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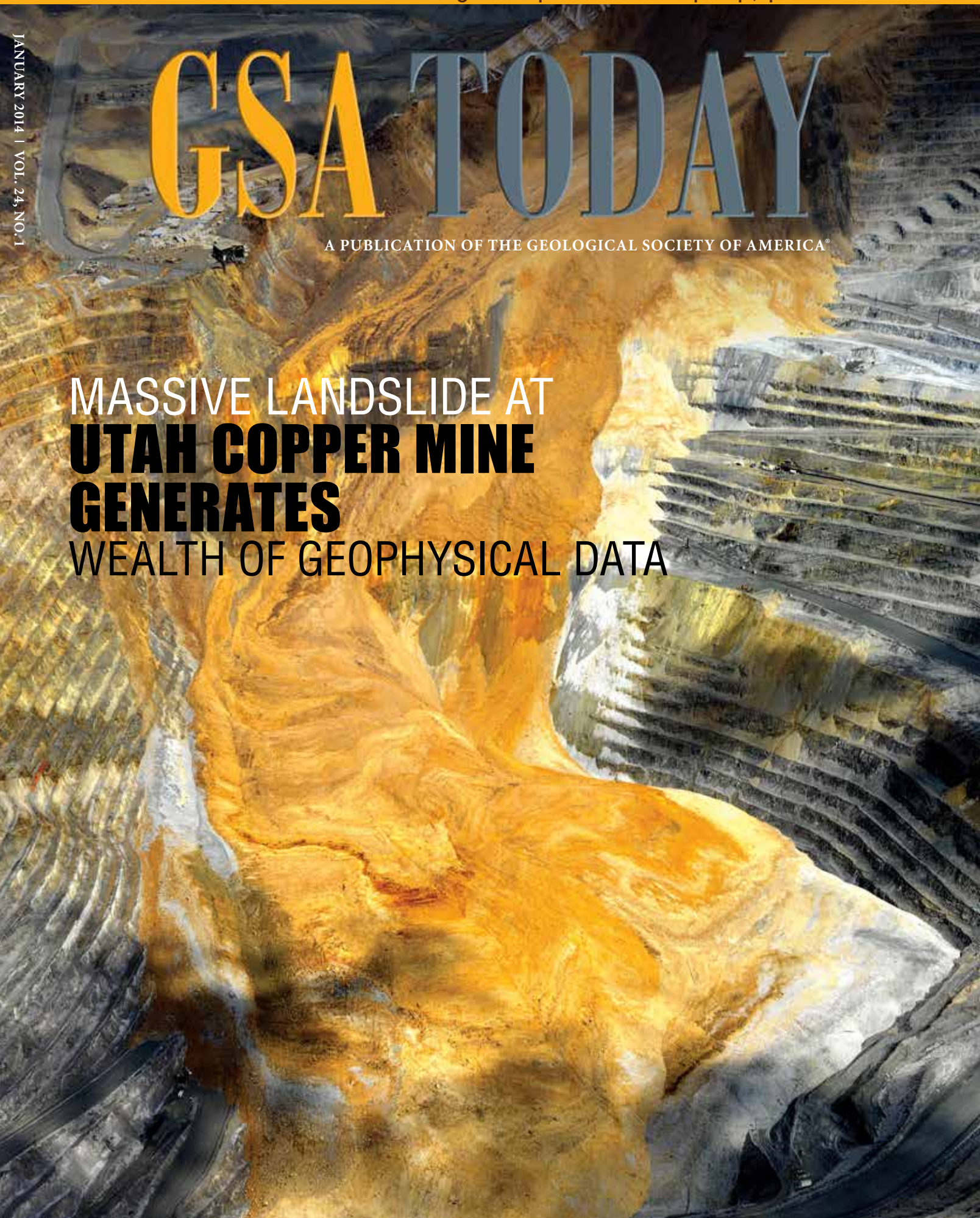

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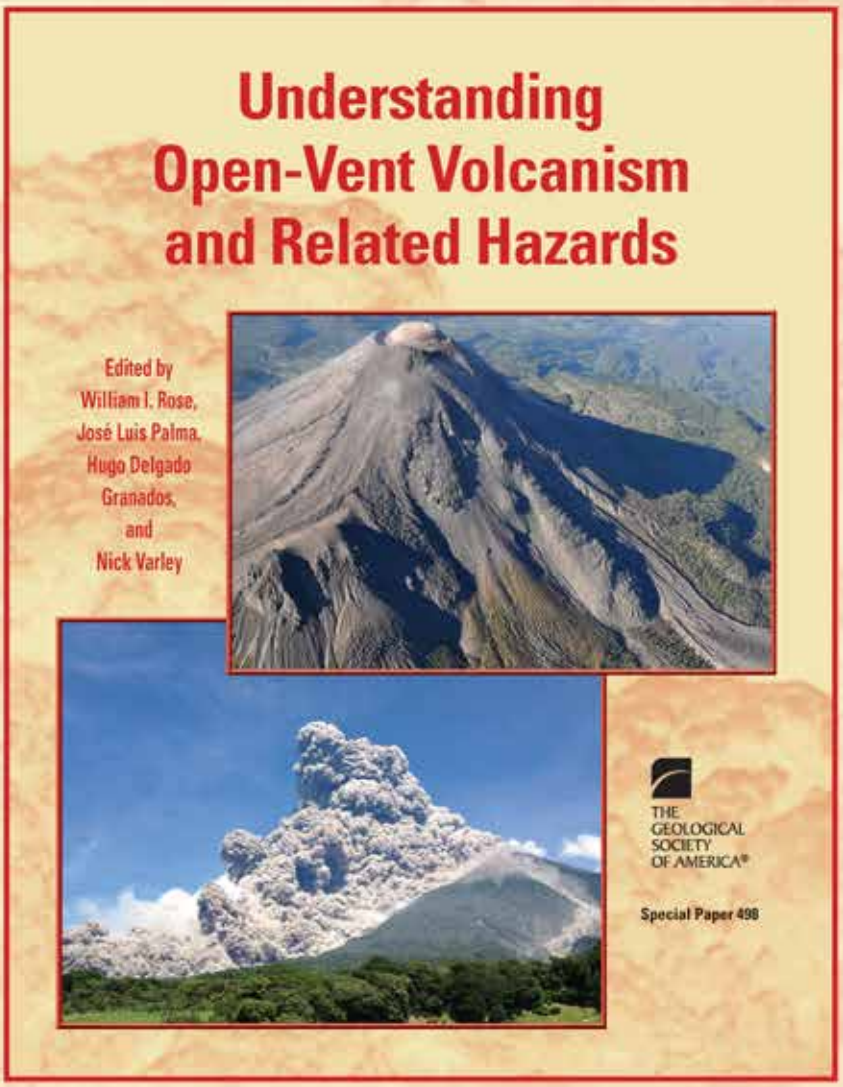

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Cover photo: Massive landslide on 30 April 2013 in the Bingham Canyon open-pit copper mine near Salt Lake City, Utah, USA. Image copyright Rio Tinto Kennecott Utah Copper; used with permission. See related article, p. 4–9.

GROUNDWORK:

GSA News

Massive landslide at Utah copper mine generates wealth of geophysical data

Kristine L. Pankow*, Jeffrey R. Moore, J. Mark Hale, Keith D. Koper, Tex Kubacki, Katherine M. Whidden, *and* ***Michael K. McCarter,*** *College of Mines and Earth Sciences, University of Utah, Salt Lake City, Utah 84112, USA*

ABSTRACT

On the evening of 10 April 2013 (MDT) a massive landslide occurred at the Bingham Canyon copper mine near Salt Lake City, Utah, USA. The northeastern wall of the 970-m-deep pit collapsed in two distinct episodes that were each sudden, lasting ~90 seconds, but separated in time by ~1.5 hours. In total, ~65 million cubic meters of material was deposited, making the cumulative event likely the largest non-volcanic landslide to have occurred in North America in modern times. Fortunately, there were no fatalities or injuries. Because of extensive geotechnical surveillance, mine operators were aware of the instability and had previously evacuated the area. The Bingham Canyon mine is located within a dense regional network of seismometers and infrasound sensors, making the 10 April landslide one of the best recorded in history. Seismograms show a complex mixture of short- and long-period energy that is visible throughout the network (6–400 km). Local magnitudes (M_L) for the two slides, which are based on the amplitudes of short-period waves, were estimated at 2.5 and 2.4, while magnitudes based on the duration of seismic energy (m_d) were much larger (>3.5). This magnitude discrepancy, and in particular the relative enhancement of long-period energy, is characteristic of landslide seismic sources. Interestingly, in the six days following the landslide, 16 additional seismic events were detected and located in the mine area. Seismograms for these events have impulsive arrivals characteristic of tectonic earthquakes. Hence, it appears that in this case the common geological sequence of events was inverted: Instead of a large earthquake triggering landslides, it was a landslide that triggered several small earthquakes.

INTRODUCTION

Landslides are among the most destructive geological forces in nature, causing billions of dollars in damage annually (see landslides.usgs.gov [USGS, 2013]). For the period of 2004–2011, more than 32,000 landslide-related fatalities have been documented, not including those landslides caused by earthquakes (Petley, 2012). Here, we describe a recent massive landslide in Utah that was successfully forecast and thus resulted in no fatalities or injuries. Furthermore, it occurred within a dense regional network of seismic and acoustic sensors, generating a valuable and unique data set for studying landslide physics.

THE BINGHAM CANYON LANDSLIDE

The landslide occurred on 10 April 2013 at the Bingham Canyon open-pit copper mine, located in the Oquirrh Mountains ~33 km southwest of downtown Salt Lake City, Utah, USA (Fig. 1A). Leaving a massive scar on the upper half of the northern pit wall, the slide filled the mine floor with thick debris (Fig. 1B). The long runout and distinctive flow-like character of the deposit suggest that the event was a particular type of extremely rapid mass movement known as a rock avalanche (Hungr et al., 2001).

At more than 970 m deep, Kennecott's Bingham Canyon mine is the largest man-made excavation in the world. It has been in operation since 1906 and produces 25% of the copper used in the United States. The site has produced more copper than any mine in history. For decades, mine operators have monitored the stability of pit slopes within the Bingham Canyon mine, operating a surveillance network that includes the latest techniques in early-warning monitoring, such as automated geodetic networks, in situ extensometers, and ground-based radar interferometry (e.g., Gischig et al., 2011). These monitoring systems proved crucial in first identifying, and then monitoring, the displacement of the incipient landslide on the northeastern wall of the Bingham Canyon mine.

Signs of increasing instability were evident throughout early 2013 as displacements accelerated within the unstable area. A visitor center, which had been located within the landslide source region, was closed and removed. Ultimately, on 10 April, movements became so strong that mine operators evacuated the area and issued a press release stating that failure was imminent and rising dust might become visible. The first rock avalanche occurred roughly seven hours later at 9:30 p.m. MDT. Because the area had been evacuated, there were no injuries; however, several pieces of heavy equipment and critical infrastructure were damaged or impacted. These included 14 haul trucks, three shovels, and the forced closure of the pit's main access ramp.

Comparing digital elevation models from before and after the event, Kennecott estimated the landslide moved a total mass of 165 million tons (Kennecott Utah Copper, 2013), equivalent to a source volume of roughly 55 million cubic meters. As the source rock breaks up, it expands, typically by 10%–30%, so the deposit volume was likely in the range of 65 million cubic meters. For comparison, the deposit would cover New York City's Central Park with ~20 m of debris. These volumes make the Bingham Canyon rock avalanche likely the largest non-volcanic landslide in North American history, eclipsing the recent 2012 Lituya Bay rock avalanche in Alaska (volume <50 million m^3), the 2010 Mount Meager rock slide/debris flow in British Columbia (48 million m^3),

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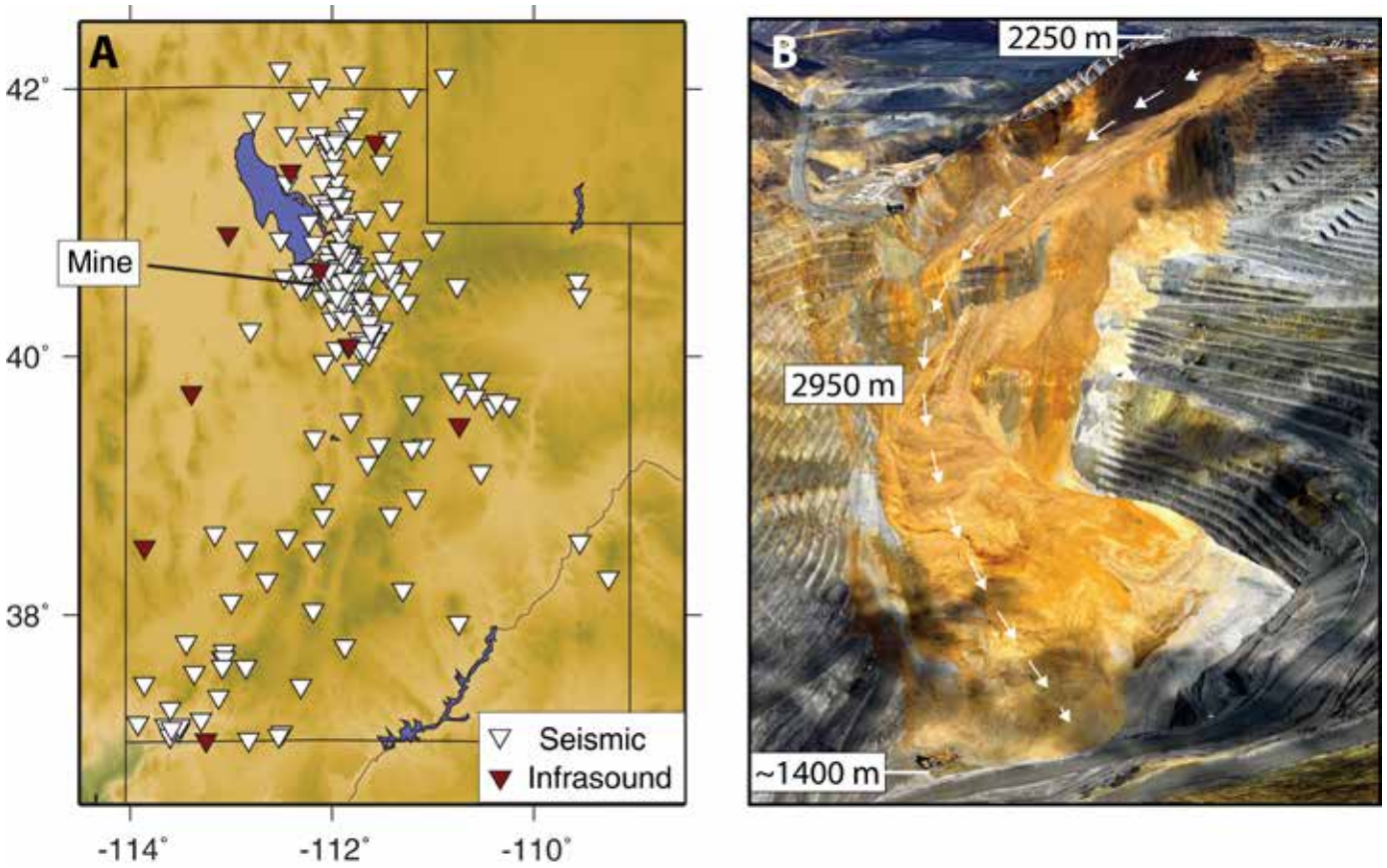

Figure 1. (A) University of Utah seismic and infrasound network, and location of the Bingham Canyon mine. (B) Photograph of the 10 April 2013 rock avalanche (copyright Kennecott Utah Copper, used with permission). Elevation of the crest and toe of the slide are shown, as well as an estimate of the runout distance along the arcuate travel path. A group of large haul trucks damaged by the slide can be seen at lower left.

the 1965 Hope rock slide in British Columbia (47 million m^3), the 1959 Madison River Canyon landslide in Montana (30 million m^3), and the 1903 Frank slide in the Northwest Territories of Canada (30 million m^3). In North America and worldwide, rock avalanches of this size routinely claim lives; the Madison River Canyon slide killed 28, the Frank slide killed up to 90, while the 2009 Xiaolin landslide in Taiwan (25 million m^3) caused nearly 500 fatalities. These statistics highlight the potentially devastating consequences of catastrophic rock avalanches and emphasize the importance of early-warning monitoring systems, such as those used at the Bingham Canyon mine.

Rock avalanches are distinguished from other types of landslides by their massive volume and characteristically fast and long runout. While rock fall debris, for example, accumulates at steep inclinations close to the angle of repose, rock avalanche deposits can spread over many kilometers, leaving gently inclined, characteristically hummocky terrain containing highly crushed and fragmented, yet compact, debris. Typical flow velocities are in the range of tens of meters per second and can reach as high as 100 m/s (e.g., Crosta et al., 2004). In the past, such runout was often thought to be anomalous, but today we know it is common for source volumes of this size that fail in a catastrophic manner, although the precise mechanisms driving rock avalanche dynamics are still debated (Davies and McSaveney, 2012). Comparing the geometry (fall height and length) of the Bingham Canyon rock avalanche with other events from across the globe shows that, at roughly 2950 m, the total travel distance from crest to toe is within the expected range for events of this size (Fig. 2). The slide would likely have run farther had it not impacted the southern pit wall. Considerable variability exists within the global data set, however, and precise prediction of runout distance, even with the aid of numerical modeling, is challenging.

Local news agencies reported initial cost estimates related to the Bingham Canyon rock avalanche approaching one billion dollars. If these estimates prove correct, the rock avalanche will become the most expensive landslide in U.S. history, surpassing the 1983 Thistle slide (also in Utah), which at the time was estimated to have cost between 460 and 940 million dollars (values adjusted for inflation). For now, the successful monitoring and hazard mitigation are heralded as an achievement, as well as an example to others facing the danger of catastrophic rock slope failures.

