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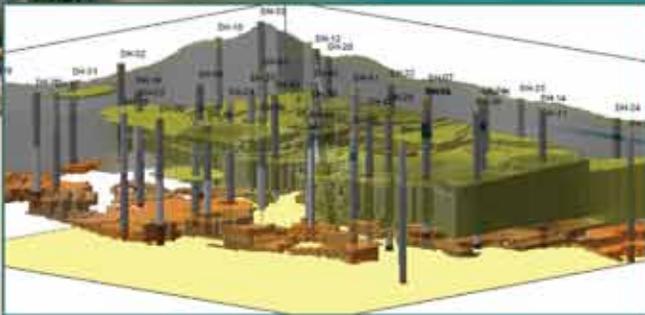
Future volcanism at Yellowstone caldera: Insights from geochemistry of young volcanic units and monitoring of volcanic unrest

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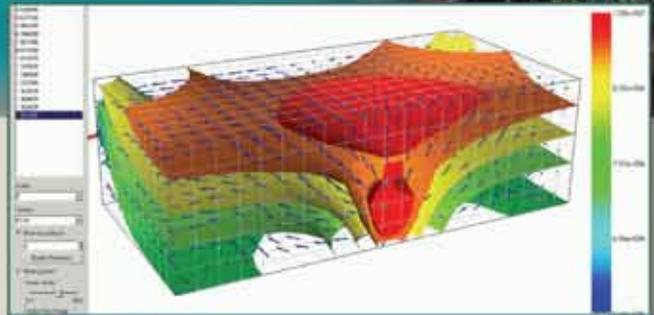
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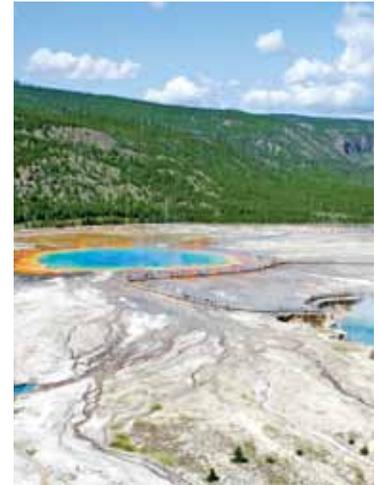
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Cover: View looking west into the Midway geyser basin of Yellowstone caldera (foreground) and the West Yellowstone rhyolite lava flow (background). Photo by Guillaume Girard. See related article, p. 4–10.

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Future volcanism at Yellowstone caldera: Insights from geochemistry of young volcanic units and monitoring of volcanic unrest

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ABSTRACT

In order to understand possible future scenarios of intracaldera volcanism at Yellowstone, we provide new insights on the generation and eruption of the youngest intracaldera rhyolitic magmas using quartz petrography, geochemistry, and geobarometry. We propose that magma ascent occurred rapidly from the source regions at 8–10 km to the surface along major regional faults, without storage at shallower depths. These source regions coincide with the upper parts of the present-day imaged magma chamber, while the faults focus much of the present-day caldera unrest. Based on these combined observations, we propose that volcanism has a higher probability to resume in three fault-controlled NNW-trending lineaments, the first coinciding with the western caldera rim, the second lying across the central region of the caldera, and the third extending across the northeastern caldera. The first two lineaments focused recent intracaldera volcanism (174–70 ka), while the latter is the most active in terms of current caldera unrest. Future volcanism could include large-volume lava flows and phreato-magmatic rhyolitic eruptions. The identification of these three regions together with potentially rapid eruptive mechanisms may help to better define future monitoring efforts necessary to improve eruption forecasting in this vast area of volcanic unrest.

INTRODUCTION

Yellowstone caldera has produced three very large Pleistocene caldera-forming eruptions, also referred to as “super-eruptions” (Sparks et al., 2005): the 2450 km³ Huckleberry Ridge Tuff at 2.06 Ma, the 280 km³ Mesa Falls Tuff at 1.29 Ma, and the 1000 km³ Lava Creek Tuff at 0.64 Ma (Christiansen, 2001; Lanphere et al., 2002). All Yellowstone eruptions combined equal ~6000 km³ in volume (Christiansen, 2001). Although the caldera does not show signs of an imminent eruption and has not produced Holocene eruptions, the system exhibits numerous signs of unrest, including the highest volcanic degassing rates on Earth (Lowenstern et al., 2006; Christiansen et al., 2007; Lowenstern and Hurwitz, 2008). Whether Yellowstone is capable of generating future eruptions is a key scientific question. These concerns have spurred recent reappraisals of Yellowstone volcanism, neotectonics, seismicity, ground deformation, and hydrothermal activity, and large geochronological, geochemical, and geophysical datasets have

been collected in the past decade (e.g., Christiansen et al., 2007; Smith et al., 2009; Girard and Stix, 2010, and references therein). Christiansen et al. (2007) discussed possible future hydrothermal explosions, toxic gas emissions, and volcanic eruptions and their respective associated hazards. They identified hydrothermal explosions and toxic gas emissions as the volcanic hazards most likely to impact humans at Yellowstone. Using geochronology and volumes of volcanic units, they proposed probabilistic assessments of future volcanic eruptions and suggested that a fourth caldera-forming eruption was the least likely scenario. Instead, they suggested that intracaldera rhyolitic eruptions and small basaltic or rhyolitic extra-caldera eruptions were more likely, with yearly probabilities of $\sim 5 \times 10^{-5}$, 6×10^{-5} and 2×10^{-5} , respectively.

This contribution aims to complement the volcanic eruption hazard model proposed by Christiansen et al. (2007) by examining localities where volcanism is most likely to resume within the caldera. Potential future extra-caldera volcanism is not considered here. We synthesize and expand recent data on rhyolite quartz geochemistry with implications for magma generation, ascent, and eruption forecasting and integrate this information with recent data on the current state of the magma reservoir and geophysical unrest. We identify three NNW-trending intracaldera lineaments that cut through the caldera as foci where volcanism may resume. The western and central lineaments coincide with the eruptive vents of the youngest intracaldera rhyolites (the Central Plateau Member), whereas the eastern lineament lies across the northeastern part of the caldera and is the focus of notable geophysical unrest.

INTRACALDERA VOLCANISM

Overview and Recent Work

Since its most recent collapse at 640 ka, Yellowstone caldera has experienced a complex history of rhyolitic volcanism. The earliest eruptive products, defined as the Upper Basin Member, are exposed near the two resurgent domes (Fig. 1). Two pyroclastic units and six lava flows were erupted between 516 and ca. 255 ka (Bindeman and Valley, 2001; Christiansen, 2001; Girard and Stix, 2009; Pritchard and Larson, 2012). These rhyolites exhibit extremely depleted and heterogeneous $\delta^{18}\text{O}$ isotopic signatures of 0–4‰, suggesting pervasive hydrothermal alteration of their parent magma or protolith (Hildreth et al., 1984; Bindeman and Valley, 2001; Bindeman et al., 2008).

The Central Plateau Member rhyolites, erupted from 174 to 70 ka, are the youngest Yellowstone rhyolites (Christiansen, 2001). They

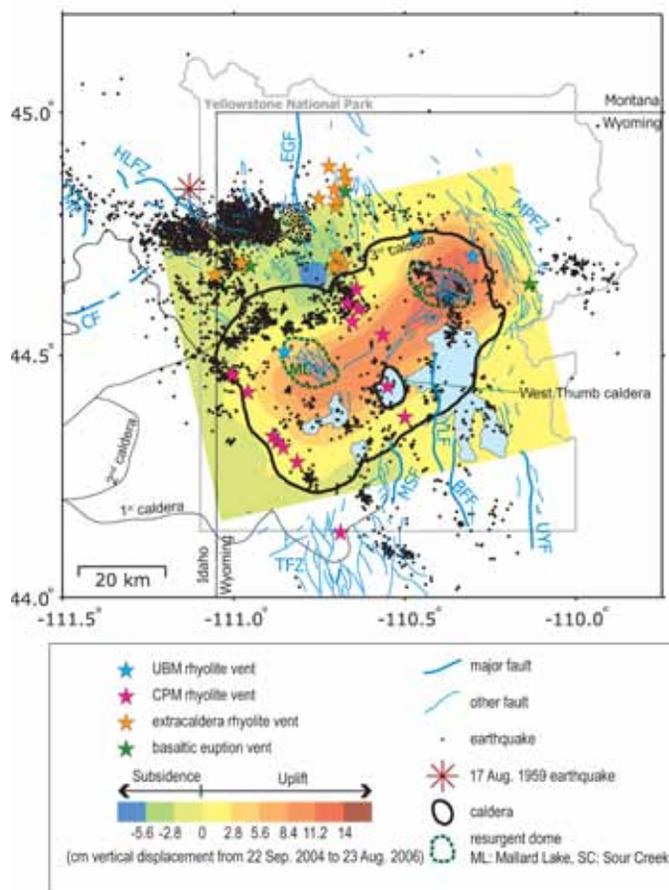


Figure 1. Synthetic compilation map of the Yellowstone region showing mapped eruptive vents active since the last caldera collapse at 640 ka (Christiansen, 2001; Christiansen et al., 2007) (vents for the Gerrit Basalt within the second caldera are omitted on this map and are not considered in this study); earthquakes recorded between 2003 and 2008 (Smith et al., 2009; Taira et al., 2010); faults (Pierce and Morgan, 1992; Farrell et al., 2009); and ground deformation obtained from InSAR measurements during the 2004–2006 uplift episode (Chang et al., 2007). Map contours modified from Taira et al. (2010). CPM—Central Plateau Member; UBM—Upper Basin Member; BFF—Buffalo Fork Fault; CF—Centennial Fault; EGF—East Gallatin Fault; HLFZ—Hebgen Lake Fault Zone; MF—Madison Fault; ML—Mallard Lake resurgent dome; MPFZ—Mirror Plateau Fault Zone; MSF—Mount Sheridan Fault; TFZ—Teton Fault Zone; UYF—Upper Yellowstone Fault; YLF—Yellowstone Lake Fault.

comprise exceptionally large lava flows, with individual volumes of $<1 \text{ km}^3$ to 70 km^3 , and cumulative volumes of $\sim 360\text{--}600 \text{ km}^3$ (Christiansen et al., 2007). Together with lavas erupted at ca. 255 ka, they define a cogenetic series in which the concentrations of most incompatible elements (e.g., Nb, Y, HREE) increase as the lavas become younger, whereas those of compatible elements (e.g., Sr, Ba, Mg, Ti, LREE) decrease, and clinopyroxene and fayalite become more iron-rich (Fig. 2A) (Vazquez et al., 2009; Girard and Stix, 2010). Compared to the Upper Basin Member rhyolites, the Central Plateau Member rhyolites exhibit less depleted and more homogeneous $\delta^{18}\text{O}$ signatures (4–5‰) (Hildreth et al., 1984; Bindeman and Valley, 2001; Watts et al., 2012). These lavas also

have the least radiogenic Nd isotopic compositions among all Yellowstone rhyolites, approaching the compositions of some Yellowstone basalts. This suggests an increased mantle-derived component compared to older Yellowstone rhyolites (Hildreth et al., 1991; Vazquez et al., 2009).

Quartz Geochemistry, Geobarometry, and Textures and Implications for Central Plateau Magmas

In order to determine crystallization depths, we investigated a selection of Central Plateau Member lavas for Ti in quartz, which can be used as a geobarometer (Thomas et al., 2010; Huang and Audétat, 2012). Measurements were obtained by laser-ablation inductively coupled plasma–mass spectrometry (LA-ICP-MS) following the protocol of Campbell et al. (2009). In all investigated lavas, a variable fraction (25%–60%) of quartz crystals were zoned under cathodoluminescence, defining a bright core and a darker rim with a sharp core-rim contact (Fig. 2B). Rims have 17–30 ppm less Ti, on average, relative to the cores (Fig. 2C). The remaining quartz crystals were homogeneous, lacked clear cathodoluminescence and Ti zoning, and had Ti concentrations similar to those of the zoned crystal rims (Fig. 2C). The data show a general decrease in the Ti content of quartz from 255 ka to 70 ka in the high Ti cores, lower Ti rims, and unzoned crystals (Fig. 2D). A good correlation also exists between Ti in rims and unzoned crystals and Ti in matrix glass (Fig. 2D), with generally constant partition coefficients of 0.10–0.15 for Ti between melt and quartz ($K_{D_{\text{Ti}}}^{\text{quartz}} = 0.10\text{--}0.15$). Cores are also typically rounded, suggesting an episode of resorption before the growth of the rims (Fig. 2B). Finally, quartz crystals are typically subhedral (partially rounded) to anhedral (rounded) and commonly show long glass embayments (Figs. 2B and 2E).

We used the recent TitaniQ titanium-in-quartz geobarometer (Thomas et al., 2010; Huang and Audétat, 2012) to estimate depths of formation of the Central Plateau Member quartz crystals (see supplemental Table DR1¹), using magmatic temperatures and TiO_2 activity calculated on similar Central Plateau Member units by Vazquez et al. (2009). Despite large uncertainties resulting from the variability in Ti concentrations and imprecision in temperatures and TiO_2 activity, the equation of Thomas et al. (2010) gives a pressure range between 5 and 13 kbar throughout the magmatic episode, approximating depths of 20–50 km in the crust. Using the same temperature and activity estimates, the equation of Huang and Audétat (2012) gives a pressure range of 0.6–5 kbar, approximating depths of 2–20 km. Using average values of the Ti contents, TiO_2 activity, and temperatures for each lava flow, we obtain pressures of 9–10 kbar and 2–2.5 kbar from these equations, approximating depths of 35–40 km and 8–10 km, respectively. These calculations reveal large discrepancies between the two experiment-based equations, suggesting that the results should be used with caution. Depths associated with the equation of Thomas et al. (2010) may be unrealistically high, although the continental crust beneath Yellowstone does appear to exceed 40 km in thickness (Stachnik et al., 2008). By contrast, the depths obtained with the equation of Huang and Audétat (2012) coincide with the depth of the present-day imaged magma reservoir (Husen

¹ Supplemental item 2012246 (Table DR1), is online at www.geosociety.org/pubs/ft2012.htm. You can also request a copy from *GSA Today*, P.O. Box 9140, Boulder, CO 80301-9140, USA; gsatoday@geosociety.org.

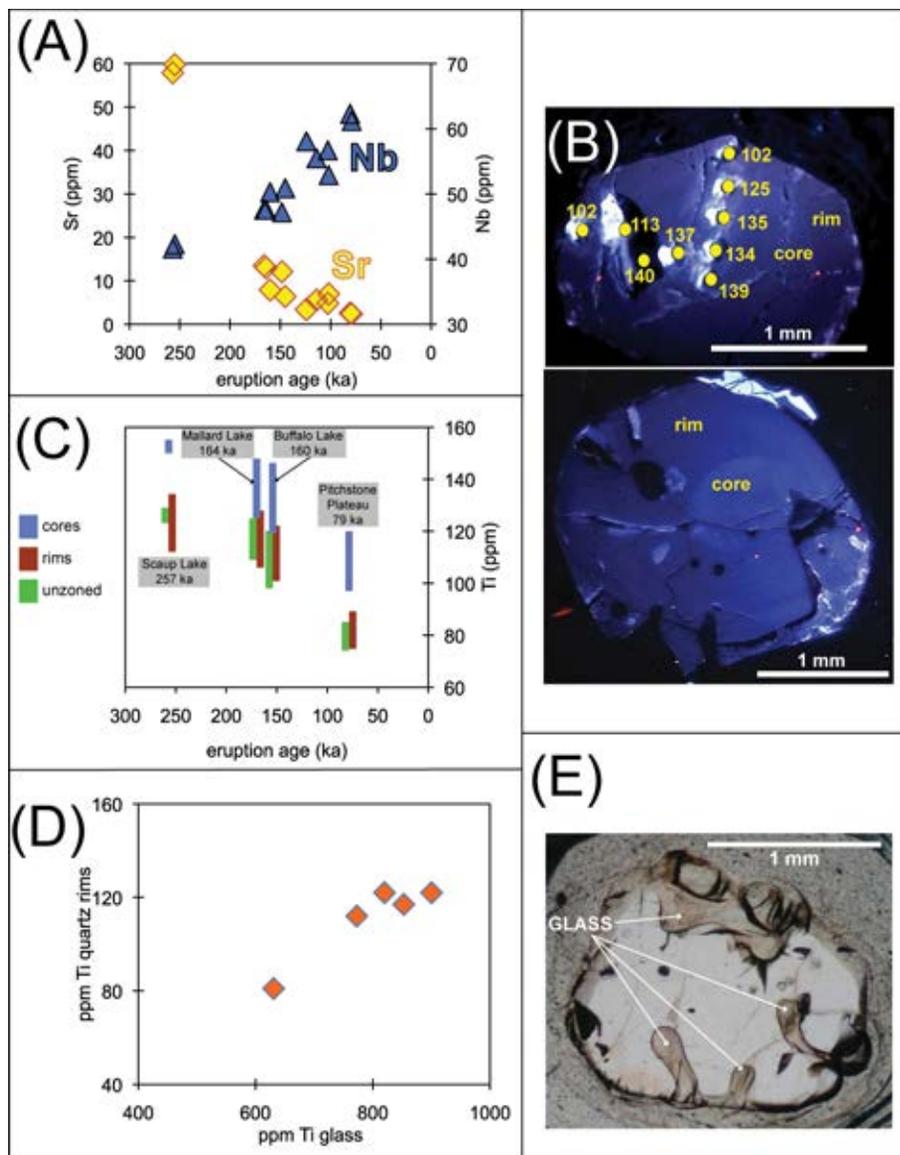


Figure 2. (A) Temporal evolution of Sr (compatible element) and Nb (incompatible element) as a function of eruption age in the Central Plateau Member lavas (X-ray fluorescence data on whole rock; Girard and Stix, 2010); ppm—parts per million. (B) Cathodoluminescence photomicrographs of two Central Plateau Member quartz grains (top: Buffalo Lake lava flow, 160 ka; bottom: West Yellowstone lava flow, 110 ka) exhibiting dark rims and bright cores, rounded cores, and sub-rounded to rounded rims. Yellow circles are Ti analyses (ppm) by laser-ablation ICP-MS. (C) Ti in Central Plateau Member quartz crystals as a function of eruption age. (D) Average Ti content of quartz rims and unzoned quartz crystals as a function of Ti in glass (electron microprobe analyses; Girard and Stix, 2010). (E) Photomicrograph of glass embayments in a Central Plateau Member quartz crystal (Moose Falls lava flow, 80 ka).

et al., 2004) (see the “Yellowstone magma reservoir” section), leading us to prefer these values.

Common magmatic processes such as a rapid temperature increase caused, for example, by the injection of a replenishing magma, as well as ascent toward shallower depths, lead to higher solubility of Ti in quartz (Wark and Watson, 2006; Thomas et al., 2010). Should any of these processes have occurred in the Central Plateau magmas to allow for the formation of overgrowths, reverse zoning with higher Ti in rims would be observed, as reported at many silicic magmatic systems elsewhere (e.g., Wark et al., 2007; Wiebe et al., 2007; Shane et al., 2008; Campbell et al., 2009; Matthews et al., 2012). Normal zoning like that observed at Yellowstone appears to be a less common feature in magmatic quartz. The general subhedral (partially rounded) to anhedral (rounded) morphologies of the quartz grains and their abundant glass embayments (Fig. 2E) are most commonly explained by adiabatic decompression during ascent, heating, or a combination of both (Donaldson and Henderson, 1988; Streck, 2008). These features and the lack of reverse zoning lead us to propose that

ascent from source region to surface was rapid, with little or no storage at shallower depths. As we discuss in the following section, such rapid ascent may have important implications for our ability to predict volcanic eruptions.

Finally, the higher core Ti content of the zoned crystals may have been inherited from earlier stages of Central Plateau magmatism. In particular, the zoned quartz cores of the 70 ka Pitchstone Plateau lava flow have Ti compositions that closely match those of the unzoned crystals and zoned crystal rims of the 160 ka Buffalo Lake lava flow (Fig. 2C). Hence, the Pitchstone Plateau zoned quartz grains may be antecrysts from the Buffalo Lake episode.

