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# GSA TODAY

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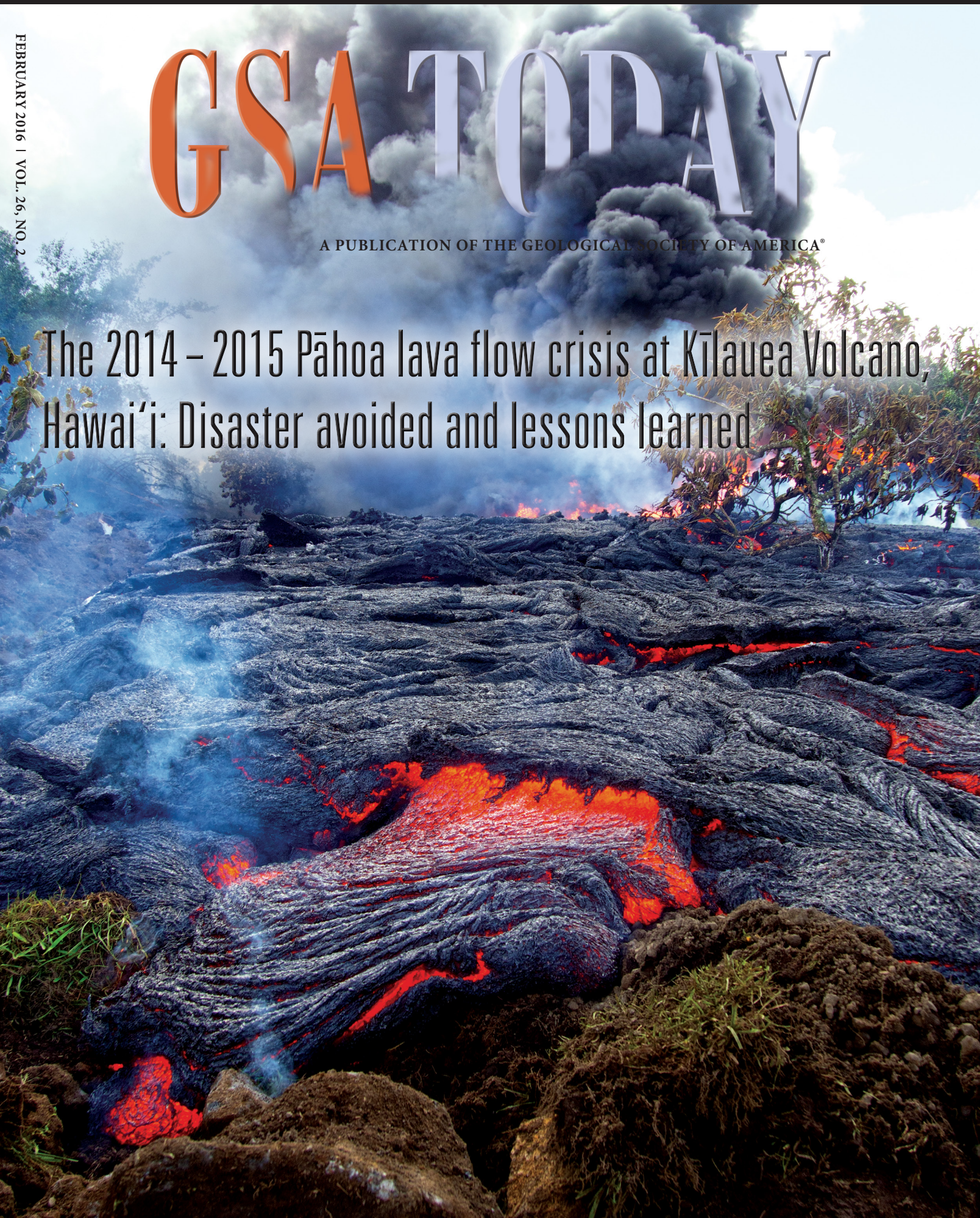
## The 2014 – 2015 Pāhoa lava flow crisis at Kīlauea Volcano, Hawai'i: Disaster avoided and lessons learned



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GSA TODAY

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# Featured Article

## SCIENCE



**Cover:** Lava destroys a small orchard in Pāhoa, Hawai'i, on 28 Oct. 2014, as it advances toward the main road through the village. The plume in the background is from a burning pile of tires ignited by lava. USGS photo by Kyle Anderson. See related article, p. 4–10.

# GSA News

# The 2014 – 2015 Pāhoa lava flow crisis at Kīlauea Volcano, Hawai'i: Disaster avoided and lessons learned

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## ABSTRACT

Lava flow crises are nothing new on the Island of Hawai'i, where their destructive force has been demonstrated repeatedly over the past several hundred years. The 2014–2015 Pāhoa lava flow crisis, however, was unique in terms of its societal impact and volcanological characteristics. Despite low effusion rates, a long-lived lava flow whose extent reached 20 km (the longest at Kīlauea Volcano in the past several hundred years) was poised for months to impact thousands of people, although direct impacts were ultimately minor (thus far). Careful observation of the flow reaffirmed and expanded knowledge of the processes associated with pāhoehoe emplacement, including the direct correlation between summit pressurization and flow advance, the influence of existing geologic structures on flow pathways, and the possible relationship between effusion rate and flow length. Communicating uncertainty associated with lava flow hazards was a challenge throughout the crisis, but online distribution of information and direct contact with residents proved to be effective strategies for keeping the public informed and educated about flow progress and how lava flows work (including forecasting limitations). Volcanological and sociological lessons will be important for inevitable future lava flow crises in Hawai'i and, potentially, elsewhere in the world.

## INTRODUCTION

Basaltic lava flows were very much in the news in 2014. In August of that year, Bárðarbunga erupted in Iceland, eventually extruding more than a cubic kilometer during six months of activity (Gíslason et al., 2015). Pico do Fogo in the Cape Verde islands began erupting in November, sending out lava flows that overran two villages and displaced ~1,000 people (González et al., 2015). And in June 2014, an outbreak of lava at Kīlauea Volcano sent flows toward communities in the Puna District on the east side of the Island of Hawai'i (Fig. 1).