SEISMIC AND INFRASOUND RECORDINGS OF THE LANDSLIDE

The University of Utah Seismograph Stations (UUSS) has operated a seismic network in the Utah region (Fig. 1A) since the early 1960s (Pechmann et al., 2007; Thomas et al., 2013) with the goal of detecting, locating, and characterizing regional earthquakes associated with the Intermountain Seismic Belt (Smith and Arabasz, 1991). The network is a Tier I component of the

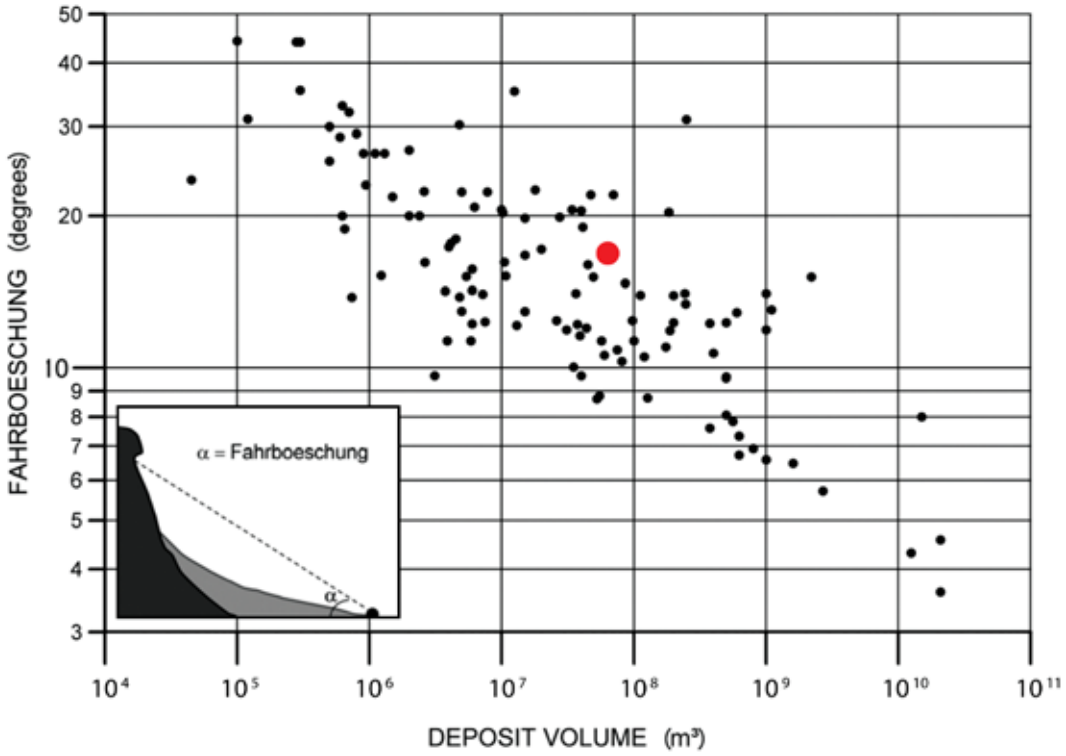

Figure 2. Comparison of the Bingham Canyon rock avalanche (red dot) with other reported landslide events from across the globe (figure modified from Bourrier et al., 2013, with data from C. Davidson, unpublished M.Eng. thesis, 2011). The estimated geometry results in a Fahrboeschung value (defined as the angle α relating the fall height and length) of 16°, which is within the expected range for events of this size.

Advanced National Seismic System (ANSS) of the U.S. Geological Survey (USGS, 1999) and is funded via a state-federal partnership. As of 1 April 2013, the Utah network consisted of 200 seismographs, including broadband, accelerometer, and short-period sensors, generating 667 channels of 100 Hz seismic data, which are telemetered in near–real-time to the UUSS operations center and archived at the public data center of the Incorporated Research Institutions for Seismology (IRIS, see www.iris.edu). Station density is greater along the Wasatch Front, an area of high seismic hazard. In addition to the seismic network, UUSS operates nine infrasound arrays throughout the state in collaboration with Southern Methodist University and Los Alamos National Laboratory (Hale et al., 2010).

Seismic signals from the Bingham Canyon landslide were recorded by UUSS at distances ranging from ~6 to over 400 km, while infrasound signals were recorded at seven arrays at distances from 13 to 400 km. Inspection of the seismic data importantly revealed that the landslide consisted of two distinct rock avalanche events separated by ~1.5 h. Raw seismograms for the two rock avalanches appear similar and are dominated by persistent, long-period (>10 s) energy; however, isolation of the long-period signals reveals significant differences (Fig. 3). For example, low-passed data from the first rock avalanche show a high-amplitude peak near the end of the coda, a feature that the second event lacks; meanwhile, the timing of the two maxima differs by tens of seconds.

Inspection of the infrasound data confirms that there were two distinct rock avalanche events. Figure 3 shows beams formed by steering the arrays at two stations, NOQ and WMUT, toward the mine. For the first rock avalanche, there is a coherent signal on both arrays, arriving at times consistent with the slide as the source. However, at NOQ (13 km from the mine) the energy consists primarily of a sharp impulse, while at WMUT (57 km from the mine) the energy is >30 s in duration with both a long onset and coda. Differences in the waveforms likely result from different atmospheric travel paths. For the second rock avalanche, array processing shows no coherent signal at NOQ coming from the mine, while the coherent signal at WMUT is short in duration and only slightly visible above background noise. Infrasound data from the second event are more difficult to discern because of increased background noise, possibly due to local winds (there was a rainstorm the night of the landslide).

We can use the seismic observations to generate first-order estimates of the relative volumes of the two rock avalanches. Comparing signal durations, peak amplitudes of the seismogram envelopes, and area underneath each envelope (as in Dammeier et al., 2011), we find that the two slides were roughly equal in volume; this would correspondingly split and move the data point presented in Figure 2. We note, however, that photographs suggest that the second rock avalanche likely contained a greater proportion of waste-rock deposited on the slope during previous mining and so may have had a lower bulk density than the first failure. Photographs also show that the first rock avalanche filled the entire pit floor, while the second apparently stopped short of the southern wall, suggesting the first slide may have been slightly larger.

The ultra-emergent nature of seismic signals from the rock avalanches made standard earthquake detection algorithms

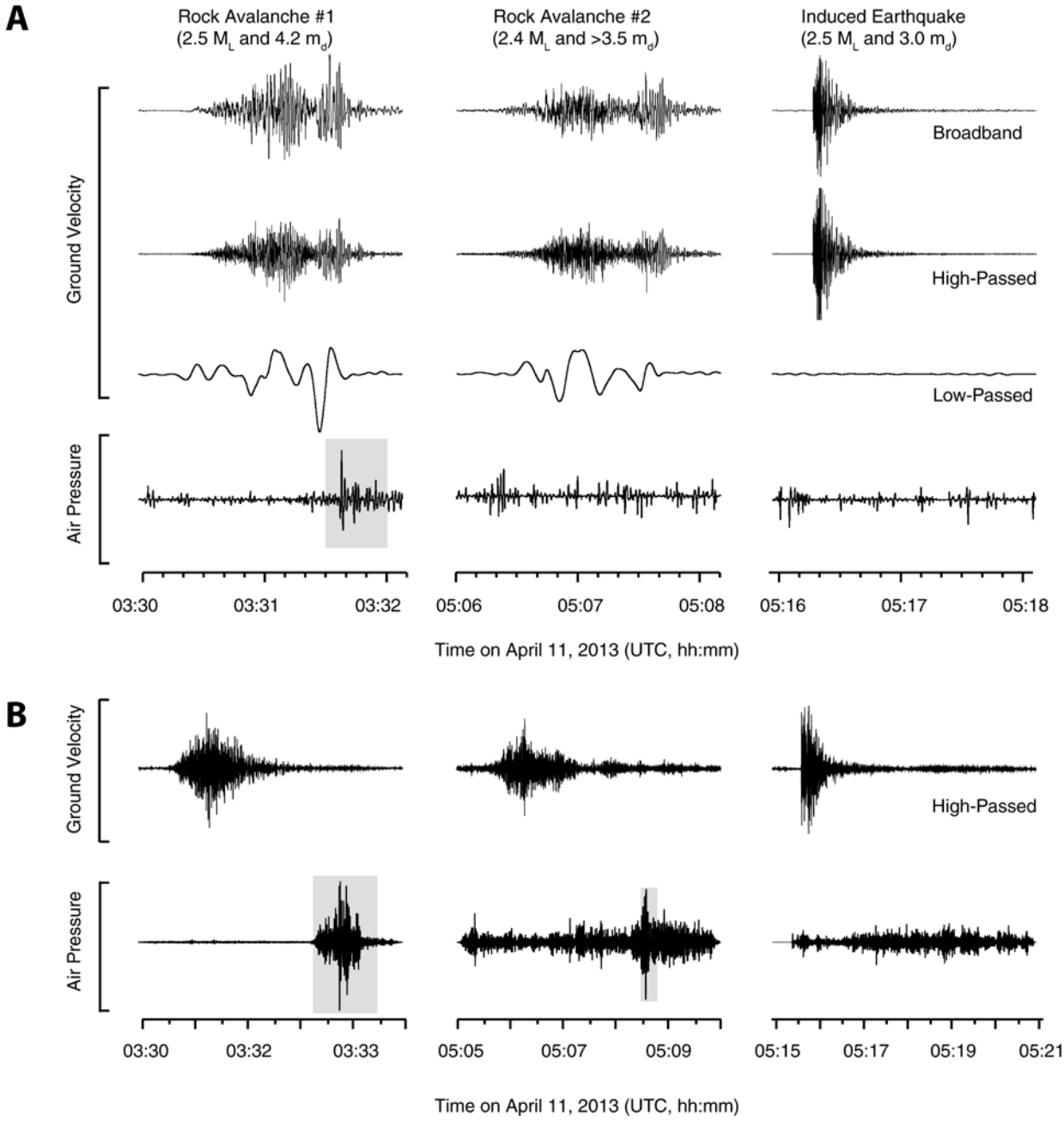

Figure 3. (A) Seismic and acoustic waveforms recorded at NOQ (13 km from slide), the closest broadband seismic station. Seismic traces are vertical component-velocity in different frequency bands (broadband, high-passed at 1 Hz, low-passed at 0.1 Hz); acoustic traces are infrasonic beams steered toward the mine in a pass band of 0.5–5.0 Hz. Gray box indicates time period with coherent signal originating from the mine. Amplitude scales are consistent for each pass band (i.e., they are consistent across each row). (B) Same as in (A) for seismic and acoustic waveforms recorded at station WMUT (57 km from the slide). Seismic traces were recorded by a short-period vertical-component seismometer.

employed by UUSS ineffective. Such power detectors rely on short-term versus long-term averages and are tuned to alarm on impulsive P waves. However, the two rock avalanches were automatically detected and located using an algorithm based on the continuous back propagation of globally recorded long-period surface waves (Ekström, 2006), which has previously been successful in detecting large landslides (Ekström and Stark, 2013). The detection amplitudes correspond to surface-wave magnitudes (M_s) of 5.1 and 4.9 for the first and second events, respectively (G. Ekström, personal commun., 2013).

With no clear P-wave arrivals, UUSS determined the location for the two rock avalanches at 40.536°N 112.142°W using satellite images. Origin times of 03:30:22 and 05:05:22 on 11 April 2013 (UTC) were estimated by subtracting 1 s from the arrival time of the initial seismic energy at nearby stations (CFS, 6 km away; MID, 8 km away). Given the unknown phase of the first arrivals, we are unable to calculate a more precise time. Using the estimated location, local (M_L) and duration (m_d, also known as M_c or coda magnitude) magnitudes for the first rock avalanche were calculated to be 2.5 and 4.2, respectively. For the second rock

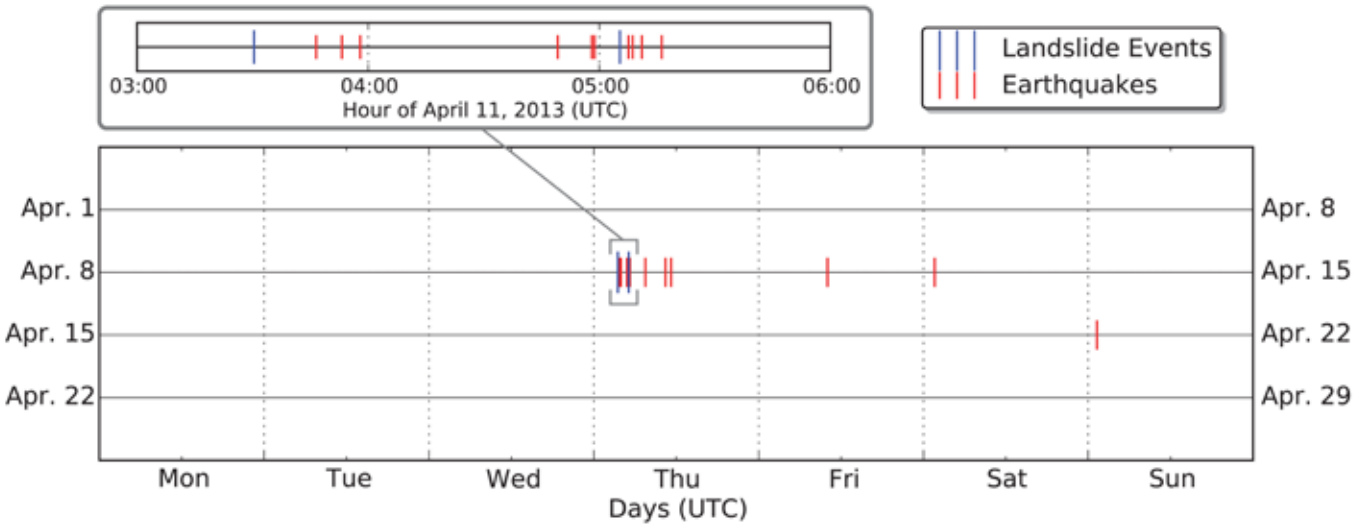

Figure 4. Time period of cross-correlation template analysis. Earthquake activity began shortly after the first rock avalanche and ceased 10 days later.

avalanche, the magnitudes were 2.4 and 3.5, respectively. Raw waveforms for each slide show two successive packets of energy with approximately equal peak amplitudes (Fig. 3A). For the first rock avalanche, the trailing packet is dominated by low-frequency energy, while for the second event it is rich in high-frequency energy. This secondary pulse of high-frequency energy for the second slide results in waveforms that differ from the typical coda decay seen in earthquakes or in the first rock avalanche (Fig. 3B) and makes comparison of duration magnitudes between the two events difficult. The m_d 3.5 for the second rock avalanche should thus be considered a lower bound.

The two UUSS magnitudes scales are designed to overlap seamlessly. For the 6,664 earthquakes that occurred in the Utah region during 2000–2011 and were large enough for M_L to be estimated, the mean M_L–m_d difference is only −0.12 with a standard deviation of 0.30. Therefore, the large M_L–m_d values observed for the two rock avalanches (−1.7 and <−1.1) are indicative of non-earthquake seismic sources, and are consistent with enhanced ratios of long-period to short-period energy relative to earthquakes (cf. Fig. 3). This, in turn, is consistent with previous seismic observations of landslides showing large M_s–m_b differences compared to earthquakes (Weichert et al., 1994).

There were no obvious seismic or acoustic signals preceding the first rock avalanche. However, immediately following the second slide, an M_L 2.5 (m_d 3.0) earthquake, plus three smaller quakes, occurred at shallow depths (<2 km) beneath the mine. All four of these events were automatically detected and located using normal UUSS procedures. The events have short impulsive waveforms (Fig. 3) that are characteristic of tectonic earthquakes and unlike the rock avalanche waveforms. Cross-correlation analyses using the M_L 2.5 event and the three smaller quakes as templates (Kubacki et al., 2013) suggest the existence of twelve additional earthquakes, with magnitudes ranging from M_L −0.8 to 0.5. Six occurred between the two rock avalanches, five occurred in the two days following the second rock avalanche, and one occurred ten days later on April 20 (Fig. 4). There were no earthquakes detected in the ten days preceding the first slide. The coincidence between the timing of these tectonic events and the landslide suggests the tectonic events are triggered aftershocks of the rock avalanches. Other shallow, non-earthquake seismic sources, such as mine collapses (Pechmann et al., 2008) and nuclear explosions (Ford and Walter, 2010), have been known to generate aftershock sequences. The causative nature of aftershock triggering at the Bingham Canyon mine can be confirmed by detailed analysis of previous seismicity in the area, which will be pursued in a future study.

FUTURE RESEARCH DIRECTIONS

Initial observations of the Bingham Canyon landslide presented here indicate a complex sequence of events consisting of two large rock avalanches and sixteen smaller, possibly triggered, earthquakes. Clearly, much work remains in order to understand the details of this sequence. Important research questions include

- How is the geometry of the rock avalanches reflected in the geophysical data?
- Do the seismic and infrasound signals have a common source?
- Are differences in the seismic and infrasound signals of the two rock avalanches related to different physical properties of the mass flows?
- Can the long-period seismic radiation be well fit by an equivalent-force model dominated by a single force, or is a more complex source model required?
- How are the 16 small seismic events (~−0.8–3.0 m_d) that occurred in the mine area in the ten days following the landslide related to the two rock avalanches?

ACKNOWLEDGMENTS

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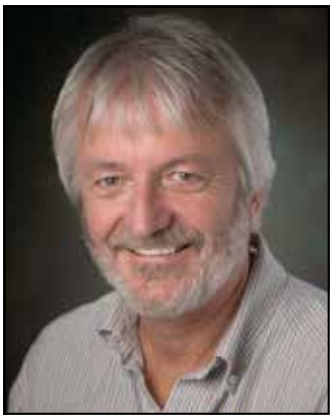
GSA TODAY Science Editor Changes

Science editor **Bernard (Bernie) Housen** of Western Washington University (WWU) finished his extended term with *GSA Today* at the end of December. As science editor, Housen's primary goal was to ensure that *GSA Today* remained "an interesting venue for the presentation of new research and synopses of important topics in the geosciences." Housen is chair of the geology department at WWU and specializes in Cordilleran tectonics and structure, with an emphasis on paleomagnetism. Learn more at http://myweb.facstaff.wwu.edu/bernieh/.

Incoming science editor **Steven J. Whitmeyer** is associate professor of structural geology and tectonics at James Madison University. He is primarily interested in tectonic evolution through time and uses structural and geospatial analyses to develop and visualize tectonic reconstructions. He has co-edited two GSA Special Papers (*Google Earth and Virtual Visualizations in Geoscience Education and Research* and *Field Geology Education: Historical Perspectives and Modern Approaches*) and one GSA Field Guide (*The Mid-Atlantic Shore to the Appalachian Highlands: Field Trip Guidebook for the 2010 Joint Meeting of the Northeastern and Southeastern GSA Sections*). Learn more at www.jmu.edu/geology/people/whitmesj.html.