Eruptive Vents and Associated Faults

A key aspect of the Central Plateau Member rhyolites that is important for assessing future eruption scenarios is the distribution of their eruptive vents along two NNW-trending lineaments aligned with active regional faults. One lineament coincides with the western caldera rim, while the other cuts across the central part of the caldera between the two resurgent domes (Fig. 1).

These structures traverse the caldera perpendicular to the Yellowstone–Snake River Plain hotspot track and appear to be unrelated to the caldera ring fracture zones (Pierce and Morgan, 1992; Christiansen, 2001) (Fig. 1). Both vent lineaments and, in particular, the central lineament also coincide with regions of high intracaldera tectonic seismicity and hydrothermal activity (Lowenstern and Hurwitz, 2008; Farrell et al., 2009; Smith et al., 2009) (Fig. 1).

Outside the caldera, there is evidence of recent tectonic activity along the faults associated with these lineaments. The Hebgen Lake fault zone, northwest of the western lineament, experienced an M_s 7.5 earthquake in 1959, the epicenter of which was 25 km from the caldera rim (Doser, 1985) (Fig. 1). Also in this region, an earthquake swarm in 1985 was interpreted to reflect migration of hydrothermal fluids at depth (Waite and Smith, 2002). Aseismic extension has also been identified in this region (Puskas et al., 2007), as has a low-velocity zone at ~2 km depth, interpreted as gas-filled (Husen et al., 2004). South of the western lineament, major Holocene earthquakes with >1 m vertical displacement, possibly inherited from melting of the kilometer-thick ice cap that covered Yellowstone during the 35–14 ka Pinedale glaciation, have been documented along the Teton fault (Hampel et al., 2007). Leveling measurements along this fault have revealed episodes of uplift and subsidence on the order of ~7 mm yr⁻¹ (Puskas et al., 2007).

Activity along faults associated with the central lineament (the East Gallatin fault to the north and the Mount Sheridan fault to the south; Fig. 1) is less precisely documented. Nevertheless, these faults exhibit large Pleistocene offsets (Pierce and Morgan, 1992), and the East Gallatin fault hosts active hydrothermal features and volcanic eruptive vents along the Norris-Mammoth Corridor (Christiansen, 2001). Holocene displacements also have been documented along these fault lines in Yellowstone Lake (Morgan et al., 2007).

Considering the volume of the Central Plateau eruptions and the extent of the present-day Yellowstone magma reservoir, which spans much of the caldera subsurface (Husen et al., 2004), it is reasonable to infer that the Central Plateau magma reservoir was not spatially restricted to the areas underlying the vent lineaments. Rather, it might have spanned much of the western and central parts of the caldera subsurface. The faults may have facilitated ascent and eruption of large volumes of poorly phyric rhyolitic magma, preventing their accumulation at shallower levels. The relatively low viscosity of these hot, low-crystallinity magmas and their transit along faults could result in rapid, possibly aseismic (Castro and Dingwell, 2009), ascent with little to no pre-eruptive shallow storage, making forecasting of potential future Central Plateau-type eruptions difficult.

THE YELLOWSTONE MAGMA RESERVOIR

Seismic tomography and gravity studies beneath Yellowstone caldera have shown the presence of a -60 mGal gravity anomaly and low P-wave and low V_p/V_s velocity zone with a density of ~2500 kg m⁻³ at 10–16 km depth, interpreted as a crystal mush or partial melting zone with 5%–15% melt fraction (Husen et al., 2004; DeNosaquo et al., 2009). This magma body lies beneath most of the caldera and has two shallower lobes rising to 6 km depth beneath each of the two resurgent domes. It may attain 15,000 km³ in volume (Lowenstern et al., 2006). Chu et al. (2010) documented a low-velocity body centered at 5 km depth beneath

the northwestern caldera rim, interpreted as partial melts with ~30% melt and up to 8% volatiles. Such melt fractions are usually too low for magma to be eruptible (Marsh, 1981).

The chemical composition of the melts is not well characterized. Owing to the predominance of rhyolite among Yellowstone eruptive products, the reservoir is commonly perceived as rhyolitic. The presence of basalt beneath Yellowstone is suggested by the very large CO₂ and S degassing rates (Werner and Brantley, 2003; Lowenstern and Hurwitz, 2008), yet there is no evidence for a deep mafic magma reservoir clearly separated from the imaged reservoir, in part because of the inability of current seismic tomography techniques to detect deeper structures (Husen et al., 2004; Stachnik et al., 2008; Smith et al., 2009). Thus, Smith et al. (2009) have proposed that the shallow crustal magma reservoir consists of a combination of basaltic dykes, sills, and magma chambers and melting zones where silicic magma is generated. Our geobarometry data on Central Plateau Member quartz crystals (see Table DR1 [footnote 1]) suggest depths of crystallization of 8–10 km, which coincide with the imaged magma reservoir.

FUTURE VOLCANISM AND HAZARDS

Southwestern and Central Caldera

As outlined in the previous sections, evidence from crystal textures suggests rapid ascent of the Central Plateau Member magmas. Most of the recent eruptions (174–70 ka) were large-volume lava flows, also known as Snake River-type lavas (Branney et al., 2008). Their associated hazards remain largely unknown and their mechanisms of emplacement, including extrusion rates, are not well quantified (Branney et al., 2008). The amount of degassing associated with such eruptions is also unknown; degassing may have begun long before eruption while magma was still accumulating, suggesting the possibility of prolonged pre-eruptive degassing crises. Four pyroclastic units, the tuffs of Sulphur Creek (473 ka, ~10–50 km³), Uncle Tom's Trail (~480 ka, <1 km³), Bluff Point (173 ka, 50 km³), and Cold Mountain Creek (143 ka, 10 km³) are documented among the Upper Basin and Central Plateau members (Christiansen, 2001; Christiansen et al., 2007; Pritchard and Larson, 2012). The Tuff of Bluff Point was associated with the formation of the 6 × 8 km West Thumb caldera of Yellowstone Lake (Christiansen, 2001) (Fig. 1). There is no clear geochemical difference between the pyroclastic tuffs and coeval lavas (Christiansen, 2001; Girard and Stix, 2009, 2010); hence, the factors causing these eruptions to be explosive rather than effusive are not known. Thus, the possibility of future intracaldera pyroclastic eruptions should not be ruled out. Should an eruption occur, the abundance of lakes, snow, groundwater, and hydrothermal areas within the caldera increases the likelihood of phreatomagmatic volcanism. The faults along which the Central Plateau eruptive vents are located remain tectonically active and would likely act as pathways for magma ascent, should eruptible magma be generated at depth.

Northeastern Caldera

In contrast with the southwestern and central regions of the caldera, where hundreds of cubic kilometers of magma have been erupted, no volcanism has occurred in the northeastern caldera since 480 ka (Christiansen, 2001; Christiansen et al., 2007) (Fig. 3).

Nevertheless, this region is undergoing significant ground deformation, including rapid uplift from 2004 to 2006, interpreted to reflect the injection of a sill at ~10 km depth within the magma reservoir (Wicks et al., 2006; Chang et al., 2007, 2010; Smith et al., 2009) (Fig. 1). Some of the most active hydrothermal basins are located in this area, including the Mud Volcano area and the floor of Yellowstone Lake (Morgan et al., 2007, 2009). The largest documented hydrothermal explosion in Yellowstone, the Mary Bay crater, also formed in this area (Christiansen et al., 2007; Morgan et al., 2009). Numerous tectonic earthquakes are observed across this region; they are mainly distributed along a NNW-trending lineament that (1) cuts through the Sour Creek resurgent dome and Yellowstone Lake; (2) lies parallel to the Central Plateau eruptive vent lineaments; and (3) is aligned with an active extra-caldera fault, the Upper Yellowstone fault (Pierce and Morgan, 1992; Farrell et al., 2009) (Fig. 1). The presence of intracaldera faults such as the Yellowstone Lake fault (Fig. 1) may favor rapid eruption of newly generated magma. Thus, resumption of volcanism in the northeastern caldera, with eruptions and hazards similar to those of the Central Plateau Member, is a reasonable scenario.

SUMMARY AND CONCLUSIONS

1. In all investigated lavas, quartz crystals define two populations: unzoned crystals and zoned crystals with bright cores and dark rims when observed by cathodoluminescence. Bright cores and dark rims correlate with high Ti and low Ti concentrations, respectively, while the unzoned crystals have Ti concentrations similar to those of the zoned crystal rims. As lavas become younger, zoned quartz cores, zoned quartz rims, and unzoned crystals all exhibit progressively lower Ti concentrations. Geobarometry using Ti in quartz suggests crystallization at ~8–10 km depth.
2. The generally rounded morphology of the quartz crystals and their abundant glass embayments suggest decompression, potentially preceded, or accompanied, by rapid heating. The lack of high-Ti overgrowths also suggests rapid ascent with no storage at shallow levels.

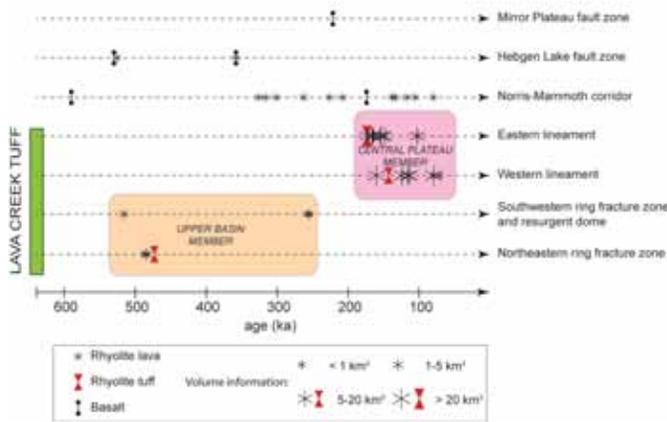


Figure 3. Distribution of Yellowstone eruptions by eruptive locations, age, style, and volumes, using data from Christiansen (2001) and Christiansen et al. (2007).

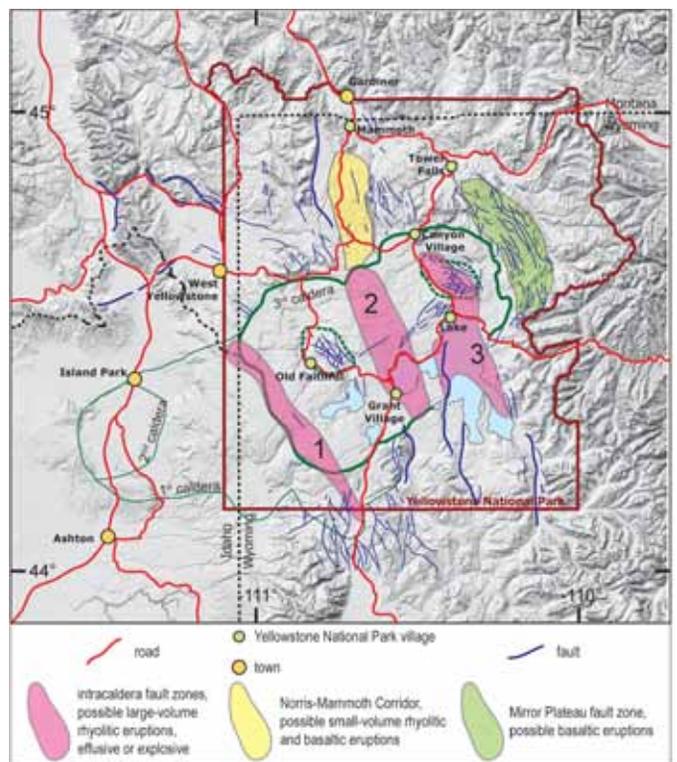


Figure 4. Map of the Yellowstone area showing our hypothesized foci of future volcanism in relation to the main National Park infrastructure, roads, and surrounding towns. The numbers 1, 2, and 3 refer to the three intracaldera fault-controlled lineaments as discussed in the text. See Christiansen et al. (2007) for a discussion of possible future extra-caldera volcanism in the Norris-Mammoth corridor and Mirror Plateau fault zone.

3. A large crustal magma reservoir is interpreted to be present beneath Yellowstone caldera at between 16 and 6 km depth, but there is no indication that this reservoir, or parts of it, are currently in an eruptible state. However, rapid reheating and magma extraction events appear to have occurred episodically during times of Central Plateau magmatism.
4. If reactivation of the current reservoir were to occur, eruptions would most likely be focused along the two fault lines that localized all Central Plateau eruptions between 174 and 70 ka and that continue to host intense caldera unrest (Fig. 4). A third parallel lineament across the northeastern caldera, while not hosting volcanism in the last half million years, focuses the most intense caldera unrest and is underlain by the magma reservoir (Figs. 1 and 4).
5. Eruptions could include large rhyolitic lava flows and/or pyroclastic eruptions, with generally unknown precursory signs and emplacement mechanisms, as well as pheatomagmatic eruptions due to the abundance of ground- and surface water at Yellowstone.

ACKNOWLEDGMENTS

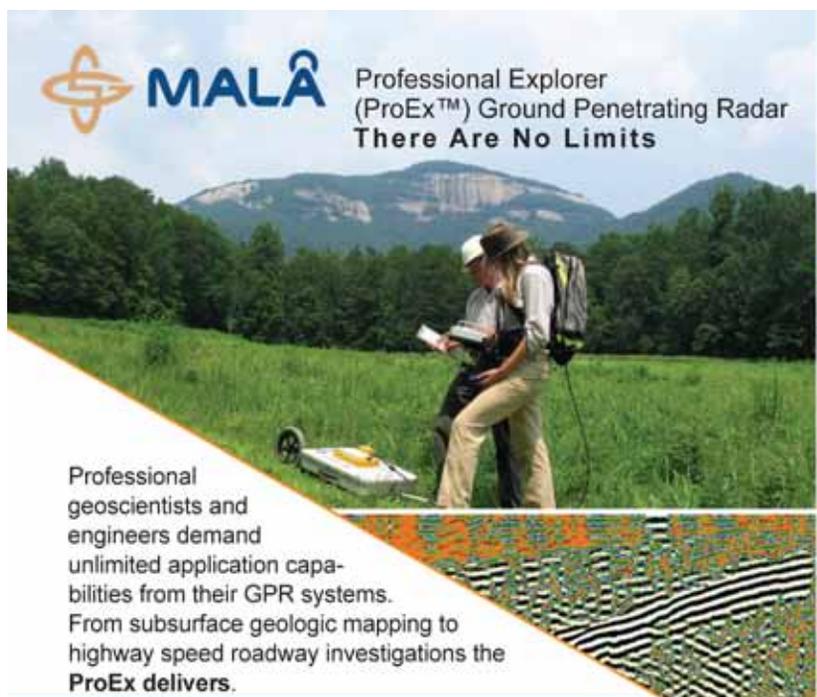
We thank Dr. Jake Lowenstern of the U.S. Geological Survey for comments on an early version of the manuscript, two anonymous reviewers who helped substantially improve this work, and Dr. Damian Nance for editorial handling. This work was supported by grants to John Stix from the Natural Sciences and Engineering Research Council of Canada.

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GSA ANNUAL MEETING & EXPOSITION



A Message from Melissa Cummiskey, GSA's Senior Director of Meetings & Events

A common theme of feedback about GSA Annual Meetings is that there are so many things to do, it's hard to decide on which event or session to attend at any given time. Our meeting venues overflow with opportunities for networking and meeting up with friends—in session rooms before and after talks, in hotels and corridors, on sidewalks and greenways, and in every corner of the convention center.

I have worked for GSA for close to thirteen years, and one of the things that I love about this society and the annual meeting is being able to see people come together who are so incredibly passionate about their work and their research. It's very refreshing in today's world. At GSA, we strive to put together events and programs of the highest quality. It's the least we can do for our members.

Every year, we try to improve on what we've done in the past, and we continue to bring new things to the table—from special lectures to movies to new presentation formats. Last

year, we added digital posters to our meeting, and they were a huge success. The people who presented on these digital screens were so excited by this response, most spent the entire day showing their research to thousands of attendees as they perused the poster and exhibit halls. It was hard to miss this new format and gratifying to see the interest level.

At a GSA Annual Meeting, you can expect to be part of a community. We hear more often than not that attending a GSA Annual Meeting is like coming home, and many attendees like to share memories of their first GSA Annual Meeting years ago. We bring members of the greater geoscience community together for several days to present research, network with colleagues, do business, and have fun. We know you have a choice in where to present your research, and we hope that you see the value in GSA and choose to spend a few days with us this year in Charlotte!

4–7 NOVEMBER 2012
CHARLOTTE, NORTH CAROLINA, USA

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Your support of GSA's 2012 Annual Meeting & Exposition continues a tradition of more than a century of serving science and the profession. The Society appreciates your investment in the growth of current and future leaders in the geosciences community.

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GSA would like to acknowledge and give a special thank you to the GSA Foundation for their continued support.

* In-kind donation.

Meeting Schedule AT-A-GLANCE

Beginning with...

Pre-Meeting Field Trips: Thurs., 1 Nov.–Sat., 3 Nov.

Short Courses: Fri., 2 Nov.–Sat., 3 Nov.

Charlotte Icebreaker: Meet with friends, enjoy a beer, and plan your week in Charlotte! Saturday, 3 Nov., 5–7 p.m.

Sunday, 4 November

GSA President's Student Breakfast: 7–8:30 a.m.

Special Session: *GSA Bulletin*: 125th Celebration Presentations: 8 a.m.–5:30 p.m.

Coffee Break in the Poster Hall: 9 a.m.

Screening of *Switch*, Scott Tinker's Switch Energy Project: 9 a.m.–11 a.m.

GSA Presidential Address & GSA President's Medal Presentation: Lunchtime Lecture #1: 12:15–1:15 p.m.

Exhibit Hall open: 2–6:30 p.m.

Exhibit Hall Opening Reception: 4:30–6:30 p.m.

Monday, 5 November

Pardee Session 1: Digital Geology Speed-Dating: An Innovative Coupling of Interactive Presentations and Hands-On Workshop (Digital Posters): 8 a.m.–6 p.m.

Pardee Session 2: Mars Rover *Curiosity*: Geoscience in Gale Crater: 8 a.m.–noon

Coffee Break in the Exhibit Hall: 9 a.m.; **Exhibit Hall open** 9 a.m.–6 p.m.

Screening of *Switch*, Scott Tinker's Switch Energy Project: 9 a.m.–11 a.m.

GSA Awards Ceremony: Lunchtime Lecture #2: 12:15–1:15 p.m.

Pardee Session 5: Supercontinent Cycles through Earth History: 1:30–5:30 p.m.

Afternoon Beer Reception: 4:30–6 p.m.

Group Alumni Reception: 7–9:30 p.m.

Subaru Outdoor Life Lecture: Julie Brigham-Grette: 6–7 p.m.

Tuesday, 6 November

Election Day (U.S.)—Make sure to vote early or request an absentee ballot!

Pardee Session 4: Shale Gas Development and Hydraulic Fracturing Impacts on Water Resources in the United States: 8 a.m.–noon.

Coffee Break in the Exhibit Hall: 9 a.m.; **Exhibit Hall open** 9 a.m.–6 p.m.

Lunchtime Lecture #3: Michel T. Halbouty Distinguished Lecturer Scott Tinker: 12:15–1:15 p.m.

Pardee Session 3: Meltwater Production from Source (Ice Margins) to Sink (Ocean); Magnitude, Chronology, and Significance: 1:30–5:30 p.m.

Afternoon Beer Reception: 4:30–6 p.m.

Wednesday, 7 November

Pardee Session 6: Understanding Earth through Carbon, 8 a.m.–noon

Coffee Break in the Exhibit Hall: 9 a.m.; **Exhibit Hall open** 9 a.m.–2 p.m.

Lunchtime Lecture #4: The National Election: What do the Results Mean for Science?: 12:15–1:15 p.m.

Exhibit Hall closes: 2 p.m.

