAMP Province: Compositional Variation, Sources, and Environmental Effects.** Johan (Joop) C. Varekamp, Wesleyan Univ., jvarekamp@wesleyan.edu; Anthony R. Philpotts, Univ. of Connecticut, philpotts@charter.net; Paul E. Olsen, Columbia Univ., polsen@ldeo.columbia.edu.

### Theme Sessions

1. **Future Directions in Appalachian Tectonics: Building on Recent Lithotectonic Syntheses.** Sandra M. Barr, Acadia Univ., sandra.barr@acadiau.ca; James P. Hibbard, North Carolina State Univ., jim\_hibbard@ncsu.edu; Margaret D. Thompson, Wellesley College, mthompson@wellesley.edu.
2. **High-Strain Zone Kinematics, From the Microscopic to the Macroscopic Scale.** Yvette Kuiper, Colorado School of Mines, ykuiper@mines.edu; Scott Giorgis, SUNY Geneseo, giorgis@geneseo.edu.
3. **Modeling Deformation from the Micro to the Macro.** Phil Resor, Wesleyan Univ., presor@wesleyan.edu; Michele Cooke, Univ. of Massachusetts, Amherst, cooke@geo.umass.edu.
4. **The Legacy of Humans and Glaciation in Northeastern Rivers.** Will Ouimet, Univ. of Connecticut, william.ouimet@uconn.edu; Denise Burchsted, Univ. of Connecticut, denise.burchsted@uconn.edu; Jon Woodruff, Univ. of Massachusetts, woodruff@geo.umass.edu.
5. **Using Ground-Penetrating Radar to Analyze Geomorphic and Sedimentary Records of Environmental Change.** James A. Hyatt, Eastern Connecticut State Univ., hyattj@easternct.edu; Peter A. Drzewiecki, Eastern Connecticut State Univ., drzewieckip@easternct.edu.
6. **State and Fate of Urban Watersheds in the Northeast.** Jonathan R. Gourley, Trinity College, jonathan.gourley@trincoll.edu; Suzanne O'Connell, Wesleyan Univ., soconnell@wesleyan.edu.
7. **Environmental Impact of Historical Landfills.** Rudolph Hon, Boston College, hon@bc.edu; William C. Brandon, USEPA, brandon.bill@epa.gov; Marcel Belaval, USEPA, belaval.marcel@epamail.epa.gov.
8. **Human Impacts on Estuaries.** Vincent T. Breslin, Southern Connecticut State Univ., breslinv1@southernct.edu.