Damian Nance of Ohio University remains onboard through December 2014.

GSA Today science editors are charged with obtaining first-class, focused articles that collectively reflect and summarize current topics and discoveries in the earth sciences. Science editors also solicit "Groundwork" articles, which are meant to further the influence of earth science on education, policy, planning, and funding. All submissions, whether solicited or volunteered, are peer reviewed. To submit an article to *GSA Today*, please go to **www.geosociety.org/pubs/gsatguid.htm** for instructions and a link to our online manuscript tracking system.

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SCIENCE EDITOR OPENINGS FOR 2015

GSA is soliciting applications and nominations for science co-editors for *GSA Bulletin, GSA Today, Lithosphere,* and GSA books with four-year terms beginning 1 January 2015. Duties include: ensuring stringent peer review and expeditious processing of manuscripts; making final acceptance or rejection decisions after considering recommendations of reviewers; and maintaining excellent content through active solicitation of diverse and definitive manuscripts or book proposals.

POSITIONS AVAILABLE

GSA Books ▸ 2 positions

GSA BOOK EDITORS' duties include soliciting high-quality book proposals as well as ensuring that proper peer review procedures have been followed by volume editors. In the case of authored volumes, book editors handle the entire peer-review process. The successful candidate will have a wide range of interests and expertise, prior editing experience, and a strong publication record.

GSA Today ▸ 1 position

GSA TODAY The editor of *GSA Today,* one of the most widely read earth science publications in the world, must have a wide range of interests and expertise along with the ability to identify research topics of both high quality and broad appeal. Prior editing experience and a publication record in a wide range of journals is key.

GSA Bulletin ▸ 1 position

GSA BULLETIN For the *GSA Bulletin* position, research interests that would best complement those of the continuing editors include—but are not necessarily limited to: geobiology, geochemistry, geomicrobiology, paleobotany, paleoclimatology, paleontology, sedimentology, and geomorphology.

Lithosphere ▸ 1 position

LITHOSPHERE For the *Lithosphere* position, research interests that would best complement those of the continuing editors include—but are not necessarily limited to: petrology, deformation, structural geology, Precambrian geology, thermochronology, isotope geochemistry, and geochronology.

Note that the volume of papers received or other circumstances may mean *GSA Bulletin* and *Lithosphere* science editors will sometimes need to handle papers outside of their main areas of expertise.

A SUCCESSFUL EDITOR WILL HAVE

- a broad interest and experience in geosciences, including familiarity with new trends;
- international recognition and familiarity with many geoscientists and their work;
- a progressive attitude and a willingness to take risks and encourage innovation;
- experience with online manuscript systems and the ability to make timely decisions; and
- a sense of perspective and humor.

INTERESTED?

Please submit a curriculum vitae and a letter describing why you are suited for the position. To nominate another, submit a nomination letter and the person's written permission and CV. Send nominations, applications, or questions to Jeanette Hammann, jhammann@geosociety.org, GSA Publications, P.O. Box 9140, Boulder, CO 80301, USA. Editors work out of their current locations at work or at home. GSA provides an annual stipend and funds for office expenses. Nominations or applications received by 15 February 2014 will be given first consideration.

FUTURE OPENINGS (Terms Beginning January 2016): *GSA Bulletin,* 1 position; *Geology,* 2 positions; *Lithosphere,* 1 position.

2013 GSA Annual Meeting & Exposition

THE GEOLOGICAL SOCIETY OF AMERICA®

1888 125 2013 Years

CELEBRATING ADVANCES IN GEOSCIENCE

WRAP-UP

TOTAL ATTENDANCE: 8,061

- **Countries represented:** 62
- **Students:** more than 3,300
- **On To the Future scholars:** 125
- **Technical sessions:** 408
- **Abstracts presented:** 4,795
- **Posters:** 1,848
- **Digital posters:** 45
- **Field trips:** 22
- **Field trip participants:** 523
- **Short courses:** 29
- **Short course participants:** 663
- **Exhibiting companies:** 246
- **Sponsors & contributors:** 27
- **Connected Community profiles updated with photos:** 134
- **News stories/blog posts:** more than 85
- **Bottles of Field Assistant Ale consumed:** more than 20,000

GET MORE ANNUAL MEETING NEWS

- More than 85 news and blog articles were written about annual meeting science: **http://community.geosociety.org/2013AnnualMeeting/MediaCenter/NewsBlogs**
- GSA put together seven special e-newsletters for meeting attendees: **http://community.geosociety.org/2013AnnualMeeting/MediaCenter/AMDaily**
- Quite a few press releases were also generated about the meeting by GSA and other organizations: **http://community.geosociety.org/2013AnnualMeeting/MediaCenter/PressReleases**

MAJOR ANNUAL MEETING SPONSORS

We just can't say enough to thank our sponsors (opposite page) for investing in GSA and in the growth of current and future leaders in the geosciences.

27–30 OCTOBER 2013 • DENVER, COLORADO, USA

THANK YOU SPONSORS!

Your support of the Geological Society of America's Annual Meeting & Exposition continues a tradition of 125 years of serving science and the profession. The Society appreciates your investment in the growth of current and future leaders in the geoscience community.

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CONTRIBUTORS

Dept. of Earth and Atmospheric Sciences, University of Northern Colorado
Dept. of Earth & Planetary Sciences, Northwestern University
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The GSA Foundation is proud to continue its work in support of GSA and its programs.

*Denotes in-kind contribution

2013 GSA Annual Meeting Chair Vince Matthews in Victorian garb at the 125th Anniversary Gala.

ANNUAL MEETING WRAP-UP

My home in Leadville, Colorado, is about two blocks from where one of my heroes and 1903 GSA president set up his camp while studying the geology of the Leadville Mining District. Samuel F. (Frank) Emmons served as one of the two chief geologists for Clarence King's Survey of the fortieth parallel. When the USGS was established in 1879, with King as its director, Emmons was made director of the Rocky Mountain Division. His first charge from King was, "You will devote the first years of your administration of your division exclusively to a study of the mineral wealth of the Rocky Mountains."

This work resulted in the publication of *Geology and Mining Industry of Leadville, Colorado*, which quickly became a worldwide classic. From Emmons' excellent maps, cross sections, and descriptions, I have learned a lot about this world-class mining district in my backyard. But, the 125th Anniversary Meeting that celebrated this wonderful society that Emmons and 99 of his fellow geologists founded in 1888 gave me the opportunity to learn even more about the Leadville Mining District.

As general chair of the meeting, I selfishly suggested to field trip co-chair Lon Abbott that he try and arrange a field trip to Leadville. He did more than that. He set up a three-day trip to the Henderson and Climax molybdenum mines, in addition to one to the Leadville District led by Ralph Stegen and Tommy Thompson. This is just one example of how the Organizing Committee and GSA staff went above and beyond for this very special celebration of the long and distinguished history of our society.

The myriad of special creations for our anniversary gave attendees a wonderful, commemorative experience. The historical map gallery documented the evolution of mapping in the U.S. and was enjoyed by all as they entered the Exhibit Hall. Flags with images of the founders fluttered in the same hall as flags with images of GSA honorees for 2013. Left Hand Brewery's Field Assistant Ale was bottled for our celebration and was sampled in the Exhibit Hall every afternoon at beer thirty. The symphony, "Formations," which was written for our anniversary and performed by the Boulder Philharmonic Orchestra, brought a standing ovation from the Victorian-garbed audience. The Governor of Colorado, John Hickenlooper, gave an enjoyable talk to hundreds of attentive fellow geologists.

And then, there was the plain-old GSA convention itself, where a record number of attendees (about 8,000) renewed friendships, shared ideas and data, and had a stimulating (if not exhausting) four days. The end of the government shutdown enabled our federal colleagues to join us. With more than 4,900 abstracts submitted, there was something(s) for everyone. An outstanding session on the mid-September Colorado floods was put together at the last minute. Twenty-nine short-course workshops, 22 field trips (be sure to order a copy of the beautiful guidebook), and 13 Pardee Symposia attracted record and near-record participants.

I thoroughly enjoyed the convention and hope you did too. Thank you to all who made this a memorable occasion!

Vince Matthews, 2013 Annual Meeting General Chair

Best Student Geologic Map Competition Award Winners

The inaugural Best Student Geologic Map competition at the 2013 GSA Annual Meeting in Denver celebrated GSA's 125th Anniversary *and* the 125th year of geologic mapping. The competition highlighted student research from around the world that utilized field mapping and the creation of geologic maps as a major component. The top three student geologic maps were selected for recognition and awards at a special judging session at the meeting.

First Place: Robert Mahon, University of Wyoming: "Geologic Map of the Saddle Peak Hills 7.5–Quadrangle, Death Valley National Park, San Bernardino County, California." Mahon was awarded a Brunton Compass from the Association of American State Geologists.

Second Place: Kent Walters, University of Cincinnati: "Glacial Geomorphology of Central Upper Peninsula of Michigan, USA." Walters was awarded a rock hammer and hand lens from the American Institute of Professional Geologists.

Third Place: Jens-Erik Lund Snee, Stanford University: "1:24,000 Scale Geologic Mapping of Cenozoic Units in Huntington Valley and the Eastern Piñon Range, Elk County, Nevada." Snee was awarded the 125th Anniversary Volume: GSA Special Paper 500, *The Web of Geological Sciences: Advances, Impacts, and Interactions* from the GSA Foundation.

Award, Recognition, and Grant Deadlines

Detailed information on the following awards, honors, and grants was published in the October 2013 issue of *GSA Today*, **www.geosociety.org/gsatoday/archive/23/10/.** If you have questions or need hardcopy forms, please contact Jamie Recio, at +1-303-357-1028 or awards@geosociety.org.

GSA'S TOP MEDALS & AWARDS

Nomination deadline: 1 February
Learn more at **www.geosociety.org/awards/aboutAwards.htm.**

- Penrose Medal
- Day Medal
- Donath Medal (Young Scientist Award)
- GSA Public Service Award
- Bromery Award for the Minorities
- GSA Distinguished Service Award
- Subaru Outstanding Woman in Science Award

GSA FELLOWSHIP

Nomination deadline: 1 February

Existing GSA Fellows may nominate GSA members to fellowship in recognition of their distinguished contributions to the geosciences through publications, applied research, teaching, administration of geological programs, contributing to the public awareness of geology, leadership of professional organizations, and taking on editorial, bibliographic, and library responsibilities. Learn more about making a nomination at **www.geosociety.org/members/fellow.htm.** Read about the 2013 Fellows at **www.geosociety.org/members/newFellows.htm.**

GSA POST-DOCTORAL RESEARCH AWARDS (COLE AWARDS)

Nomination deadline: 1 February

These awards are managed by the GSA Foundation. Learn more at **www.geosociety.org/grants/postdoc.htm.**

- **Gladys W. Cole Memorial Research Award** for research on the geomorphology of semiarid and arid terrains in the U.S. and Mexico.
- **W. Storrs Cole Memorial Research Award** for research on invertebrate micropaleontology.

JOHN C. FRYE ENVIRONMENTAL GEOLOGY AWARD

Nomination deadline: 31 March

This US$1,000 cash award, which is managed by the GSA Foundation, recognizes the best paper on environmental geology published by GSA or by a state geological survey within the past three years. To nominate a report, please submit a letter describing its importance, with up to three letters from users of the publication, along with three copies of the publication, to Program Officer: Grants, Awards, and Recognition, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA; awards@geosociety.org.

AGI AWARDS

Nomination deadline: 1 February
Learn more at **www.agiweb.org/direct/awards.**

- AGI Medal in Memory of Ian Campbell
- AGI Marcus Milling Legendary Geoscientist Medal

NATIONAL AWARDS

Nomination deadlines vary; learn more at **www.agiweb.org/direct/awards.**

- William T. Pecora Award
- National Medal of Science
- Vannevar Bush Award
- Alan T. Waterman Award

GSA GRADUATE STUDENT RESEARCH GRANTS

Application deadline: 3 February at 11:59 p.m. MST
Cosponsored by GSA, the GSA Foundation, and ExxonMobil

Learn more and *submit your applications online* at **www.geosociety.org/grants/gradgrants.htm.**

GSA's Research Grants Program supports excellence in graduate student research. Last year, 307 grants were awarded, totaling US$582,340. The standard maximum award per grant is US$2,500. ***New for 2014:*** ExxonMobil is sponsoring 10 research grants at US$7,500 each. All applicants to the student research grant program are eligible for these awards, regardless of the topic or location of their research. Questions? Call +1-303-357-1028 or e-mail awards@geosociety.org.

2014 GSA Distinguished International Lecturer

MARJORIE A. CHAN

The goal of this lecture tour is to send an excellent speaker with scientific stature and impact to discuss a topic at the forefront of research, to promote GSA, and to raise awareness in the international geoscience community about the relevance of GSA and its activities. Marjorie Chan is one such speaker.

Chan is a professor of geology at the University of Utah in Salt Lake City, Utah, USA. Her research spans the geologic time scale from the Precambrian to the Pleistocene, and her recent projects connect geology and planetary science to better understand and interpret Mars. She has authored or co-authored more than 100 peer-reviewed articles on a wide range of sedimentary topics involving clastic depositional environments, sedimentology, fluid flow/diagenesis (e.g., iron oxide sandstone coloration and concretions), Earth analogs to Martian environments, and geoconservation.

As a strong advocate and role model for women in science for the past three decades, Chan is active in encouraging women and minorities in the science disciplines. She is excited to represent GSA and a new age of science that will be dependent on sustainable practices, global cooperation, and engaged students who will help lead our future.

LECTURE TOPICS

- Eolian Explorations: Dunes, Deformation, and Diagenesis
- Mars for Earthlings: Using Earth Analogs to Decode the Sedimentary History of Mars

Dr. Chan will be giving lectures in China, India, Korea, New Zealand, and Australia in the spring of 2014. For lecture tour dates and detailed information, go to **www.geosociety.org/Sections/International/LectureTour.htm.**

The GSA International Lecture Tour is made possible through a generous gift to the GSA Foundation and co-sponsorship through the University of Utah and the Geological Society of Australia. It is organized under the guidance of GSA's International Section.

GSA Hydrogeology Division Awards

THE GEOLOGICAL SOCIETY OF AMERICA®
HYDROGEOLOGY DIVISION

Submission deadline: 1 February

NEW! KOHOUT EARLY CAREER AWARD

How to nominate: http://gsahydro.fiu.edu/Kohout.htm

This new award is generously endowed by the estate of Francis Kohout, an early pioneer in the study of geothermal salt water convection in carbonate platforms. The award will be presented to a distinguished early career scientist (35 years of age or younger throughout the year in which the award is to be presented or within 5 years of receiving his or her highest degree or diploma) for outstanding achievement in contributing to the hydrogeologic profession through original research and service, and for the demonstrated potential for continued excellence throughout their career. The nominee does not have to be a member of GSA or hold a Ph.D.

O.E. MEINZER AWARD

How to nominate: http://gsahydro.fiu.edu/OEMeinzer.htm

This award's namesake, Oscar Edward Meinzer (1876–1948), has been called the "father of modern groundwater hydrology." The award recognizes the author or authors of a publication or body of publications that have significantly advanced the science of hydrogeology or a closely related field. There are no restrictions as to the publisher of the work(s) and the award is not restricted to GSA members or members of the Hydrogeology Division. Particular weight is given to contributions that can be shown to have strongly influenced subsequent hydrogeologic research.

2014 Section Meeting Calendar

www.geosociety.org/Sections/

SOUTH-CENTRAL SECTION
Fayetteville, Arkansas, USA
17–18 March 2014
University of Arkansas Global
Local Committee chair: Steve Boss
Early registration deadline: 10 Feb. 2014

NORTHEASTERN SECTION
Lancaster, Pennsylvania, USA
23–25 March 2014
Lancaster Marriott
Local Committee co-chairs: Noel Potter and Roger Thomas
Early registration deadline: 18 Feb. 2014

SOUTHEASTERN SECTION
Blacksburg, Virginia, USA
10–11 April 2014
Skelton Conference Center at Virginia Tech
Local Committee chair: Robert Tracy
Early registration deadline: 10 Mar. 2014

NORTH-CENTRAL SECTION
Lincoln, Nebraska, USA
24–25 April 2014
Cornhusker Marriott
Local Committee chair: Matt Joeckel
Early registration deadline: 24 Mar. 2014

ROCKY MOUNTAIN/
CORDILLERAN SECTIONS
Bozeman, Montana, USA
19–21 May 2014
Montana State University,
Strand Union Building
Local Committee chairs: Dave Lageson and Jeff Vervoort
Abstracts deadline: 11 Feb. 2014
Early registration deadline: 14 Apr. 2014

Wilson Park, Fayetteville, Arkansas; used with permission of Wikimedia Commons.

Ohiopyle falls at Ohiopyle State Park, Ohiopyle, Pennsylvania; used with permission of Wikimedia Commons.

Blue Ridge Mountains, Shenandoah National Park, Virginia. Photo by Amrinder Arora; used with permission of Wikimedia Commons.

Chimney Rock National Historic Site, Morrill County, Nebraska. Photo by Allen Stutheit; used with permission of Wikimedia Commons.

Grinnell Glacier, Glacier National Park, Montana. Public domain.

Get into the Field with GSA & ExxonMobil

FIELD CAMP SCHOLAR AWARD

Who should apply? Undergraduate students

Deadline to apply: 18 April

This year's field award will provide US$2,000 each to 17 undergraduate students so they can attend the summer field camp of their choice. These scholarships are based on diversity, economic/financial need, and merit.

BIGHORN BASIN FIELD AWARD

Who should apply? Undergraduate and graduate students and faculty

Deadline to apply: 18 April

Camp dates: 4–10 August

This award covers all costs for selected students and faculty to take part in a week-long field seminar in the Bighorn Basin of north-central Wyoming that emphasizes multidisciplinary integrated basin analysis.

FIELD CAMP EXCELLENCE AWARD

Who should apply? Anyone, but the award must be used toward field camp operations

Deadline to apply: 18 April

One field camp instructor/director will receive an award of US$10,000 to assist with his or her summer field season. This award will be based on safety awareness, diversity, and technical excellence.