Afternoon Beer Reception in Poster Hall: 4:30–6 p.m.

Ending with...

Meeting officially ends Wednesday evening, 7 Nov.

Post-Meeting Field Trip departures begin Wed., 7 Nov.

Last Field Trip ends Sat., 10 Nov.

2012 GSA MEDAL & AWARD RECIPIENTS



Raymond A. Price



John M. Eiler



Katharine W. Huntington



Bill McKibben



Roger A. Pielke Jr.



Lisa Norby



Bob Stewart



Kenneth D. Ridgway



Phoebe A. Cohen



Gordon E. Brown Jr.

PENROSE MEDAL

Raymond A. Price, Queen's University (Professor Emeritus)

ARTHUR L. DAY MEDAL

John M. Eiler, California Institute of Technology

YOUNG SCIENTIST AWARD (DONATH MEDAL)

Katharine W. Huntington, University of Washington

PRESIDENT'S MEDAL OF THE GEOLOGICAL SOCIETY OF AMERICA

Bill McKibben, Middlebury College

GSA PUBLIC SERVICE AWARD

Roger A. Pielke Jr., University of Colorado Center for
Science and Technology

GSA DISTINGUISHED SERVICE AWARD

Lisa Norby, National Park Service Geologic Resources Division

Bob Stewart, ExxonMobil Exploration Company

RANDOLPH W. "BILL" AND CECILE T. BROMERY AWARD FOR THE MINORITIES

Kenneth D. Ridgway, Purdue University

SUBARU OUTSTANDING WOMAN IN SCIENCE AWARD



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Phoebe A. Cohen, Massachusetts Institute of Technology

AGI MEDAL IN MEMORY OF IAN CAMPBELL

Gordon E. Brown Jr., Stanford University



As you look around the Convention Center, you will find several screens displaying the digital Hall of Fame acknowledging our well-deserving and hard-working colleagues, mentors, and students. Take a moment to watch our honorees scroll by and be sure to congratulate them if you see them at the meeting.

TOP SCIENCE!

PARDEE KEYNOTE SYMPOSIA

- P1. **Digital Geology Speed-Dating: An Innovative Coupling of Interactive Presentations and Hands-On Workshop (Digital Posters):** Mon., 5 Nov., 8 a.m.–6 p.m. This is a new style of symposium, with six simultaneous presentations at adjacent digital poster stations.
- P2. **Mars Rover *Curiosity*: Geoscience in Gale Crater:** Mon., 5 Nov., 8 a.m.–noon. This session will provide an overview of Gale Crater.
- P3. **Meltwater Production from Source (Ice Margins) to Sink (Ocean); Magnitude, Chronology, and Significance:** Tues., 6 Nov., 1:30–5:30 p.m. This symposium will focus on the last deglaciation of the Laurentide Ice Sheet and its effects on ocean salinity, surface temperature, and eustatic sea level.
- P4. **Shale Gas Development and Hydraulic Fracturing Impacts on Water Resources in the United States:** Tues., 6 Nov., 8 a.m.–noon. This symposium addresses the key issues related to the possible impacts of shale gas development on water resources in the United States.
- P5. **Supercontinent Cycles through Earth History:** Mon., 5 Nov., 1:30–5:30 p.m. This symposium covers the implications of tectonic, petrologic, geochronologic and biologic processes.
- P6. **Understanding Earth through Carbon:** Wed., 7 Nov., 8 a.m.–noon. This symposium address the goals of the Deep Carbon Observatory (DCO).



Artist rendering of the new Mars Rover, *Curiosity*. Image courtesy NASA.



SPECIAL SESSIONS

GSA BULLETIN: 125th Celebration Presentations

Organizer: J. Brendan Murphy

This session features a series of presentations based on articles to be published in the *Geological Society of America Bulletin* starting in January 2013 as part of the celebration to mark GSA's 125th birthday.

The Fluvial System: The Legacy of Stanley A. Schumm

Organizers: Allen C. Gellis and Benjamin Hayes; **Cosponsors:** *GSA Quaternary Geology and Geomorphology Division and SEPM (Society for Sedimentary Geology)*.

This session brings together leading scientists and engineers whose work builds upon the scientific contributions of Stanley A. Schumm, one of the greatest geomorphologists of all time. Schumm helped pioneer the field of process geomorphology. During his more than fifty-year career with the U.S. Geological Survey and academia, he mentored hundreds of students and contributed landmark papers and books on fluvial and watershed processes, hillslope, and planetary landscapes. The session is organized around key paradigms Schumm established: dynamic equilibrium, episodic response, sediment and channel morphology, river variability and complexity, base-level change and tectonics, and climate-watershed dynamics.

Recent Advances in Carbonate Sedimentology and Stratigraphy: In Memory of Gerald M. Friedman

Organizers: Janok P. Bhattacharya, Paul A. Washington; and James R. Ebert. **Cosponsors:** *SEPM (Society for Sedimentary Geology), Eastern Section SEPM, and GSA International Section*.

This session, which explores recent advances in the understanding of modern and ancient carbonate systems, including deposition, diagenesis, and stratigraphic architecture, is dedicated to the memory of Gerald Friedman and his contributions to carbonate sedimentology.

HAVE FUN!

EXTRAS!

2012 SUBARU OUTDOOR LIFE LECTURE



Sponsored by Subaru of America Inc.

Driven to Extremes—The Roadless Pursuit of Scientific Drilling at El'gygytgyn Crater Lake, Arctic Russia

Julie Brigham-Grette

Monday, 5 Nov., 6–7 p.m.

As the U.S. Chief Scientist of this international effort, Brigham-Grette will describe “the thrill to drill in the chill,” following a politically roadless and scientifically risky path while succeeding in one of the most remote parts of Northeast Russia. In collaboration with Russian and German co-chief scientists (Pavel Minyuk and Martin Melles), she will detail the 15-year-long pursuit of scientific drilling with photography, videos, and bizarre stories.

SWITCH FILM SHOWINGS

Sun., 4 Nov., and Mon., 5 Nov., 9–11 a.m.

Switch is an insightful look at our energy future and the challenge of transitioning to alternatives—told through a wild, globe-hopping road movie that explores the world’s premiere energy sites for all resources, coal to solar, oil to biofuels, most of them highly restricted and never before seen on film. In the end, it offers a roadmap to our energy future that is surprising and remarkably pragmatic. The film features Scott Tinker, director of the Bureau of Economic Geology and world-renowned energy expert. Tinker is also the 2012 Michel T. Halbouty Distinguished Lecturer and will speak during the Lunchtime Lecture hour on Tues., 6 Nov., from 12:15–1:15 p.m.



WATERCOLOR & WINE

Monday, 5 Nov., 2:30–4:30 p.m., US\$35; minimum: 10.

Do you want an afternoon that is fun and different? Are you looking for a way to explore your artistic side? Watercolor & Wine is an upbeat creative class for everyone—beginners through experts. Learn the basics of watercolor painting while enjoying the company of friends and a glass of wine. A professional instructor will guide you step-by-step through the process of creating a finished painting.

BUILDING STONE WALKING TOUR

Have a few extra minutes during the meeting?

The buildings and infrastructure of “uptown” Charlotte host a wide array of rocks that will pique the interest of even the most seasoned rock hound. We have prepared a field guide (available as a printable download) of building stones around the convention center. The guide is written so that both the novice and the expert can find something new to learn. Enjoy exploring amazing examples of stones from all over the world, many of which have unusual and even relatively rare geologic features.

GUEST PROGRAM

Is your guest looking for something to do while you attend sessions? For a small fee, he or she can register to receive guest privileges, including the Guest Hospitality Suite, with complimentary refreshments, entertaining and educational seminars, and a local expert with information about the area.

LOCAL TOURS

Want a break from the science or the busy-ness of the convention center? Join your guest on one of the local tours and learn more about the area. Fees for these tours cover the costs of professional tour guides, transportation, admission, and gratuities. Each tour requires a minimum of 24 participants. For event descriptions and more information, check out the website.

101. “A Day with the Queen” Charlotte City Tour: US\$28; Sun., 4 Nov., 9 a.m.–noon.
102. Charlotte Historic Home Tour: US\$39; Sun., 4 Nov., 1–5 p.m.
103. Reed Gold Mine Adventure: US\$36; Mon., 5 Nov., 1:30–5:30 p.m.
104. Old Salem Moravian Community: US\$95; Tues., 6 Nov., 9 a.m.–5 p.m. Includes lunch; please check the box on your online registration and let us know of any special dietary needs.
105. Winghaven Garden and Elizabeth Lauren House and Gardens Tour: US\$36; Tues., 6 Nov., 1:30–5:30 p.m.
106. Harvest Vineyard Tour: US\$98; Wed., 7 Nov., 9 a.m.–4 p.m. Includes lunch; please check the box on your online registration and let us know of any special dietary needs.

EXTRAS!

NASCAR HALL OF FAME**Discount Tickets**

If you're looking for some pedal-to-the-metal fun, look no further than the NASCAR Hall of Fame. The NASCAR Hall of Fame is connected to the CCC and is a "must-see" part of your trip to Charlotte. The Hall is fueled with more than 50 interactive experiences like tire-changing stations, realistic race simulators, a broadcast booth, and even a Kids Zone. Purchase a one-day or three-day discounted entrance ticket through online registration or at the onsite registration desk.

EARTHCACHE™ SITES

GSA Annual Meeting attendees are invited to visit EarthCache sites in the Charlotte area. *EarthCaching* is a GPS-based outdoor activity that brings people to sites of geological interest. To find EarthCache sites near Charlotte, go to www.geocaching.com and enter any of the following "GC-codes": GC1KGQ2 ("Big Rock EarthCache"); GC1PPCG ("Cabarrus County Syenite Ring Dike"); GC1HGBX ("Hills Iron Mines"); and GC2B035 ("The Deconsolidators–Abrasion").

FOURTH ANNUAL PHOTO EXHIBIT CONTEST

Submission deadline: 15 Sept. 2012

Categories

1. **Regional Geology:** Landscapes, features, or geologic activity within the Southeastern U.S.;
2. **Abstract Images:** The patterns of geology at any scale.
3. **Geologic Processes Past and Present:** Processes or features resulting from a specific geologic process.
4. **Iconic Landscapes:** Iconic geologic landscapes and features.

Timeline

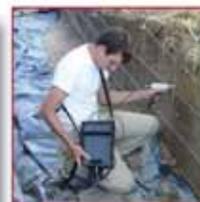
- Submit your .jpg files (max. two entries per category) by 15 Sept. to geosocphotos@gmail.com.
- Winners will be notified by 30 Sept.
- Winners must send final files of appropriate size for printing by 10 Oct.

Magnetic Susceptibility System

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STAYING IN TOUCH

GSA'S CONNECTED COMMUNITIES

MOBILE MEETING

www.geosociety.org/meetings/2012/web2.htm



Mobile App Encore

Download *m²*, GSA's free meeting app, at www.geosociety.org/mobilemeeting/ and get the meeting at your fingertips.

- View the entire 2012 Annual Meeting technical program;
- Locate the talk you want to hear, add it to your calendar, and pinpoint the location on a map;
- See who's exhibiting and find them on the exhibit hall floor plan;
- Select events to attend and get alerts and reminders.



Meeting Bulletin Board

- Connect with other meeting attendees;
- Discuss what you want, when you want;
- Network, coordinate schedules, and plan activities;
- Save money by sharing travel & lodging expenses.

Information entered to this bulletin board is secure and only accessible by login at <http://rock.geosociety.org/forumstudenttravel>.



Twitter

- Get up-to-the-second meeting news by joining a global audience of more than 5,000 geoscientists, students, agencies, and geoscience companies who follow @geosociety and by watching this year's meeting hashtag, #GEO2012;
- Let others know you'll be tweeting about the meeting on the Twitter Roll at www.geosociety.org/meetings/2012/mtg-twitterroll.asp;
- Tweet with #GEO2012 in your message to create a rolling narrative & stretch the meeting's virtual boundaries.



Facebook

Check out GSA's vibrant Facebook page and join more than 12,000 fans worldwide at www.facebook.com/GSA.1888.



LinkedIn

GSA manages an active LinkedIn group to help you network and stay connected with your professional peers. Build and shape our scientific exchange and move your career forward at www.linkedin.com/groups/Geological-Society-America-1298547?home.



Blog Roll

Let everyone know about your meeting-related blog posts! Add your info to the Blog Roll at www.geosociety.org/meetings/2012/mtg-blogroll.asp. Also, check out GSA's blog, *Speaking of Geoscience™*, at <http://geosociety.wordpress.com/>, and learn how YOU can add to the discussion.

PERSONAL SCHEDULER

Simplify your time during the annual meeting by taking advantage of the free Personal Scheduler. The scheduler is designed so that you may easily browse all events scheduled for this meeting, create your own schedule of events, record notes, and download to your PDA or other mobile device or print for easy reference. Learn more at

<http://gsa.confex.com/gsa/2012AM/scheduler/index.epl>.

The Personal Scheduler
—a simple, effective
planning tool available
to you at no charge.



ESPECIALLY FOR STUDENTS

PRESIDENT'S STUDENT BREAKFAST RECEPTION

Sponsored by
ExxonMobil

Hosted by GSA
THE GEOLOGICAL SOCIETY
OF AMERICA®

Sunday, 4 Nov.

GSA President **George H. Davis** invites all students registered for the meeting to attend a free breakfast buffet sponsored by ExxonMobil Corporation. Davis, members of GSA leadership, and ExxonMobil staff members will be on hand to answer questions and address student issues. Take this opportunity to network with fellow students, meet the officers of GSA, and recognize fellow student award recipients!

GRADUATE SCHOOL INFORMATION FORUM

Searching for the right graduate school? Maximize your time and save money by interviewing with university representatives from across the nation. Visit the meeting website for a list of participating universities.

STUDENT VOLUNTEERS

GSA student members: Get free meeting registration when you volunteer for ten hours — *plus* a US\$25 stipend for every five hours worked — *plus* get an insider's view of the meeting! Sign up on the meeting website (click on *Conference*, then *Student Info*) and then register for the meeting as a student volunteer.

STUDENT NETWORKING LUNCHEON

Mon., 5 Nov., 11:30 a.m.–1 p.m.

This luncheon, supported by industry donations and organized by GSA and AGI, features a FREE lunch for undergraduate and graduate students with an exciting opportunity to network with 40+ geoscience professionals.

MENTOR PROGRAMS

GSA runs four mentoring programs at the annual meeting, all designed to

- Concentrate on employment within various sectors;
- Confront specific issues;
- Facilitate future career choices by sharing resources, skills, and knowledge;
- Enhance professional development;

- Provide networking opportunities with professionals and other students; and
- Provide attendees with critical feedback.

GEOLOGY IN GOVERNMENT MENTOR LUNCHEON

Mon., 5 Nov., 11:30 a.m.–1 p.m.



This popular program, sponsored by the GSA Foundation, features a FREE lunch for undergraduate and graduate students with a panel of mentors representing the USGS, NASA, the National Park Service, the U.S. Forest Service, the U.S. Army Corps of Engineers, and the GSA-USGS Congressional Science Fellowship.

GEOLOGY IN INDUSTRY

Tues., 6 Nov., 11:30 a.m.–1 p.m.

Chevron, Shell, Alpha Natural Resources, CH2M Hill, ExxonMobil, the Society of Economic Geologists, and the GSA Foundation cosponsor this mentor program, which features a FREE lunch for undergraduate and graduate students with a panel of mentors representing these sponsors.

CAREER & NETWORKING

CAREER & NETWORKING OPPORTUNITIES

WOMEN IN GEOLOGY



Sun., 4 Nov., 5–6:30 p.m.

This mentor program, sponsored by Subaru of America Inc. and Shell, and supported by the Association for Women Geoscientists, addresses issues faced by women in geology. This informal gathering begins with remarks from a few key speakers, followed by time for networking, sharing ideas, and getting to know other women geoscientists and geosciences educators. See www.geosociety.org/meetings/2012/mentor.htm for a full list of speakers.

DIVERSITY IN THE GEOSCIENCES
SOCIAL RECEPTION

Tues., 6 Nov., 5:30–7:30 p.m.

The GSA Diversity in the Geosciences Committee and the NSF's Opportunities for Enhancing Diversity in the Geosciences would like to invite you to attend a relaxing forum for socializing, sharing ideas and meeting other geoscience community members interested in diversity issues. Appetizers and cash bar provided.

EMPLOYMENT SERVICES

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

Visit the GSA Employment Service Center!

Sunday, 4 Nov., 2–6 p.m.

Monday, 5 Nov., 9 a.m.–6 p.m.

Tuesday, 6 Nov., 9 a.m.–1 p.m.

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.



ANNUAL GEOSCIENCE EDUCATORS' RECEPTION

Sunday, 4 Nov., 6:30–8 p.m.

Geoscience educators at all levels are invited to this reception for networking and sharing ideas with other geoscience community members interested in education. *Appetizers and cash bar provided.*

SHORT COURSES FOR K–12 TEACHERS

All short courses for K–12 Teachers are on Saturday, 3 Nov.

511A. Active Lectures in Classrooms of All Sizes.

511B. Teaching about Hazards in the Geoscience Classroom.

511C. Making the Invisible Visible: Assessing Higher Order Thinking in your Students.

511D. Design an Effective Field Experience.

516. An Inquiry Approach to Teaching Plate Tectonics.

518. Using a Constructivist Approach to Teach Rocks.

524. Quantitative Literacy and Geology in the National Parks.

Check the website for details on which courses provide lunch, free resources, and discounts!





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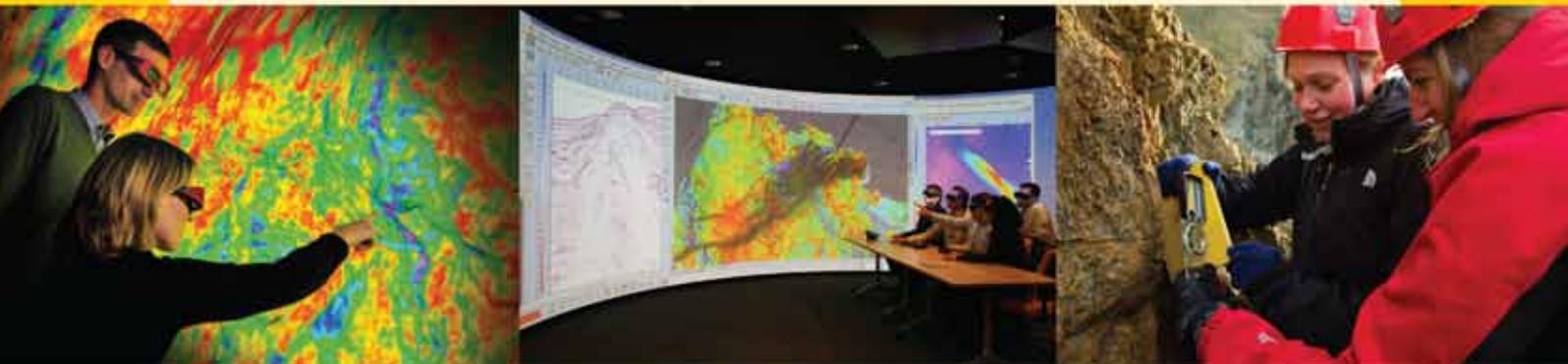
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Staying and Playing



Photo courtesy Visit Charlotte.

CHARLOTTE

STAYING

So, you know where you will be presenting, but do you know where you will be staying in Charlotte? Make your hotel reservation before the **9 October deadline** to take advantage of the GSA group rates. GSA has contracted with seven hotels in the Uptown Charlotte area. All hotels are within five blocks of the Charlotte Convention Center and are located along the LYNX light rail or are just a couple of blocks from a LYNX stop. Take advantage of the compact Uptown Charlotte area and reduce your need to use a car or taxi during the meeting.

Reservations can be made online, by phone, or by fax through the GSA Housing Bureau/Visit Charlotte. Making a reservation online provides you with the most up-to-date availability and an immediate confirmation. Remember, the GSA group rates include internet in the guest rooms—see the GSA website for all the details!