- .edu; Johan (Joop) C. Varekamp, Wesleyan Univ., jvarekamp@wesleyan.edu.
9. **Mercury Dynamics in Northeastern North America.** Johan (Joop) C. Varekamp, Wesleyan Univ., jvarekamp@wesleyan.edu; Robert Mason, Univ. of Connecticut, robert.mason@uconn.edu.
  10. **Can the Fractured Bedrock Water Resource be Sustained Given Trends in Rural Development?** Gary Robbins, Univ. of Connecticut, gary.robbs@uconn.edu.
  11. **News from the Newark Supergroup.** *Cosponsored by the Eastern Section SEPM (Society for Sedimentary Geology).* Elizabeth Gierlowski-Kordesch, Ohio Univ., gierlows@ohio.edu.
  12. **Where It All Began: Trace Fossil Research in Northeastern North America.** *Cosponsored by the Eastern Section SEPM (Society for Sedimentary Geology).* Patrick R. Getty, Univ. of Connecticut, patrick.getty@uconn.edu; Jacob S. Brenner, Tufts Univ., jacob.benner@tufts.edu.
  13. **Microbial Mats and Microbialites: From Ancient to Modern.** *Cosponsored by the Eastern Section SEPM (Society for Sedimentary Geology).* Kristen L. Myshrall, Univ. of Connecticut, kristen.myshrall@uconn.edu; Natalie J. Stork, Univ. of Connecticut, natalie.stork@uconn.edu.
  14. **Mineralogy in Health Sciences: Sources to Applications.** Catherine Skinner, Yale Univ., catherine.skinner@yale.edu; John A. Smoliga, Boehringer Ingelheim Pharmaceuticals, Inc., john.smoliga@boehringer-ingelheim.com.
  15. **Historical Perspectives: 250 Years of Geology in the Northeast.** William R. Brice, Univ. of Pittsburgh, wbrice@pitt.edu; Sally Newcomb, senewcomb@earthlink.net.
  16. **Women in the Geosciences: Past, Present, and Future.** *Cosponsored by the Association for Women Geoscientists (AWG).* Kristine Larsen, Central Connecticut State Univ., larsen@ccsu.edu; Heidi Hoffower, Chevron Corp., hoffowerhl@gmail.com.
  17. **Inquiry-Based Activities: Examples and Effectiveness.** *Cosponsored by the National Association of Geoscience Teachers (NAGT).* Karen Kortz, Community College of Rhode Island, kkortz@ccri.edu; Ann Hadley, Manchester Community College, ahadley@mcc.commnet.edu.
  18. **Technology Integration in K–16 Geoscience Education.** *Cosponsored by the National Association of Geoscience Teachers (NAGT).* Christine Witkowski, Middlesex Community College, cwitkowski@mxcc.commnet.edu; Dawn Cardace, Univ. of Rhode Island, cardace@uri.edu.
  19. **Presenting Geoscience Digitally: For the Classroom, Workplace, and/or Outreach.** Stephen A. Nathan, Univ. of Massachusetts, snathan@geo.umass.edu; Chris Condit, Univ. of Massachusetts, ccondit@geo.umass.edu.
  20. **Geologic Hazards and Climate Change in the Northeast: Impacts and Opportunities.** *Cosponsored by the Eastern Section SEPM (Society for Sedimentary Geology).* Nicholas K. Coch, CUNY Queens College, coch@earthlink.net; Laurence R. Becker, Vermont Geological Survey, laurence.becker@state.vt.us.
  21. **Energy Geoscience and Climate Change Issues in the Northeast.** Fred Loxsom, Eastern Connecticut State Univ., loxsofmf@easternct.edu; Stephen A. Nathan, Univ. of Massachusetts, snathan@geo.umass.edu.
  22. **Geothermal Potential in the Northeast: A Quixotic Quest or Reality?** J. Michael Rhodes, Univ. of Massachusetts, jmrhodes@geo.umass.edu; Stephen B. Mabee, Univ. of Massachusetts, sbmabee@geo.umass.edu.
  23. **Seeing through the Haze: Remote Sensing, Geophysical Investigations, and Neotectonics in Northeastern North America.** Robert J. Altamura, consulting geologist, raltamura@comcast.net; John E. Ebel, Boston College, john.ebel@bc.edu.

#### PLENARY SESSION

**Discussion on Careers in Geoscience.** Kevin M. Bohacs, ExxonMobil Upstream Research Co.; Nathan W. Hagelin, AMEC Environment & Infrastructure; John G. Nevius, Anderson Kill & Olick P.C.

#### FIELD TRIPS

1. **Were Early Jurassic Dinosaurs Gregarious? Reexamining the Evidence from Dinosaur Footprint Reservation in Holyoke, Massachusetts.** Patrick R. Getty, Univ. of Connecticut, patrick.getty@uconn.edu; Aaron I. Judge, Univ. of Massachusetts, judge@ecs.umass.edu; Jayme Csonka, Univ. of Connecticut, jayme.csonka@uconn.edu; Andrew Bush, Univ. of Connecticut, andrew.bush@uconn.edu.
2. **In the Footsteps of Dinosaurs: A Guided Tour of Dinosaur State Park for K–16 Educators.** *Cosponsored by the National Association of Geoscience Teachers (NAGT).* Christine Witkowski, Middlesex Community College, cwitkowski@mxcc.commnet.edu; Margaret Enkler, Dinosaur State Park, margaret.enkler@ct.gov; Karen Kortz, Community College of Rhode Island, kkortz@ccri.edu.
3. **The Hartford Basin from the Hanging Hills to the Sound.** Brian Skinner, Yale Univ., brian.skinner@yale.edu; Leo Hickey, Yale Univ., leo.hickey@yale.edu; Anthony R. Philpotts, Univ. of Connecticut, philpotts@charter.net; Jay Ague, Yale Univ., jay.ague@yale.edu.
4. **Tying the Tales of Two Basins: Relation of Temperature-Time Paths in the Bronson Hill Terrane to the Narragansett and Hartford Basins.** Robert P. Wintsch, Indiana Univ., wintsch@indiana.edu; Mary K. Roden-Tice, SUNY Plattsburgh, mary.rodentice@plattsburgh.edu; Michael J. Kunk, U.S. Geological Survey, mkunk@usgs.gov; John N. Aleinikoff, U.S. Geological Survey, jaleinikoff@usgs.gov.
5. **Unraveling Alleghanian Orogenesis in Southern Connecticut: The History of the Lyme Dome.** Gregory J. Walsh, U.S. Geological Survey, gwalsch@usgs.gov; John N. Aleinikoff, U.S. Geological Survey, jaleinikoff@usgs.gov; Robert P. Wintsch, Indiana Univ., wintsch@indiana.edu.