Questions? Contact Jennifer Nocerino, jnocerino@geosociety.org, 1-303-357-1036.

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ExxonMobil

https://rock.geosociety.org/ExxonMobilAward/index.asp

Second Announcement

NORTHEASTERN SECTION

49th Annual Meeting of the Northeastern Section, GSA
Lancaster, Pennsylvania, USA

23–25 March 2014

www.geosociety.org/Sections/ne/2014mtg/

Cucumber Falls in Ohiopyle State Park, Ohiopyle, PA. Photo by Frank Kovalchek, used with permission via Wikimedia Commons.

At the Junction of the Northern and Southern Appalachians

LOCATION

Lancaster is a small, vibrant city situated between the classic Valley and Ridge province of the Appalachians and the geologically complex Piedmont. It is near the Susquehanna River, by which it was historically accessible from Chesapeake Bay. Lancaster has lately become an important focus for studying the effects of climate change and the human influence on its verdant and productive landscape. The meeting is hosted by Franklin & Marshall College; Dickinson College; Lafayette College; Gettysburg College; Millersville University of Pennsylvania; Enviroscan Inc., and the Pennsylvania Topographic & Geologic Survey. Interest in the varied program we have compiled for this meeting is mounting. *We strongly recommend* early registration and booking of accommodations.

REGISTRATION

Early registration deadline: 18 February
Cancellation deadline: 24 February
REGISTRATION FEES (all fees are in U.S. dollars)

	EARLY		STANDARD	
	Full mtg.	**One day**	**Full mtg.**	**One day**
Professional Member	$180	$130	$225	$150
Professional Nonmember	$200	$150	$250	$185
Professional Member 70+	$100	$80	$130	$100
Student Member	$60	$50	$80	$70
Student Nonmember	$70	$60	$90	$80
K–12 Teacher	$65	$50	$85	$60
Guest	$50		$60	
Field Trip/Workshop only	$40		$45	

ACCOMMODATIONS

Reservation deadline: 28 February

A substantial block of rooms is being held for use by meeting participants at the Lancaster Marriott at Penn Square Hotel, which is an integral part of the Lancaster County Convention Center. Rate: US$129 + 11% tax for single/double/triple/quad occupancy. Please use the group code "GSA" and the dates of the meeting when you call Marriott reservations at +1-800-228-9290 or +1-717-239-1600, or use the link at **www.geosociety.org/Sections/ne/2014mtg/registration.htm.**

SAVE $$ — Share a Room/Share a Ride

Use the GSA Meetings Bulletin Board

http://community.geosociety.org/Communities/RoommatesRides

Connect with colleagues to find roommates, arrange rides, and share common interests. The service is free, but you must register to use it (this limits misuse).

TECHNICAL PROGRAM

Symposia

S1. **Tectonic Links between the Northern and Southern Appalachians.** Don Wise, Univ. of Massachusetts–Amherst, dwise@geo.umass.edu; Hal Bosbyshell, West Chester Univ. of Pennsylvania, hbosbyshell@wcupa.edu; Gale Blackmer, Pennsylvania Topographic & Geologic Survey, gblackmer@pa.gov.

S2A. **Origin and Evolution of the Appalachian Critical Zone. I. Physical, Chemical, and Biological Processes.** Jason Price, Millersville Univ. of Pennsylvania, jason.price@millersville.edu; Joel Moore, Towson Univ., moore@towson.edu.

S2B. **Origin and Evolution of the Appalachian Critical Zone. II. Anthropogenic Sediments and Their Impacts on Aquatic Ecosystems.** Robert C. Walter, Franklin & Marshall College, robert.walter@fandm.edu; Allen C. Gellis, USGS, agellis@usgs.gov; Jeffrey Niemitz, Dickinson College, niemitz@dickinson.edu.

Theme Sessions

T1. **Karst Research and the Sustainable Use and Management of Karst Aquifers.** Malcolm Field, U.S. Environmental

Protection Agency, field.malcolm@epa.gov; Neven Kresic, AMEC Environment & Infrastructure Inc., neven.kresic@amec.com.

T2. **Interpreting Sedimentary Records of Past Changes in Climate and Ecology.** Kira Lawrence, Lafayette College, lawrenck@lafayette.edu; David Sunderlin, Lafayette College, sunderld@lafayette.edu.

T3. **Implementing Recent Innovations in Thermobarometry to Constrain Igneous and Metamorphic Evolution.** Kyle Ashley, Virginia Tech., ktashley@vt.edu; Victor Guevara, Virgina Tech., vguevara@vt.edu; Donald Stahr III, Virgina Tech., dstahr@vt.edu.

T4. **Gaining a Greater Understanding of Mars from Gale Crater and Beyond.** Rebecca Williams, Planetary Science Institute, williams@psi.edu.

T5. **Embracing Digital Technologies and the Geoweb: The Changing Philosophies and Practices of Geologic Mapping.** Joseph Kopera, Massachusetts Geological Survey, jkopera@geo.umass.edu; John Van-Hoesen, Green Mountain College, vanhoesenj@greenmtn.edu.

T6. **Service Learning in the Geosciences: Deep Learning through Critical, Reflective Thinking, and Civic Responsibility.** Steve Winters, Holyoke Community College, swinters@hcc.edu; Lori Weeden, Univ. Massachusetts, Lowell, lori_weeden@uml.edu.

T7. **EarthScope Arrives on the East Coast.** Charles Scharnberger, Millersville Univ. of Pennsylvania, charles.scharnberger@millersville.edu.

T8. **Coastal Storms in the Mid-Atlantic: Research and Teaching Opportunities.** Marcus Key, Dickinson College, key@dickinson.edu; Sean Cornell, Shippensburg Univ. of Pennsylvania, srcornell@ship.edu.

T9. **Acadian Paleoenvironments of the Appalachians: Mountains Carved by "Alpine" Glaciers, Forested Lowlands, and Swamps, and a Marine Foreland Basin with Limited Circulation.** Alexander Bartholomew, SUNY–New Paltz, barthola@newpaltz.edu; Edward B. Daeschler, Academy of Natural Sciences of Drexel Univ., daeschler@ansp.org; Frank R. Ettensohn, Univ. of Kentucky, f.ettensohn@uky.edu; William E. Stein, Binghamton Univ., stein@binghamton.edu.

T10. **Paleoclimate Records of All Types and Ages.** John Rayburn, SUNY–New Paltz, rayburnj@newpaltz.edu; David Barclay, SUNY–Cortland, barclayd@cortland.edu; Tara Cutrin, Hobart & William Smith Colleges, curtin@hws.edu.

T11. **Examples of Next Generation Science Standards Implemented in the K–12 Classroom by and for Teachers.** Tanya Furman, The Pennsylvania State Univ., furman@psu.edu; Laura Guertin, Penn State–Brandywine, guertin@psu.edu.

T12. **Geologizing in America: From Wilderness to Megalopolis.** Jeri L. Jones, Jones Geological Services, jonesgeo@comcast.net; Mary Ann Schlegel, Millersville Univ. of Pennsylvania, maryann.schlegel@millersville.edu; Nicholas G. McDonald, Westminster School, ngm@westminster-school.org.

T13. **Scratching the Surfaces: Advances in Continental and Marine Ichnology.** Ilya Buynevich, Temple Univ., coast@temple.edu; Logan Wiest, Temple Univ., logan.wiest@temple.edu.

T14. **An Interdisciplinary Approach to Taphonomy: The Impact of Morphological, Molecular, and Isotopic Changes on Environmental Proxies.** Qin Leng, Bryant Univ., qleng@bryant.edu; Chris Williams, Franklin & Marshall College, chris.williams@fandm.edu; Hong Yang, Bryant Univ., hyang@bryant.edu.

T15. **Significant 21st-Century Paleontological Discoveries in Northeastern North America.** Roger D.K. Thomas, Franklin & Marshall College, roger.thomas@fandm.edu; Roger Cuffey, The Pennsylvania State Univ., rcuffey@psu.edu.

T16. **Emerging Techniques and Applications in Paleolimnology.** Greg de Wet, Univ. of Massachusetts–Amherst, gdewet89@gmail.com.

T17. **Glaciers, Sediments, and Landforms of Northeast North America and Beyond.** Sarah Principato, Gettysburg College, sprincip@gettysburg.edu; Benjamin Laabs, SUNY–Geneseo, laabs@geneseo.edu.

T18. **Using LiDAR Imagery to Map Features Generated by Quaternary Glacial, Periglacial, and Mass Movement Processes.** Duane Braun, Bloomsburg Univ. of Pennsylvania, dbraun9@roadrunner.com; Gary Fleeger, Pennsylvania Geologic & Topographic Survey, gfleeger@pa.gov.

T19. **Echoes of Exhumation: Comparing Exhumation Processes of the Ancient Appalachians to Those of Currently Active Orogens.** Craig Dietsch, Univ. of Cincinnati, dietscc@ucmail.uc.edu.

T20. **Groundwater Contamination and Remediation: Challenges and Innovative Solutions.** Martin Helmke, West Chester Univ. of Pennsylvania, mhelmke@wcupa.edu; Tripp Fischer, Brownfields Science and Technology, tfischer@bstiweb.com.

T21. **Abandoned Mine Drainage: Impacts, Treatment, and Novel Uses.** Jennifer Whisner, Bloomsburg Univ. of Pennsylvania, jwhisner@bloomu.edu; Cynthia Venn, Bloomsburg Univ. of Pennsylvania, cvenn@bloomu.edu.

T22. **Marcellus and Utica Shales: Geology, Natural Gas Production, and Water Resources Issues**. Dru Germanoski, Lafayette College, germanod@lafayette.edu.

T23. **Dr. Allan M. Thompson: Honoring His Legacy as a Geologist and Educator**. John A. Conrad, Conrad Geoscience Corp., jconrad@conradgeo.com; Ralph R. Leon, Exxon Mobil Corp., ralph.r.leon@exxonmobil.com.

T24. **Mineral Resource Geology of Northeastern North America.** Elizabeth A. Graybill, Magnesita Refractories, lizgraybill@gmail.com; G. Robert Ganis, Consulting Geologist, bobganis@mac.com.

T25. **Microbe Mineral Interactions: Observations, Experiments, and Modeling.** Dawn Cardace, University of Rhode Island, cardace@mail.uri.edu.

FIELD TRIPS

1. **Sources and Sinks of Anthropogenic Sediments in the Mid-Atlantic Region.** Sat., 22 March, 8 a.m.–5 p.m. US$80; includes field-trip guide, transportation, lunch, and refreshments. Robert C. Walter, Franklin & Marshall College, robert.walter@fandm.edu; Allen C. Gellis, U.S. Geological Survey, agellis@usgs.gov; William B. Hilgartner, Johns Hopkins Univ.

and Friends School, hilgartner@jhu.edu; Dorothy J. Merritts, Franklin & Marshall College, dorothy.merritts@fandm.edu.

2. **Tectonics of Southeastern Pennsylvania, West Grove Metamorphic Suite.** Sat., 22 March, 8 a.m.–7 p.m. US$75; includes field trip guide, transportation, lunch, and refreshments. Howell Bosbyshell, West Chester Univ. of Pennsylvania, hbosbyshell@wcupa.edu; Gale Blackmer, Pennsylvania Geologic & Topographic Survey, gblackmer@pa.gov; William "Sandy" Schenk, Delaware Geological Survey, rockman@udel.edu; LeeAnn Srogi, West Chester Univ. of Pennsylvania, esrogi@wcupa.edu.
3. **Geology of the Baltimore Mafic Complex Adjacent to the Pennsylvania–Maryland State Line.** Sat., 22 March, 7:30 a.m.–6 p.m. US$70; includes field trip guide, transportation, lunch, and refreshments. Stephen Shank, Pennsylvania Geologic & Topographic Survey, stshank@pa.gov; Lynn Marquez, Millersville Univ. of Pennsylvania, lynn.marquez@millersville.edu; Christopher R. Hardy, Millersville Univ. of Pennsylvania, christopher.hardy@millersville.edu.
4. **Stratigraphy and Structure of the Chilhowee Group in Lancaster and York Counties.** Sat., 22 March, 8:30 a.m.–4:30 p.m. US$75; includes field trip guide, transportation, lunch, and refreshments. Charles Scharnberger, Millersville Univ. of Pennsylvania, charles.scharnberger@millersville.edu; Joseph P. Smoot, USGS, jpsmoot@usgs.gov; Edward L. Simpson, Kutztown Univ. of Pennsylvania, simpson@kutztown.edu; Jeri L. Jones, Jones Geological Services, jonesgeo@comcast.net.
5. **Late Devonian Vertebrate Fossils from the Catskill Formation at Red Hill, Clinton County, Pennsylvania**. Sat., 22 March, 7:30 a.m.–9 p.m. US$110; includes field trip guide, transportation, lunch, and refreshments. Edward B. Daeschler, Academy of Natural Sciences of Drexel Univ., daeschler@ansp.org; Walter L. Cressler, West Chester Univ. of Pennsylvania, wcressler@wcupa.edu.
6. **Hydrogeologic Framework Based on Van Houten Cyclic Stratigraphy and Gamma-Ray Logging, Naval Air Warfare Center, West Trenton, New Jersey.** Sat., 22 March, 8 a.m.–4:30 p.m. US$90; includes field trip guide, transportation, lunch, and refreshments. Pierre Lacombe, USGS, placombe@usgs.gov; Daniel Goode, USGS, djgoode@usgs.gov; Thomas Imbrigiotta, USGS, timbrig@usgs.gov.

OPPORTUNITIES FOR STUDENTS

More opportunities, including workshops just for students, are listed online.

Mentor Luncheons

Students will have the opportunity to discuss career prospects and challenges with professional geoscientists over a FREE lunch. See **www.geosociety.org/mentors/** for more information. *Cosponsored by the GSA Foundation.*

Roy J. Shlemon Mentor Program in Applied Geoscience: Sun., 23 March, noon–1:30 p.m.

John Mann Mentors in Applied Hydrogeology Program: Mon., 24 March, noon–1:30 p.m.

TRAVEL GRANTS

Application deadline: 18 February

Check **www.geosociety.org/grants/negrant.htm** for guidelines and eligibility. Students must register for the meeting before applying for a travel grant.

LOCAL COMMITTEE

General Co-Chairs: Roger Thomas, roger.thomas@fandm.edu; Noel Potter, pottern@dickinson.edu

Field Trip Chair: Andrew de Wet, adewet@fandm.edu

Technical Program Co-Chairs: Chris Williams, chris.williams@fandm.edu; Dru Germanoski, germanod@lafayette.edu; Zeshan Ismat, zeshan.ismat@fandm.edu

Workshops: Rob Sternberg, rob.sternberg@fandm.edu

The Columbia-Wrightsville Bridge, officially the Veterans Memorial Bridge, spans the Susquehanna River. Photo courtesy www.discoverlancasterpa.com.

Downtown Lancaster, Pennsylvania. Photo by Randolph Carney; used with permission via Wikimedia Commons.

Second Announcement

SOUTHEASTERN SECTION

63rd Annual Meeting of the Southeastern Section, GSA
Blacksburg, Virginia, USA

10–11 April 2014

www.geosociety.org/Sections/se/2014mtg/

Duck Pond at Virginia Tech. Photo by Eric T. Gunther.

Elevating Geosciences in the Southeastern U.S.: New Ideas about Old Terranes

LOCATION

Blacksburg is about 40 miles west-southwest of Roanoke and 150 miles north of Charlotte. It is located near the boundary of the Valley and Ridge geologic province to the west and the Blue Ridge to the east, conveniently close to a wide range of geologic features. We have developed a technical program and field trips that cover a diverse set of geologic topics and processes, from seismology, to Cenozoic volcanism, to Paleozoic sedimentation on the Laurentian margin, to surface water and groundwater processes, to Paleozoic magmatism and metamorphism, to Paleozoic and Mesozoic geobiology. Our meeting is also at that magical time of Appalachian Spring when the mountains of southwestern Virginia are at their best. Please join us for an exciting meeting!

REGISTRATION

Early registration deadline: 10 March
Cancellation deadline: 17 March
REGISTRATION FEES (all fees in U.S. dollars)

	Early		Standard	
	Full Mtg.	**One Day**	**Full Mtg.**	**One Day**
Professional Member	$235	$145	$265	$165
Professional Nonmember	$255	$165	$285	$185
Student Member	$105	$85	$125	$95
Student Nonmember	$125	$105	$145	$115
K–12 Teacher	$50	$40	$55	$45
Guest	$50		$60	
Short Course/Field Trip only	$40		$50	

ACCOMMODATIONS

Hotel reservation deadline: 10 March

A block of rooms has been reserved for meeting attendees at the Inn at Virginia Tech, 901 Prices Fork Road, Blacksburg, Virginia 24061, USA, +1-540-231-8000. Rate: US$144 + tax, single or double. When making your reservation, be sure to ask for the **GSA Southeastern Section** room block.

TECHNICAL PROGRAM

Abstract deadline: 7 January
Submit online: www.geosociety.org/Sections/se/2014mtg/.
Abstract submission fee: US$10 for students; US$15 for all others.

Symposia

S1. **Contextualizing the Importance of the Newark Supergroup to Understanding the Biotic Change in the Early Mesozoic**. Sterling Nesbitt, Virginia Tech; Paul Olsen, Columbia University.

S2. **Adaptation and the Architects of Change: The Reciprocal Relationship between Life and the Environment through Time.** Mike Meyer, Western Carolina University; A. Drew Muscente, Virginia Tech.

S3. **A Symposium in Honor of the Career of Richard Bambach.** Shuhai Xiao, Virginia Tech; Gwen Daley, Winthrop University; Andrew M. Bush, University of Connecticut.

S4. **In Honor and Memory of Dr. Robert B. Neuman: New Directions in Southern Appalachian Geologic Research, Foreland to Hinterland**. Mark Carter, USGS; Arthur Merschat, USGS; Elizabeth McClellan, Radford University; Melissa Brett, Radford University.

Theme Sessions

T1. **Modern and Ancient Sediment Routing Systems in the Southeastern United States.** William Craddock, USGS; Kenneth Eriksson, Virginia Tech.

T2. **Geologic Studies of the U.S. Atlantic Coastal Plain.** Christopher Swezey, USGS; William R. Doar III, South Carolina Geologic Survey.