Kīlauea's outbreak was noteworthy for its potential (and uncertain) impact and long months of anticipation by communities at risk. Had the flow extended far enough along the path it was following, it would have crossed a highway used by thousands of vehicles each day; isolated a portion of the island that is home to nearly 10,000 residents (Callis, 2014); cut power, water, and other infrastructure on which those residents depend; and overrun homes in multiple communities. The flow stalled repeatedly within several hundred meters of the highway, destroying only one house before breakouts ~15 km upslope in March 2015 diverted lava away from the front. The activity provided new information about the behavior of pāhoehoe lava flows, as well as lessons about communicating information to the public during a prolonged crisis. Although the 2014–2015 crisis has passed, the lava flow remains active and could threaten communities in the future.

## SETTING THE STAGE

Kīlauea, one of the most active volcanoes in the world, has erupted almost continuously from East Rift Zone (ERZ) vents since 1983 and from a vent at the summit (which hosts an active lava lake) since 2008 (Orr et al., 2015a; Patrick et al., 2015a) (Fig. 1). The current ERZ eruption has extruded more than 4 $km^3$ of lava, covering more than 142 $km^2$ of land (updated from Orr et al., 2015a). Such a large amount of lava has had a significant impact on island residents, destroying 215 primary structures as of 2015, including nearly all of the village of Kalapana in 1990. Roads and other infrastructure have also been covered, and vog (volcanic smog) has impacted the health of people, animals, and agricultural products across the island.

Pu'u 'Ō'ō, a cinder cone and lava shield, is the dominant vent for the ongoing ERZ eruption, although other vents within a few kilometers uprift and downrift have also been active. Following an uprift fissure eruption in March 2011, lava slowly filled the crater of Pu'u 'Ō'ō until September 2011, when a small fissure eruption on the east flank of the cone fed the informally named Peace Day lava flow. A lava tube system developed, and within weeks, lava flowed southeast from the vent more than 10 km to the Pacific Ocean (Orr et al., 2015a). While this behavior is common for the current ERZ eruption, the lava discharge rate for the Peace Day flow was low (1–2 $m^3/s$), which is about half the average rate measured since 1983 (Poland, 2014).

The eruption remained relatively stable until January 2013, when lava overtopped the crater of Pu'u 'Ō'ō and spread to the northeast. The new flows, informally named the Kahauale'a flows (Patrick et al., 2015b), gradually became dominant, and the Peace Day flow ceased activity by November 2013. The northeast trajectory of the Kahauale'a flows was significant because of the

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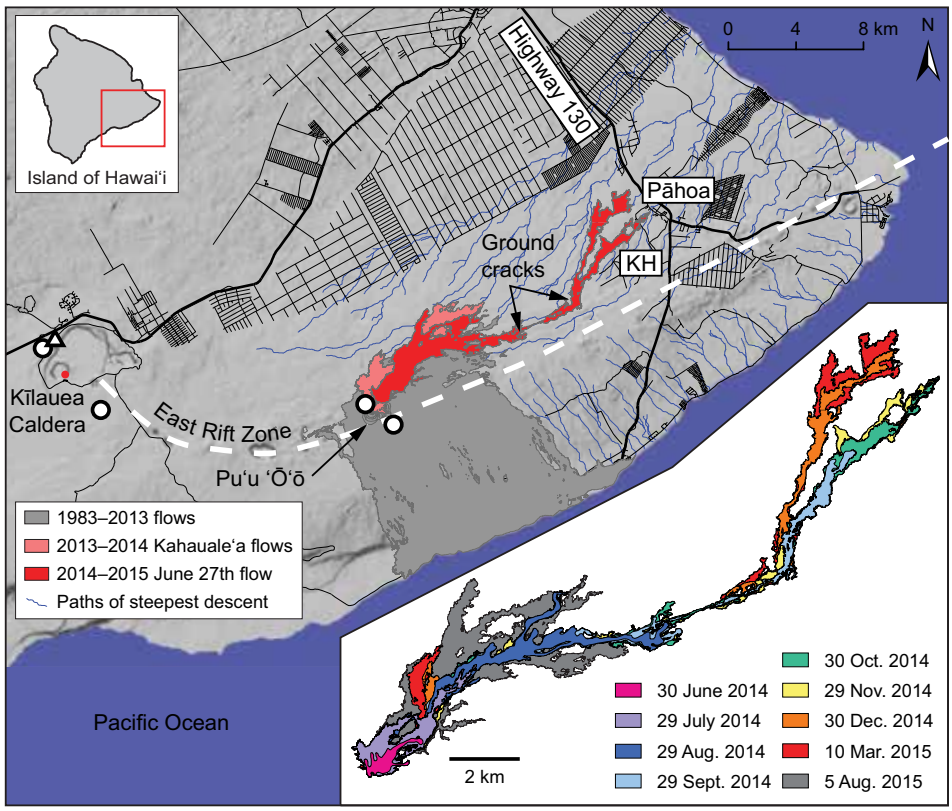


Figure 1. Map of the eastern portion of Kīlauea Volcano, which comprises the Puna District of the Island of Hawai'i. Red dot in caldera gives location of 2008–present eruptive vent. GPS stations indicated by white circles and tiltmeter by white triangle. East Rift Zone noted by white dashed line, with Pu'u 'Ō'ō eruptive vent labeled and lava flows from 1983 to 2015 colored as gray—1983–2013; pink—2013–2014 Kahauale'a lava flows; red—2014–2015 June 27th lava flow (as of 5 Aug. 2015). Pāhoa and Kaohe Homesteads ("KH") are labeled, as is Highway 130 connecting Pāhoa and nearby communities to the rest of the island. Black lines are roads, with thicker lines indicating more heavily used roads. Denser groupings of roads occur in subdivisions. Blue lines are paths of steepest descent based on analysis of topography. Area of heavily cracked ground occurs between labeled arrows. Lower right gives zoom of the June 27th flow, with colors indicating flow extent over time.

population downslope in the island's lower Puna District (Fig. 1). Pu'u 'Ō'ō lies at the topographic crest of the ERZ, so the direction that lava travels is dependent on the location from which lava is extruded. Lava that erupts from the south side of Pu'u 'Ō'ō flows south toward the ocean, whereas lava that erupts from the north side flows northeast toward residential and commercial areas (Patrick et al., 2015b) (Fig. 1).