6. **The Geology of Walden Pond.** Robert Thorson, Univ. of Connecticut, robert.thorson@uconn.edu.

## WORKSHOPS

1. **Ancient Lake and River Environments: A Core and Field Workshop on the Jurassic Portland Formation.** Peter A. Drzewiecki, Eastern Connecticut State Univ., drzewiecki@easternct.edu; Elizabeth H. Gierlowski-Kordesch, Ohio Univ., gierlows@ohio.edu; Randolph P. Steinen, Connecticut Geological Survey, randolph.steinen@ct.gov; David Finkelstein, Univ. of Massachusetts, dfink@geo.umass.edu.
2. **Misconceptions in Introductory Geology Courses and Ways to Reduce Them with Active Learning Techniques.** *Cosponsored by the National Association of Geoscience Teachers (NAGT).* Karen Kortz, Community College of Rhode Island, kkortz@ccri.edu.
3. **Teaching about Energy in Geoscience Courses.** Fred Loxsom, Eastern Connecticut State Univ., loxsofmf@easternct.edu.

## REGISTRATION

**Early registration deadline:** 13 February 2012

**Cancellation deadline:** 21 February 2012

Registration opens in December 2011. For further information or if you need special accommodations, please contact the general chair, Jean Crespi, at jean.crespi@uconn.edu.

## ACCOMMODATIONS

**Hotel registration deadline:** 24 February 2012

A block of rooms has been reserved at the Hartford Marriott Downtown, 200 Columbus Blvd., Hartford, CT 06103, USA. The meeting rate is US\$129 per night plus tax and includes wireless Internet access. Reservations should be made electronically at [https://resweb.passkey.com/Resweb.do?mode=welcome\\_ei\\_new&eventID=3421743](https://resweb.passkey.com/Resweb.do?mode=welcome_ei_new&eventID=3421743). Alternatively, you may call the Marriott at +1-800-266-9432 (toll free) or +1-506-474-2009 (local). The reservation website and phone numbers are dedicated to the meeting. *Please do not use the hotel website or direct phone number to make reservations.*



[www.goesociety.org/Sections/ne/2012mtg/](http://www.goesociety.org/Sections/ne/2012mtg/)

# 2012



### SOUTH-CENTRAL

**7-9 March 2012**

Alpine, Texas, USA

Local Committee Chair: Kevin Urbanczyk

Abstracts deadline: 6 Dec. 2011

Early reg. deadline: 6 Feb. 2012

### NORTHEASTERN

**18-20 March 2012**

Hartford, Connecticut, USA

Local Committee Chair: Jean Crespi

Abstracts deadline: 13 Dec. 2011

Early reg. deadline: 13 Feb. 2012

### CORDILLERAN

**29-31 March 2012**

Querétaro, Mexico

Local Committee Chair: Luca Ferrari

Abstracts deadline: 10 Jan. 2012

Early reg. deadline: 27 Feb. 2012

### SOUTHEASTERN

**1-2 April 2012**

Asheville, North Carolina, USA

Local Committee Co-Chairs: Blair Tormey;

Cheryl Waters-Tormey

Abstracts deadline: 17 Jan. 2012

Early reg. deadline: 27 Feb. 2012

### NORTH-CENTRAL

**22-24 April 2012**

Dayton, Ohio, USA

Local Committee Co-Chairs: Charles

Ciampaglio; David Miller

Abstracts deadline: 24 Jan. 2012

Early reg. deadline: 19 Mar. 2012

### ROCKY MOUNTAIN


**9-11 May 2012**

Albuquerque, New Mexico, USA

Local Committee Chair: Laura Crossey

Abstracts deadline: 14 Feb. 2012

Early reg. deadline: 2 Apr. 2012



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## GSA Section Meeting Schedule