T3. **Paleontologists of the Southeast: Characters Welcome!** Michael A. Gibson, Univ. of Tennessee–Martin; Richard A. Laws, Univ. of North Carolina–Wilmington.

T4. **Revealing the Cenozoic Fossil Record in Eastern North America.** Michelle R. Stocker, Virginia Tech; Gregg F. Gunnell, Duke University.

T5. **Ichnology in the Southeast USA.** Andrew K. Rindsberg, Univ. of West Alabama.

T6. **EarthScope Targets in the Eastern United States.** John Hole, Virginia Tech; Steven Whitmeyer, James Madison Univ.

T7. **Lessons Learned from the 2011 Virginia Earthquake.** J. Wright Horton, USGS; Martin Chapman, Virginia Tech; Russell Green, Virginia Tech.

T8. **Geohazards: Methods for Mapping, Monitoring, and Mitigating.** C.F. (Skip) Watts, Radford Univ.; M.J. (Marty) Woodard, Haley and Aldrich.

T9. **Geologic Maps, Geophysical Maps, Digital Geologic Maps, and Derivatives from Geologic and Geophysical Maps (Posters).** Michael W. Higgins; Ralph F. Crawford, The Geologic Mapping Institute.

T10. **Digital Devices and Online Resources for Geospatial Visualization.** Callan Bentley, Northern Virginia Community College; Declan DePaor, Old Dominion Univ.

T11. **Hydrocarbon Recovery Using Fracking Technologies.** John Chermak, Virginia Tech.

T12. **Virginia Uranium.** Robert J. Bodnar, Virginia Tech.

T13. **Evaluating Dust Contaminant Exposure and Impact on Human Health and Community Well-Being Associated with Coal Mining Activities.** Nicholas Basta, The Ohio State Univ.; John R. Craynon, Virginia Tech; Nancy E. Johnson, Kentucky College of Public Health; J. Buchanich, Univ. of Pittsburgh; E. Talbott, Univ. of Pittsburgh; Vladislav Kecojevic, West Virginia Univ.; Braden Lusk, Univ. of Kentucky; Susan L. Meacham, Virginia Tech; Michael E. Karmis, Virginia Tech.

T14. **Mineralogy and Geochemistry of Mine Wastes.** J. Donald Rimstidt, Virginia Tech; Lee Daniels, Virginia Tech.

T15. **Melting Processes in the Eastern U.S.** Esteban Gazel, Virginia Tech; Elizabeth Johnson, James Madison Univ.

T16. **The Next Generation Science Standards, Common Core, and STEM: Opportunities for Geoscience Education in K–12 and Beyond.** William Witherspoon, Fernbank Science Center, DeKalb County School District; Denise Hills, Geological Survey of Alabama; Lionel Crews, Univ. of Tennessee at Martin.

T17. **Progress in Online Geoscience Education.** Jennifer Sliko, Western Carolina Univ.; Hannah Scherer, Virginia Tech.

T18. **Earth-Science Instruction in 2013 and Beyond: How Teaching Practical Science Classes Will (and Must!) Adapt in a World of MOOCs and Social Media Options.** Douglas W. Haywick, Univ. of South Alabama; Ann E. Holmes, Univ. of Tennessee–Chattanooga; David Kopaska-Merkel, Geological Survey of Alabama.

T19. **Innovative, Multidisciplinary Approaches to Teaching Core Geoscience Courses.** Lynn Fichter, James Madison Univ.; Lawrence Malinconico, Lafayette College; David Sunderlin, Lafayette College; Steven Whitmeyer, James Madison Univ.

T20. **Undergraduate Research as Teaching Practice in the Southeastern Section.** Jeff Ryan, Univ. of South Florida; Weston Dripps, Furman Univ.; Lee Phillips, Univ. of North Carolina at Pembroke.

T21. **Karst and Caves.** Madeline Schreiber, Virginia Tech; John Haynes, James Madison Univ.; Dorothy Vesper, West Virginia Univ.

T22. **Hydrologic Characterization of Crystalline-Rock Aquifers of the Blue Ridge and Piedmont Provinces.** Tom Burbey, Virginia Tech; Larry Murdoch, Clemson Univ.

T23. **Water-Quality Issues in the Southeast U.S.** Vijay Vulava, College of Charleston; Madeline Schreiber, Virginia Tech.

T24. **Hidden Gems: Geological Collections and Museums in the Southeastern U.S.** Jim Beard, Virginia Museum of Natural History; Llyn Sharp, Virginia Tech Museum of Geosciences; Sarah Timm, Virginia Museum of Natural History.

T25. **Watershed Processes.** Jeff Wilcox, Univ. of North Carolina–Asheville; Weston Dripps, Furman Univ.

T26. **Hands-on Geoscience Activities for Complex Topics: A Marketplace of Ideas.** Denny Casey, Virginia Museum of Natural History; David Kopaska-Merkel, National Association of Geoscience Teachers; Eric Pyle, James Madison Univ.; Llyn Sharp, Virginia Tech.

T27. **Metamorphism in the Southeast and Beyond**. Ted Labotka, tlabotka@mac.com; Harry Y. McSween, mcsween@utk.edu, University of Tennessee–Knoxville.

T28. **Economic Geology in the Southeast: Gold, REE, V, U, Other Critical Minerals, and the Indispensible Industrial Minerals.** Nora Foley, USGS.

FIELD TRIPS

Pre-Meeting

1. **"Active" Features along a "Passive" Margin: The Intriguing Interplay between Silurian-Devonian Stratigraphy, Alleghanian Structures, and Eocene Magmatism of Highland and Bath Counties, Virginia.** Tues.–Wed., 8–9 April. John Haynes, James Madison Univ., haynesjx@jmu.edu; Elizabeth Johnson, James Madison Univ.; Steve Whitmeyer, James Madison Univ.
2. **Does the Chopawamsic Fault Represent the Main Lapetan Suture in the Southern Appalachians? Geology, Geochemistry, and Geochronology of the Western Piedmont in Northern Virginia.** Tues.–Wed., 8–9 April. K. Stephen Hughes, North Carolina State Univ., kshughes@ncsu.edu; James P. Hibbard, North Carolina State Univ.
3. **Key Structural and Stratigraphic Relationships from the Northeast End of the Mountain City Window and Mount Rogers Area, Virginia–North Carolina–Tennessee.** Mon.–Wed., 7–9 April. Arthur J. Merschat, USGS, amerschat@usgs.gov; Richard Tollo, George Washington Univ.; Elizabeth McClellan, Radford Univ.; Scott Southworth, USGS.
4. **Geologic Setting of the August 2011 Central Virginia Earthquake.** Tues.–Wed., 8–9 April. Bill Burton, USGS, bburton@usgs.gov; David Spears, Virginia Dept. of Mines, Minerals, and Energy; Rich Harrison, USGS; Nick Evans; Steve Schindler, USGS; Ron Counts, USGS.
5. **The Marcellus/Millboro Shale in Virginia and West Virginia.** Tues.–Wed., 8–9 April. Daniel Soeder, U.S. Dept. of Energy, daniel.soeder@netl.doe.gov; John Chermak, Virginia Tech; Cathy Enomoto, USGS.

Post-Meeting

6. **Karst Geomorphology and Hydrology in the Shenandoah Valley, Virginia.** Fri.–Sun., 11–13 April. Daniel Doctor, USGS, dhdoctor@usgs.gov; Wil Orndorff, Virginia Dept. of Conservation and Recreation; Joel Maynard, Virginia Dept. of Environmental Quality; Jerry Casile, USGS; Matt Heller, Virginia Dept. of Mines, Minerals, and Energy.
7. **Tectonics and Stratigraphy of the Eastern Blue Ridge: Regional Correlations of the Ashe and Alligator Back Formation (Metamorphic Suites), Southern Virginia and Northwestern North Carolina.** Sat.–Sun., 12–13 April. Mark Carter, USGS, mcarter@usgs.gov; Arthur J. Merschat, USGS.
8. **Geology of the Scottsville Mesozoic Basin, Virginia Piedmont.** Sat.–Sun., 12–13 April. Christopher M. Bailey, College of William & Mary, cmbail@wm.edu; Jacob Rosenthal, College of William & Mary; Robert Weems, USGS.
9. **Mesozoic Fauna from the Solite Quarry, Dan River Basin, Virginia.** Sat., 12 April. Andy Heckert, Appalachian State Univ., heckertab@appstate.edu; Cynthia Liutkus-Pierce, Appalachian State Univ.; Alton Dooley, Virginia Museum of Natural History.
10. **Stratigraphy and Sedimentology of the Upper Mississippian Pride Shale in the Appalachian Basin.** Sat., 12 April. Ken Eriksson, Virginia Tech, kaeson@vt.edu; Ty Buller, Virginia Tech.
11. **Geology of the Coles Hill Uranium Deposit, Virginia Piedmont.** Fri.–Sat., 11–12 April. Joe Aylor, Virginia Uranium Corporation, jaylor@vauinc.com; James Beard, Virginia Museum of Natural History; Bob Bodnar, Virginia Tech.

STUDENT MENTOR LUNCHEONS

Cosponsored by the GSA Foundation. Students will have the opportunity to discuss career prospects and challenges with professional geoscientists over a FREE lunch. See www.geosociety.org/mentors/ for more information.

Roy J. Shlemon Mentor Program in Applied Geoscience: Thurs., 10 April.

John Mann Mentors in Applied Hydrogeology Program: Fri., 11 April.

LOCAL COMMITTEE

General Chairs: Robert J. Tracy, rtracy@vt.edu; Kenneth A. Eriksson, kaeson@vt.edu

Technical Program Chair: Steven Whitmeyer, whitmesj@jmu.edu

Field Trip Chairs: Chuck Bailey, cmbail@wm.edu; Lorrie Coiner, lorrie.coiner@dmme.virginia.gov

Exhibits Coordinator: Sarah Timm, sarah.timm@vmnh.virginia.gov

Posters Coordinator: Esteban Gazel, egazel@vt.edu

Sponsorships Coordinator: Chester (Skip) Watts, cwatts@radford.edu

GSA Mentor Programs at the 2014 Section Meetings

Plan now to attend a **Roy J. Shlemon Mentor Program in Applied Geoscience** and/or a **John Mann Mentor Program in Applied Hydrogeology** luncheon at your 2014 Section Meeting to receive career advice and chat one-on-one with practicing geoscientists. **FREE lunches** will be served! Check the Section Meetings website, **www.geosociety.org/mentors/sectionSched.htm,** for times and locations. A reminder will be included on all student badges at the onsite registration desk. Space is limited, so plan to arrive early: first come, first served. If you have questions or want to serve as a mentor, please contact Jennifer Nocerino at jnocerino@geosociety.org.

SOUTH-CENTRAL
Fayetteville, Arkansas, USA
Shlemon luncheon: Mon., 17 March
Mann luncheon: Tues., 18 March

NORTHEASTERN
Lancaster, Pennsylvania, USA
Shlemon luncheon: Sun., 23 March
Mann luncheon: Mon., 24 March

SOUTHEASTERN
Blacksburg, Virginia, USA
Shlemon luncheon: Thurs., 10 April
Mann luncheon: Fri., 11 April

NORTH-CENTRAL
Lincoln, Nebraska, USA
Shlemon luncheon: Thurs., 24 April
Mann luncheon: Fri., 25 April

JOINT ROCKY MOUNTAIN & CORDILLERAN
Bozeman, Montana, USA
Shlemon luncheon: Mon., 19 May
Mann luncheon: Tues., 20 May

www.geosociety.org/Sections/meetings.htm

2014 INHIGEO CONFERENCE

International Commission on the History of Geological Sciences

6–10 July 2014

Asilomar Conference Grounds, Pacific Grove, California, USA

The 2014 International Commission on the History of Geological Sciences (INHIGEO) conference will be held on the Asilomar Conference Grounds, situated by the ocean on the Monterey Peninsula, California, USA. Asilomar provides an outstanding setting for extensive interaction among meeting participants, with meals taken in common at the center's dining hall. Participants should plan to arrive at Asilomar on the afternoon of 6 July with departure on the 11th. A post-meeting field trip is planned for 11–16 July.

This meeting is sponsored jointly by the INHIGEO and the Geological Society of America (GSA). North American members of INHIGEO and the GSA History and Philosophy of Geology Division are partners in planning this meeting.

CALL FOR PRESENTATION PROPOSALS

Deadline: 17 Jan. 2014

If you wish to make a presentation at the meeting, please complete the online proposal form at **http://community.geosociety.org/INHIGEO2014/Home.** Membership in INHIGEO or GSA is **not** a prerequisite for presentation and participation in the conference. The organizers strongly encourage attendance and participation by everyone with interest in the themes of the conference and hope for active involvement by many who are not INHIGEO members.

DUAL CONFERENCE THEMES

1. **Doing the History of the Earth Sciences: What, Why, and How?**
   Keynote speakers: Claudine Cohen (École des Hautes Études en Sciences Sociales, Paris) and Ernst Hamm (York University, Toronto).
   In 1994, GSA hosted the Penrose Conference, "From the Inside and the Outside: Interdisciplinary Perspectives on the History of the Earth Sciences." The focus of that meeting was on how practicing scientists (geoscience "insiders") and professional historians ("outsiders") approached research in our field. Twenty years later, it is fitting to ask where we stand on fundamental questions about scholarly inquiry into the development of the geosciences.
   - *What* is properly encompassed within historical studies of the earth sciences? How is the domain of investigation defined? Where do its boundaries lie?
   - *Why* should the history of the earth sciences be investigated and analyzed? What purposes are served by such historical examination? Who should care?
   - *How* should research on history of the geosciences be conducted? How should the results be formulated? How can constructive dialogue between scientists and historians be promoted? How can our research be better shared with colleagues and with the public at large?
2. **California's Place in the History of the Earth Sciences.**
   Keynote speakers: Eldridge Moores (University of California, Davis) and William R. Dickinson (University of Arizona).
   With this meeting's venue in California—and at the site of the watershed 1969 Penrose Conference ("The Meaning of the New Global Tectonics for Geology")—it is especially appropriate that the second conference theme be about California's place in the history of the earth sciences.

PROGRAM

The Program Committee will entertain all proposals addressing the history of the geosciences but strongly encourages presentations relevant to either of the two conference themes. For those who may need this encouragement, it should be said that research into any area of the history of the geosciences can be organized so as to address aspects of the programmatic, historiographical, and

California's Big Sur Coast near Pacific Grove, California, USA. Image credit: Robert Schwemmer, NOAA photo library, www.flickr.com/photos/noaaphotolib/5436397416/.

methodological issues stated in the first of the conference themes. Presentations will include posters as well as talks.

Closing keynote speaker: Henry R. Frankel (University of Missouri–Kansas City) will speak at the closing banquet.

Posters: Poster presenters will have the opportunity, in advance of the poster session, to make very brief remarks about their presentations as part of the oral program.

Panel sessions: The Program Committee will endeavor to cluster some presentations as components of panel sessions for contributions that relate to a common problem or issue. Identification and organization of such panel sessions will depend on proposals received. As examples, here are two potential Panel Session topics:

A. ***We belong too*:** Inclusion of "outlier disciplines" in the history of the earth sciences. How can fields outside "geology proper" be integrated within the history of the earth sciences? How important is it to attempt to do this? Such a panel might incorporate oceanography, meteorology and climatology, geography, cartography, soil science, geochemistry, physics, engineering, mathematics, environmental planning, and alchemy and early chemistry.

B. ***Organizing research around theory* and *practice*:** At the close of his 1986 book, *Controversy in Victorian Geology: The Cambrian-Silurian Debate*, Jim Secord argued for a reorientation away from a handful of classic theoretical debates toward concrete traditions of research, or what he called "an approach through the study of practice." What is the present state of affairs (and what are the prospects for the immediate future) regarding this polarity—placing historical research around twin poles of theory and practice?

REGISTRATION

http://community.geosociety.org/INHIGEO2014/Home/

Among the costs covered by the registration fee, which will be posted online, are pre-dinner receptions and private dining rooms on the evenings of the conference opening and closing; coffee breaks; expenses for meeting space, audio-visual equipment and service, and poster equipment; program printing; and meeting administrative and planning expenses.

VENUE

Dates: 6–11 July 2014
Reservations open: 6 Jan. 2014
Reservation deadline: 6 June 2014

The Asilomar Conference Grounds in California, USA, has been the site of many notable meetings over the past several decades. Learn more at **www.visitasilomar.com.**

Asilomar is located about 120 miles (190 km) south of San Francisco and about 330 miles (530 km) north of Los Angeles. Airline travelers can reach Asilomar via the nearby Monterey Regional Airport (MRY), with service from San Francisco, Los Angeles, San Diego, Las Vegas, Phoenix, and Denver. The much larger international airports of San Francisco (SFO), about 110 miles away (177 km), and San Jose (SJC), 80 miles distant (130 km), are linked by direct shuttle (Monterey Airbus, www.montereyairbus.com).

Participants should plan to arrive at Asilomar on the afternoon of 6 July, with departure on the 11th. Dinner on the 6th is included in the lodging package (Asilomar lodging includes three meals per day in the Crocker Dining Hall). A non-refundable deposit of the charge for one night's accommodation plus a one-time housing bureau fee of US$20 per person will be required when you make your reservation.

Rates for combined lodging and meals (alcoholic beverages not included), per person, are set as follows: Single occupancy: US$262.47; double occupancy: US$167.42 per person; youth (ages 3 to 12, in a shared room): US$94.32. There are also very limited possibilities for triple and quad accommodation, at the daily rates of US$139.40 and US$125.40 per person, respectively. These rates are inclusive of all fees and taxes. It is important to remember that these daily amounts include three meals as well as lodging.

While conference participants are not required to take accommodation at Asilomar, the organizers very strongly encourage doing so in order to promote interactions among conferees. Conference registrants who choose to book lodging elsewhere will be charged a daily fee of US$10, required by Asilomar for "off-grounds participants."

ITINERARY

9 July: Mid-Meeting Excursion Day

Point Lobos State Natural Reserve, a spectacular coastal headland ten miles south of Asilomar, is also a locality of geologic interest. Here one can examine ocean-side exposures of Paleocene-age submarine canyon infill deposits lying unconformably on mid-Cretaceous granitic rocks. Leaders: Léo Laporte, Bob Garrison, and Steve Rowland. Learn more about Point Lobos at **www.parks.ca.gov/?page_id=571.**

Options for those preferring to make independent excursions include the outstanding Monterey Bay Aquarium (**www.montereybayaquarium.org**), located just two and a half miles from Asilomar, and accessible by public bus; and the historic town of Carmel, site of one of the earliest California missions, about six miles away (www.carmelcalifornia.com).