Puna is a zone of high lava flow hazard due to frequent inundation during the past several hundred years (Kauahikaua and Tilling, 2014). In 2007, a northeast-directed flow caused concern because, had it followed the most likely path of steepest descent, it would eventually have imperiled downslope communities (Kauahikaua, 2007); however, after a few months, a breakout at the vent directed lava to the south and stopped the northeast advance. Although no such change in direction occurred in 2013, the low–effusion-rate conditions that characterized the Peace Day flow persisted, and lava never advanced more than 9 km from Pu'u 'Ō'ō through mid-2014 (Patrick et al., 2015b).

## THE JUNE 27TH LAVA FLOW

The first indication of an impending change in activity at Kīlauea was the onset of sustained inflation at the volcano's summit and at Pu'u 'Ō'ō in late May 2014 (Fig. 2). Inflation indicates increasing pressure within the volcano's magmatic system and often precedes intrusions and the formation of new eruptive vents (e.g., Orr et al., 2015a). The pressurization culminated on 27 June 2014, when new fractures opened on the northeast flank of Pu'u 'Ō'ō (Fig. 3A). This new vent system diverted lava from the Kahauale'a flows, which ceased all activity soon after (Patrick et al., 2015b). The initial pulse of the "June 27th lava flow," as it was informally called, advanced quickly along a narrow front to the east-northeast (Fig. 1). The flow emerged from near the base of Pu'u 'Ō'ō, ~50 m lower than the source of the Kahauale'a flows, and drainage of magma contributed to early high effusion rates and rapid flow-front advance.

Lava reached ~4.5 km from the vent over the ensuing month, developing a lava tube system to feed the distal part of the flow. The floor of Pu'u 'Ō'ō subsided throughout this period as

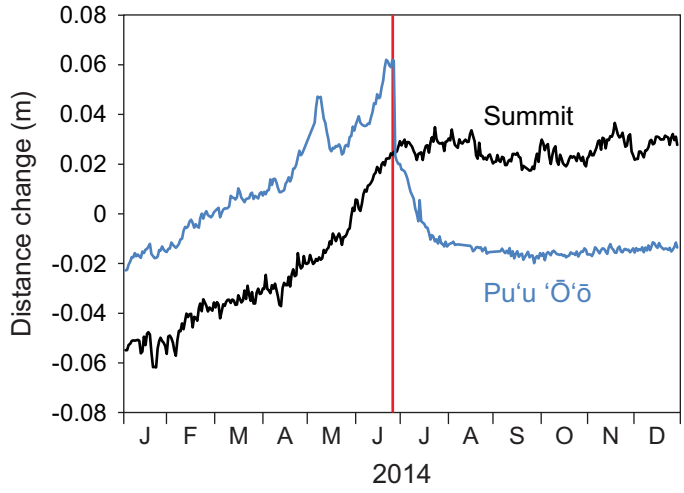


Figure 2. Distance change between continuous GPS stations spanning Kīlauea's summit (black) and Pu'u 'Ō'ō (blue) during 2014. Positive change is generally indicative of inflation and negative, deflation. Red line marks 27 June 2014. Station locations are given in Figure 1.


Figure 3. (A) New vents formed on the NE flank of Pu'u 'Ō'ō cone on 27 June 2014, ~50 m below the elevation of the previously active vent for the Kahauale'a flows. Aerial view looking WSW. (B) Lava flowed within ground cracks in Aug.–Sept. 2014, with small plumes of condensed steam marking the extent of activity. Aerial view looking ENE along East Rift Zone. (C) Asphalt burns as lava crosses a road on the outskirts of Pāhoa on 25 Oct. 2014. The utility pole at right, surrounded by lava, has been wrapped in insulation and its base covered by cinder. These measures prevented the pole from burning for a time, but after several days, the pole collapsed. (D) Lava crosses through a fence on private land in Pāhoa on 28 Oct. 2014. (E) Several lobes of the lava flow threatened the town of Pāhoa and its highway during late 2014 and early 2015. Aerial view looking south. Damaged transfer station is labeled, and location of house destroyed by lava is noted by red circle. (F) Community meetings in Pāhoa were an effective means of sharing the latest hazards information with the public. During Sept.–Oct. 2014, some individual meetings were attended by more 600 people. Photo locations are indicated by place names and feature labels in Figure 1. All photos by U.S. Geological Survey.

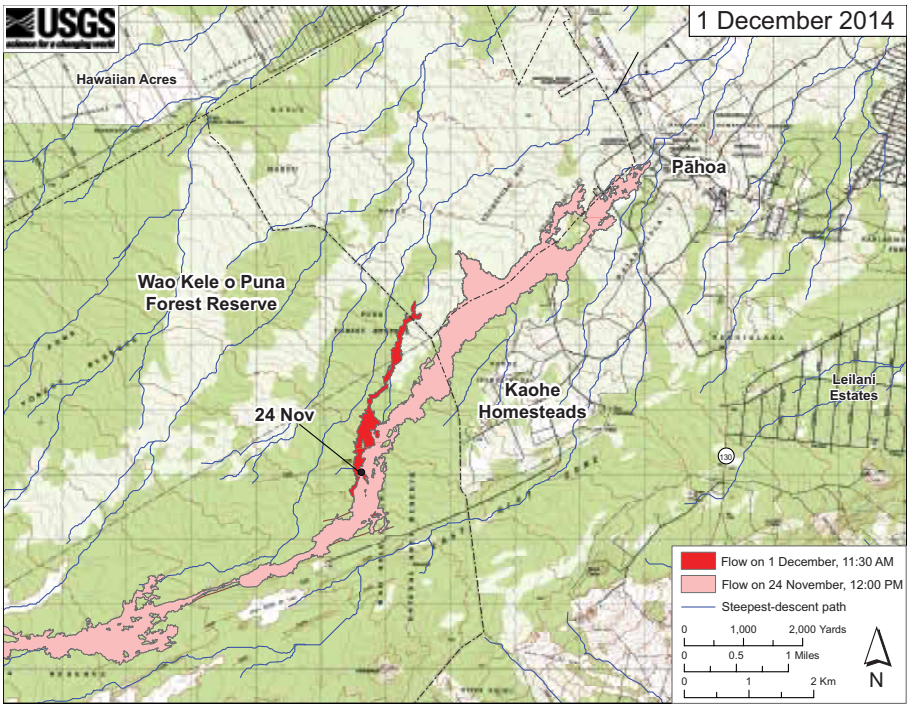


Figure 4. Map distributed to the public on 1 Dec. 2014, showing June 27th lava flow on 24 Nov. 2014 (pink), and expansion as of 1 Dec. 2014 (red). Blue lines are calculated paths of steepest descent. Black lines are roads.