## Classified Rates—2011

Ads (or cancellations) must reach the GSA advertising office no later than the first of the month, one month prior to the issue in which they are to be published. Contact [advertising@geosociety.org](mailto:advertising@geosociety.org), +1.800.472.1988 ext. 1053, or +1.303.357.1053. All correspondence must include complete contact information, including e-mail and mailing addresses. To estimate cost, count 54 characters per line, including punctuation and spaces. Actual cost may differ if you use capitals, bold-face type, or special characters. Rates are in U.S. dollars.

Classification	Per Line for 1st month	Per line each add'l month (same ad)
Positions Open	\$8.90	\$8.65
Fellowship Opportunities	\$8.90	\$8.65
Opportunities for Students		
First 25 lines	\$0.00	\$4.50
Additional lines	\$4.50	\$4.50

## Positions Open

### TENURE-TRACK APPLIED GEOPHYSICIST DEPT. OF GEOLOGY, BAYLOR UNIVERSITY

The Dept. of Geology at Baylor University invites applications for a tenure-track Assistant Professor in Applied Geophysics, beginning August 2012. Applicants must hold a Ph.D. in geophysics, physics, or geology with an emphasis in geophysics at the time of appointment. The department currently consists of 15 geoscientists ([www.baylor.edu/Geology/](http://www.baylor.edu/Geology/)).

Preference will be given to a candidate with a strong background in quantitative sciences whose research interests complement those of existing geophysical strengths in our department. Current strengths include earthquake seismology, potential field methods, geodynamics, and petroleum geology. Research involving processing and interpretation of seismic reflection data, and integrated interpretation with other geophysical and geological data, is desirable, although other research areas in applied geophysics would be considered. The successful candidate should have the potential to attract external funds and to build a strong research program involving graduate students. Research space is available in the state-of-the-art, 500,000-square-foot Baylor Sciences Building.

The successful candidate should have the potential to build a vibrant teaching program involving graduate students, as well as teach undergraduate courses in geophysics and/or petroleum geology.

**Application Process:** Send letter of application, including statement of teaching and research interests, curriculum vitae, copies of transcripts, and the names and contact information for three references to: Dr. Jay Pulliam, Chair, Search Committee, Dept. of Geology, Baylor University, One Bear Place #97354, Waco, TX 76798-7354 (Tel: 254-710-2361; e-mail: [Jay.Pulliam@baylor.edu](mailto:Jay.Pulliam@baylor.edu)). The review of applications will begin 15 Dec. 2011 and will be accepted until the position is filled. To ensure full consideration, application must be completed by 15 Jan. 2012. Baylor is a Baptist university affiliated with the Baptist General Convention of Texas. As an Affirmative Action/Equal Opportunity employer, Baylor encourages minorities, women, veterans and persons with disabilities to apply.

### TENURE-TRACK MINERALOGIST/PETROLOGIST DEPT. OF GEOLOGY, BAYLOR UNIVERSITY

The Dept. of Geology at Baylor University invites applications for a tenure-track Assistant Professor in Mineralogy or Petrology, beginning August of 2012. Applicants must hold a Ph.D. in geology at the time of appointment. The department currently consists of 16 geoscientists ([www.baylor.edu/Geology/](http://www.baylor.edu/Geology/)).

**Research:** We seek an individual with research interests in mineralogy, igneous or metamorphic petrology or high-temperature geochemistry who is capable of building a strong, externally funded research program. Research space is available in the 500,000-square-foot, state-of-the-art Baylor Sciences Building. Research equipment currently available includes a Siemens D5000 X-ray diffractometer, a Rigaku Primus wavelength-dispersive X-ray fluorescence spectrometer, a Thermo Finnigan Delta V IRMS and sample preparation facilities, including a strong-acid-rated fume hood and high-temperature furnace. A shared ICP-MS instrument is also available, as well as a SEM, TEM, and confocal microscopy in a shared lab facility.