PLAYING

Combine your scientific trip with a leisure trip and bring your children to Charlotte. The youngest attendees can enjoy the meeting while you are in sessions by participating in the KiddieCorp childcare program. The program is open to children six months to 12 years for only US\$7 per hour per child (two hour min.). Register online through the GSA website.

Do you have a favorite place in the Charlotte area? Share it with fellow attendees at www.geosociety.org/meetings/2012/area.htm.

CREATE YOUR OWN MINI FOOD VACATION!

- Start with a traditional southern style meal at **Mert's Heart and Soul Restaurant**. Located on College Street by the Holiday Inn Center City, it is easy walking distance from the convention center. You don't want to miss Mert's buttery cornbread with shrimp and grits or their salmon cakes.
- If you are a fan of the farm-to-fork concept, add the **Harvest Moon Grille** to your food vacation. Located on N. Tryon Street, in the Dunhill Hotel, this restaurant is also walking distance from the convention center. The chef/owner is also the owner of **Grateful Growers Farms**. All food is sourced within 100 miles of Charlotte. Menus change almost daily, so stop by to see what fresh salads, seafood, and vegetarian options are on the menu.
- If you are a fan of the show, *Diners, Drive-ins and Dives*, you might know all about **Cabo Fish Taco**. Take a short ride to NoDa and enjoy the—what else?—fish tacos! Don't forget to add a side of the guacamole and maybe a margarita or two. This restaurant was a popular destination for some of the actors in *The Hunger Games*, which was filmed in and around Charlotte.
- Another local spot with ties to *The Hunger Games* is **Amélie's French Bakery**, which created some of the lavish sweet treats featured in the movie. There are two locations to choose from: the original in NoDa and the Uptown version located on S. Tryon, only a block or two from the convention center. The bakery serves pastries and breakfast sandwiches and also offers a coffee bar.



U.S. National Whitewater Center. Photo courtesy of Visit Charlotte.



Charlotte Light Rail. Photo courtesy of Visit Charlotte.

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Short Course Program

These courses fill up quickly—early registration is recommended. If you register after 1 Oct., you will need to pay an additional US\$30. Earn continuing education credits (CEUs)—all short courses offer CEUs, and most are at low or no cost. Go to the website for full course descriptions.

FAQ: Can I take a short course if I am not registered for the meeting? YES! You're welcome to—just add the meeting nonregistrant fee to your course enrollment cost. GSA K–12 teacher members: You are welcome to take short courses without registering for the meeting or paying the nonregistrant fee.

501. **New Developments in Fluorescence Spectroscopy to Characterize Dissolved Organic Matter.** Fri., 2 Nov., 8 a.m.–5 p.m. US\$35; includes continental breakfast and lunch.
502. **Sequence Stratigraphy for Graduate Students.** Fri.–Sat., 2–3 Nov., 8 a.m.–5 p.m. US\$25. **Bonus!** Get a US\$25 coupon for the onsite GSA bookstore when you sign in at the course.
503. **Field Safety Leadership.** Fri.–Sat., 2–3 Nov., 8 a.m.–5 p.m. US\$25; includes continental breakfast and lunch. **Bonus!** Get a US\$25 coupon for the onsite GSA bookstore when you sign in at the course.
504. **Introduction to Petroleum Structural Geology.** Fri.–Sat., 2–3 Nov., 8 a.m.–5 p.m. US\$25; includes continental breakfast and lunch. **Bonus!** Get a US\$25 coupon for the onsite GSA bookstore when you sign in at the course.
505. **Volcanic Crisis Awareness.** Fri., 2 Nov., 8 a.m.–5 p.m. and Sat., 3 Nov., 8 a.m.–noon. FREE, but you must register to attend.
506. **Structural and Stratigraphic Concepts Applied to Basin Exploration.** Fri.–Sat., 2–3 Nov., 9 a.m.–5 p.m. US\$25; includes continental breakfast and lunch. **Bonus!** Get a US\$25 coupon for the onsite GSA bookstore when you sign in at the course.
507. **Best Practices for Preparing Workforce and Transfer Students in Two-Year Colleges for Geoscience Careers.** Sat., 3 Nov., 8 a.m.–4 p.m. US\$25; includes lunch.
508. **Instructional Approaches to Access, Accommodation, and Inclusion of Students with Disabilities in the Geosciences.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$35; includes lunch. **Bonus!** This fee will be refunded upon completion of the course.
509. **Near-Surface Geophysics for Non-Geophysicists.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$110; includes lunch and course materials.
510. **Estimating Groundwater Recharge.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$140; includes lunch.
- 511A. **Active Lectures in Classrooms of All Sizes.** Sat., 3 Nov., 8 a.m.–noon US\$45; includes lunch. **Bonus!** Get two-for-one if you combine this course with 511C or 511D.
- 511B. **Teaching about Hazards in the Geoscience Classroom.** Sat., 3 Nov., 8 a.m.–noon. US\$45; includes lunch. **Bonus!** Get two-for-one if you combine this course with 511C or 511D.
- 511C. **Making the Invisible Visible: Assessing Higher Order Thinking in your Students.** Sat., 3 Nov., 1–5 p.m. US\$45; includes lunch. **Bonus!** Get two-for-one if you combine this course with 511A or 511B.
- 511D. **Design an Effective Field Experience.** Sat., 3 Nov., 1–5 p.m. US\$45; includes lunch. **Bonus!** Get two-for-one if you combine this course with 511A or 511B.
512. **Using the Grand Challenges to Improve Instruction of Scientific Literacy and Quantitative Reasoning.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$46; includes continental breakfast and lunch.
513. **Research Initiatives in Northern Hemisphere Quaternary Non-Marine Ostracoda, Workshop II.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$20; includes lunch. **Bonus!** Get a US\$20 coupon for the onsite GSA bookstore when you sign in at the course.
514. **Rationale and Methods for Regional 3-D Geological Mapping by Geological Survey Agencies.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$85; includes lunch.
515. **Education Research I: Conducting Qualitative Geoscience Education Research.** Sat., 3 Nov., 8 a.m.–noon. US\$70.
516. **An Inquiry Approach to Teaching Plate Tectonics.** Sat., 3 Nov., 8 a.m.–noon. US\$25, includes lunch. **Bonus!** Get a US\$25 coupon for the onsite GSA bookstore when you sign in at the course.
517. **U-Pb Geochronology and Hf Isotope Geochemistry Applied to Detrital Minerals.** Sat., 3 Nov., 9 a.m.–5 p.m. US\$41, includes continental breakfast and lunch.
518. **Using a Constructivist Approach to Teach Rocks.** Sat., 3 Nov., 1–5 p.m. US\$25, includes lunch. **Bonus!** Get a US\$25 coupon for the onsite GSA bookstore when you sign in at the course.
519. **Mars for Earthlings: Teaching Modules Integrating Earth and Planetary Science.** Sat., 3 Nov., 1–5 p.m. US\$20. **Bonus!** Get a US\$20 coupon for the onsite GSA bookstore when you sign in at the course.

GSA ANNUAL MEETING & EXPOSITION

520. **Getting Started in Undergraduate Research for New and Future Faculty.** Sat., 3 Nov., 1–5 p.m. US\$25.

521. **Recalling Optical Mineralogy: Teaching it with Newer Methods and its Role in Current Mineralogy Research.** Sat., 3 Nov., 8 a.m.–noon. US\$25.

522. **Communicating Science: Tools for Scientists.** Sat., 3 Nov., 1–5 p.m. US\$25. **Bonus!** Get a US\$25 coupon for the onsite GSA bookstore when you sign in at the course.

523. **Education Research II: Conducting Quantitative Geoscience Education Research.** Sat., 3 Nov., 1–5 p.m. US\$70.

524. **Quantitative Literacy and Geology in the National Parks.** Sat., 3 Nov., 1–5 p.m. US\$20. **Bonus!** This fee will be refunded upon completion of the course.

525. **Terrestrial Laser Scanning (Ground-Based LiDAR) Methods and Applications in Geologic Research & Education.** Sun., 4 Nov., 8 a.m.–5 p.m. US\$36, includes lunch. **Bonus!** Some financial support is available for student registrants.

526. **Introductory Remote Sensing for Geoscientists.** Sun., 4 Nov., 9 a.m.–5 p.m. US\$83, includes lunch.

527. **X-Ray Diffraction in Geosciences.** Sun., 4 Nov., 9 a.m.–5 p.m. US\$35, includes lunch. **Bonus!** Get a US\$25 coupon for the onsite GSA bookstore when you sign in at the course.

528. **Engaging ALL Students: Effective Strategies for Teaching Diverse College Students.** Sun., 4 Nov., 9 a.m.–5 p.m. US\$35, includes lunch.

GSA ASSOCIATED SOCIETY COURSE

The Paleontological Society: **Reconstructing Earth's Deep-Time Climate—The State of the Art in 2012.** Sat., 3 Nov., 8 a.m.–5 p.m. FREE. Limit: 200. Registration is not necessary; just show up to attend. Linda Ivany, Syracuse University; Brian Huber, Smithsonian Institution. Learn more at www.paleosoc.org.



Association for Women Geoscientists

WWW.AWG.ORG

The AWG Foundation supports AWG programs:

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

Join us for one of many exciting AWG events at GSA 2012



The hands that cradle the Rock

- * Women in Geology Mentor Program
Sunday, Nov 4th
5–6:30 PM
- * AWG Breakfast & Awards Ceremony
Monday, Nov 5th
6:30 AM
- * AWG Booth 441
Sunday through Wednesday

Association of Earth Science Editors 46th Annual Meeting

“Earth Science Editing for the World”

Hacienda Hotel—Old Town, San Diego, California
October 8–12, 2012

Technical sessions October 9–10

Field trip, Laguna Mountains to Anza-Borrego Desert
October 12

For more information about the annual meeting, visit www.aese.org or contact Carole Ziegler, host chair and president, SDAGeditor@gmail.com, or Melanie Parker, AESE vice president, technical program chair, mparker@usgs.gov.

AESE is an organization of editors, journal managers, and others involved with publication in the earth sciences. Its purpose is to facilitate cooperation among editors and to promote effective dissemination of earth-science information.

AESE maintains liaisons with AGI, AAAS, CSE, EASE, and GSA.

The registration fee for the annual meeting includes a current membership in AESE for new members. Membership benefits include a subscription to AESE's quarterly digital newsletter, the *Blueline*, and access to a members-only listserv and jobs board.

Follow us on our Web site at www.aese.org, on our blog at geoeditors.wordpress.com, on Facebook at tinyurl.com/3n2vrw, on Twitter at twitter.com/#!/AESErocks, and LinkedIn at tinyurl.com/3sept7e



Scientific Field Trips

Field-trip chairs: Missy Eppes, meppes@unc.edu; Jerry Bartholomew, jbrthlm1@memphis.edu

GSA contact: Beth Engle, bengle@geosociety.org

For trip descriptions, fees, services, and leader contact information (and if you have questions about a particular trip) please check the meeting website at www.geosociety.org/meetings/2012/FieldTrips.htm.

402. **Igneous Activity, Metamorphism, and Deformation in the Mount Rogers Area, SW Virginia and NW North Carolina: A Geologic Record of Precambrian Tectonic Evolution of the Southern Blue Ridge Province.** Thurs.–Sat., 1–3 Nov. US\$344.
403. **The Neocadian Orogenic Core of the Southern Appalachians: A Geo-Traversal through the Migmatitic Inner Piedmont from the Brushy Mountains to Lincolnton, North Carolina.** Thurs.–Sat., 1–3 Nov. US\$245.
404. **The New Madrid Seismic Zone.** Fri., 2 Nov. US\$79.
405. **Neoproterozoic to Mesozoic Petrologic and Ductile-Brittle Structural Relationships along the Alleghanian Nutbush Creek Fault Zone and Deep River Triassic Basin in North Carolina.** Fri.–Sat., 2–3 Nov. US\$185.
406. **Hydrology Field Research in the Congaree River Floodplain: Engaged Learning about Research, Resource Management, and Education at Congaree National Park.** Fri.–Sat., 2–3 Nov. US\$218.
407. **Traversing Suspect Terranes in the Central Virginia Piedmont: From Proterozoic Anorthosites to Modern Earthquakes.** Fri.–Sat., 2–3 Nov. US\$211.
408. **The Early-Middle Mississippian Borden-Grainger–Fort Payne Delta/Basin Complex: Field Evidence for Delta Sedimentation, Basin Starvation, Mud-Mound Genesis, and Tectonism during the Neocadian Orogeny.** Fri.–Sun., 2–4 Nov. US\$360.
409. **Disequilibrium in Landscape Evolution of the Southern Appalachian Mountains.** Sat., 3 Nov. US\$96.
410. **Historic Mill Ponds & Piedmont Stream Water Quality: Making the Connection near Raleigh, North Carolina.** Sat., 3 Nov. US\$102.
411. **Kirk Bryan Field Trip: Piedmont Potpourris: New Perspectives on An Old Landscape (and Some of its Younger Parts).** Wed., 7 Nov. US\$81.
412. **Significance of the Geology of the Talladega Belt to Southern Appalachian Tectonics.** Wed.–Fri., 7–9 Nov. US\$248.
413. **Of Mushwads and Mayhem: Disharmonically Deformed Gas Shale in the Southern Appalachian Thrust Belt.** Wed.–Fri., 7–9 Nov. US\$294.
414. **Geology, Geography, and Environment of Viticulture in the Upper Hiwassee River Basin, Southwestern North Carolina and Northern Georgia—Terroir of An Emerging American Wine-Producing Area.** Wed.–Fri., 7–9 Nov. US\$319.
415. **The Fractured Foundation of the Post-Orogenic (Mesozoic-Cenozoic) Southern Appalachian Piedmont and Coastal Plain in Georgia and South Carolina.** Wed.–Fri., 7–9 Nov. US\$300.
416. **Late Quaternary Geology and Geomorphology of Floodplain Deposits in Congaree National Park.** Thurs.–Fri., 8–9 Nov. US\$222.
417. **The Great 1886 Charleston Earthquake: Visible Damage from the Largest United States Earthquake of the 1800s.** Thurs.–Fri., 8–9 Nov. US\$194.
418. **Geology of Ediacaran–Earliest Cambrian Rocks of the Western Carolina Terrane in South Carolina.** Thurs.–Sat., 8–10 Nov. US\$308.
419. **Stratigraphy, Paleontology, and Geological Resources of the Upper Triassic Newark Supergroup Basins, North Carolina and Southern Virginia.** Thurs.–Sat., 8–10 Nov. US\$338.

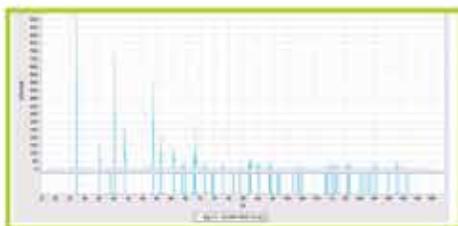




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Welcome to Charlotte



EpiCenter—Open air pavilion with great views of Charlotte skyline along with restaurants, shops, and entertainment

The Green—Great outdoor park with restaurants nearby. Pick up a quick to go lunch and enjoy the park!



11
NODA
Historic Arts
District

(11th to 36th is 2 miles)

5th Street & N. Tryon—At this intersection you will find a cluster of pubs such as RiRa's and Connolly's on Fifth

Gold Rush Shuttle & LYNX Rapid Transit

LYNX Blue Line

LYNX Stations

Gold Rush Shuttle

Orange Line

Red Line

Hotel Locations

- A.** Hilton Center City (Co-Headquarter)
- B.** Weston Charlotte (CO-Headquarter)
- C.** Hampton Inn Uptown
- D.** Hilton Garden Inn Uptown
- E.** Holiday Inn Center City
- F.** Marriott City Center
- G.** Omni Charlotte Hotel

Places of Interest

- 1** Bechtler Museum of Modern Art
- 2** Charlotte Convention Center
- 3** Discovery Place Science Museum
- 4** EpiCentre
- 5** Gant Center for African American Art + Culture
- 6** Historic South End
- 7** Levine Museum of the New South
- 8** Mint Museum of Art
- 9** NASCAR Hall of Fame
- 10** NC Music Factory
- 11** NODA

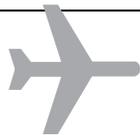


TRAVEL & TRANSPORTATION



Photo by Patrick Schneide, courtesy of Visit Charlotte.

GETTING TO CHARLOTTE



BY PLANE

Charlotte Douglas International Airport (CLT), which won the 2010 “Best Airport” award, serves more than 34 million passengers annually, with more than 670 daily flights and nonstop service to 138 national and international cities. The airport is a 15-minute drive from downtown/Center City. Taxi service is available curbside on the baggage claim level. Fare from the airport to Center City is ~\$25. Hotel courtesy vehicles may also be available. All participating hotels may be contacted through one of four traveler information centers on the baggage claim level. The airport also houses a variety of private shuttle services and car rental agencies that you can search online by clicking on “Visitor Services” and then “Ground Transportation” on the airport website, www.charlotteairport.com.



BY CAR

Highways I-77 and I-85 link Charlotte to hubs across the Northeast, Southwest, and Midwest, and I-40 offers a coast-to-coast link less than an hour north of the city. Visit www.nccommerce.com for further information.



BY BUS

Greyhound offers daily service to and from Charlotte along the East Coast and across the Southeast. Major cities include Raleigh, Atlanta, and Richmond. For more information contact www.greyhound.com.



BY TRAIN

Three Amtrak routes serve Charlotte, “the Queen City,” daily. The *Piedmont* connects Charlotte and Raleigh; the *Carolinian* runs to/from New York; and the *Crescent* travels from New York to New Orleans. More information on Amtrak schedules is available at www.amtrak.com.



Charlotte Convention Center.
Photo by Patrick Schneider,
courtesy of Visit Charlotte.



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Exhibitors by Category

Computer Software

International Centre for
Diffraction Data
iXRF Systems Inc.

Gems/Minerals Dealers, Jewelry/Gifts

Cornerstone Minerals
Finesilver Designs/Jewelry
Gems & Crystals Unlimited
IKON Mining & Exploration
Janice Evert Opals
Komodo Dragon
Natural Earth Craft LLC/Heidi
Scheirer McGrew

General Educational Products

Cengage Learning
Friendship Publications
i>clicker
Little River Research & Design
Macmillan New Ventures

Geographic Supplies and Related Equipment

Big C: Dino-Lite Scopes
Forestry Suppliers Inc.
Rite in the Rain

Geological and Geophysical Instrumentation

ASC Scientific
Bruker AXS
Decagon Devices Inc.
elementar Americas
EmCal Scientific Inc.
Gatan Inc.
Geophysical Survey Systems
Inc.
Gran Systems
Horiba Instruments Inc.
IsotopX Inc.
Leica Microsystems
Mala Geoscience USA Inc.
Meiji Techno America
Optech
PANalytical
Retsch Inc.
RIEGL USA
Rigaku Americas Corporation
Sensors & Software Inc.
Thermo Scientific
UNAVCO

Geological Society of America

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Geophysics Division
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Higher Logic Connected
Community
History and Philosophy of
Geology Division
Headquarters Services
Hydrogeology Division
Limnogeology Division
Membership Services
Mineralogy, Geochemistry,
Petrology, and Volcanology
Division
Planetary Geology Division

Government Agencies (Federal, State, Local, International)

NASA
NASA Earth Science Data &
Services
National Park Service
National Science Foundation
U.S. Forest Service
U.S. Geological Survey

Other

Consortium for Ocean
Leadership
Coordinating Office for
Research on the Sedimentary
Crust, Deep-Time, and
Earth-Life System
CUAHSI
EARTHTIME
Estwing Mfg. Co.
European Geosciences Union
IRIS Consortium
Subaru of America Inc.