magma continued to drain from the edifice; deflation did not cease until the end of July (Fig. 2). On 21 August, the June 27th flow was 9.4 km downslope from Pu‘u ‘Ō‘ō in a densely forested area, where it encountered a series of large ground cracks parallel to the rift zone. Lava flowed into the crack system and advanced within it for 1.3 km, with the inferred location of the flow front indicated by the downrift extent of small plumes of condensed steam in the forest (Fig. 3B). The flow emerged from the crack system 11.4 km downslope from Pu‘u ‘Ō‘ō on 24 August but repeated its disappearing act—entering a crack and then emerging downslope days later—three more times. Lava cleared the region of heavily cracked ground on 6 September at a point 13.3 km from Pu‘u ‘Ō‘ō, within a few kilometers of the rural Kaohe Homesteads subdivision above the town of Pāhoa (Fig. 1).

Over the succeeding weeks, the flow skirted the northwest margin of Kaohe Homesteads, stalled in late September, resumed its advance at the end of September, and, in mid-October, stalled again ~1 km from the uppermost road of Pāhoa (Fig. 1). The flow began advancing again on 22 October and crossed the road on 25 October (Fig. 3C) before passing through a cemetery and across private land (Fig. 3D), winding its way between several residences that homeowners protected with hastily constructed berms of soil and cinder. By 30 October, the flow was within ~150 m of Pāhoa’s main street (Figs. 1 and 3E), where it stalled, widening slightly without advancing over the ensuing days. This widening damaged the Pāhoa solid waste transfer station and, on 10 November, claimed a residence upslope of the flow front—the only dwelling to be destroyed during the 2014–2015 Pāhoa lava flow crisis.

The events of late September to early November established a pattern that was to recur several times during the months that followed: the lava flow front advanced, stalled, and widened, and then became inactive due to fluctuating supply of lava from the source vent and breakdowns in the lava tube. Upslope breakouts then formed a new lobe that advanced alongside the previous one (Fig. 1). In late January 2015, one of these lobes was within ~500 m of Highway 130, which links Pāhoa and nearby communities to the rest of the island (Fig. 3E), but this lobe also stalled and widened. New breakouts near Pu‘u ‘Ō‘ō in mid-March robbed the downslope flow field of its supply of lava, and flows near Pāhoa became inactive, thus ending the crisis. Since then, lava has not advanced beyond ~9 km from Pu‘u ‘Ō‘ō.

## JUNE 27TH LAVA FLOW HAZARDS ASSESSMENT, MITIGATION, AND IMPACT

The response to the 2014–2015 Pāhoa lava flow crisis by the public, businesses, and federal, state, and county agencies was as complex as the June 27th flow itself. The Hawaiian Volcano Observatory (HVO) tracked the lava flow by helicopter overflights, ground-based mapping, and satellite imagery, working closely with Hawai‘i County Civil Defense (HCCD) to map flow progress. Observations were more frequent as the flow neared homes, involving a continuous presence on the ground during the height of the crisis. HVO and HCCD shared data on flow activity and issued frequent updates, maps, and imagery via the Internet and media outlets. HCCD updates played on the radio, and an information and command center was opened in Pāhoa while active lava was near the town.

At the direction of the mayor, the County of Hawai‘i organized a community meeting in Pāhoa on 27 August 2014—two days after HVO’s first press release and 10 days before the mayor would issue an emergency declaration. For the next several months, these community meetings were at least a weekly occurrence, with attendance at some meetings exceeding 600 people (Fig. 3F). Overview presentations by HVO, the

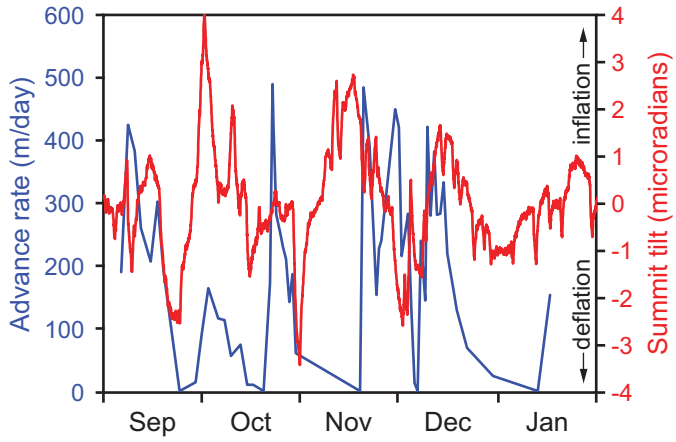


Figure 5. Advance rate of June 27th lava flow (blue) versus tilt at Kīlauea's summit measured radial to the caldera (azimuth 327°; red). Positive tilt indicates inflation and negative, deflation. Tiltmeter location given in Figure 1.

mayor, HCCD, and, occasionally, local and national elected representatives were followed by individual interactions among members of the public, HVO staff, state and county agencies, and many other groups (the Red Cross, the Federal Emergency Management Agency [FEMA], Hawai'i Volcanoes National Park, etc.).

The meetings built trust among scientists, managers, and the community and helped residents and businesses understand the products used to show the flow location and likely pathways. Equally important, the meetings gave residents a perspective on the nature of pāhoehoe flows and limitations in forecasting flow activity. The most important products were current lava flow maps that included potential flow paths (Fig. 4) based on topographic steepest-descent calculations (Kauahikaua et al., 2003; Kauahikaua, 2007). Online release of the maps was eagerly anticipated by the community, and HVO and HCCD devoted significant resources to collecting lava flow data, developing products for rapid public release, and updating the products in response to user feedback.

Estimation of the lava's likely time of arrival at a given area was the most unreliable forecasting parameter because the advance rate varied rapidly between 0 and 500 m/day (Fig. 5). The measured advance rates, however, provided a range of potential arrival times that were used to develop contingency plans. For example, the county expended significant effort to ensure that alternate routes were operational in advance of the potential inundation of Highway 130, which would have cut off several thousand residents from the rest of the island. This effort cost about US$15 million, but will mostly be reimbursed by FEMA (Nakaso, 2015a) thanks to a Disaster Declaration signed by President Obama on 3 November 2014 (Moseley, 2014). Attempts were also made to time the deployment of National Guard units and other public safety personnel and to harden power (Fig. 3C) and water supply systems. Infrastructure protection before the arrival of the lava flow involved consultations by utility companies with HVO and University of Hawai'i at Hilo researchers and is an example of collaborations that formed during the crisis.