11–16 July: Post-Meeting Field Trip

Plans are in progress for a six-day post-meeting field excursion, limited to 32 participants. The itinerary will take the group from Asilomar eastward across the San Joaquin Valley to Yosemite National Park (with two nights at Yosemite Lodge at the Falls), then across the Sierra Nevada to the western margin of the Great Basin (two nights at Mammoth Lakes). On the return via Lake Tahoe, the group will be able to visit localities associated with the mid-19th-century California Gold Rush. For those who prefer not to terminate the trip with a return to Asilomar, afternoon drop-off on 16 July at a major airport (probably Sacramento) will be an option. Trip leaders: Tony Orme and Ken Aalto.

Organizing Committee

Kenneth R. Aalto, Victor R. Baker, Kennard B. Bork, Renee M. Clary, James C. Dawson, Gregory A. Good, Léo F. Laporte, and Kenneth L. Taylor.

Program Committee

Vic Baker, Jim Dawson, Mott Greene, Sally Newcomb, and Ken Taylor.

THE GEOLOGICAL SOCIETY OF AMERICA®

Welcome New GSA Members!

The following individuals submitted their applications for GSA membership between 16 Feb. and 19 Sept. 2013 and were approved by GSA Council during the 2013 GSA Annual Meeting & Exposition in October 2013.

PROFESSIONALS

Erin Adams
Timothy Adams
Alfredo Aguillón-Robles
Adel Alaraifi
Murray Allan
Jessica Allewalt
Thomas Ambroz
Muhammad Azrul Amir
Colin D. Anderson
Songjian Ao
Troy Ardon
Joe Alan Artz
Bernard Appiah Asare
Glen W. Atwood
Brittany Austin
Gerry Austin
Kamlesh Awatramani
Ogochukwu Azike
Norman Richard Bailie
Lawrence E. Band
Yvonne Barbee
Thomas E. Barchyn
Jessica L. Barone
Kenneth T. Barrow
Attila Bartha
Hazel A. Barton
Margaret Benoit
Hermann Bermudez
Fiona Claire Best
Kathakali Bhattacharyya
Joseph A. Biaglow
Thomas S. Bianchi
Jens Thomas Birkholzer
Tabitha Bittinger
Brian S. Blais
Kelly Blake
Beth Boddiger
Richard Bolen
Jacquelyn Renee Bolman
Clint Aaroen Boyd
Oscar Paulo Gross Braun
Christopher Michael Breeding
John R. Broker
Alan Lee Brown
Jacinda Nettik Brown
Larry Buckley
George Burke
Heath Bush
Nicholas Butterfield
William T. Cains Sr.
David Calvert
Cory James Cantrell
Lorraine H. Carey
Thomas J. Casadevall
Stephan Mark Castle
Tiffany Caudle
James Cearley III
Joel Chacon
Lisa B. Chaddock
Korey Byron Champe
Indrajeet Chaubey
Yong Chen
Jennifer T. Cholnoky
Christina Lynn Clark
Donald Michael Cobb
Peter C. Cooper
Sarah Martha Cooper
William Corbin
William Maclin Cowan
Brooke Crowley
Mariah Cushing
Jayesh P. Das
Jenny Marie Dauer
Jerry D. Davis
Joseph Davis
Jeff B. de Graffenried
Rachel Ann Dearden
Nicholas D. Deardorff
Michael J. DeFrisco
Robert K. Denton Jr.
Daniel Dickerson
Noah Diffenbaugh
Philip Difilippo
James M. Dohm
Donglin Dong
John J. Donohue IV
Harry Dowsett
Patrick J. Drohan
Jennifer Druhan
Assem El-Haddad
Ettebong Eshiet Emmanuel
Victoria Ershova
Eden Espino
Perry Fields
Daniel C. Fisher
William H. Fleming Jr.
Robert John Floran
Matthew Fox
Dylan H. Frazer
Richard Friese
Wayne Thomas Froehlich
Cunhai Gao
Carlos Alberto Garcia-Ramirez
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In Memoriam

The Society notes with regret the deaths of the following members (notifications received between 1 Aug. and 31 Oct. 2013)

Norman R. Anderson
Tacoma, Washington, USA
Date of death: 28 Oct. 2011
GSA notified: 21 Oct. 2013

Charles V. Campbell
Fruita, Colorado, USA
GSA notified: 16 Oct. 2013

A. Eugene Fritsche
Winnetka, California, USA
Date of death: 7 July 2013

Howard R. Gould
DeKalb, Illinois, USA
Date of death: 29 Aug. 2013

Gottfried K. Guennel
Littleton, Colorado, USA
Date of death: 13 May 2013

Robert J. Gutru
Wichita, Kansas, USA
Date of death: 1 Oct. 2012
GSA notified: 10 Oct. 2013

Verne Q. Hornback
Weed, California, USA
Date of death: 4 Aug. 2013

James S. Kahn
Galena, Illinois, USA
Date of death: 27 July 2013

Derek J. Main
Irving, Texas, USA
Date of death: 4 June 2013

Eric P. Nelson
Golden, Colorado, USA
Date of death: 27 Aug. 2013

Jerry C. Olson
Mesa, Arizona, USA
Date of death: 12 Mar. 2013

David G. Roberts
Combloux, France
Date of death: 5 July 2013

James A. Roddick
Vancouver, British Columbia, Canada
Date of death: 19 Feb. 2013

Eugen Seibold
Freiburg, Germany
Date of death: 23 Oct. 2013

Paul K. Sims
Fort Collins, Colorado, USA
Date of death: 29 Oct. 2011
GSA notified: 11 Sept. 2013

Samuel J. Sims
Bethlehem, Pennsylvania, USA
Date of death: 13 May 2013

Sarah J. Stoll
Sheyboygan, Wisconsin, USA
Date of death: 13 Sept. 2013

Leigh Van Valen
Chicago, Illinois, USA
GSA notified: 29 Oct. 2013

John Vecchioli
Odessa, Florida, USA
Date of death: 9 Feb. 2013

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GSA ELECTIONS

GSA's success depends on you—its members—and the work of the officers serving on GSA's Executive Committee and Council.

In early March, you will receive a postcard with instructions for accessing your electronic ballot via our secure website, and biographical information on the nominees will be online for you to review at that time. Paper versions of both the ballot and candidate information will also be available.

Please help continue to shape GSA's future by voting on the nominees listed here.

2014 OFFICER AND COUNCIL NOMINEES

PRESIDENT
We congratulate our incoming President (July 2014–June 2015), who was elected by GSA membership in 2013: **Harry (Hap) Y. McSween Jr.** of the University of Tennessee–Knoxville.

VICE PRESIDENT/PRESIDENT ELECT
(July 2014–June 2016)
Jonathan G. Price
Jonathan G. Price, LLC
Reno, Nevada, USA

TREASURER
(July 2014–June 2015)
Bruce R. Clark
The Leighton Group Inc.
Irvine, California, USA

COUNCILOR POSITION 1
(July 2014–June 2018)
Aaron Cavosie
University of Puerto Rico–Mayagüez
Mayagüez, Puerto Rico

Anke M. Friedrich
Universität München
Munich, Germany

COUNCILOR POSITION 2
(July 2014–June 2018)
Timothy Bralower
Pennsylvania State University
State College, Pennsylvania, USA

Shuhai Xiao
Virginia Polytechnic Inst. and State University
Blacksburg, Virginia, USA

COUNCILOR POSITION 3
(July 2014–June 2018)
Steven G. Pollock
University of Southern Maine
Gorham, Maine, USA

Alan E. Kehew
Western Michigan University
Portage, Michigan, USA

Elections begin 7 March 2014. Ballots must be submitted electronically or postmarked by 13 April 2014. www.geosociety.org/aboutus/officers.htm

LAST Call for Applications

2014–2015 GSA–USGS Congressional Science Fellowship

Deadline: 1 Feb. 2014

Bring your science and technology expertise to Capitol Hill to work directly with national leaders at the interface between geoscience and public policy. The GSA-USGS Congressional Science Fellowship provides a rare opportunity for a geoscientist to spend a year working for a Member of Congress or congressional committee. If you are an earth scientist with a broad geologic background, experience applying scientific knowledge to societal challenges, and a passion for helping shape the future of the geoscience profession, GSA and the USGS invite your application. The fellowship is open to GSA members who are U.S. citizens or permanent residents, with a minimum requirement of a master's degree with at least five years of professional experience or a Ph.D. at the time of appointment. Learn more at www.geosociety.org/csf or by contacting Susan Lofton, +1-303-357-1040, slofton@geosociety.org. ***Apply today!***

THE GEOLOGICAL SOCIETY OF AMERICA®

USGS science for a changing world

P. Geoffrey Feiss, GSA Foundation President

The Charles M. Shaw Bequest

In November, I reported on the transformative gift that former GSA Treasurer Robbie Griess made in creating the International Distinguished Lecturer Program at GSA. This is typical of how a member with a strong interest in advancing GSA's mission works with staff and Council to enhance a new initiative at GSA.

It doesn't always work quite like this. In March of 2013, we received word that the late Charles M. Shaw of La Conner, Washington, USA, had named the GSA Foundation, among others, in his estate. Few of us knew Shaw and certainly no one had talked with him about a gift to GSA. A native of southern California and a Navy veteran of World War II, he had majored in chemistry at the University of California–Berkeley and then received his Ph.D. in 1956 in experimental metamorphic petrology with the legendary John Verhoogen. He held a Fulbright Fellowship at the University of Oslo, where he worked with the equally legendary Tom Barth. His subsequent career was as an independent consulting geologist in the western United States and New Zealand. We understand that he had a keen interest in mining and minerals, especially ore specimens from unusual locales.

The late Charles M. Shaw of La Conner, Washington, USA

This was about *all* we knew of Shaw—and most of that we learned through the "miracle" of the Internet.

As time passed, we learned that the Charles M. Shaw estate would provide the GSA Foundation with an unrestricted gift totaling at least half a million dollars. Such generosity could not go unnoted or unacknowledged. But how were we to honor the

We learned a bit about his passions from the fact that we shared his estate with Berkeley, the Population Institute, The Nature Conservancy, Save the Redwoods, and the Audubon Society, among others. His executor made it clear he trusted us to put his bequest to good use.

With this responsibility on our shoulders, we discussed the Society's top priorities with GSA leadership. Though we could have spent the bequest in any way that our Board of Trustees deemed appropriate, we soon realized that we would best honor a geological life well lived if we created a board-designated fund that aligned Shaw's interests, as we best understood them, with GSA's greatest needs.

Thus, at the 2013 Annual Meeting in Denver, the GSA Foundation Board of Trustees created the **Charles M. Shaw Fund.** For the next five years, income distributions from the fund will be used to support the new Science Policy Fellow in GSA's D.C. Office. This was a top priority of GSA Council and aligns, we think, with Shaw's interests as exemplified by those other organizations with whom we share his generous bequest. After five years, we will revisit this allocation to assure that it is fulfilling the intent of Council and Shaw.

I tell this story for two reasons: First, to celebrate a marvelous act of generosity by a GSA member; second, to convey the seriousness with which the Society and Foundation take their obligation to serve its members and to honor donor intent to the extent we can—even when we must use some serious deductive reasoning to understand what a donor might have wanted us to

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THE GEOLOGICAL SOCIETY OF AMERICA®

EarthCache™ is Turning 10!

Since the first EarthCache (GCHFT2) was placed on 10 January 2003, an amazing four-million people have visited more than 16,200 EarthCaches in 165 countries around the globe. That is a truly outstanding impact—people outside, having fun, and learning about our dynamic planet all at the same time.

The EarthCache program came from humble beginnings. A GSA member at the 2003 Annual Meeting in Seattle, Washington, USA, mentioned that GSA should look into geocaching. Then a GSA staff member and his daughter developed the first site with a noble aim—to use Earth to teach people about the geology under their feet. "Let the Earth be your teacher" still encapsulates what the EarthCache program is about.

Now ten years on, the EarthCache program continues to provide a way for geocachers to experience some amazing places in a way a traditional geocache (a hidden plastic box with a log book) just can't do.

Throughout the ten years, the program built its support for EarthCachers through the EarthCache Masters and Discovery Programs, EarthCache Day, and the International EarthCache Events (IEEs). We have also started to organize EarthCache GeoVentures—special field trips for EarthCachers. These are wonderful programs that have helped to build a community of EarthCachers, through which some lifelong friendships have been formed.

This month, the EarthCache community is celebrating the 10th Anniversary of EarthCache by holding events around the globe. We also are working on more activities to run through the year to get people involved—photo and video competitions, a virtual 5-K race, and more.

Our future continues to be very bright. We want to build on all these programs and work with our extraordinary volunteer reviewers (the "Geoawares") to help cachers around the world continue to enjoy and learn about all aspects of geoscience.

GSA thanks everyone who has been involved—Groundspeak Inc., volunteers, staff, and the wider geocaching community.

Happy Birthday EarthCache!

EarthCaching is for the young and young at heart. Photo by Gary Lewis.

A dike of once molten rock cuts the rock platform at EarthCache I in Australia. Photo by Gary Lewis.

2014 GSA GeoVentures

EXPLORE HAWAIIAN VOLCANOES FOR COLLEGE STUDENTS I*: 2–11 February

THE GEOLOGY OF CANYON COUNTRY, MOAB, UTAH: 11–17 May

GEOLOGY OF DINOSAUR MONUMENT, YAMPA RIVER: 5–11 June

EXPLORE AUSTRALIA'S GEOLOGY FOR K–12 TEACHERS: 14–26 June

SURVEY OF COLORADO'S MINING GEOLOGY, COLORADO SPRINGS, COLORADO: 22–28 June

EXPLORE SOUTHERN AUSTRALIA (extension trip): 26 June–3 July

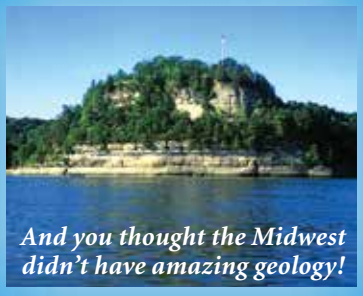
EXPLORE DYNAMIC ICELAND: 27 July–7 August**

EXPLORE HAWAIIAN VOLCANOES FOR COLLEGE STUDENTS II*: 27 July–4 August

EXPLORE HAWAIIAN VOLCANOES FOR K–12 TEACHERS: 6–13 August

GEOCACHING ON AN ACTIVE VOLCANO: 8–15 November

***Contact* Gary Lewis *for more information on GeoVentures at* glewis@geosociety.org.**



And you thought the Midwest didn't have amazing geology!

Mammouth Cave National Park. Image courtesy Wikimedia Commons.

2014 Field Camps

for K–12 Teachers

ILLINOIS BASIN FIELD CAMP: 15–19 June

ROCKY MOUNTAIN FIELD CAMP: 21–26 June

MAMMOTH CAVE FIELD CAMP: 14–19 July

***Contact* Davida Buehler *for more information on Field Camps at* dbuehler@geosociety.org.**

www.geoventures.org

www.facebook.com/GSAGeoVentures

*** These trips are almost full. Register now to secure your spot.**

**** Wait-list only.**

Classified Rates—2014

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.

Classification	Per Line for 1st month	Per line each addt'l month (same ad)
Positions Open	$9.10	$8.85
Fellowship Opportunities	$9.10	$8.85
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First 25 lines	$0.00	$5.00
Additional lines	$5.00	$5.00

Positions Open

EXECUTIVE DIRECTOR AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS

The American Institute of Professional Geologists is accepting applications for the position of Executive Director. The successful candidate will succeed the current director who has announced his intent to retire. Applications will be accepted until the position is filled. Details can be found at www.aipg.org/AIPGExDirSearch.pdf.

TWO TENURE-TRACK INSTRUCTORS GEOSCIENCE THE UNIVERSITY OF CALGARY

Applications are invited for two tenure-track initial term instructor positions in the Dept. of Geoscience. These teaching positions are part of an ongoing effort to improve the experience of undergraduate students through student engagement and student learning in any area of geoscience. The successful applicants will have an advanced degree in geoscience (Ph.D. or equivalent expected) and a desire to achieve teaching excellence and pedagogical and curricular development within an academic setting. All candidates who consider themselves passionate and adaptable with respect to teaching across a variety of geoscience disciplines (see www.geoscience.ucalgary.ca/courses for reference to courses) are welcome to apply.

Known as Canada's energy capital, Calgary is a bustling city of more than 1.2 million, located near the foothills of the Canadian Rocky Mountains. The University of Calgary is a global intellectual hub where students thrive in programs made rich by research and hands-on experiences. The Dept. of Geoscience is one of the largest geoscience departments in North America, with comprehensive undergraduate and graduate programs recognized for excellence world-wide and research strengths in energy and environmental geoscience.

Applications must include a cover letter indicating your qualifications for the position, a *curriculum vitae*, a maximum two-page statement of teaching philosophy including a list of disciplinary areas in which the candidate would like to teach, and the complete contact information of three referees. Appointment will be within the Instructor stream, with a 12-month salary commensurate with experience (see Collective Agreement at www.tucfa.com/?page_id=111). Review of applications will commence on Jan. 17, 2014 and continue until the positions are filled.

Applications should be sent to: Prof. Charles Henderson, Head, Dept. of Geoscience, University of Calgary, 2500, University Drive, Calgary, AB., CANADA T2N 1N4, Fax: (403) 284-0074, e-mail: headgeo@ucalgary.ca.

All qualified candidates are encouraged to apply and excellence will be the primary decision criterion; however, in accordance with Canadian immigration requirements, preference will be given to Canadian citizens and permanent residents of Canada. The University of Calgary respects, appreciates, and encourages diversity.