Professional Societies and Associations

AAPG Bookstore & Student
Programs
AASP - The Palynological
Society
American Geophysical Union
American Geosciences
Institute
American Institute of
Professional Geologists
American Meteorological
Society
American Quaternary Assoc.
Assoc. for Women
Geoscientists
Assoc. of Earth Science Editors
Assoc. of Environmental &
Engineering Geologists
Clay Minerals Society
Council on Undergraduate
Research
Cushman Foundation
Environmental and
Engineering Geophysical
Society
Geochemical Society
Geological Assoc. of Canada
Geological Society of London
Geoscience Information
Society
GeoScienceWorld
Geoscientists *Without Borders*[®]
(SEG)
International Assoc. of
GeoChemistry
Mineralogical Assoc. of
Canada
Mineralogical Society of
America
National Assoc. of Black
Geologists & Geophysicists
National Assoc. of Geoscience
Teachers
National Cave & Karst
Research Institute
National Ground Water Assoc.
National Speleological Society
Paleontological Research
Institution
Paleontological Society
SEPM (Society for Sedimentary
Geology)
Sigma Gamma Epsilon

Society for the Preservation of
Natural History Collections
Society of Economic Geologists

Publications, Maps, Films

Cambridge University Press
Elsevier
Esri
Jones & Bartlett Learning
Kendall Hunt Publishing
McGraw-Hill Company
Micropaleontology Project
Nature Publishing Group
Pearson
Springer
Taylor & Francis
*Treatise on Invertebrate
Paleontology*
University of California Press
University of Chicago Press/
The Journal of Geology
W.H. Freeman
W.W. Norton
Waveland Press Inc.
Wiley-Blackwell
Yale University Press

Services (Exploration, Laboratories, Consulting, etc.)

Beta Analytic Inc.
DOSECC
Environmental Isotope Lab
Geoinformatics for the
Geosciences
GNS Science/Rafter
Radiocarbon Laboratory
Isotope Tracer Technologies
Ruen Drilling Inc.

State Surveys

Assoc. of American State
Geologists

Universities/Schools

American Museum of Natural
History—MAT Program in
Earth Science
Baylor Univ. Dept. of Geology
China University of
Geosciences
Cooper Center at California
State Univ.—Fullerton
EarthScope

Gemological Institute of America
 Geocognition Research Lab
 Mississippi State Univ.
 National Centre for Groundwater Research & Training

Texas A&M Univ. Dept. of Geology & Geophysics
 Univ. of Nevada–Las Vegas
 Univ. of Nevada–Reno
 Univ. of Texas at Austin Jackson School of Geosciences
 Wright State University

Note: Exhibitors are listed as of press time. Please check the meeting website for newer exhibitors.

GSA Exhibits Hall Opening Reception

Sunday, 4 Nov., 4:30–6:30 p.m.

Exhibit Hall Hours

Sunday, 4 Nov., 2–6:30 p.m.
 Monday, 5 Nov., 9 a.m.–6 p.m.
 Tuesday, 6 Nov., 9 a.m.–6 p.m.
 Wednesday, 7 Nov., 9 a.m.–2 p.m.

www.geosociety.org/meetings/2012

General Chair: Michael H. Powers
Technical Chair: Bruce D. Smith

| | | |
|---------------------------|------------------------|---------------------|
| Technical Sessions | <i>Save the Dates!</i> | Field Trips |
| Exhibits | | Workshops |
| Short Courses | | EEGS Annual Meeting |
| Special Sessions | | Posters |
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 The 5th Edition of Weather Studies introduces students to key meteorological concepts like temperature, pressure and stability by using real-world environmental data. The 5th Edition textbook features discussions on atmospheric rivers, the record-breaking 2011 tornado season, and hurricane-related extreme flooding events. The textbook is best utilized as part of the AMS Weather Studies course, including the corresponding full-color Investigations Manual and password-protected websites. A new look includes QR codes, providing access to animations and real-time maps.

AMS Ocean Studies
 Ocean Studies highlights the ocean's physical and chemical properties, and their effect on climate, coastlines and ecosystems. The 3rd Edition textbook features ocean-climate feedbacks, the Deepwater Horizon oil spill, the 2011 Japanese Tsunami, coastal dead zones, and oceanic methane hydrates. Full-color lessons investigating the world ocean on the AMS inflatable globe demonstrate the scale of global phenomena such as tides, the Coriolis Effect, and El Niño/La Niña.

AMS Climate Studies
 Climate Studies brings climate science to students at the introductory level. It explores the principles that govern Earth's climate system, climate variability and climate change. During the course, the concept of a global climate is developed as a multi-component, interactive system grounded in the laws of chemistry and physics. Topics include Earth's radiation budget, paleoclimate, and geoengineering mitigation efforts. Students experiment with a simple climate model, the AMS Conceptual Energy Model, and investigate data and information relevant to their lives.

Visit the AMS Education booth at the 2012 GSA Annual Meeting Booth #412
 Request an examination copy:
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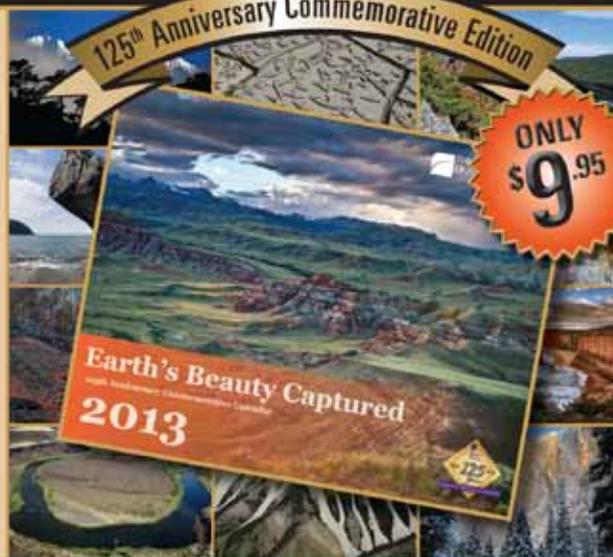
Earth's Beauty Captured

This 12-month, 11" x 14" calendar celebrates the beauty of nature, as well as GSA's 125th Anniversary. Photographs were selected from award-winning submissions to the 2011 GSA Annual Meeting Photo Exhibition in Minneapolis, Minnesota. Featuring many landscapes and iconic images, such as Kannesteinen (Norway), Grosvenor's Arch (Utah), and Twelve Apostles (Australia), as well as closer shots of mud curls (along the Utiuta River, Chile) and chevron folds (New Zealand), this stunning calendar will delight the geologist in all of us.

CAL2013, 11" x 14" calendar | \$9.95 (sorry, no additional discount)

SPECIAL FEATURES

- Dates of many noteworthy eruptions and earthquakes
- Monthly QR codes that link to a FREE version of 12 GSA articles of interest
- Birthdates of famous geoscientists
- Calendar of 2013 GSA events, meetings, and deadlines
- Timeline of important events in GSA history



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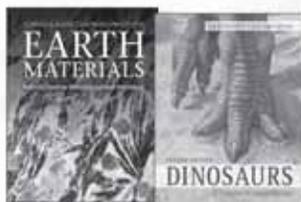
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Second Edition
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Planets and their Place in the Cosmos

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Second Edition
Climate Change Biological and Human Aspects

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\$69.99: Pb: 978-1-107-60356-1: 560 pp.

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Prices subject to change.

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REGISTRATION

| REGISTRATION FEES (in U.S. dollars) | Early | | Standard & On-Site | |
|--|----------|---------|--------------------|---------|
| | Full Mtg | One Day | Full Mtg | One Day |
| Member professional | \$330 | \$215 | \$410 | \$245 |
| Member professional (70+ years old) | \$255 | \$155 | \$340 | \$175 |
| Nonmember professional | \$430 | \$285 | \$510 | \$315 |
| Member student | \$109 | \$70 | \$144 | \$80 |
| Nonmember student | \$149 | \$90 | \$184 | \$100 |
| K-12 professional | \$50 | | \$60 | |
| High school student | \$40 | | \$40 | |
| Guest or Spouse | \$85 | | \$90 | |
| Field Trip or Short Course only | \$40 | | \$40 | |
| Low Income Country* | 50% | | 50% | |

*Participants from countries classified as “Low or Lower Middle Income Economies” by the World Bank need only pay 50% of the category fee for full meeting or one day registration. Online registration is not available for “Low or Lower Middle Income Economy” registrants; please fill out a printed version of the registration form (see the meeting website) and mail it to GSA, 3300 Penrose Place, Boulder, Colorado 80301, USA; or FAX to +1-303-357-1070.

WHEN YOU REGISTER, DON'T FORGET TO

- Register for tours, special events, field trips, and workshops;
- Apply for the Student Travel Grant (by 1 Oct.);
- Make your hotel reservation;
- Book your travel; and
- Invite a colleague to attend!

Reminder: Election Day (6 Nov.) occurs during the GSA meeting this year. We encourage attendees to vote early or request an absentee ballot. More information can be found at www.longdistancevoter.org.

GRANTS

Need assistance getting to the Annual Meeting? Don't forget to apply for a grant from a GSA Section or Division! Various groups are offering grants to help defray your costs for registration, field trips, travel, etc. Check out the website for application and deadline information. Note: Eligibility criteria and deadlines vary by grant.

Want to help? You can **donate to the Student Travel Fund** when you register.



GREENING OUR MEETINGS

In furtherance of GSA's mission in promoting stewardship of Earth, GSA works continuously to minimize the environmental impacts associated with the planning and execution of all our meetings. You can help in this effort—learn more via the *Green Meetings* link under the *About* tab for the annual meeting. You can also offset travel emissions via the GSA Foundation Energy Fund. All donations to the fund go toward reducing GSA's headquarters footprint on the environment. **To participate, check the box on your registration form**, and we'll collect US\$25 for the fund.



**GSA meetings are about SCIENCE
and scientific discussions are EVERYWHERE
at a GSA meeting!**

There are thousands of opportunities to network and socialize
—both formally and informally
—so join us for an invaluable experience.

*“As a first time attendee I was extremely impressed by
how orderly everything ran, and the sheer volume of talks, posters, and
activities that were put together in one place...
It was truly fascinating and a real learning experience.”*

*“I just really enjoyed learning more about different fields
in geology with like-minded individuals.”*

*“It was well organized, interesting, and had
excellent opportunities for networking.”*

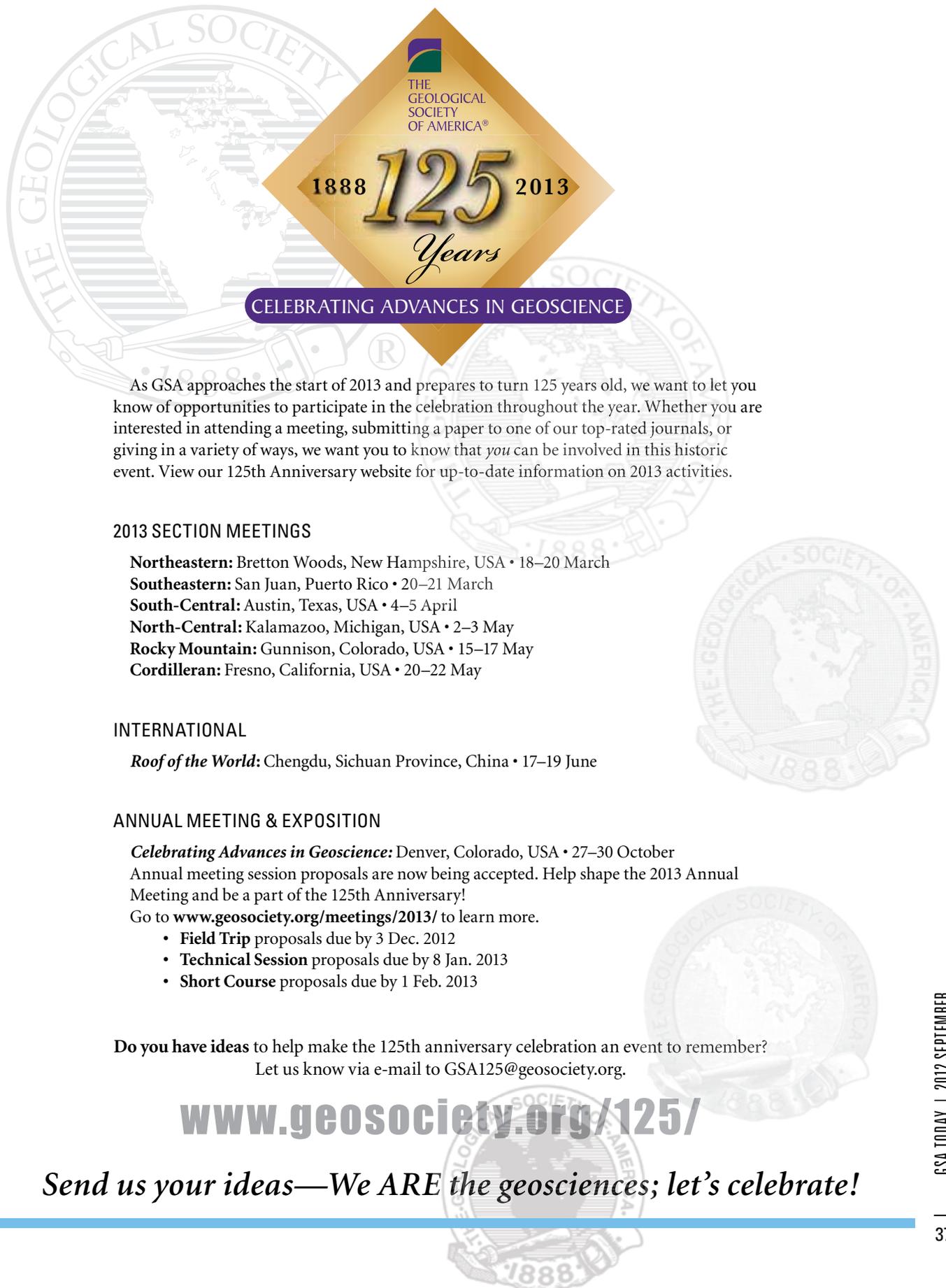
*“I always enjoy the diversity
and rich experience at GSA.”*



GSA ANNUAL MEETING & EXPOSITION

4–7 NOVEMBER 2012 • CHARLOTTE, NORTH CAROLINA, USA

The Geological Society of America is Turning 125!



As GSA approaches the start of 2013 and prepares to turn 125 years old, we want to let you know of opportunities to participate in the celebration throughout the year. Whether you are interested in attending a meeting, submitting a paper to one of our top-rated journals, or giving in a variety of ways, we want you to know that *you* can be involved in this historic event. View our 125th Anniversary website for up-to-date information on 2013 activities.

2013 SECTION MEETINGS

- Northeastern:** Bretton Woods, New Hampshire, USA • 18–20 March
- Southeastern:** San Juan, Puerto Rico • 20–21 March
- South-Central:** Austin, Texas, USA • 4–5 April
- North-Central:** Kalamazoo, Michigan, USA • 2–3 May
- Rocky Mountain:** Gunnison, Colorado, USA • 15–17 May
- Cordilleran:** Fresno, California, USA • 20–22 May

INTERNATIONAL

- Roof of the World:** Chengdu, Sichuan Province, China • 17–19 June

ANNUAL MEETING & EXPOSITION

Celebrating Advances in Geoscience: Denver, Colorado, USA • 27–30 October
Annual meeting session proposals are now being accepted. Help shape the 2013 Annual Meeting and be a part of the 125th Anniversary!

Go to www.geosociety.org/meetings/2013/ to learn more.

- **Field Trip** proposals due by 3 Dec. 2012
- **Technical Session** proposals due by 8 Jan. 2013
- **Short Course** proposals due by 1 Feb. 2013

Do you have ideas to help make the 125th anniversary celebration an event to remember?
Let us know via e-mail to GSA125@geosociety.org.

www.geosociety.org/125/

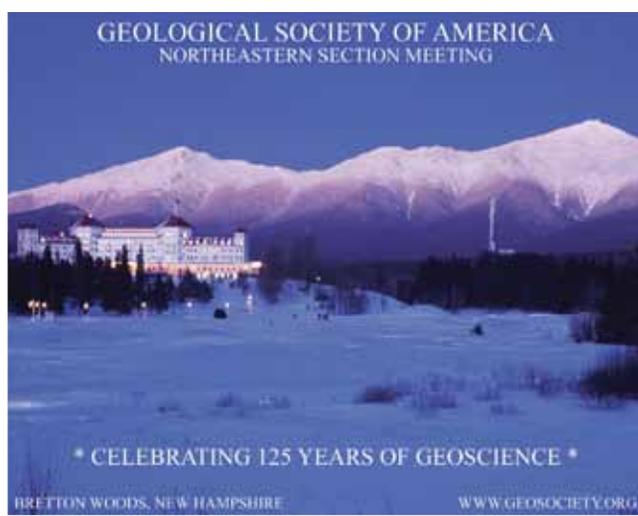
Send us your ideas—We ARE the geosciences; let's celebrate!

NORTHEASTERN

48th Annual Meeting of the Northeastern
Section, GSA

Bretton Woods, New Hampshire, USA
18–20 March 2013

www.geosociety.org/Sections/ne/2013mtg/



LOCATION

This meeting will celebrate the 125th Anniversary of the founding of GSA. Our venue is the spectacular Omni–Mount Washington Hotel, whose historic and gracefully relaxed atmosphere has fostered intellectual exchange and reflection for more than 100 years. This location is like no other for the Northeastern Section; it offers a unique opportunity for relaxed connection, learning, and celebration. Check the website for details of the Technical Program, unique advance registration and reservation opportunities, and special housing bargains for students.

CALL FOR PAPERS

Abstract Deadline: 11 December 2012

Please submit your abstract at www.geosociety.org/Sections/ne/2013mtg/techprog.htm. An abstract submission fee of US\$10 for students and \$15 for professionals is required. If you are unable to submit an abstract online, please contact Linda Battan, +1-303-357-1018, lbattan@geosociety.org.

Symposia

- S1. **Climate Change in Space and Time.** P. Thompson Davis, Bentley Univ., pdavis@bentley.edu; David Gilliken, Union College, gillikid@union.edu; Donald Rodbell, Union College, rodbell@union.edu.
- S2. **History of Geology in the Northeast: A Symposium to Mark the 125th Anniversary of the Geological Society of America.** Noel Potter, Dickinson College, pottern@dickinson.edu; Woodrow Thompson, Maine Geological Survey, woodrow.b.thompson@maine.gov.
- S3. **The Northern Appalachians: What We Have Learned in the Past 40 Years.** Yvette Kuiper, Colorado Schools of Mines, ykuiper@mines.edu; Doug Rankin, USGS (retired), dwraink@usgs.gov; Paul Karabinos, Williams College, paul.m.karabinos@williams.edu.

Theme Sessions

- T1. **Paleoenvironmental Records in the Northeast from the late Pleistocene to the Anthropocene.** Michael Retelle, Bates College, mretelle@bates.edu; Tim Cook, Worcester State Univ., tcook3@worcester.edu; Andrea Lini, Univ. of Vermont, alini@uvm.edu.
- T2. **Lakes as Sentinels for Climate Change: Monitoring and Sedimentary Records at the Junction of Paleo and Modern Limnology.** Lisa Doner, Plymouth State Univ., ladoner@plymouth.edu; Craig E. Williamson, Miami Univ., craig.williamson@muohio.edu.
- T3. **Salt Marsh Ecogeomorphology.** Beverly Johnson, Bates College, bjohnson3@bates.edu; Kristin Wilson, Allegheny College, kwilson@allegheny.edu; Susan Adamowicz, U.S. Fish and Wildlife Service, susan_adamowicz@fws.gov.
- T4. **Nearshore and Coastal Processes and Environments in the Northeast.** Joseph Kelly, Univ. of Maine, jtkelly@maine.edu; Daniel Belknap, Univ. of Maine, belknap@maine.edu.
- T5. **Critical Zone Processes.** Amada Albright Olsen, Univ. of Maine, amanda.a.olsen@maine.edu; Andrew S. Reeve, Univ. of Maine, asreeve@maine.edu; Sean M.C. Smith, Univ. Maine, sean.m.smith@maine.edu.
- T6. **State and Fate of Urban Wetlands in the Northeast.** Jonathan R. Gourley, Trinity College, jonathan.gourley@trincoll.edu; Suzanne O'Connell, Wesleyan Univ., soconnell@wesleyan.edu.
- T7. **Naturally Occurring Contaminants in Groundwater Used for Water Supply in the Northeastern United States.** Joseph D. Ayotte, USGS, jayotte@usgs.gov; Yan Zheng, Queens College, CUNY, and LDEO, Columbia Univ., yzheng@ldeo.columbia.edu.
- T8. **Naturally Occurring and Synthetic Fibers including Nanofibers and Nanotubes.** Brooke T. Mossman, Univ. of Vermont, brooke.mossman@uvm.edu; Catherine W. Skinner, Yale Univ., catherine.skinner@yale.edu.
- T9. **Geomorphic Impacts of Tropical Storm Irene.** Frank Magilligan, Dartmouth College, magilligan@dartmouth.edu; Shane Csiki, New Hampshire Geological Survey, shane.csiki@des.nh.gov.