Thus far, direct impacts from the June 27th lava flow have been minimal, considering the potential destruction. Only one house was lost, one utility pole destroyed (power was never interrupted), and the Pāhoa solid waste transfer station sustained only minor damage and returned to service in March 2015. Indirect impacts, however, were substantial. Real estate values plummeted as the flow advanced toward Pāhoa, and many residents—perhaps 10%–15% of the area's population—moved away from the region (Nakaso, 2015b). Since flow activity near Pāhoa ceased in March 2015, however, the housing market has rebounded (Stewart, 2015).

As soon as the June 27th lava flow threat was realized, public debate began regarding lava flow diversion. Some residents supported intervention to protect homes and businesses, while others strongly opposed any interference, due to the long-term cost of diversion efforts once started, potential for litigation, cultural sensitivities, and the low probability of long-term success. Ultimately, diversion was not attempted in any official capacity.

## NEW INSIGHTS INTO LAVA FLOW EMPLACEMENT

The June 27th flow is significant for not only the havoc it has caused, but also its globally unprecedented style. The overall low effusion rate (1–2 $m^3/s$), lack of limits on its extent (by the ocean, for example), interaction with existing ground cracks, and 20 km length (longest at Kīlauea in at least the past 500 years; Clague et al., 1999) combine to make the June 27th flow the longest-lived low-effusion-rate pāhoehoe flow known on Earth. Data collected throughout its evolution has helped to elucidate lava flow processes, which may aid in future crises in Hawai'i and elsewhere.

Pressure fluctuations in the summit magma reservoir had a significant impact on the behavior of flows that were ~40 km downrift. Stalling of the flow front was generally preceded by summit deflation, while rapid flow advance at the stalled front or of upslope breakouts often followed summit inflation (Fig. 5). Cyclic deflation-inflation (DI) events at the summit are a common occurrence at Kīlauea (Anderson et al., 2015) and clearly impact eruptive vigor from Pu'u 'Ō'ō, where the slightly attenuated tilt cycles are also recorded (Orr et al., 2015b). The June 27th flow further demonstrated the importance of these relatively minor pressure fluctuations within the summit magma reservoir on distal lava flow activity. Summit deformation may, in fact, provide a means of forecasting effusion rates (Patrick et al., 2015a). Decreases in flow-front vigor were also impacted by upslope leaks along the length of the lava tube system, highlighting another control on flow advance.

The data that connect summit deformation to flow advance may be useful for improving models of pāhoehoe flow hazards by providing a means of anticipating changes in effusion and advance rates. Lava-emplacement models, coupled with high-resolution topography, do a good job of approximating flow pathways (e.g., Favalli et al., 2005; Harris and Rowland, 2015), but forecasting advance rate remains problematic, especially for pāhoehoe flows. No forecasts of the June 27th flow advance rate proved accurate, although they were still useful to emergency managers for understanding the time frames of potential impacts. Research into the physics of pāhoehoe flows—particularly the interaction among topography, effusion rate, lava tube formation and collapse, and flow characteristics (e.g., crystallinity, volatiles, temperature, and composition)—is needed to address this limitation in current models.

One of the most obvious questions regarding the June 27th flow is why it traveled no farther than 20 km from its source. For ʻaʻā lava flows, a well-established relationship, governed by flow cooling, exists between maximum flow length and effusion rate (Walker, 1973). No such relation is known for pāhoehoe flows, however, because they frequently form insulating tubes, enabling them to travel much farther than would otherwise be possible (Keszthelyi, 1995; Kauahikaua et al., 1998, 2003). Long-lived pāhoehoe flows with 1–2 $m^3/s$ discharge rates, however, represent a largely unknown low-effusion-rate end member for that lava flow style. The June 27th flow's low effusion rate, coupled with cooling, crystal growth, loss of volatiles, lava tube breakdown, and other factors, might indicate that—at 20 km from its source—it had reached its maximum length for its effusion rate. The situation may be analogous to that of better-modeled ʻaʻā flows, but since long-lived, low-effusion-rate pāhoehoe flows that are not limited in the extent they can travel (by the ocean, for example) are nearly unknown in nature, the June 27th flow represents a key example that should be the basis of future modeling.

Finally, the infiltration of lava into and downslope movement within existing ground cracks has not previously been observed to the extent seen at Kīlauea during August and September 2014. Lava disappeared from the surface for several days at a time. Small plumes of condensed steam coming from the forest were the only visible indication of flow advancement (Fig. 3B), although crack opening was indicated by nearby borehole tiltmeter and GPS instruments. The flow of lava through existing cracks should be considered in flow-path modeling, since such structures divert lava from its previous trajectory and may influence advance rate and longevity.

## FUTURE IMPACTS AND CONCLUSIONS

The future of the June 27th lava flow is unclear. Although the 2014–2015 Pāhoa lava flow crisis is over, the lava flow remains active north of the ERZ and could advance downslope, especially if there is an increase in effusion rate. On the other hand, the 1983–present eruption has become consistently inconsistent, with new vents forming every few years (e.g., Orr et al., 2015a); a future reconfiguration could once more direct lava south to the ocean. The current ERZ eruption may also cease—an eventuality that cannot be forecast, but one that would obviously have profound implications for ongoing hazards (where would the next eruption occur?).

The June 27th flow has, thus far, provided numerous learning opportunities without causing widespread destruction. While many insights have been driven home by the flow—for example, the linkage between flow advance and summit pressurization, the interaction between lava flows and existing geologic structures, and the notorious leaky nature of lava tubes—a number of knowledge gaps have been put in the spotlight, including possible length-limiting factors for pāhoehoe flows and the need for better models of pāhoehoe lava advance rate. Lessons also extend to social science, where the response by HVO and the County of Hawaiʻi highlighted the value of a coordinated and diverse approach to communicating uncertain hazards information and the importance of frequent interactions with people living and working in potential inundation areas. Indeed, the high level of involvement with the community may have helped to prevent the perception that HVO and the county were "crying wolf," given that the crisis ultimately passed with little direct harm. These volcanological and sociological issues are the subject of a recently funded interdisciplinary National Science Foundation Hazards SEES project with many collaborating institutions (including HVO). Developing new tools based on the June 27th lava flow and similar experiences will be an important task for the next, inevitable, lava flow crisis, whether in Hawaiʻi or elsewhere in the world.