**Teaching:** We seek an individual with a strong commitment to excellence in teaching, and require that he/she contribute significantly to the undergraduate program, by teaching undergraduate mineralogy and petrology courses, as well as contributing to the graduate (M.S. and Ph.D.) programs in Geology by teaching graduate courses or seminars in his/her areas of specialization.

**Application Process:** Send letter of application, including statement of teaching and research interests, curriculum vitae, copies of transcripts, and the names and contact information for three references to: Dr. Steve Dworkin, Chair, Search Committee, Dept. of Geology, Baylor University, One Bear Place #97354, Waco, TX 76798-7354 (Tel: 254-710-2361; e-mail: [Steve.Dworkin@baylor.edu](mailto:Steve.Dworkin@baylor.edu)). The review of applications will begin 15 Dec. 2011. To ensure full consideration, application must be completed by 1 Jan. 2012. Baylor is a Baptist university affiliated with the Baptist General Convention of Texas. As an Affirmative Action/Equal Opportunity employer, Baylor encourages minorities, women, veterans and persons with disabilities to apply.


### GEOSCIENCE ASSISTANT SCIENCE EDUCATION RESOURCE CENTER CARLETON COLLEGE

The Science Education Resource Center (SERC) welcomes applications for a Geoscience Assistant. SERC works to improve education through projects that support educators with an emphasis on the geosciences. The office has special expertise in effective pedagogies, geoscience education, community organization, workshop leadership, digital libraries, website development and program and website evaluation. The Geoscience Assistant works as a member of the SERC webteam to develop new and improve existing websites, to support professional development workshops, and to maintain the SERC collections. The successful candidate must possess a master's degree in geoscience or a closely related field as well as the ability to create well designed web pages and working with

groups of workshop participants during one-on-one virtual interactions and in large group face-to-face settings. For additional job requirements and qualifications, and to apply online, please visit <http://jobs.carleton.edu>. Carleton College is an equal opportunity employer committed to excellence through diversity.

### VISITING ASSISTANT PROFESSOR IN GEOLOGY PALEONTOLOGY/SOFT-ROCK GEOLOGY COLBY COLLEGE

The Dept. of Geology invites applications for a one-year, non-tenure track, Visiting Assistant Professor in paleontology and soft-rock geology beginning 1 Sept. 2012. The successful applicant will be expected to teach a core-curriculum Paleontology course (200-level: Record of Life) with laboratory and an upper division course of his/her choice for geology majors during the academic year. The upper division course should complement those already offered in the department. The remainder of the teaching assignment will be an introductory course offering (100-level) for potential majors and non-majors. Additionally, the candidate may have the opportunity to direct one or more independent research projects. Colby is a highly selective liberal arts college recognized for excellence in undergraduate education and for close student-faculty interaction. Ph.D. with teaching experience at time of employment preferred; ABDs encouraged to apply. Applicants should submit a letter of application, curriculum vitae, statements of teaching and research interests, and three letters of reference to Dr. Robert A. Gastaldo, Chair, Dept. of Geology, 5807 Mayflower Hill Drive, Waterville, ME 04901. Review of applications will begin on 14 Nov. 2011 and will continue until the position is filled. Colby is an Equal Opportunity/Affirmative Action employer, committed to excellence through diversity, and strongly encourages applications and nominations of persons of color, women, and members of other under-represented groups. For more information about the College, please visit the Colby Web site: [www.colby.edu](http://www.colby.edu).



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OF  
GEOLOGY**

**Hydrogeology, Geomorphology  
or Environmental Geology  
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The Department of Earth Sciences at the State University of New York at Oswego invites applications for a tenure-track Assistant Professor with emphasis in Hydrogeology, Geomorphology or Environmental Geology. We are searching for a broadly trained field-oriented geologist who can promote students' ability to succeed in a multicultural and global community.

Review of applications will begin September 15, and will continue until the position is filled.

For complete information about the position and application procedures, visit our website at  
[www.oswego.edu/vacancies](http://www.oswego.edu/vacancies)

*SUNY Oswego is an Affirmative Action Employer*

**ENVIRONMENTAL GEOBIOLOGY  
KANSAS STATE UNIVERSITY**

The Dept. of Geology at Kansas State University invites applications for a tenure-track assistant professorship for the fall of 2012, in the field of Environmental Geobiology. For details of this advertisement, please visit our website at [www.ksu.edu/geology](http://www.ksu.edu/geology). Questions about this position may be directed to Dr. Saugata Datta at [sdatta@ksu.edu](mailto:sdatta@ksu.edu), or (785)532-2241. Kansas State University is an equal opportunity/affirmative action employer and actively seeks diversity among its employees. A successful pre-employment background check is required before a job is offered.