- T10. **Glacial History of the New England–Canadian Border Region.** Woodrow Thompson, Maine Geological Survey, woodrow.b.thompson@maine.gov; Michel Lamothe, Univ. du Québec à Montréal, lamothe.michel@uqam.ca.
- T11. **Dates and Rates: Two Decades of Cosmogenic Studies in Eastern North America, the Canadian Arctic, and Greenland.** Paul R. Bierman, Univ. of Vermont, pbierman@uvm.edu; Lee Corbett, Dartmouth College, ashley.corbet.gr@dartmouth.edu; Meredith Kelly, Dartmouth College, meredith.a.kelly@dartmouth.edu.
- T12. **Unconventional Natural Gas Plays in the Eastern U.S. and Canada with Emphasis on the Marcellus Shale and Potential Impacts of Hydraulic Fracturing.** Brett McLaurin, Bloomsburg Univ. of Pennsylvania, bmclauri@bloomu.edu; Cynthia Venn, Bloomsburg Univ. of Pennsylvania, cvenn@bloomu.edu.
- T13. **Bridging the Curriculum Divide: Using Geophysical Data and Field Methods in Undergraduate Courses to Anchor Theory and Application.** Sean Cornell, Shippensburg Univ., srcornell@ship.edu; Joe Zume, Shippensburg Univ. jtzume@ship.edu.
- T14. **Natural and Induced Seismic Hazards in Intraplate Regions.** John E. Ebel, Weston Observatory, Boston College, ebel@bc.edu; Margaret Boettcher, Univ. of New Hampshire, margaret.boettcher@unh.edu.
- T15. **Past, Present and Future Mining in the Northeast USA and Adjacent Canada.** Jeri L. Jones, Jones Geological Services, jonesgeo@comcast.net; Brian Skinner, Yale Univ., brian.skinner@yale.edu.
- T16. **Rheological Information from Structures and Microstructures.** Chris Gerbi, Univ. of Maine, gerbi@umit.maine.edu; Scott Johnson, Univ. of Maine, johnsons@maine.edu.
- T17. **The Contributions of Geochemistry toward Our Understanding of the Appalachian Orogen.** Adam Shoonmaker, Utica College, adschoonmaker@utica.edu; Mike Dorais, Brigham Young Univ., dorais@byu.edu.
- T18. **Mesozoic Igneous Features of Northeastern North America: Magmatic Origins and Links to Tectonic Events.** J. Gregory McHone, Grand Manan, New Brunswick, Canada, greg@earth2geologists.net; John H. Puffer, Rutgers Univ., jpuffer@andromeda.rutgers.edu; G. Nelson Eby, UMass-Lowell, nelson_eby@uml.edu.
- T19. **Tectonic–Climate System Links: Insights from the Appalachian Orogen and Elsewhere.** Doug Reusch, Univ. of Maine–Farmington, reusch@maine.edu; John Garver, Union College, garverj@union.edu; Will Amidon, Middlebury College, wamidon@middlebury.edu.
- T20. **The New England–Canadian Bedrock and Tectonic Connections.** Keith Klepeis, Univ. of Vermont, keith.klepeis@uvm.edu; John Kim, Vermont Geological Survey, jon.kim@state.vt.us.
- T21. **Metamorphic Petrology and Thermodynamic Modeling: Progress and Practice.** Kurt Hollocher, Union College, hollochk@union.edu; Matt Manon, Union College, manonm@union.edu.
- T22. **Innovations in Geoscience Education and Research Using Google Earth and Related Digital Technologies.** Steve Whitmeyer, James Madison Univ., whitmesj@jmu.edu; Declan De Paor, Old Dominion Univ., ddepaor@odu.edu.
- T23. **Getting The Work Done: State Geological Surveys; Partnering and Progress.** Robert Marvinny, Maine Geological Survey, robert.g.marvinny@maine.gov; Laurence Becker, Vermont Geological Survey, laurence.becker@state.vt.us; Jonathan Kim, Vermont Geological Survey, jon.kim@state.vt.us; Rick Chormann, New Hampshire Geological Survey, frederick.chormann@des.nh.gov.
- T24. **The History of Exhumation in the Appalachians from Orogenic to Glacial Rebound.** Robert P. Wintsch, Indiana Univ., wintsch@indiana.edu; Mary Roden-Tice, SUNY-Plattsburgh, rodentmk@plattsburgh.edu.
- T25. **Environmental Geochemistry of Contaminants.** Rudolph Hon, Boston College, rudy.hon@bc.edu; Melissa Lombard, Keene State College, mlombard1@keene.edu; Douglas Allen, Salem State Univ., douglas.allen@salemstate.edu.
- T26. **The Syn-Rift and Early Post-Rift Sedimentary Tectonics and Biotic Record of the Late Proterozoic–Cambrian Transition, Northeastern North America.** Gary D. Johnson, Dartmouth College, gary.d.johnson@dartmouth.edu; David A. Franzi, Plattsburgh State Univ., franzida@plattsburgh.edu.
- T27. **The Emerging LiDAR Landscape: Applications of Digital Terrain Data in Research, Mapping, and Design.** Rick Chormann, New Hampshire Geological Survey, frederick.chormann@des.nh.gov; Fay Rubin, Univ. of New Hampshire, fay.rubin@unh.edu.
- T28. **Connecting Students with Place: Technology-Enhanced Teaching Using Local Resources.** Tarin Weiss, Westfield State Univ., tweiss@westfield.ma.edu; Bruce Rueger, Colby College, bfrueger@colby.edu.
- T29. **Refining the Iconic New York Devonian: A New Time-Rock Synthesis.** Charles Ver Straeten, New York Geological Survey, cverstra@mail.nysed.gov; Carlton Brett, Univ. of Cincinnati, carlton.brett@uc.edu; Gordon Baird, SUNY-Fredonia, gordon.baird@fredonia.edu; D. Jeffrey Over, SUNY-Geneseo, over@geneseo.edu.
- T30. **Ground–Penetrating Radar Investigations for Geologic Formations.** Steven Arcone, U.S. Army ERDC–Cold Regions Research & Engineering Laboratory, steven.a.arcone@erdc.dren.mil; Seth Campbell, Climate Change Institute, Univ. of Maine, seth.w.campbell@erdc.dren.mil.
- T31. **The New England Legacy of Jim Thompson: Stratigraphy, Tectonics, Phase Petrology, and Crystal Chemistry.** Peter Robinson, Geological Survey of Norway, peter.robinson@ngu.no; Charles Burnham, Fort Lewis College and Prof. Emeritus, Harvard Univ., burnham_c@fortlewis.edu.
- T32. **Mineral Transformations in the Environment: Geobiological and Geochemical Aspects.** Dawn Cardace, Univ. of Rhode Island, dawn.cardace@gmail.com; Amanda Olsen, Univ. of Maine, amanda.a.olsen@maine.edu; Nishanta Rajakaruna, College of the Atlantic, nishi.rajakaruna@gmail.com.

Field Trips

1. **Bedrock Geology and Tectonics of the Presidential Range on Nordic Skis.** J. Dykstra Eusden, Bates College, deusden@bates.edu.
2. **Type Localities of Marland Billings' 1935 Paleozoic Bedrock Stratigraphy near Littleton, New Hampshire.** Douglas Rankin, Scientist Emeritus, USGS, dwraink@usgs.gov.

3. **Glacial Geology and Archeology, Northern White Mountains.** Woodrow Thompson, Maine Geological Survey, woodrow.b.thompson@maine.gov; Richard Boisvert, New Hampshire Division of Historical Resources, richard.a.boisvert@dcr.nh.gov.
4. **Landslides in the White Mountains.** P. Thompson Davis, Bentley Univ., pdavis@bentley.edu.
5. **Mount Washington: Its Summit & Observatory.** Michelle Cruz, Mount Washington Observatory, mcruz@mountwashington.org; Steve Roberts, Mount Washington Observatory.
6. **Nature and Culture in Northern New Hampshire.** Catherine Amidon, Museum of the White Mountains, camidon@plymouth.edu.
7. **The Museum of the White Mountains.** Catherine Amidon, Museum of the White Mountains, camidon@plymouth.edu.

Workshops & Short Courses

1. **Building Google Earth Geologic Maps and Information Systems for Desktops, Laptops, and Mobile Devices.**
2. **LiDAR 101.**
3. **Working with LiDAR Data.**

4. **GIS on Pennies a Day: An Exploration of Free and Open Sources of GIS Software.**
5. **Mapping in an "App" World: The Power of Mapping with Your Phone.**
6. **Python Scripting for Earth Science Data Analysis.**
7. **Groundwater Issues Related to Fracking for Natural Gas Recovery.**
8. **Demonstration: Field Techniques in Paleolimnology, Ammonoosuc Lake, Crawford Notch, New Hampshire.**
9. **K–12 Earth-Space Science Education in the 21st Century.**

REGISTRATION

Early registration deadline: 11 February 2013

Cancellation deadline: 19 February 2013

ACCOMMODATIONS

Hotel registration deadline: 21 February 2013

A specially selected but limited block of rooms has been reserved in the Omni–Mount Washington Hotel and its nearby resort facilities at US\$149 + tax per room/night for professionals and US\$89 + tax per room/night for students and student groups. These rooms will book quickly, so we strongly encourage you to register for the meeting and reserve your space as soon as possible.

www.geosociety.org/Sections/ne/2013mtg/

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SOUTHEASTERN

62nd Annual Meeting of the Southeastern
Section, GSA

San Juan, Puerto Rico

20–21 March 2013

www.geosociety.org/Sections/se/2013mtg/



Palominito Islet, Puerto Rico. Image courtesy seepuertorico.com.

LOCATION

The Department of Geology at the University of Puerto Rico–Mayagüez is pleased to host the 62nd Annual Meeting of GSA's Southeastern Section in San Juan, Puerto Rico. The meeting will take place at the Caribe Hilton Hotel, which is located between historic Old San Juan and the Condado area. Puerto Rico is not only an idyllic tropical setting; it also features stunning geology and thousands of years of history and culture. The wide variety of geologic and geographic settings on the island (100 × 35 miles) include a world-class karst province, a central mountain range with igneous and metamorphic terrane, serpentinites, economic mineral deposits, a classic rudist outcrop, the only tropical rain forest in the U.S. National Forest system, limestone cliffs, and active tectonics. Also in store: geoarchaeology, natural hazards, anthropogenic impacts, water resource issues, and much more.

CALL FOR PAPERS

Abstract deadline: 11 December 2012

Submit online: www.geosociety.org/Sections/se/2013mtg/

Abstract submission fee: US\$10 for students; US\$15 for all others. Contact Linda Battan, +1-303-357-1018, lbattan@geosociety.org, if you are unable to submit your abstract via the online system.

Theme Sessions

- T1. **Gondwanan Crust and Lithosphere along the Gulf of Mexico Margin: The Record of Pangea Accretion and Dispersal.** David A. Foster, University of Florida, dafoster@ufl.edu; Paul A. Mueller, University of Florida, pamueller@ufl.edu; Craig B. Grimes, Ohio University, CGrimes@geosci.msstate.edu.
- T2. **Assessing Coastal Vulnerability: Technical and Management Considerations.** Chester Jackson, Georgia Southern, cjackson@georgiasouthern.edu; Clark Alexander, Skidaway Ocean Institute, clark.alexander@skio.usg.edu.
- T3. **Multidisciplinary Approaches to Caribbean Stratigraphy and Paleontology.** Jorge Vélez-Juarbe, Howard University, velezjuarbe@gmail.com; Alvin J. Bonilla-Rodríguez, University of Kansas, alvin12@ku.edu.
- T4. **Science Dissemination through Informal Geoscience Education: Current Approaches and Future Directions.** Pablo A. Llerandi-Román, Grand Valley State University, llerandp@gvsu.edu.
- T5. **Caribbean Earthquakes and Tsunamis.** Alberto López, University of Puerto Rico–Mayagüez, alberto.lopez3@upr.edu; Brian Atwater, USGS, atwater@usgs.gov; Christa G. Hillebrandt, NOAA, christa.vonh@noaa.gov.
- T6. **The Present is the Key to the Future: Experiences and Initiatives in Undergraduate Research.** Michael Martínez-Colón, University of South Florida, mmartin8@mail.usf.edu.
- T7. **From Provenance to Sequestration: A Heavy Metal Journey.** Michael Martínez-Colón, University of South Florida, mmartin8@mail.usf.edu; Warner Ithier-Guzmán, UPRRP, warner.ithier1@upr.edu.
- T8. **Using Interactive Video and Other Visualizations to Support Teaching and Enhance Learning in Geoscience Courses.** David McConnell, North Carolina State University, david_mcconnell@ncsu.edu; Katherine Ryker, North Carolina State University, kdalmqi@ncsu.edu.
- T9. **Karst Processes, Development, and Paleoclimate Studies in the Neotropics, Caribbean, and Gulf of Mexico.** Thomas Miller, University of Puerto Rico–Mayagüez, thomase.miller@upr.edu.
- T10. **Characterization and Utilization of Carbonate Reservoirs.** Tina Roberts-Ashby, USGS, troberts-ashby@usgs.gov; Jessica Pierson Moore, West Virginia Geological & Economic Survey, jmoore@geosrv.wvnet.edu.
- T11. **Critical Zone Processes and the Geology of Puerto Rico.** F.N. Scatena, University of Pennsylvania, fns@sas.upenn.edu.
- T12. **Quaternary Caribbean Reef Systems.** Clark Sherman, University of Puerto Rico–Mayagüez, clark.sherman@upr.edu; Wilson Ramírez, University of Puerto Rico–Mayagüez, wilson.ramirez1@upr.edu; David Cuevas, U.S. EPA Caribbean Environmental Protection Division, cuevas.david@epa.gov.
- T13. **Lesser Antilles: Volcanology, Petrology, and Monitoring.** Alan L. Smith, California State University, alsmith@csusb.edu; Lizzette A. Rodríguez, University of Puerto Rico–Mayagüez, lizzette.rodriguez1@upr.edu.

- T14. **Oceanic Trench Research in the 21st Century.** Wilford Schmidt, University of Puerto Rico–Mayagüez, wilford.schmidt@upr.edu; Alberto López, University of Puerto Rico–Mayagüez, alberto.lopez3@upr.edu; Manuel Jiménez, University of Puerto Rico–Mayagüez, mjuimenez@ece.uprm.edu; Hirohishi Kitazato, kitazato@jamstec.go.jp.
- T15. **Sustainable Water Resources and Water Treatment in Haiti.** Peter J. Wampler, Grand Valley State University, wamplerp@gvsu.edu; Richard R. Rediske, Grand Valley State University, redisker@gvsu.edu; Azizur R. Molla, Grand Valley State University, mollaziz@gvsu.edu.
- T16. **Extreme Interglacial Events: The Late Neogene–Quaternary Record of Climate Instability from North American and Caribbean Coasts.** Blair R. Tormey, Western Carolina University, btormey@wcu.edu; Paul J. Hearty, University of North Carolina–Wilmington, kaisdad04@gmail.com.
- T17. **Collaborative Seismology in the Caribbean and Central America.** Jay Pulliam, Baylor University, jay_pulliam@baylor.edu; Víctor Huérfano Moreno, Puerto Rico Seismic Network, victor@prsn.uprm.edu; Olga Cabello, IRIS Consortium, olga.cabello@iris.edu.
- T18. **Dolomitization in the Caribbean.** Luis González, University of Kansas, lgonzlez@ku.edu; Wilson R. Ramírez, University of Puerto Rico–Mayagüez, wilson.ramirez1@upr.edu.
- T19. **New Insights into Old Arcs: Petrology, Geochemistry, and Tectonics of Island Arcs.** Aaron J. Cavosie, University of Puerto Rico–Mayagüez, aaron.cavosie@upr.edu; Yomayra Román, Univ. of Puerto Rico–Mayagüez, yomayra.roman@gmail.com.
- T20. **The Shoreline of Puerto Rico: Session in Honor of Jack Morelock.** Maritza Barreto, University of Puerto Rico–Río Piedras, maritzabarretoorta@gmail.com; Wilson Ramírez, University of Puerto Rico–Mayagüez, wilson.ramirez1@upr.edu; David M. Bush, University of West Georgia, dbush@westga.edu;
- T21. **Volcanic Hazards and Risk in Latin America and the Caribbean.** Lizzette A. Rodríguez, University of Puerto Rico–Mayagüez, lizzette.rodriguez1@upr.edu; Carlos J. Ramírez Umaña, Universidad de Costa Rica, carlosjr@yahoo.com; Raúl Mora Amador, Universidad de Costa Rica, raulvolcanes@yahoo.com.mx; Gino S. González Ilama, Universidad de Costa Rica, ginovolcanico@gmail.com.
- T22. **Mapping Puerto Rico and Beyond in the Digital Age and in the Past: From the Mountains to the Sea, Exploring Historical and New Geospatial and Visualization Techniques for Crafting Modern Maps.** Chester W. Jackson, Jr., Georgia Southern University, cjackson@georgiasouthern.edu.
- T23. **Applications of Tracers in Geology, Hydrology, and Environmental Sciences.** Sam Mutiti, Georgia College, samuel.mutiti@gcsu.edu.

Workshops

1. **Problem-Based Learning Activity Workshop in Earth Science (Grades 4–9).** Michael Martínez-Colón, University of South Florida, mmartin8@mail.usf.edu; Shirley Mercado-González, Colegio San Juan Bosco–Santurce, csjbshirley@gmail.com.
2. **Coastal Hazards of Puerto Rico.** Chester W. Jackson, Jr., Georgia Southern University, cjackson@georgiasouthern.edu; David M. Bush, University of West Georgia, dbush@westga.edu.

Field Trips

1. **Karst Terranes of Puerto Rico: A Mix of Lithology, Hydrology, and Climate.** Thomas Miller, University of Puerto Rico–Mayagüez, thomase.miller@upr.edu. One day.
2. **Snorkeling Field Trip.** Milton Carlo, University of Puerto Rico–Mayagüez, milton.carlo@upr.edu. One day.
3. **Volcanic Evolution of Montserrat: From the Silver Hills to the Soufriere Hills Current Eruption.** Lizzette A. Rodríguez, University of Puerto Rico–Mayagüez, lizzette.rodriguez1@upr.edu; Alan L. Smith, California State University–San Bernardino, alsmith@csusb.edu; Paul Cole, Montserrat Volcano Observatory, paul@mvo.ms. Three days post-meeting.
4. **Geology of Mona Island.** Luis González, University of Kansas, lgonzlez@ku.edu; Wilson R. Ramírez, University of Puerto Rico–Mayagüez, wilson.ramirez1@upr.edu. Three days post-meeting.

ACCOMMODATIONS

A block of rooms has been reserved for meeting attendees at the Caribe Hilton, 1 San Geronimo St., San Juan, PR, USA, +1-787-721-0303. Room rate: US\$189 per night, plus tax. Please use group code “GSAA13” when making your hotel reservations.

LOCAL COMMITTEE

General Chairs: Lizzette A. Rodríguez, lizzette.rodriguez1@upr.edu; David M. Bush, dbush@westga.edu.