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# Call for Nominations

## GSA DIVISION AWARDS

### ARCHAEOLOGICAL GEOLOGY DIVISION

Nomination and application information is online at www.geosociety.org/arch/.

#### Rip Rapp Award

**Nominations due** 15 February
**Submit nominations to** mandel@ku.edu

This award is given for outstanding contributions to the interdisciplinary field of archaeological geology. Nominations should include a biographical sketch, a statement of outstanding achievements, and a selected bibliography of the nominee.

#### Claude C. Albritton, Jr., Award

**Nominations due** 5 March
**Submit nominations to** gsa.agd@gmail.com

This award provides research support for graduate students in the earth sciences or archaeology. Recipients of the award are students who have (1) an interest in achieving a master's or Ph.D. degree in earth sciences or archaeology; (2) an interest in applying earth-science methods to archaeological research; and (3) an interest in a career in teaching and academic research.

#### Richard Hay Student Paper/Poster Award

**Nominations due** 20 August
**Submit nominations to** gsa.agd@gmail.com

This award is a travel grant for a student (undergraduate or graduate) who is presenting a paper or poster at GSA's annual meeting. It is given based on evaluation of the scientific merit of the research topic and the clarity of an expanded abstract for a student presentation in the Division's technical session at the meeting.

### ENERGY GEOLOGY DIVISION

#### Gilbert H. Cady Award

**Nominations due** 28 February
**Submit nominations to** Jen O'Keefe at j.okeefe@moreheadstate.edu

This award recognizes outstanding contributions in the field of coal geology that advance the science both within and outside of North America. For more information, go to www.uky.edu/KGS/coal/GSA/awards.htm.

### ENVIRONMENTAL AND ENGINEERING GEOLOGY DIVISION

#### E.B. Burwell, Jr., Award

**Nominations due** 1 February
**Submit nominations to** Dennis Staley at dstaley@usgs.gov

This award is made to the author(s) of a published paper of distinction that advances knowledge concerning the principles or practice of engineering geology or of related fields of applied soil or rock mechanics where the role of geology is emphasized. The paper must: (1) deal with engineering geology or a closely related field, and (2) have been published no more than five years prior to its selection. For more information, go to http://rock.geosociety.org/egd/Awards.html#Burwell.

#### Richard H. Jahns Distinguished Lecturer

**Nominations due** 28 February
**Submit nominations to** Matt Crawford at mcrawford@uky.edu

This lectureship is given to an individual who through research or practice has made outstanding contributions to the advancement of environmental and/or engineering geology. The awardee will speak on topics of earth processes and the consequences of human interaction with these processes, or the application of geology to environmental and/or engineering works. For more information, go to http://rock.geosociety.org/egd/Awards.html#Jahns.

### GEOPHYSICS DIVISION

#### George P. Woollard Award

**Nominations due** 15 February
**Submit nominations to** Nick Schmerr, Chair, Geophysics Division, nschmerr@umd.edu

This award recognizes outstanding contributions to geology through the application of the principles and techniques of geophysics. For more information, go to www.geosociety.org/divisions/geop/Awards.htm.

### GEOSCIENCE EDUCATION DIVISION

#### Biggs Award for Excellence in Earth Science Teaching

**Nominations due** 15 February
**Submit nominations to** community.geosociety.org/gedivision/news/awards/biggsaward. Questions should be directed to GEOEDGSA@gmail.com

This award recognizes innovative and effective teaching in college-level earth science. Earth-science instructors and faculty members from any academic institution engaged in undergraduate education who have been teaching full time for 10 years or fewer are eligible (part-time teaching is not counted).

### HISTORY AND PHILOSOPHY OF GEOLOGY DIVISION

#### Mary C. Rabbitt History and Philosophy of Geology Award

**Nominations due** 15 February
**Submit nominations to** Kathleen Lohff, Secretary/Treasurer, kathylohff@msn.com

This award is presented annually to an individual for exceptional scholarly contributions of fundamental importance to our

# Call for Nominations

## GSA DIVISION AWARDS

understanding of the history of the geological sciences. For more information, go to community.geosociety.org/histphildiv/awards#dsa.

### Gerald M. and Sue T. Friedman Distinguished Service Award

**Nominations due** 15 February
**Submit nominations to** Kathleen Lohff, Secretary/Treasurer, kathylohff@msn.com

This award is presented for exceptional service to the advancement of our knowledge of the history and philosophy of the geological sciences. For more information, go to community.geosociety.org/histphildiv/awards#dsa.

### History and Philosophy of Geology Student Award

**Nominations due** 15 June
**Submit nominations to** Kathleen Lohff, Secretary/Treasurer, kathylohff@msn.com

This student award, in the amount of US$1000, is provided for a paper to be given at the GSA Annual Meeting. The proposed paper may be (1) about the history or philosophy of geology; (2) a literature review of ideas for a technical work or thesis/dissertation; or (3) some imaginative aspect of the history or philosophy of geology we have not thought of before. For more information, go to community.geosociety.org/histphildiv/awards#dsa.

## HYDROGEOLOGY DIVISION

### O.E. Meinzer Award

**Nominations due** 1 February
**Submit nominations to** gsa.hydro.nominations@gmail.com; questions should be directed to David Parkhurst, Committee Chair, dlpark@usgs.gov

This award recognizes the author(s) of a publication or body of publications that have significantly advanced the science of hydrogeology or a closely related field. For more information, go to http://gsahydrogeology.org/OEMeinzer.htm.

### George Burke Maxey Distinguished Service Award

**Nominations due** 1 February
**Submit nominations to** gsa.hydro.nominations@gmail.com; questions should be directed to Brian Katz, Committee Chair, brian.katz@dep.state.fl.us

This award will be made in recognition of distinguished personal service to the hydrogeology profession and to the Hydrogeology Division. For more information, go to http://gsahydrogeology.org/DistinguishedService.htm.