**EARTH SYSTEMS SCIENTIST  
STRUCTURAL GEOLOGY/TECTONICS  
TENURE-TRACK POSITION, DEPT. OF EARTH &  
ENVIRONMENTAL SCIENCES, BOSTON COLLEGE**

The Dept. of Earth and Environmental Sciences at Boston College invites applications for a tenure-track position in the area of Structural Geology/Tectonics to start in Fall 2012. The successful candidate will be expected to develop an externally-funded research program integrated with excellence in teaching within the geological sciences and environmental geoscience curriculum at both the undergraduate and graduate levels. Teaching responsibilities include courses in structural and field geology as well as others in the candidate's area of expertise. Specific research subfields of the successful applicant could include crustal dynamics, thermochronology, tectonic history of orogenic belts, tectonic-climate interactions, paleoseismology, and/or active deformation/geodesy. The department is equipped with a mineral separation laboratory including Wilfley table, heavy liquids separation lab, Franz magnetic separator, and stereomicroscope. Other labs in the department include state-of-the-art petrographic microscopes, a laser Raman micro-spectroscopic imaging system, and an isotope ratio mass spectrometer for light stable isotope analyses. Information on the department, its faculty and research strengths can be viewed at [www.bc.edu/eesciences](http://www.bc.edu/eesciences). Applicants should send a curriculum vita, statements of teaching and research interests, and the names and contact information of at least three references as a single PDF-file-mail attachment to [tectonics-position@bc.edu](mailto:tectonics-position@bc.edu). Review of applications will begin on 28 Oct. 2011. Department faculty will be available at the GSA and AGU fall meetings to meet with applicants. Boston College is an academic community whose doors are open to all students and employees without regard to race, religion, age, sex, marital or parental status, national origin, veteran status, or handicap.

**DEVON ENERGY CORPORATION  
CHAIR OF BASIN RESEARCH  
OKLAHOMA STATE UNIVERSITY**

The Boone Pickens School of Geology at Oklahoma State University (OSU) is extending its search for the endowed Devon Energy Corporation Chair of Basin Research. This Chair will be filled at the level of Professor, will carry tenure in the School of Geology, and will be filled by Jan. or Aug. 2012. Applicants must have a Ph.D. degree in geology or related field and have an outstanding record of research, commensurate with the rank of tenured full professor and a demonstrated record of funding. The specific field of study is open but special consideration will be given to geoscientists with interests in one or more of the following research areas: reservoir characterization and modeling, unconventional petroleum reservoirs, depositional and/or diagenetic systems, geochemistry of petroleum systems, and/or origin and migration of basinal fluids. Preference will be given to candidates with a close working relationship with the petroleum industry. The applicant must be committed to excellence in teaching both undergraduate and graduate students, will be expected to supervise M.S.- and Ph.D.-level graduate students and develop courses in his/her specialty.

The successful candidate will join a faculty of twelve geoscientists and will take a leadership role as part of campus and industry research groups in a department that has close ties to the petroleum industry. The school's teaching and research facilities include state-of-the-art geophysical field and laboratory equipment and software, the Devon Visualization Laboratory, and a wide range of petrographic and geochemical instrumentation. The School also maintains a field camp in Cañon City, Colorado.

Candidates should submit a letter of application, including (1) a discussion of research interests, (2) approach to teaching, (3) curriculum vitae, and (4)

the names, addresses, e-mail addresses, and phone numbers of three references to Devon Chair Search, Boone Pickens School of Geology, 105 Noble Research Center, Oklahoma State University, Stillwater, Oklahoma 74078-3031, Phone: (405) 744-6358, Fax: (405) 744-7841. Screening of candidates will begin 17 Oct. 2011 and continue until the position is filled.