Technical Program Chairs: Aaron Cavosie, aaron.cavosie@upr.edu; Pablo Llerandi-Román, llerandp@gvsu.edu.

Field Trip Chairs: Wilson Ramírez, wilson.ramirez1@upr.edu; Thomas Miller, thomase.miller@upr.edu.

Student Involvement and Outreach: Fernando Gilbes, fernando.gilbes@upr.edu; Maritza Barreto, maritzabarretoorta@gmail.com.

Exhibits and Sponsorships: Jeanette López, jeanette.lopez2@upr.edu; Víctor Huérfano, victor@prsn.uprm.edu; Alejandro Soto, asoto@geocim.com.

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GSA FOUNDATION UPDATE

P. Geoffrey Feiss, GSA Foundation President

Student Support of GSA



Last year, 4,673 individual gifts—from almost 20% of GSA's active members—were received by the GSA Foundation in support of the myriad activities of GSA. This is a tribute to both the high quality of GSA programs that serve to inspire members to consider additional support beyond their dues as well as to the deep sense of commitment GSA members have to furthering the work of the society on behalf of all geoscientists.

As I expect many of these generous donors know, a significant portion of these gifts support the activities of GSA's student members. This may be through student research grants, career mentoring events, field camp scholarships, or internships on public lands through GSA's GeoCorps™ America program. Other gifts underwrite student travel to the GSA Annual Meeting, to Section Meetings, and to international meetings like the 34th International Geological Congress held last month in Brisbane, Australia.



What I suspect few GSA members realize is that included in these 4,673 gifts are 1,049 contributions from GSA's student members. While the actual dollar amount, predictably, may not be as proportionally large as the contributions from professional members—we all can recall how little spare cash we had as students—I believe this demonstration of confidence in GSA by our youngest and newest members and the future leaders of the profession is a graphic tribute to the impact of GSA's privately supported programs on all GSA members.

If you are one of our student supporters, thank you so much for your contribution. Your gift, no matter the size, gives me a sense that we are on the right path to meeting the needs and gaining the confidence of our profession's future practitioners.

And, if you are a student who gave last year and plan to attend the Annual Meeting in Charlotte this November, please stop by the GSA Foundation booth in the Exhibit Hall to receive our personal thanks, a small gift in recognition of your support, and a ribbon that you may attach to your nametag so others may be encouraged to follow your example in supporting the work of GSA on behalf of your fellow students.

If you would like to make a contribution to the Foundation, please go to www.gsafweb.org/makeadonation.html or contact Anna Christensen, Chief Development Officer, GSA Foundation, +1-303-357-1007, achristensen@geosociety.org.

Teacher Advocate Program (TAP)

"I walked away with knowing the relevance to implementing it into my curriculum."



Caves and Karst Evolution in the Classroom Earth Cycles
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Earth Science Teacher Advocate Representatives (ESTAR)

"Great hands-on activities!"

Having teachers as advocates for earth science is the key to getting students interested and informed about its importance. The purpose of GSA's Teacher Advocate Program is to provide support for teachers, and we are pleased to announce a new program: Earth Science Teacher Advocate Representatives (ESTAR).

ESTARs act as liaisons between teachers and school districts and GSA members and programs. They also serve as sources of information about GSA programs and the resources available to K-12 teachers.

ESTAR Objectives

1. Promote GSA (TAP) functions such as conferences and field camps;
2. Publicize non-GSA, earth science functions within the state;

3. Communicate with school districts to determine their needs and how GSA members can be of service to them (i.e., as judges for science fairs, hosting the "Science Speaker Series," create field trips for teachers, and so forth);
4. Connect GSA members with local schools; and
5. Recruit teachers to become GSA members.

Stay tuned—More details to follow!

Questions? Contact Davida Buehler, GSA Teacher Advocate Program Officer, at dbuehler@geosociety.org or +1-303-357-1015.

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Put your professional and academic background, experience applying scientific knowledge to societal challenges, and passion for shaping the future of the geosciences, to work in this coveted arena.

Apply today!



NOTICE

of Council Meeting

2012 GSA Annual Meeting
Charlotte, North Carolina, USA

The next meetings of the GSA Council will be 8 a.m.–noon, Saturday, 3 Nov. 2012, and 8 a.m.–noon, Wednesday, 7 Nov. 2012, at the Westin Charlotte, 601 South College Street, Charlotte, North Carolina, USA.

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.



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Classified Rates—2012

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, +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, boldface type, or special characters. Rates are in U.S. dollars.

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Positions Open

GEOCHRONOLOGY/GEOCHEMISTRY/ PETROLOGY/MINERAL PHYSICS THE DEPARTMENT OF EARTH SCIENCE AT THE UNIVERSITY OF CALIFORNIA AT SANTA BARBARA Dept. of Earth Science, Provision #: GEOL13, Geochronology / Geochemistry / Petrology / Mineral Physics

The Dept. of Earth Science at the University of California at Santa Barbara seeks a broadly educated geoscientist who conducts creative research on the long-term evolution of the solid Earth. A strong field orientation combined with expertise in analytical tools, such as electron-probe micro-analysis, electron-backscatter diffraction or mass spectrometry, is required. The appointee is expected to develop a vigorous, externally funded research program and teach a broad spectrum of undergraduate and graduate courses. This tenure-track appointment will be as an Assistant Professor to begin 1 July 2013.

A Ph.D. is required at the time of appointment. Review of applications will begin 15 October 2012. Applicants should request three referees to send letters of evaluation by 15 October. Applicants should submit a PDF containing a letter of application, curriculum vita, a description of teaching and research objectives and accomplishments, and the contact information of the referees who are providing letters. The application file and letters of reference should be submitted to betancourt@geol.ucsb.edu. Queries about this application can be directed to Bradley Hacker (hacker@geol.ucsb.edu).

The department is especially interested in candidates who can contribute to the diversity and excellence of the academic community through research, teaching and service. For more information about the department, visit our webpage (www.geol.ucsb.edu). UCSB is an Equal Opportunity/Affirmative Action employer.

TENURE-TRACK APPLIED GEOPHYSICIST BAYLOR UNIVERSITY

Baylor, the world's largest Baptist university, holds a Carnegie classification as a "high-research" institution. Baylor's mission is to educate men and women for worldwide leadership and service by integrating academic excellence and Christian commitment within a caring community. Baylor is actively recruiting new faculty with a strong commitment to the classroom and an equally strong commitment to dis-

covering new knowledge as Baylor aspires to become a top tier research university while reaffirming and deepening its distinctive Christian mission as described in Pro Futuris (www.baylor.edu/profuturis/).

The Dept. of Geology at Baylor University invites applications for a tenure-track Assistant Professor in Applied Geophysics, beginning August 2013. 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 14 geoscientists (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 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. The successful candidate should also have the potential to build a vibrant teaching program including graduate and 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). Applications will be reviewed beginning 30 Sept. 2012 and applications will be accepted until the position is filled. 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.

SENIOR-LEVEL FACULTY POSITION PALEOCLIMATOLOGY/PALEOCLIMATE MODELING, BAYLOR UNIVERSITY

Baylor, the world's largest Baptist university, holds a Carnegie classification as a "high-research" institution. Baylor's mission is to educate men and women for worldwide leadership and service by integrating academic excellence and Christian commitment within a caring community. Baylor is actively recruiting new faculty with a strong commitment to the classroom and an equally strong commitment to discovering new knowledge as Baylor aspires to become a top tier research university while reaffirming and deepening its distinctive Christian mission as described in Pro Futuris (www.baylor.edu/profuturis/).

The Dept. of Geology at Baylor University is pleased to announce a search for a new faculty position for hire with an open starting date beginning in August of 2013, in **Paleoclimatology or Paleoclimate Modeling**. The Department currently consists of 14 geoscientists, including geologists, geophysicists and geographers (please see the Department website at www.baylor.edu/Geology/ for further information). A Ph.D. in Geology, Geochemistry, Biogeochemistry, or related field is required at the time of appointment. The Geology Dept. seeks an individual with an established, strong research record and a research area that complements the existing group of six tenured and tenure-track faculty members in terrestrial paleoclimatology. Some examples might include bio-

geochemistry or paleoclimate modeling applied to field and laboratory studies of terrestrial climate records archived within fluvial (river and floodplain), eolian (loess and sand dune), lacustrine (lake), and coastal systems. The individual must be able to communicate and collaborate with Geology faculty members who are currently engaged in studies in the general area of paleoclimatology, and to carry out a vigorous externally funded research program that involves both undergraduate and graduate students. A strong commitment to excellence in teaching is essential, with both undergraduate and graduate courses that might include paleoclimate modeling or biogeochemistry, as well as other courses in his/her area of specialization. Research space for terrestrial paleoclimatology is available in the 500,000-square-foot "state-of-the-art" Baylor Sciences Building, and startup funds associated with this position are highly competitive.

Send letter of application, including statement of teaching and research interests, curriculum vitae, transcripts, and the names and contact information for three references to Dr. Steven G. Driese, Paleoclimatology Search Committee Chair, Dept. of Geology, Baylor University, One Bear Place #97354, Waco, TX 76798-7354 (Tel: 254-710-2361; applications sent by e-mail to Steven_Driese@baylor.edu). The review of applications will begin 1 December 2012 and applications will be accepted until the position is filled. 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.

ASSISTANT PROFESSOR STRATIGRAPHY AND SEDIMENTOLOGY (SEARCH #COS-295) SOUTHERN ILLINOIS UNIVERSITY— CARBONDALE

The Dept. of Geology at Southern Illinois University Carbondale invites applications for a tenure-track position in sedimentology and stratigraphy at the assistant professor level, starting 16 August 2013. More information is available at our website: www.siu.edu/jobs. SIU Carbondale is an affirmative action/equal opportunity employer that strives to enhance its ability to develop a diverse faculty and staff and to increase its potential to serve a diverse student population. All applications are welcomed and encouraged and will receive consideration.

GEOLOGIST III ENERGY RESOURCES TEAM, ALASKA DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

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The Alaska Division of Geological & Geophysical Surveys is recruiting for a Geologist III to join its state-wide Energy Resources program in Fairbanks. This is a permanent full-time position offering the successful candidate the opportunity to conduct geologic mapping and basin analysis projects related to hydrocarbon resource assessment across diverse terranes throughout Alaska. We are seeking a person with educational training and experience in geology with emphasis in sedimentology, stratigraphy, structural geology, and field mapping. Primary duties will be to perform geologic mapping and energy resource studies to acquire the data needed to understand and describe oil and gas sedimentary basins and their geologic framework. Experience interpreting subsurface data and conducting geologic field work in remote areas is desirable.

Application must be made on the Workplace Alaska website (<http://notes3.state.ak.us/wa/postapps.nsf/JobsByTitle?OpenView&Start=1&Count=30&Expand=7#7>) or by calling 1-800-587-0430 or 1-907-465-4095 for a hard copy application. These forms, on-line or hard copy, must be submitted to the Dept. of Administration, Division of Personnel, P.O. Box 110201, Juneau, AK 99811-0201. Fax: 1-907-465-2576. The State of Alaska is an EEO/ADA employer. Individuals requiring accommodations should call 1-800-587-0430 or 465-4095 in Juneau or (907) 465-3412 (TTY) or correspond with the Division of Personnel at the address above. The State of Alaska does not sponsor work VISAs for non-U.S. citizens; non-U.S. citizens must have a valid work VISA by the time the recruitment period closes in order to be considered.

**TENURE TRACK FACULTY POSITION
HYDROGEOLOGY, COLLEGE OF EARTH
AND MINERAL SCIENCES
DEPARTMENT OF GEOSCIENCES
THE PENNSYLVANIA STATE UNIVERSITY**

The Dept. of Geosciences at The Pennsylvania State University invites applications for a tenure-track faculty position in hydrogeology at the rank of Assistant Professor. We seek a colleague who will continue a strong departmental legacy in hydrologic sciences, complement highly active and diverse research programs in the Department and College through the development of a vigorous externally funded research program, and teach undergraduate and graduate courses in subsurface fluid flow. The successful candidate will also have the opportunity to participate in several campus-wide initiatives in water resources through the Penn State Institute for Energy and the Environment (www.psiee.psu.edu) and the Earth and Environmental Systems Institute (www.eesi.psu.edu).

Applicants should have a Ph.D. in geosciences or related field, with a research focus in physical, chemical, or biological hydrogeology. Potential areas of expertise include, but are not limited to, environmental hydrogeology, reactive flow and transport, global groundwater fluxes, water resources and energy, groundwater-Earth surface interaction, impacts of climate change on groundwater resources, cryospheric hydrogeology, and related areas. Outstanding candidates who creatively apply theoretical, observational, and/or experimental approaches in their research are especially encouraged to apply.

The Dept. of Geosciences is part of the College of Earth and Mineral Sciences, and houses top-ranked research programs in environmental and climate sciences, geology, geophysics, and geochemistry (further information is available at www.geosc.psu.edu). The Department and College also host research centers with foci on climate, environment, energy, and policy, including the Shale Hills Critical Zone Observatory; Earth System Science Center; the Penn State Ice and Climate Research Center; the Riparia Center; and the Center for Geomechanics, Geofluids, and Geohazards. There are wide-ranging opportunities for collaboration in hydrogeology research and education in the College's Dept. of Energy and Mineral Engineering and Energy Institute, and in departments within the Colleges of Engineering and Agricultural Sciences.

Candidates should send a complete curriculum vita, statements of research and teaching interests, and the names and contact information of four references to Chair, Hydrogeology Search, 503 Deike Building, The Pennsylvania State University, University Park, PA 16802; application materials can

also be sent electronically to hydrosearch@psu.edu. Appointment could begin as early as August 2013. Review of applications will begin on 15 Dec. 2012 and continue until the position is filled. For further information or questions, please e-mail us at hydrosearch@psu.edu.

Penn State is committed to affirmative action, equal opportunity and the diversity of its workforce. Women and members of underrepresented groups are encouraged to apply.

**ASSISTANT/ASSOCIATE PROFESSOR
GLOBAL CHANGE OCEANOGRAPHY
UNIVERSITY OF SOUTH CAROLINA**

The Marine Science Program (www.msoci.sc.edu) and the Dept. of Earth and Ocean Sciences (www.geol.sc.edu) at the University of South Carolina invite applications for a jointly appointed, tenure-track, assistant or associate professor position in Global Change Oceanography. The position is a 9-month academic year appointment. A Ph.D. is required at the time of appointment. Post-Doctoral experience is required. We are looking for an individual with outstanding research and teaching capabilities to complement existing programs in physical, chemical, biological and geological oceanography. Specifically, we seek a marine scientist with interests in examining oceanic responses to changes in climate on modern or geologic timescales. The ideal candidate will have already established themselves as a versatile and "broad thinking" marine scientist whose research has impacts on a global scale. The successful candidate is expected to teach undergraduate and graduate courses in marine science, and to direct an active externally funded research program. Applicants should include with their application their curriculum vita, a statement of research and teaching interests, and the names, addresses, e-mails, and phone numbers of at least three references. A pdf file containing this information should be sent electronically to globalchange2012@geol.sc.edu. For more information, please contact Dr. Tammi Richardson, Chair, Global Change Oceanography Search Committee by e-mail (tammirichardson@gmail.com), or Kelly Hamilton, Administrative Assistant, Marine Science Program, University of South Carolina, 701 Sumter Street, EWS 617, Columbia, SC 29208 (globalchange2012@geol.sc.edu). To ensure full consideration, applications should be submitted by 1 October 2012.

**ASSISTANT PROFESSOR
SEDIMENTARY SYSTEMS GEOLOGY
UNIVERSITY OF SOUTH CAROLINA**

The Dept. of Earth & Ocean Sciences (www.geol.sc.edu) at the University of South Carolina invites applications for a tenure-track, assistant professor position in the area of Sedimentary Systems Geology. The position is a 9-month academic-year appointment. A Ph.D. is required at the time of appointment. Post-Doctoral experience is preferred. We seek a candidate with outstanding research and teaching capabilities in sedimentary systems to complement our existing strengths in sediment transport, stratigraphy, geochemistry, geophysics, tectonics, paleoclimate, hydrology and paleoceanography. Although the specialty is open, we are looking for an individual with broad or interdisciplinary research interests that combine field, theoretical and experimental approaches to address scientific problems on a variety of timescales. Areas of interest include but are not limited to source-to-sink dynamics, basin analysis, paleoclimatology of sedimentary rocks, sea-level change & sequence stratigraphy, sedimentary geochemistry, energy resources, or stratigraphic

paleobiology. The successful candidate is expected to direct an active externally funded research program, and to teach undergraduate courses in sedimentology-stratigraphy, Earth history, and/or field geology, as well as graduate courses specific to her/his field. Applications should include a curriculum vita, a statement of research and teaching interests, and the names, addresses, e-mails, and phone numbers of at least three references. A single pdf file containing this information should be sent by e-mail to sedsystems2012@geol.sc.edu. For more information, please contact Search Committee Chair by e-mail at sedsystems2012@geol.sc.edu. To ensure full consideration, applications should be submitted by 1 October 2012.

**GEOCHEMIST/PETROLOGIST
ASSOCIATE/ASSISTANT PROFESSOR
OCCIDENTAL COLLEGE**

The Dept. of Geology at Occidental College invites applications for a tenure-track/tenured faculty position in geochemistry/petrology. We seek a broadly educated geologist with the academic training to teach mineralogy, petrology, and geochemistry and contribute to teaching introductory geology and in Occidental's Core Program. Courses taught by the successful applicant should enhance students' understanding of chemical processes acting on the earth, and increase students' expertise in quantitative and instrumental methods. The successful applicant faculty member will be expected to sustain an active research program involving undergraduates and mentor students through completion of their Senior theses.

Applications including (1) a letter of interest demonstrating a commitment to academic excellence in a diverse liberal arts environment, highlighting teaching and research interests; (2) a curriculum vitae; (3) 1-3 significant publications; and (4) contact information for three referees should be submitted to the Search Committee at geosearch1@oxy.edu. Applicants may meet with search committee members at the GSA and AGU meetings; contact the search committee in advance. Address inquiries to Dr. James Sadd, Chair, jsadd@oxy.edu. Review of applications will begin 15 October 2012, and will continue until the search closes on 10 December 2012.

Occidental is a nationally ranked liberal arts college recognized for its diverse student body and outstanding undergraduate research program. Occidental College is an equal opportunity employer. Members of underrepresented groups are strongly encouraged to apply.

**ENVIRONMENTAL EARTH SCIENCES
FACULTY POSITION
UNIVERSITY OF NOTRE DAME**

The Dept. of Civil and Environmental Engineering and Earth Sciences, University of Notre Dame, invites applications for a tenure-track or tenured position in Environmental Earth Sciences to complement existing faculty in Earth science and environmental engineering. Qualified candidates at all levels will be considered, with hiring rank and tenure status commensurate with academic accomplishments. Areas of interest include, but are not limited to stable isotope geochemistry, global climate change, C sequestration, reactive transport, and biogeochemistry. The department has a unique blend of Earth science and environmental engineering faculty, and has outstanding research facilities. Our current strengths include environmental geochemistry, mineralogy, actinide chemistry and materials, high temperature isotope geochemistry, geochronology, planetary

geology, geomicrobiology, environmental engineering, environmental and computational fluid mechanics, and groundwater hydrology. Information about the department can be found at <http://ceees.nd.edu/> (note recent department name change from Civil Engineering & Geological Sciences). We seek individuals with dynamic and highly innovative research agendas that can cross traditional disciplinary boundaries. Qualifications include a Ph.D. in a field within the Earth Sciences or allied disciplines. Candidates are expected to exhibit a dedication to excellence in research, teaching, and professional service. The application package should include a cover letter addressing preparation for this position, curriculum vitae, a statement of research and teaching interests, and names and contact information of at least three references. Applications should be uploaded directly, as a single PDF file, to <http://engineering.nd.edu/departments/ceees/positions-available>; or by e-mail to Prof. Jeremy B. Fein, Chair of the Environmental Earth Science Search Committee (earthsci@nd.edu), Dept. of Civil and Environmental Engineering and Earth Sciences, 156 Fitzpatrick Hall, University of Notre Dame, Notre Dame, IN 46556-0767. Review of applications will begin immediately, but applications will be accepted until the position is filled. The University of Notre Dame is committed to diversity and equality in education and employment, and women and members of underrepresented minority groups are strongly encouraged to apply.