### Kohout Early Career Award

**Nominations due** 1 February
**Submit nominations to** gsa.hydro.nominations@gmail.com; questions should be directed to Steve van der Hoven, Committee Chair, sjvanderhoven@gmail.com

This award will be presented to a distinguished early career scientist (35 years of age or younger or within 5 years of receiving their highest degree) 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. For more information, go to http://gsahydrogeology.org/Kohout.htm.

### Birdsall-Dreiss Distinguished Lecturer

**Nominations due** 1 February
**Submit nominations to** gsa.hydro.nominations@gmail.com; please direct questions to Dani Or, Committee Chair, dani.or@env.ethz.ch

The lecturer will be selected based on outstanding contributions to hydrogeology or a closely related field through original research and public communication and the potential for continued contributions to the profession. For more information, go to http://gsahydrogeology.org/BirdsallDreiss.htm.

## LIMNOGEOLOGY DIVISION

### Israel C. Russell Award

**Nominations due** 1 March
**Submit nominations to** David Finkelstein, Division Treasurer, dfink@geo.umass.edu

This award is given for major achievements in limnogeology through contributions in research, teaching, and service. Nominations should include a CV and a letter describing the nominee's accomplishments in limnogeology (broadly defined and including limnogeology, limnology, and paleolimnology), service to students and teaching, and contributions to GSA.

## MINERALOGY, GEOCHEMISTRY, PETROLOGY, AND VOLCANOLOGY (MGPV) DIVISION

### MGPV Distinguished Geologic Career Award

**Nominations due** 15 July
**Submit nominations to** J. Alex Speer, jaspeer@minsocam.org

This award will go to an individual who, throughout his or her career, has made distinguished contributions in one or more of the following fields of research: mineralogy, geochemistry, petrology, volcanology, with emphasis on multidisciplinary, field-based contributions. For more information, go to www.geosociety.org/divisions/mgpv/awards.htm.

# Call for Nominations

## GSA DIVISION AWARDS

### MGPV Early Career Award

**Nominations due** 15 July
**Submit nominations to** J. Alex Speer, jaspeer@minsocam.org

This award will go to an individual near the beginning of his/her professional career who has made distinguished contributions in one or more of the following fields of research: mineralogy, geochemistry, petrology, volcanology, with emphasis on multi-disciplinary, field-based contributions. Nominations are restricted to those who are within eight years past the award of their final degree. For more information, go to www.geosociety.org/divisions/mgpv/awards.htm.

## QUATERNARY GEOLOGY AND GEOMORPHOLOGY DIVISION

### Farouk El-Baz Award for Desert Research

**Nominations due** 1 April
**Submit nominations to** Anne Chin, anne.chin@ucdenver.edu

This award recognizes excellence in desert geomorphology research worldwide. It is intended to stimulate research in desert environments by recognizing an individual whose research has significantly advanced the understanding of the Quaternary geology and geomorphology of deserts. For more information, go to http://rock.geosociety.org/qgg/.

### Distinguished Career Award

**Nominations due** 1 April
**Submit nominations to** Sarah Lewis, Division Secretary, sarah.lewis@oregonstate.edu

This award is presented annually to a Quaternary geologist or geomorphologist who has demonstrated excellence in their contributions to science. For more information, go to http://rock.geosociety.org/qgg/.

## SEDIMENTARY GEOLOGY DIVISION

### Laurence L. Sloss Award for Sedimentary Geology

**Nominations due** 1 March
**Submit nominations to** Linda Kah, lckah@utk.edu

This award is given annually to a sedimentary geologist whose lifetime achievements best exemplify those of Larry Sloss—i.e., achievements that contribute widely to the field of sedimentary geology and service to GSA. For more information, go to http://rock.geosociety.org/sed/SGD_Awards2.html#Sloss.

## STRUCTURAL GEOLOGY AND TECTONIC DIVISION

### Career Contribution Award

**Nominations due** 1 March
**Submit nominations to** Terry Pavlis, tlpavlis@utep.edu

This award is for an individual who throughout his or her career has made numerous distinguished contributions that have clearly advanced the science of structural geology or tectonics. For more information, go to http://rock.geosociety.org/sgt/CareerAward.htm.

### Outstanding Publication Award

**Nominations due** 1 March

This award is given annually for a published work (paper, book, or map) of exceptional distinction that clearly advances the science of structural geology or tectonics. For more information, go to http://rock.geosociety.org/sgt/BestPaperAward.htm.

## SEDIMENTARY GEOLOGY DIVISION AND STRUCTURAL GEOLOGY AND TECTONIC DIVISION JOINT AWARD

### Stephen E. Laubach Structural Diagenesis Research Award

**Nominations due** 1 April
**Submit nominations to** James Evans at james.evans@usu.edu

This joint award promotes research combining structural geology and diagenesis and curriculum development in structural diagenesis. It highlights the growing need to break down disciplinary boundaries between structural geology and sedimentary petrology. Note that the application includes a budget page; we anticipate giving one award of US$2500 in 2016. For more information, go to http://rock.geosociety.org/sgt/Laubach.htm.

Second Announcement

# NORTH-CENTRAL SECTION

**50th Annual Meeting of North-Central Section, GSA**
**Champaign, Illinois, USA**
**18–19 April 2016**

**www.geosociety.org/Sections/nc/2016mtg/**

## *1967–2016—Celebrating 50 Years of Geoscience in the Mid-Continent*

### REGISTRATION

**Early registration deadline:** 14 March
**Cancellation deadline:** 21 March

REGISTRATION FEES (all fees are in U.S. dollars)

| | Early | | Standard | |
|---|---|---|---|---|
| | Full | 1 Day | Full | 1 Day |
| Professional member | $195 | $160 | $235 | $185 |
| Professional member 70+ | $95 | $80 | $120 | $95 |
| Professional nonmember | $235 | $185 | $275 | $195 |
| Student member | $90 | $45 | $100 | $55 |
| Student nonmember | $120 | $60 | $130 | $70 |
| K–12 professional | $40 | $30 | $45 | $35 |
| Guest/spouse | $45 | $45 | $45 | $45 |
| Field Trip only | $40 | n/a | $40 | n/a |

### ACCOMMODATIONS

Rooms have been reserved at two locations: (1) The I-Hotel and Conference Center (adjoins conference center), 1900 South First Street, Champaign, Illinois 61820, USA, +1-217-819-5000. Rate: US$139 plus tax. Use the code "GSA16" online (http://stayatthei.com/) by 25 March, to make your reservation. (2) The Hawthorn Suites (www.hawthorn.com), 101 Trade Center Drive, Champaign, Illinois 61820, USA, +1-217-398-3400. Rates: US$80 (king) and US$90 (double) plus tax. Please call to request the group rate and reference the meeting name and dates. The Hawthorn Suites is located about three-quarters of a mile from the I-Hotel and Conference Center.