More information on OSU and the Boone Pickens School of Geology can be found on the web <http://osu.okstate.edu> and <http://geology.okstate.edu> respectively. Inquiries about this position may be directed to Dr. Todd Halihan ([todd.halihan@okstate.edu](mailto:todd.halihan@okstate.edu)) or Dr. Jay Gregg ([jay.gregg@okstate.edu](mailto:jay.gregg@okstate.edu)). Committed to health and safety, Oklahoma State University maintains a tobacco-free work environment. Oklahoma State University is an Affirmative Action/Equal Opportunity/E-Verify employer committed to diversity.

**Opportunities for Students**

The Consortium for Ocean Leadership together with the Integrated Ocean Drilling Program-U.S. Implementing Organization (IODP-USIO) is currently accepting applications for the Diversity Internship. The IODP-USIO Diversity Internship beginning in Jan. 2012 will have an Engineering focus and will take place at the Consortium for Ocean Leadership in Washington, D.C. The selected Intern will work closely for 12-weeks with a mentor from the IODP-USIO's Technical group to (1) develop the tools needed to quickly and accurately reduce large data sets acquired onboard the IODP U.S. scientific research vessel, *JOIDES Resolution*, and (2) prepare the data for analysis and/or interpretation. The data processing products generated by the intern as well as the project results will be documented in a comprehensive report and/or a publication.

For full details about the Internship, visit [www.oceanleadership.org/education/diversity/iodp-usio-diversity-internship/](http://www.oceanleadership.org/education/diversity/iodp-usio-diversity-internship/), or contact Margo Morell, Assistant Director, Ocean Drilling Programs at [mmorell@oceanleadership.org](mailto:mmorell@oceanleadership.org). The deadline to apply is **21 Oct. 2011**.

**Fellowship Opportunities****W.O. CROSBY POSTDOCTORAL FELLOWSHIP  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY**

The Dept. of Earth, Atmospheric and Planetary Sciences at the Massachusetts Institute of Technology (MIT) invites applications for the W.O. Crosby Postdoctoral Fellowship. We seek exceptional scientists with research interests in geology, geochemistry, or geobiology. Crosby Fellows pursue independent research, but are encouraged to collaborate with one or more researchers in the department. A faculty mentor will be assigned to host the fellow and provide intellectual guidance. Prospective fellows are encouraged to contact members of the department to discuss possible collaborations.

The fellowship appointment will be for one year, renewable for a second year, and includes an annual salary of \$60,000, a research and relocation allowance of up to \$10,000 over two years, and benefits.

Applications and three letters of reference are due by 6 Jan. 2012, with an anticipated start date between 2 June 2012 and 31 Jan. 2013.

Applicants must have obtained a Ph.D. by the start date of the fellowship, but not more than three years before the start date.

Applications and reference letters should be sent separately by email to [wocrosby@mit.edu](mailto:wocrosby@mit.edu). The application should be submitted as a single PDF file containing a CV, a list of publications, a two-page plan of research to be conducted during the fellowship, and the names, telephone numbers and email addresses of reference letter writers.

We especially encourage applications from women and underrepresented minorities.

**PETROLEUM GEOSCIENTIST**

Kansas Geological Survey, University of Kansas, Energy Research Section

Research Associate to academic rank of Senior Scientist, depending on qualifications. Full-time position to conduct advanced research and disseminate information about Kansas energy resources. Requires advanced degree in geosciences, demonstrated ability or potential to develop/implement a research program and address technical challenges related to the energy industry, and record of, or potential for, high-quality written and oral presentations, including peer-reviewed publications. Prefer terminal degree in the geosciences and background with an emphasis on petroleum. Successful candidate without terminal degree can have opportunity to pursue doctorate at U. of Kansas. Possible academic appointment in appropriate department at the U. of Kansas for either position. Women and minority candidates are especially encouraged to apply. Full announcement and application instructions at <http://www.kgs.ku.edu/General/jobs.html>, includes link to recruitment site, <https://jobs.ku.edu>. Review begins October 17, 2011, and continues until filled. Annette Delaney, HR, [hr@kgs.ku.edu](mailto:hr@kgs.ku.edu), (785) 864-2152 or K. David Newell for technical inquiries, [dnewell@kgs.ku.edu](mailto:dnewell@kgs.ku.edu). KU is an EO/AA employer.