HYDROGEOLOGIST, TENURE TRACK ASSISTANT PROFESSOR POSITION DEPT. OF GEOLOGICAL SCIENCES THE UNIVERSITY OF ALABAMA

The Dept. of Geological Sciences at The University of Alabama invites applications for a tenure-track faculty position in Hydrogeology, beginning Aug. 2014. The position will be filled at the Assistant Professor level. Candidates must have a strong record of research and a Ph.D. in the geosciences or a closely related field, preferably with specialization linking surface and groundwater processes, by the time of appointment. The successful candidate will be expected to establish a strong, externally-funded research program and to attract high-quality Ph.D. and M.S. graduate students. The successful candidate also will be expected to teach introductory geology courses and undergraduate and graduate courses in hydrogeology, advise graduate students, and contribute to the department's research program in hydrogeology and environmental geology. Opportunities for research collaboration also exist with the Geological Survey of Alabama, the newly established NOAA National Water Center, and the Center for Freshwater Studies, all located on The University of Alabama campus. The department has a broad range of resources and existing facilities, including modeling and computational resources, field and laboratory equipment, and chemical and stable isotope analytical facilities. Details regarding existing department research programs, equipment, and facilities can be found at: www.geo.ua.edu. Questions should be directed to Dr. Fred Andrus (fandrus@as.ua.edu), Chair of the Hydrogeology Search Committee. Applicants should submit a cover letter, curriculum vitae, research statement, teaching statement, and names and contact information for at least three referees through the UA Jobs website at facultyjobs.ua.edu. Review of applications will begin Jan. 10, 2014, and will continue until the position is filled.

HYDROGEOLOGIST, ASSISTANT PROFESSOR GEOLOGICAL SCIENCES, UNIVERSITY OF IDAHO, MOSCOW, IDAHO, USA

The Dept. of Geological Sciences at the University of Idaho (UI) is seeking applications for a 9-month, tenure-track position in hydrology. Applications will be accepted from candidates with research and teaching interests over a wide spectrum of groundwater science applications. Areas of specialization may include, but are not limited to all aspects of groundwater resource evaluation, groundwater hydraulics, hydrogeochemistry, and hydrogeophysics. Tentative start date will be Fall 2014. The candidate must have a Ph.D. in geological sciences or closely related field at the time of employment. Salary Range: $65,000. For more information and to apply, visit http://apptrkr.com/409605 by 3/15. Announcement #10000043970. AA/EOE.

GISCIENCE, GEOVISUALIZATION OF BIG DATA, DEPT. OF GEOSCIENCES AND COLLEGE OF ARTS AND SCIENCES GEORGIA STATE UNIVERSITY

The Dept. of Geosciences at Georgia State University invites applications for a tenured or tenure-eligible faculty position at the Associate or Full Professor level in GIScience and Geovisualization of Big Data, effective Fall 2014. Ideal candidates will focus on the geovisualization of social and/or environmental disparities, preferably in urban settings. This position is part of Georgia State University's (GSU) Second Century Initiative (www.gsu.edu/secondcentury/) to recruit up to three outstanding Big Data faculty in geosciences, business, and disease modeling.

Minimum requirements for the Big Data position in GIScience and Geovisualization are an earned Ph.D. in geography, geosciences or a related discipline; an outstanding record of scholarly publications demonstrating expertise in GIScience and Geovisualization of big data commensurate with rank at the associate or full professor level; evidence of external funding commensurate with the candidate's discipline and experience; and a demonstrated excellence in teaching in geography, geosciences, or related fields. Candidates with interests in community engagement and/or citizen science are preferred. The successful candidate will be able to provide leadership for the college's Big Data research and teaching initiatives and will also have the ability and desire to promote interdisciplinary research on the application of Geovisualization and GIScience to Big Data technologies and modeling techniques.

ABOUT THE ENVIRONMENT. Georgia State University is a leading research university in the dynamic heart of downtown Atlanta with a diverse student body of over 32,000 students. The Dept. of Geosciences (http://geosciences.gsu.edu/) offers bachelors and masters degrees in Geosciences, with concentrations in geography and geology, and a Ph.D. in Chemistry with a geology specialization.

FURTHER INFORMATION AND APPLICATION PROCEDURE. Applicants wishing to apply should register with http://academicjobsonline.org/ (the registration is free) and upload their curriculum vita, statement of research and teaching interests, and provide contact information for three references. Please indicate that you are applying for the Big Data position in Geosciences. Applicants are **required** to submit their materials via the online system. Questions about the position can be sent to BDGeosciences@gsu.edu. Review of applications will begin immediately and applicants will be reviewed until positions are filled. Positions are contingent on University budget approval.

Georgia State University is an Equal Opportunity Educational Institution/Affirmative Action Employer. Employment is contingent on background verification.

SOIL SCIENTIST
DEPT. OF ENVIRONMENTAL, GEOGRAPHICAL AND GEOLOGICAL SCIENCES
BLOOMSBURG UNIVERSITY OF PENNSYLVANIA

Bloomsburg University of Pennsylvania invites applications for a full-time, tenure-track position at the Assistant Professor level (AA# 41-3-53) to begin fall semester 2014. We seek a Soil Scientist with a focus on Food Systems/Agricultural Science. The successful candidate will be expected to teach upper-level courses in soils science and food systems/agricultural science as well as introductory courses in geography and environmental science to complete a 12-hour per semester teaching load. *The successful candidate will participate in service to the department, develop an active research program that involves undergraduates and will seek external funding.* Preference will be given to candidates with a focus on applications that will complement the developing Center for Earth and Environmental Sciences within the Dept. of Environmental, Geographical and Geological Sciences. Applicant must have a Ph.D. or doctorate from an accredited institution by Aug. 22, 2015.

The preferred candidate will have experience teaching in classroom, laboratory settings, and in the field, a demonstrated commitment to excellence in teaching, and demonstrate an ability to work with diverse populations. Finalists for this position must communicate well and successfully complete an interview process including a teaching demonstration. The successful candidate must be recommended by the majority of the regular, full-time faculty. Prior to a final offer of employment the selected candidate will be required to submit to a background check including, but not limited to, employment verification, educational and other credential verification and criminal background check.

Please submit an application packet including a letter addressing the requirements above, a curriculum vitae, unofficial copies of undergraduate and graduate transcripts, and at least three recommendation names and phone numbers to Dr. Stephen Whisner, Search Committee Chair, at geosearch@bloomu.edu. It is encouraged but not required that three letters of recommendation be included in the initial application. This position is contingent upon available funding.

For full consideration, completed applications must be received by Jan. 13, 2014. Position will remain open until filled.

Bloomsburg University of PA encourages applications from historically under-represented individuals, women, veterans, and persons with disabilities and is an AA/EOE employer. Visit our department website: http://departments.bloomu.edu/geo/.

OPEN RANK PROFESSOR IN FLUID FLOW
UNIVERSITY OF KANSAS

The Dept. of Geology at the University of Kansas invites candidates to apply for a tenure-track or tenured faculty position; rank from assistant professor to Foundation Distinguished Professor, depending on experience and program needs; appointment is expected to begin as early as Aug. 18, 2014. KU is vigorously investing in its future by creating 64 new faculty positions, 12 of which will be Foundation Professors. We are seeking an individual with a research specialty of fluid flow in and around fractures, who will contribute to research in reservoir characterization (e.g., CO_2 storage/Enhanced Oil Recovery, geothermal energy, petroleum, shale gas, waste-water disposal, water resources and contaminant transport). This position is part of a coordinated cluster of 12 new faculty hires within the College of Liberal Arts and Sciences and the School of Engineering focusing on water and energy resources, and technology and social questions related to the extraction of fossil fuels from unconventional reservoirs. Initial review of applications will begin on Feb. 3, 2014 and continue as long as needed to identify a qualified pool. Refer to www.geo.ku.edu/misc/jobAd.shtml for additional information about the position, qualifications and how to apply. Questions may be referred to the Committee Chair Randy Stotler (rstotler@ku.edu) or the Dept. Chair Luis Gonzalez (lgonzlez@ku.edu).

The University of Kansas is especially interested in hiring faculty members who can contribute to four key campus-wide strategic initiatives: (1) Sustaining the Planet, Powering the World; (2) Promoting Well-Being, Finding Cures; (3) Harnessing Information, Multiplying Knowledge; and (4) Building Communities, Expanding Opportunities. See www.provost.ku.edu/planning/themes/ for more information. More information about Foundation Professors at KU may be found at www.foundation.ku.edu.
EOE M/F/D/V.

ASSISTANT PROFESSOR IN GEOPHYSICS: ELECTRICAL/ELECTROMAGNETIC METHODS, UNIVERSITY OF KANSAS

The Dept. of Geology at the University of Kansas invites candidates to apply for a tenure-track, faculty position at the Assistant Professor level in Geophysics; appointment is expected to begin as early as Aug. 18, 2014. We are seeking an individual with a research specialty in the areas of Electrical and Electromagnetic Methods. This position is part of a university-wide cluster of 15 new faculty positions that focus on "Water Resources". Areas of study could include aquifers, geothermal and hydrocarbon reservoirs, polar environments (ice sheets; permafrost), and monitoring of hydrological and biogeochemical processes as they relate to water, energy, and environment. The successful candidate will be expected to establish an externally funded research program, direct graduate students, and participate in teaching at graduate and undergraduate levels. A Ph.D. or ABD in geophysics, geology, natural sciences, engineering, or a closely related discipline with an emphasis on electrical and electromagnetic methods is expected by the start date of the appointment. Initial review of applications will begin Feb. 3, 2014 and will continue as long as needed to identify a qualified pool. Refer to www.geo.ku.edu/misc/jobAd.shtml for additional information about the position, qualifications and how to apply. Questions may be referred to the Committee Chair George Tsoflias (tsoflias@ku.edu) or the Dept. Chair Luis Gonzalez (lgonzlez@ku.edu). The University of Kansas is especially interested in hiring faculty members who can contribute to four key campus-wide strategic initiatives: (1) Sustaining the Planet, Powering the World; (2) Promoting Well-Being, Finding Cures; (3) Harnessing Information, Multiplying Knowledge; and (4) Building Communities, Expanding Opportunities. See www.provost.ku.edu/planning/themes/ for more information. EOE M/F/D/V.

HYDROGEOCHEMIST, GEOHYDROLOGY, SECTION, KANSAS GEOLOGICAL SURVEY, THE UNIVERSITY OF KANSAS, LAWRENCE

Full-time position to lead KGS hydrogeochemical investigations. Faculty-equivalent, sabbatical-eligible position at the rank of Assistant or entry-level Associate Scientist. Requires Ph.D. with an emphasis on aqueous geochemistry related to groundwater resources, and scientific leadership potential. Background in hydrogeochemistry applied to regional-scale groundwater investigations is desired. The Geohydrology Section has 7 full-time professionals with additional support personnel. Emphasis on state-of-the-science field studies and complementary theoretical research. Complete announcement/application info at www.kgs.ku.edu/General/jobs.html. First consideration deadline: Feb. 7, 2014. Apply online at http://jobs.brassring.com/1033/ASP/TG/cim_jobdetail.asp?partnerid=25752&siteid=5447&AReq=44BR. For further information contact Geoff Bohling (geoff@kgs.ku.edu) or Don Whittemore (donwhitt@kgs.ku.edu). Equal Opportunity Employer M/F/D/V.

THE ROY J. SHLEMON CHAIR IN APPLIED GEOSCIENCES, DEPT. OF EARTH AND PLANETARY SCIENCES
UNIVERSITY OF CALIFORNIA AT DAVIS

The Dept. of Earth and Planetary Sciences at the University of California at Davis seeks an outstanding scholar for The Roy J. Shlemon Chair in Applied Geosciences in the College of Letters and Science. We seek an individual with a well-established, highly visible and interdisciplinary research program in Quaternary geomorphology with a strong quantitative background and an active interest in understanding the dynamics of Earth's surface through studies of the physics of surficial processes and the broad-scale interactions among tectonics, topography, and climate. Areas of interest include, but are not limited to, the dynamics of river and delta systems in response to tectonism, climate change and sea level change, the geomorphic evolution of mountain ranges and their local and regional impact on and feedback with climate dynamics, and theoretical modeling of fluid mechanics and sediment transport as applied to problems of geomorphology.

We anticipate an appointment at the Associate or Full Professor level to begin July 1, 2014. The successful candidate is expected to hold the academic distinction for appointment to an endowed Chair at the post-tenure level. The candidate is further expected to create a focal point for Quaternary Science research on the UC Davis campus as well as to explore links to the Center for Watershed Sciences (http://watershed.ucdavis.edu/) of the John Muir Institute of the Environment. An interest in policy development of water resource issues in California and/or the western United States is desirable.

For more information about the UC Davis Dept. of Earth and Planetary Sciences, see http://geology.ucdavis.edu. To apply, please go to https://recruit.ucdavis.edu/apply/JPF00159.

Review of applications will begin on December 20, and will continue until the position is filled. UC Davis is an affirmative action/equal employment opportunity employer and is dedicated to recruiting a diverse faculty community. We welcome all qualified applicants to apply, including women, minorities, individuals with disabilities and veterans.

Opportunities for Students

M.S. and Ph.D. Opportunities, University of Kentucky. The Dept. of Earth and Environmental Sciences at the University of Kentucky has 2014–2015 academic year assistantships and fellowships available for MS and Ph.D. students. All awards include tuition and health insurance. The department has 10 tenured/tenure-track faculty, 3 lecturers, and 11 adjuncts at the Kentucky Geological Survey and UK Center for Applied Energy Research. Research specializations include sedimentary/petroleum geology, hydrogeology, geochemistry, geophysics, igneous/metamorphic petrology, and tectonics. Facilities include the Sedimentary, Environmental and Radiochemical Research Laboratory; a state-of-the-art stable isotope laboratory; the Kentucky Seismic and Strong-Motion Network; instrumentation for potential and active source geophysics; electron microprobe and X-ray diffraction laboratories; and extensive library holdings. UK is located in Lexington, a vibrant community of nearly 300,000. The surrounding area offers a wealth of outdoor and cultural opportunities. For more information, visit http://ees.as.uky.edu or contact Dr. Edward Woolery, Director of Graduate Studies (+1-859-257-3016 or woolery@uky.edu).

Graduate Student Opportunities, Ohio University. The Dept. of Geological Sciences at Ohio University invites applications to its graduate program for the Fall of 2014. The department offers an MS degree in Geological Sciences with areas of emphasis within three research clusters: paleobiology and sedimentary geology, solid earth and planetary dynamics, and environmental and surficial processes. Prospective students are encouraged to contact faculty directly to discuss potential research topics. Qualified students are eligible to receive teaching or research assistantships that carry a full tuition scholarship and a competitive stipend. For additional program and application information, visit the department website at www.ohio.edu/geology/ or contact the graduate chair, Dr. Alycia Stigall (stigall@ohio.edu). Review of applications begins Feb. 1.

Jonathan O. Davis Scholarship, University of Nevada, Reno. The Jonathan O. Davis Scholarship supports graduate students working on the Quaternary geology of the Great Basin. The national scholarship is $5,000 and the University of Nevada, Reno stipend is $1,500. The national scholarship is open to graduate students enrolled in an M.S. or Ph.D. program at any university in the United States. The Nevada stipend is open to graduate students enrolled in an M.S. or Ph.D. program at the University of Nevada, Reno. Details on application requirements can be found at www.dri.edu/graduate-scholarships/189-jod-scholarship.

Applications must be post-marked by Feb. 2, 2014. Proposal reviews will not be returned. Applications should be addressed to: Executive Director Division of Earth and Ecosystem Sciences Desert Research Institute 2215 Raggio Parkway Reno, NV 89512, USA.

Graduate Fellowships at the University of Kentucky. Pioneer Natural Resources Fellowships are available at the University of Kentucky. Pioneer Fellowships are open to M.S. and Ph.D. candidates with research interests in stratigraphy, sedimentology, and petroleum geology. These positions include salary, tuition, research support and health insurance. Field sites for research include the western United States and the East African Rift Valley. Students with interdisciplinary geoscience backgrounds (including coursework/research in sedimentary geology, exploration seismology, petroleum geochemistry, and micropaleontology) are particularly encouraged to apply. Experience in conducting remote fieldwork is a plus. Please contact Prof. Michael McGlue (michael.mcglue@uky.edu) for more information. Further details on the Dept. of Earth and Environmental Sciences at the University of Kentucky can be found at http://ees.as.uky.edu/. The department maintains world-class facilities and an active, student-centered research program. Review of applications for Fall 2014 admission will begin Feb. 1, 2014.

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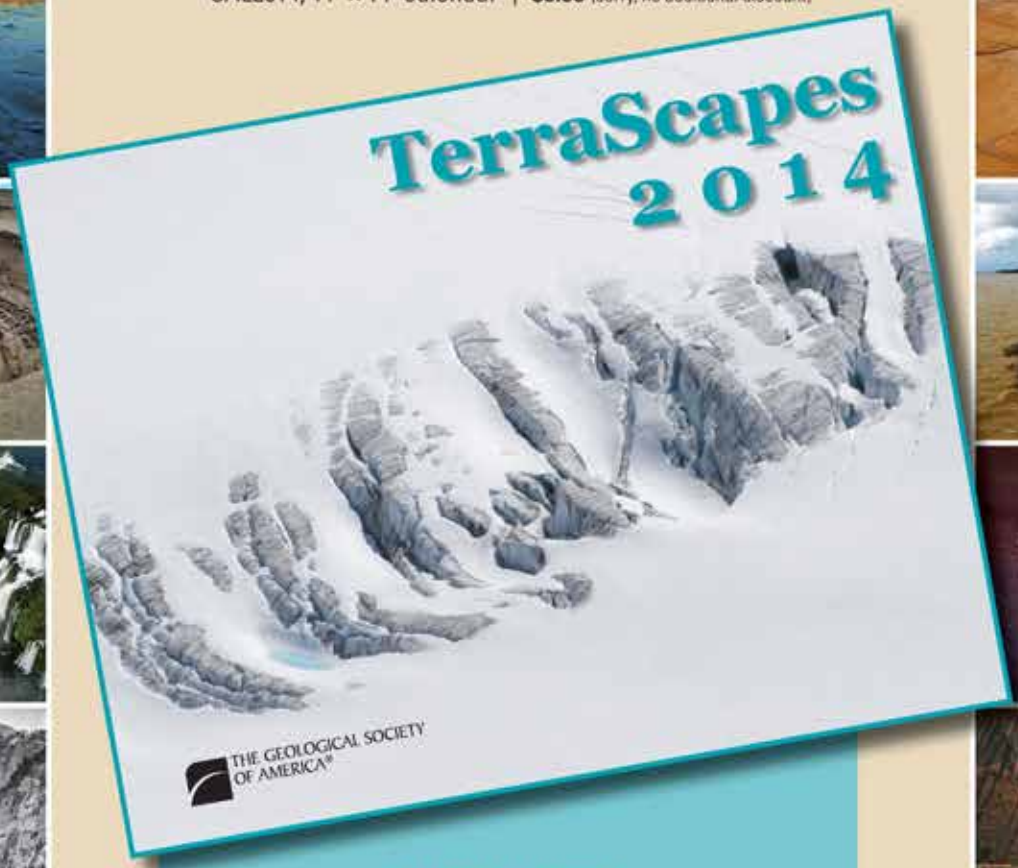

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Mosaics in Science

The new GSA–National Park Service "Mosaics in Science" program is now accepting applications for paid, short-term, multidisciplinary "STEM" (science, technology, engineering, and mathematics) positions at National Park sites across the United States. Mosaics in Science provides youth (17–25 years old) who are typically underrepresented in science career fields with on-the-ground, science-based work experiences with the National Park Service (NPS). After these jobs are completed, participants will attend a career workshop in Washington D.C. to present the results of their work, be introduced to different science career paths, and gain skills toward applying for and obtaining a federal STEM job.