TWO POSITIONS SEDIMENTARY PROCESSES AND GLOBAL CHANGE SCIENTIST/ ENVIRONMENTAL BIOGEOCHEMIST DEPT. OF EARTH & ENVIRONMENTAL SCIENCES BOSTON COLLEGE

The Dept. of Earth and Environmental Sciences at Boston College invites applications for two Earth Systems Scientists to start in Fall 2013.

Sedimentary Processes. This is a tenure-track position expected to be made at the Assistant Professor level. Areas of expertise might include (but are not limited to): basin analysis, reflection seismology, sediment transport, and biogeochemical processes in sedimentary systems. The successful candidate will be expected to develop a vigorous externally funded research program integrated with excellence in teaching within the geological sciences and environmental geoscience curriculum at both the undergraduate and graduate levels, including teaching courses in Sedimentology and Stratigraphy for majors.

Global Change Scientist/Environmental Biogeochemist. Areas of expertise might include (but are not limited to): elemental cycling and associated climate feedbacks, organic geochemistry of marine, freshwater and soil environments, and coupled hydrogeomorphic-ecosystem response to natural and human-caused change and disturbance. The successful candidate will be expected to develop a vigorous externally funded research program integrated with excellence in teaching within the earth and environmental geoscience curriculum at both the undergraduate and graduate levels, including teaching introductory courses in climate change, and upper level electives in the area of the successful candidate's expertise. Applicants at all experience levels will be considered. A successful candidate at the associate or full professor level will be expected to participate in development of interdisciplinary environmental programs.

Information on the department, its faculty and research strengths can be viewed at www.bc.edu/

essences. Applicants should send a curriculum vita, statements of teaching and research interests, and the names and contact information of at least three references as a single PDF-file e-mail attachment to either sedpos@bc.edu or globalchange@bc.edu. Review of applications will begin on 12 November 2012. 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.

TENURE TRACK FACULTY POSITION STRUCTURAL GEOLOGY DEPARTMENT OF GEOLOGY CALIFORNIA STATE UNIVERSITY, SACRAMENTO

The Geology Dept. at California State University, Sacramento, invites applications for a tenure-track faculty position at the Assistant Professor level, beginning Fall 2013. Applicants must hold a Ph.D. in geology by the time of appointment. Enthusiasm and a demonstrated commitment to teaching and mentoring are required. We encourage applicants with field-based research interests and strong skills in geologic mapping. Proficiency in active tectonics, neotectonics, GPS, GIS, LiDAR and/or other remote sensing applications is preferred.

The successful candidate will embrace the opportunity to teach general education courses to a diverse student population, conduct a field-based research program that involves undergraduate and graduate geology students, and be a full-engaged participant in a small, collegial department.

Applicants must submit (1) a cover letter that addresses their qualifications for the position, their teaching interests and experience, and their scholarly interests and experience; (2) a curriculum vita; (3) several examples of the candidates geologic mapping; (4) transcripts of college work (unofficial transcripts are acceptable; to be followed later by official transcripts before hiring); (5) three letters of reference (which may be sent directly to the search committee); and (6) the contact information (mailing address, phone number and e-mail address) for three references who can speak to the professional qualifications of the applicant. Send application material to Chair of Search Committee, Dept. of Geology, California State University, Sacramento, 6000 J Street, Sacramento, CA 95819-6043. Screening of applications will begin 2 November 2012.

Additional information can be found at www.csus.edu/geology.

GEOCHEMISTRY, PETROLOGY, AND MINERAL RESOURCES, UNIVERSITY OF ARIZONA

The Dept. of Geosciences at the University of Arizona seeks to hire a tenure-track faculty member at the Assistant or Associate Professor level with a commitment to interdisciplinary work in the general area of mineral resources. The position has been created as part of a campus-wide initiative on the sustainability of mineral resources. The successful candidate is expected to actively engage in multidisciplinary research and teaching through the Dept. of Geosciences, the School of Earth and Environmental Sciences, the partnerships and initiatives of the Lowell Institute for Mineral Resources and related professional programs. Areas of interest are very broad, and examples include: fluids in crustal processes, geothermal or active magmatic or metamorphic

systems, isotope geochemistry or petrology, or biogeochemistry of metal systems. Approaches can be field, lab or theoretical and could involve settings from surficial to magmatic, scales from microscopic to global, topics from basic science to applications and policy. The Department is seeking an individual who is able to work with diverse students and colleagues. The candidate's research should be original and address significant geological and/or geochemical questions. Apply to UA Job Number 50151, <http://www.hr.arizona.edu/jobs>; review of applications will begin on 15 September and continue until the search is completed. In addition to a cover letter, CV, and statement of teaching and research interests, please submit (preferably by e-mail) up to five reprints of published work and provide the names and contact information for at least three references to gpersearch@e-mail.arizona.edu or, by mail to The GPER Search Committee, Dept. of Geosciences, University of Arizona, Tucson, AZ 85721-0077, USA.

FACULTY POSITIONS IN AQUEOUS/LOW-TEMPERATURE GEOCHEMISTRY, GECHRONOLOGY, AND GLOBAL CLIMATE CHANGE AT THE UNIVERSITY OF MICHIGAN

The Dept. of Earth and Environmental Sciences at the University of Michigan is searching for tenure-track faculty candidates for a university-year appointment in the areas of Aqueous/Low-Temperature Geochemistry, Geochronology, and Global Climate Change, starting September 2013. Appointments at the assistant professor level are preferred, but exceptional candidates at higher levels will be considered. We encourage applications from candidates with records of research and teaching in any one of these areas.

Successful candidates are expected to establish an independent research program and contribute to both undergraduate and graduate teaching in a large public university. Candidates whose research and teaching complement and enhance the existing programs in the Dept. of Earth and Environmental Sciences will receive special consideration. Applicants must have a Ph.D. and should submit a CV, statement of current and future research plans, statement of teaching philosophy and experience, and contact information for at least four persons who can provide letters of recommendation.

Further information about the Department and the positions can be found at www.lsa.umich.edu/earth. To apply please go to www.earth.lsa.umich.edu/facultysearch/newapplicant, complete the online form, and upload the required application documents as a single PDF file. If you have any questions or comments, please send an e-mail message to earth-search@umich.edu.

The application deadline is 24 Sept. 2012 for full consideration, but applications will continue to be reviewed until the position is filled. Women and minorities are encouraged to apply. The University is supportive of the needs of dual career couples. The University of Michigan is an equal opportunity/affirmative action employer.

WILLIAM E. WHITE POSTDOCTORAL SCHOLARSHIP IN GEOLOGICAL SCIENCES AND GEOLOGICAL ENGINEERING QUEEN'S UNIVERSITY AT KINGSTON ONTARIO, CANADA

The Dept. of Geological Sciences and Geological Engineering of Queen's University, one of Canada's premier earth-science departments, invites applica-

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tions for its William E. White Postdoctoral Scholarship, created from a fund endowed by the estate of William E. White. The award will be made for one year and may be renewed for a second year. The annual stipend will be no less than \$50,000.

The William E. White Postdoctoral Scholarship will be awarded to an outstanding scientist who has completed the Ph.D. degree, normally within the two-year period preceding the time of the appointment. The area of research is open, but the scholar's research must be complementary to that being pursued in the Dept. of Geological Sciences and Geological Engineering. The research program to be undertaken and the level of support of research costs and moving expenses will be negotiated with a faculty member at the time the award is made. Potential applicants may obtain an outline of current research interests on the Departmental website, www.queensu.ca/geol/index.html, and are strongly encouraged to initiate contact with a potential faculty supervisor in advance of applying. Fit with the research interests of the Department and the research excellence of the

candidate will be the primary considerations in the selection process.

The Department invites applications from all qualified individuals. Queen's University is committed to employment equity and diversity in the workplace and welcomes applications from women, visible minorities, aboriginal people, persons with disabilities, and persons of any sexual orientation or gender identity.

Applicants should send a curriculum vitae, a statement of research interests, and samples of research writing to the following address. Applicants should contact their referees and arrange for at least three confidential letters of reference to be sent to the address below. Review of complete applications will begin on 30 Sept. 2012.

Professor D. Jean Hutchinson, Department Head, Dept. of Geological Sciences and Geological Engineering, Queen's University, Kingston, Ontario, Canada, K7L 3N6, Fax: 613-533-6592, hyde@geol.queensu.ca.

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The annual GeoCorps Alumni Reception takes place on at the 2012 GSA Annual Meeting on Monday, 5 Nov., 5–6:30 p.m. in the Harris Room at the Westin in Charlotte, North Carolina, USA. All past and present participants, partners, supervisors, and sponsors are invited to attend.

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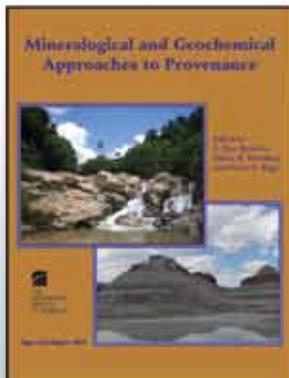
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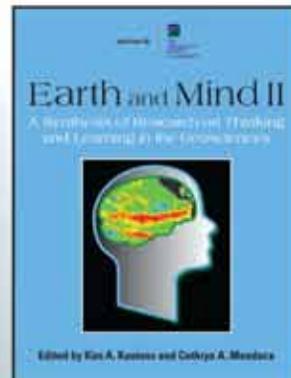




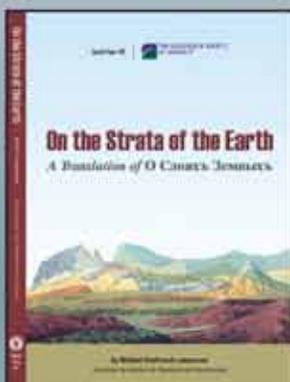
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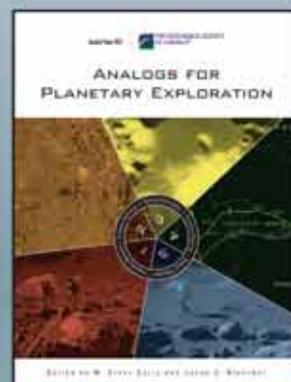
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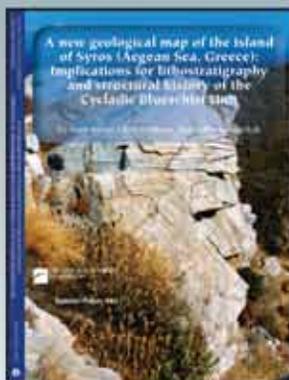
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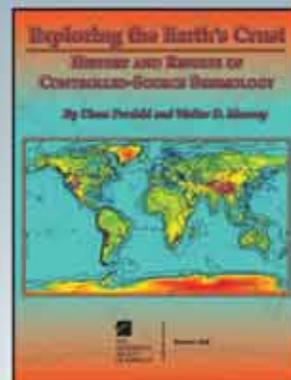
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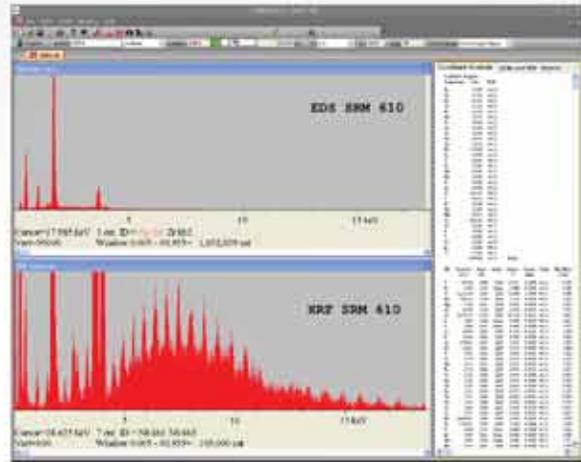
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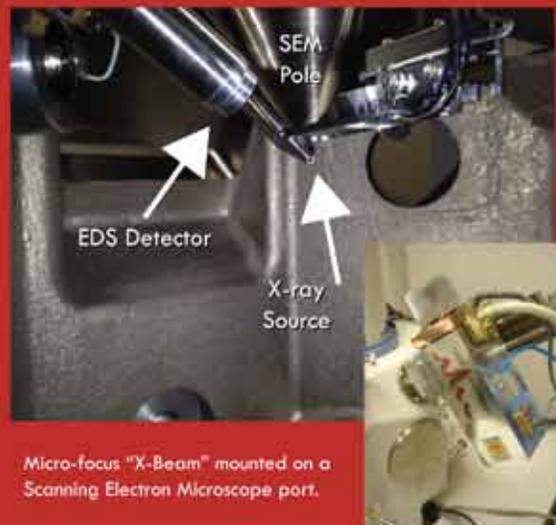
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- **Rocky Mountain Field Camp:** Boulder, Colorado, USA, 21–26 June.
- **Explore Hawaiian Volcanoes:** Hilo, Hawaii, USA, 11–19 July (this trip is open to all K–12 educators and their families).
- **Iceland—Land of Fire and Ice:** Reykjavik, Iceland, 30 July–5 August.

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Educators on a recent GSA GeoVenture to Iceland examined the Almannagjá fault at Þingvellir National Park, the site of one of the best surface expressions of mid-ocean rifting anywhere on Earth. Þingvellir is considered the most important cultural heritage site in Iceland and has been classified as a UNESCO World Heritage site.

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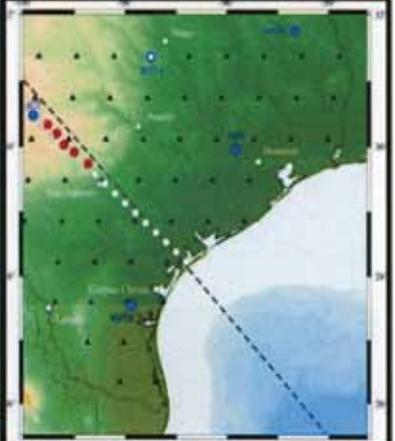
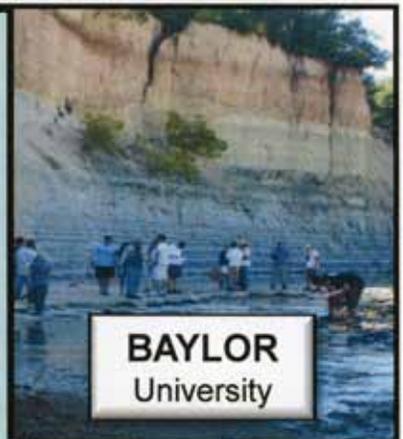
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Publications Highlights

New Impact Factors Announced

Thomson Reuters released its 2011 impact factors in June, with GSA journals making a strong showing.

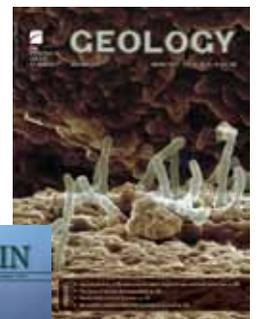
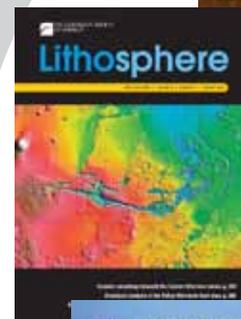
Geosphere's impact factor of 2.120 reflects a gain for the fourth year in a row. The journal's five-year impact factor, at 2.651, is also an increase.

Lithosphere, in its second year appearing on the report, is holding steady as the #11 ranked journal in the geology category. Its 2011 impact factor is 1.738.

With a 2011 impact factor of 3.612 and a five-year impact factor of 4.306, **Geology** continues to hold its spot as the #1 ranked journal in the geology category.

Geological Society of America Bulletin's impact factor rose to 3.787, the fourth consecutive increase. With a five-year impact factor of 4.045, it is the #10 ranked multidisciplinary geosciences journal.

As announced last year, Thomson Reuters selected GSA's Special Papers, Memoirs, and Reviews in Engineering Geology to include in its new Book Citation Index.



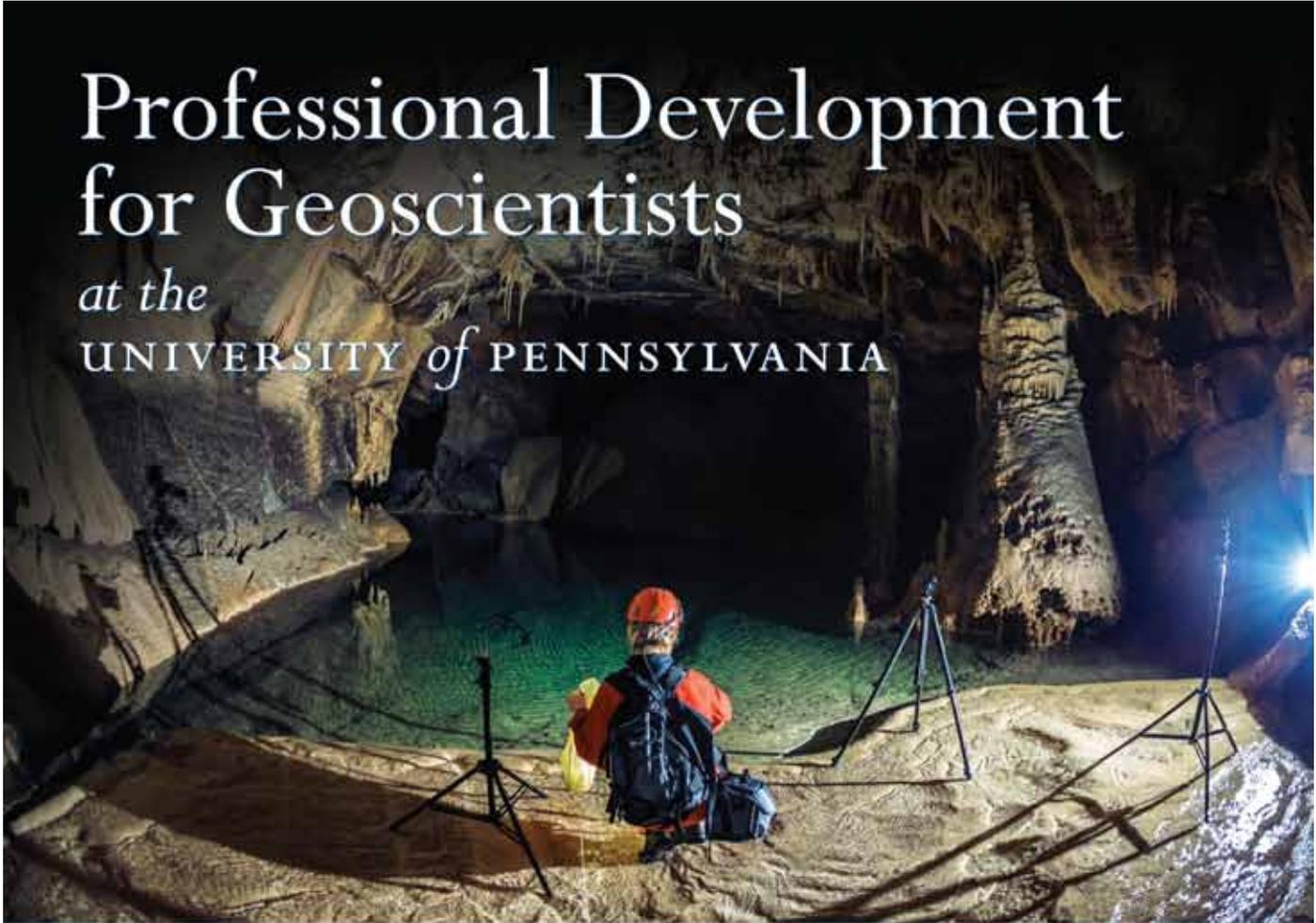

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