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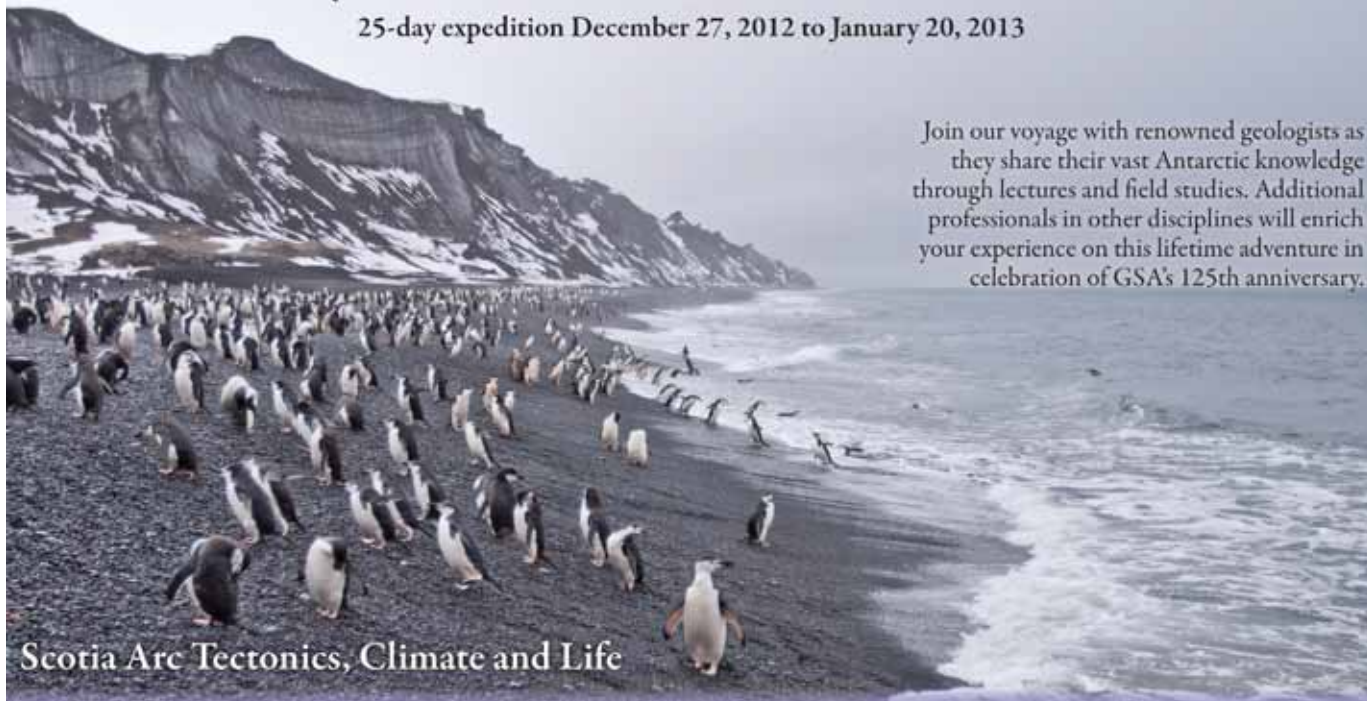
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## Publications Highlights

### New Impact Factors Announced

#### *Books to be Formally Indexed at Long Last*

Thomson Reuters released its 2010 impact factors, and GSA is pleased to announce that *Lithosphere* received its first impact factor of 1.781, making it the #11 ranked journal in the geology category.

With an impact factor of 4.026 and a five-year impact factor of 4.773, *Geology* has held its spot as the #1 ranked journal in the geology category for the fifth year in a row (of 48). It is the only journal in the category with an impact factor greater than 4.

*Geological Society of America Bulletin's* impact factor rose to 3.637, the third consecutive increase. With a five-year impact factor of 4.327, it is the #10 ranked multidisciplinary geosciences journal (of 165).

*Geosphere's* impact factor also rose for the third year in a row, setting a journal best of 2.000. Its five-year impact factor is 2.278.

While Thomson Reuters does not produce impact factors for book series, it has selected GSA's Special Papers, Memoirs, and Reviews in Engineering Geology to include in its new Book Citation Index.



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Penn's Master of Science in Applied Geosciences offers three concentration options:

## ENGINEERING GEOLOGY

- Engineering and mechanical properties and behavior of soils, water and rocks.
- Special geotechnical issues, from erosion and slope stability to geological hazards and engineered structures.

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