The Mosaics in Science program is administered by GSA in close collaboration with the NPS Geologic Resources Division and the NPS Youth Program Office.

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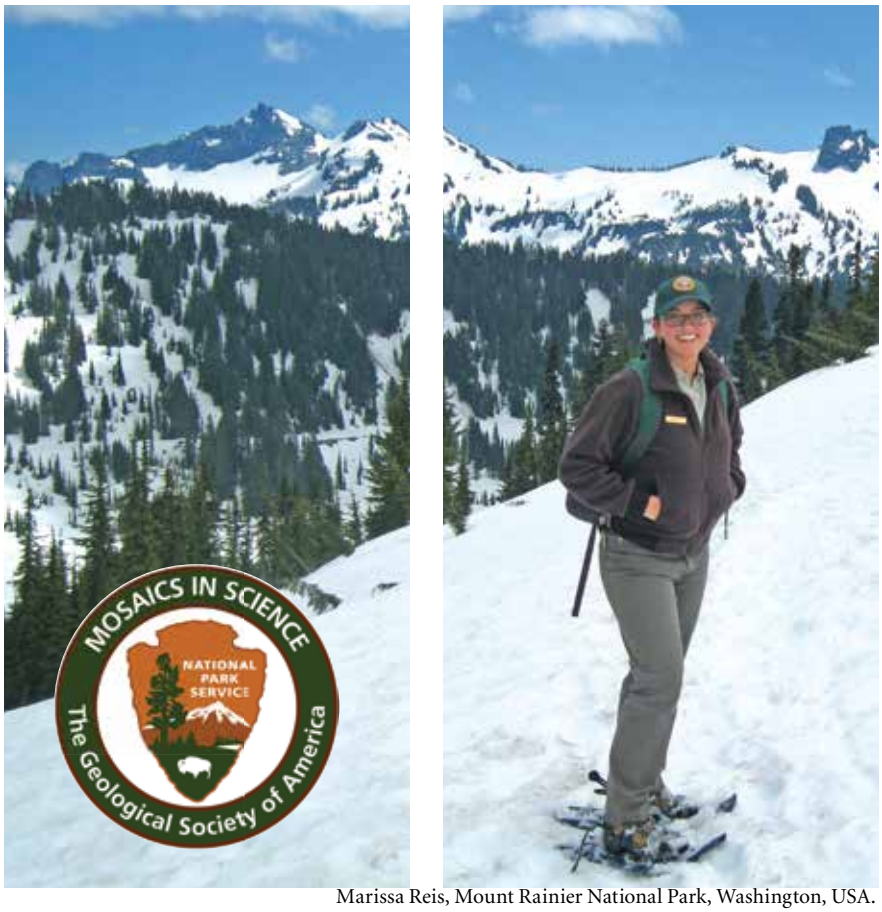

Marissa Reis, Mount Rainier National Park, Washington, USA.

GeoCorps™ America —Summer 2014

GSA is now accepting applications for paid geoscience opportunities in public lands managed by the National Park Service, the U.S. Forest Service, and the Bureau of Land Management. All levels of geologists—students, educators, professionals, retirees—are encouraged to apply.

The summer 2014 program includes Guest Scientist positions, Diversity Internships, and American Indian Internships.

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Why are there so few Hispanic students in geoscience?

Philip J. Stokes, *Dept. of Geosciences, University of Arizona, Tucson, Arizona 85721, USA;* ***Roger Levine,*** *Consultant, 168 Iris Street, Redwood City, California 94062, USA; and* ***Karl W. Flessa,*** *Dept. of Geosciences, University of Arizona, Tucson, Arizona 85721, USA*

Geoscience struggles to keep pace with the changing national demographics. Of all of the science, technology, engineering, and math (STEM) fields, geoscience has the least racial and ethnic diversity. In 2010, 20% of all U.S. bachelor's degrees were awarded to underrepresented minorities, and fewer than 7% of bachelor's degrees in geoscience were awarded to underrepresented minorities (NSF, 2013). Diversity benefits students' academic development, awareness of cultures, professional societies, and the workforce (Chan, 2013; Velasco and Velasco, 2010). Explanations offered for the limited participation of minority students in geoscience include family influences, cultural differences, and hidden barriers (e.g., O'Connell and Holmes, 2011; Lewis and Baker 2010; Seymour and Hewitt, 1997). Few explanations have been tested, and progress toward greater participation of underrepresented minorities in geosciences has been slow.

We used the Critical Incident Technique (CIT) (Flanagan, 1954) to examine the factors that affect student enrollment and persistence in geoscience. The CIT is a semi-structured interview technique that elicits reports of "critical incidents" in the subject's past that influenced their actions, decisions, or attitudes. The CIT provides a way to collect and classify the otherwise anecdotal and qualitative nature of student narratives (Fig. 1). Incidents can then be quantitatively compared across categories, groups, and respondents. We followed Levine et al.'s (2007) classification for many of the factors influencing the choice of a geoscience major.

We identified critical incidents in the transcripts as events that affected the student's feelings of self-confidence, desire to pursue a geoscience degree, persistence in the major, or perception of geoscience. If the student reported that the incident was worthwhile or supported their decision to major in geoscience, it was classified as a positive outcome. If the student reported that the incident was frustrating, created a hurdle to persistence, or detracted from their confidence about choice of major, it was classified as a negative outcome (Table 1).

We interviewed 29 current or former University of Arizona students: 17 females and 12 males. Eight students self-identified as Hispanic/Latino (Hispanic, hereafter) and 21 students self-identified as white, non-Hispanic/Latino (white, hereafter). We collected a grand total of 881 critical incidents. There was no significant difference in the average numbers of total critical incidents reported by Hispanic students and white students and no significant difference in the number of positive critical incidents between white and Hispanic students. However, Hispanic students reported more negative incidents than white students.

Whites and Hispanics differed significantly with respect to familial factors (Fig. 1). Per student, Hispanics reported twice as many critical incidents relating to familial factors during college

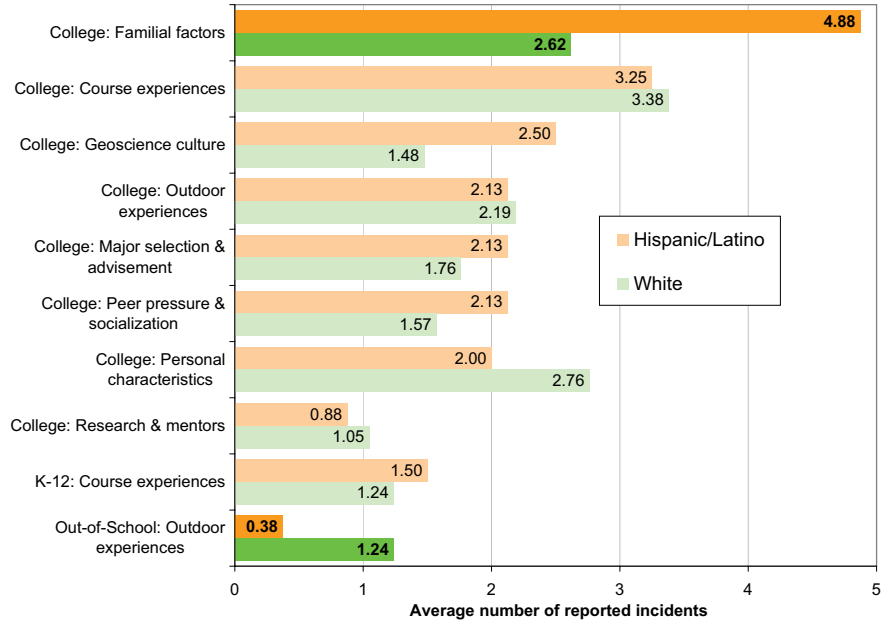

Figure 1. Average number of critical incidents provided by white and Hispanic students, by category. Statistically significant ($p < .05$) findings shown in bold typeface and darker color.

GSA Today, v. 24, no. 1, doi: 10.1130/GSATG176GW.1.

Table 1. A negative outcome, college familial factors critical incident

Interview Question	Student Response
What was the situation?	My older brothers are both farmers and they're more conservative. They have more of a traditional viewpoint of "Why aren't you married with children?," which I think that a lot of women in higher education run into.
What happened?	They ask me a lot of questions about what I can do with my degree. Because they don't work with geologists, they don't see the career opportunities.
What was the result?	I just don't talk about what I do when I go home unless it's to my parents or my sister.
How did this affect your choice of major?	It's hard, you know, knowing that they don't support my decision to major in geoscience.

than did whites. Furthermore, Hispanics reported five times more negative familial factors (2.5) than did whites (0.5).

The only other significant difference we found between white and Hispanic geoscience majors is that fewer Hispanics reported out-of-school outdoor experiences—a factor associated with geoscience career choice.

Extended families are important to Hispanics. While white students typically reported familial factors involving just parents and siblings, Hispanic students often noted interactions with aunts, uncles, cousins, and grandparents as part of their decision-making processes. In addition, Hispanic geoscience majors had significantly more negative familial experiences than their white peers. This indicates that not only do Hispanic students have more family to satisfy, but Hispanics encounter more skepticism regarding their major choice from family members than do white geoscience students.

Cultural and familial factors are very important to Hispanic students (e.g., Chapa and De La Rosa, 2006; Munro, 2009). That the eight Hispanic students involved in this study were able to persist in geoscience speaks to their abilities to handle family-based criticisms of their major choice. How many potential Hispanic geoscience majors have been steered into other fields by their families?

Geoscientists are not as visible in the workforce as other scientists or engineers, and because there are so few Hispanics among them, parents may not easily see the value of the profession. Because Hispanic students encounter more skepticism when explaining their choice of a major to their family, it would serve geosciences well to provide prospective geoscience majors with information useful in their family discussions. Sharing information on employment opportunities, job security, and starting salaries in geoscience fields should help to convince families that geoscience is a worthwhile degree (e.g., Hoisch and Bowie, 2010). Similarly, efforts to encourage Hispanic students to persist to graduate school could also benefit from admission policies that acknowledge the importance of familial factors in students' decisions. For example, the proximity of a student's family to a graduate program may influence the decision to pursue an advanced degree.

Hispanic geosciences majors had fewer informal outdoor experiences before college than white geoscience majors. This adds to the challenge of recruiting Hispanic geoscience majors. For white students who grew up with many outdoor experiences, geoscience is, perhaps, an obvious fit. For Hispanic students who had fewer outdoor experiences, geoscience might require more personal adjustment. More informal outdoor experiences for Hispanic youth could result in more Hispanic undergraduate geoscience majors.

Familial factors are important to Hispanic students considering an undergraduate major in geosciences, and Hispanic students encounter more resistance from their families than do white students. While our sample size is small ($n = 29$; 881 critical incidents), it is larger than any previous study of differences between ethnic groups of geoscience majors. Our geographic scope is also small, being limited to one institution. Furthermore, our statistical approach to hypothesis testing only allows us to identify experiences that differ in prevalence for Hispanic and white students. Results should not be interpreted as indicating that factors such as "K–12 course experiences" or "research & mentors," and the organizations that promote such activities, are unimportant—only that we are unable to detect differences in their prevalence. In these cases, the experiences appear to be equally important to both Hispanic and white majors. This study is a beginning: We make the usual call for more data and a broader scope. More focused efforts to provide Hispanic families with career information and educational outdoor experiences for their children may increase the number of Hispanic geoscience majors.

ACKNOWLEDGMENTS

We thank National Science Foundation award 0914401, the University of Arizona Graduate and Professional Student Council, Graduate College, Department of Geosciences, and The Geological Society of America for their support. QSR International donated NVivo 10 for critical incident analyses. This work is approved by the UA Human Subjects Research Office, IRB# 10-0834-02. Special thanks to Miriam Fuhrman of Rock Solid Testing Services and the American Institutes for Research.

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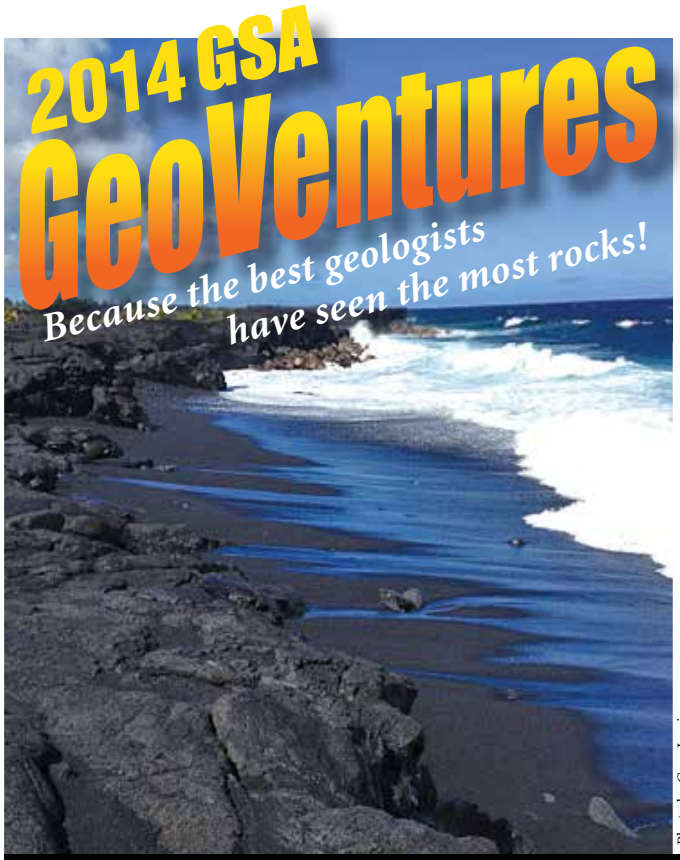

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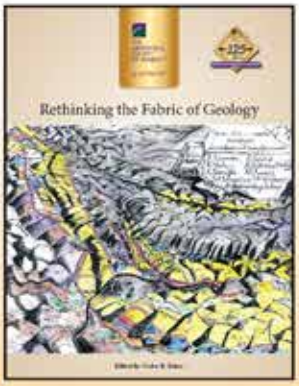

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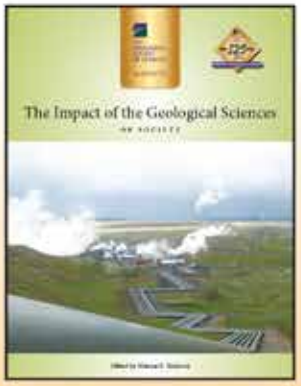

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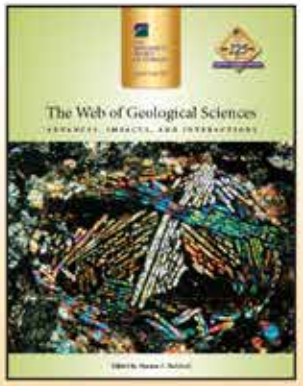

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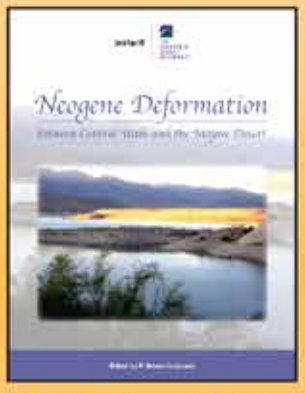

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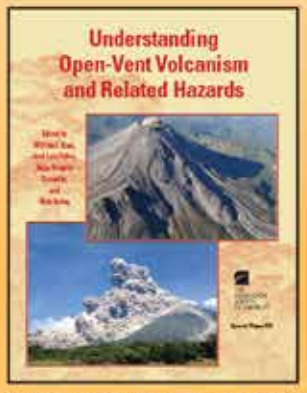

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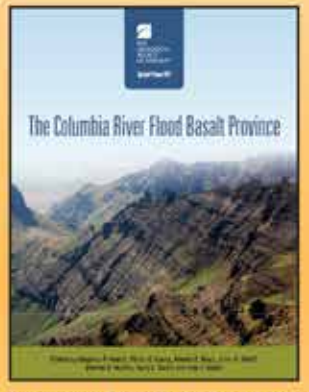

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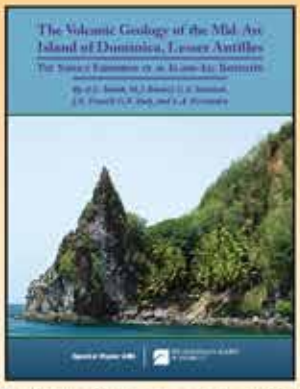

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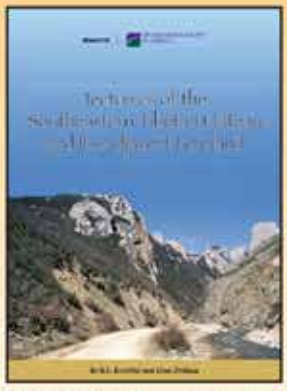

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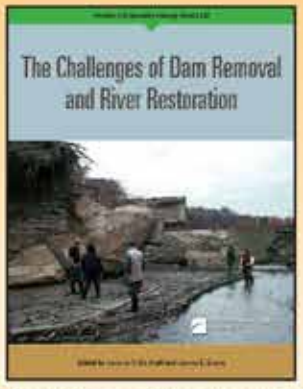

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