### TECHNICAL PROGRAM

Please direct questions to technical program co-chairs Hue-Hwa Hwang and Dave Larson at NCGSA16-tech@isgs.illinois.edu.

### Symposium

S1. **Janis Treworgy Memorial Symposium:** *Cosponsored by the National Association of Geoscience Teachers.* David H. Voorhees, Waubonsee Community College, dvoorhees@waubonsee.edu.

### Theme Sessions

T1. **50 Years of Geoscience in the Mid-Continent—Celebrating Scientists and Their Legacy of Basic and Applied Research:** David R. Larson, Illinois State Geological Survey, drlarson@illinois.edu.

T2. **Reefs and Shallow Seas: Advances in High-Resolution Stratigraphy and Paleontology in Silurian-Ordovician Rocks of North America:** Donald G. Mikulic, Illinois State Geological Survey, mikulic@illinois.edu.

T3. **Sedimentology and Stratigraphic Framework of the Cambro-Ordovician Transition:** Yaghoob Lasemi, Illinois State Geological Survey, ylasemi@illinois.edu.

T4. **Black Shale and Associated Strata: Sedimentology, Stratigraphy, and Paleontology:** *Cosponsored by the Great Lakes Section–SEPM.* Joseph T. Hannibal, Cleveland Museum of Natural History, jhanniba@cmnh.org.

T5. **Mississippi Valley–Type and Other Mineral Deposits of the Midwest USA:** F. Brett Denny, Illinois State Geological Survey, fdenny@illinois.edu; Liliana Lefticariu, Southern Illinois Univ., lefticar@siu.edu; Martin Appold, Univ. of Missouri, appoldm@missouri.edu.

T6. **Next-Generation Sedimentary Systems Geobiology:** Bruce W. Fouke, Univ. of Illinois at Urbana-Champaign, fouke@illinois.edu.

T7. **Peeling the Onion: Building on a Century and a Half of Geologic Research in the Illinois Basin:** Charles Monson, Illinois State Geological Survey, cmonson@illinois.edu; Nathan D. Webb, Illinois State Geological Survey, ndwebb2@illinois.edu.

T8. **Shoreline Behavior, Paralic Architecture, and Lake-Level Change in the Great Lakes:** Todd A. Thompson, Indiana Geological Survey, tthomps@indiana.edu; John W. Johnston, Univ. of Waterloo, jwjohnston@uwaterloo.edu; Erin P. Argyilan, Indiana Univ. Northwest, eargyila@iun.edu.

T9. **Climate and Ice Sheets—Records and Analysis during the Last Deglaciation of Central North America:** Thomas V. Lowell, Univ. of Cincinnati, thomas.lowell@uc.edu; B. Brandon Curry, Illinois State Geological Survey, b-curry@illinois.edu.

T10. **Geologic Mapping of Quaternary Deposits:** Kevin A. Kincare, USGS, kkincare@usgs.gov; Richard C. Berg, Illinois State Geological Survey, rberg@illinois.edu; Marni Karaffa, Indiana Geological Survey, karaffam@indiana.edu.

T11. **Quaternary Time Machine: Methods and Analyses of Soils and Sediments to Reveal Secrets of Past Environments:** Maija Sipola, Albion College, msipola@albion.edu; Kat Rocheford, Paul Smith's College, kat-rocheford@uiowa.edu.

T12. **Limnogeology and Paleoclimatology—Investigating Past Environments and Reconstructing Past Climates (Posters):** Melinda Higley, Univ. of Illinois at Urbana-Champaign, mchigley@illinois.edu; Jessica Conroy, Univ. of Illinois at Urbana-Champaign, jconro@illinois.edu; Dana Labotka, Illinois State Geological Survey, dlabotka@illinois.edu; B. Brandon Curry, Illinois State Geological Survey, b-curry@illinois.edu.

T13. **Glacial Meltwater Discharge Events of the Last Deglaciation in the Great Lake Region: Climate and Timing:** Hong Wang, Illinois State Geological Survey, hongwang@illinois.edu; Timothy G. Fisher, Univ. of Toledo, timothy.fisher@utoledo.edu; B. Brandon Curry, Illinois State Geological Survey, b-curry@illinois.edu.

T14. **Quaternary Chronology Conundrums: Approximating and Assessing Event Ages:** B. Brandon Curry, Illinois State Geological Survey, b-curry@illinois.edu; Thomas V. Lowell, Univ. of Cincinnati, thomas.lowell@uc.edu; Henry M. Loope, Indiana Geological Survey, hloope@indiana.edu.

T15. **Advances in Geologic Carbon Sequestration:** *Cosponsored by the Center for Geologic Storage of $CO_2$.* Edward Mehnert, Illinois State Geological Survey, emehnert@illinois.edu; James Damico, Illinois State Geological Survey, jdamico@illinois.edu; Hongbo Shao, Illinois State Geological Survey, hbshao@illinois.edu.

T16. **Anthropogenic Impacts on Soil, Water, and Air:** Liliana Lefticariu, Southern Illinois Univ. Carbondale, lefticar@siu.edu; Melissa Lenczewski, Northern Illinois Univ., lenczewski@niu.edu.

T17. **Geomorphology, Hydrology, and Critical Zone Processes in the Anthropocene:** Alison Anders, Univ. of Illinois at Urbana-Champaign, amanders@illinois.edu; Arthur Bettis, Univ. of Iowa, art-bettis@uiowa.edu.

T18. **Innovations in Environmental Assessment and Remediation—Brownfields and Redevelopment and the Impacts of Urbanization:** Patricia Bryan, Bryan Environmental Consultants, Inc., pbryan@bryanenv.com; Christopher J. Stohr, Illinois State Geological Survey, cstohr@illinois.edu; Andrew J. Stumpf, Illinois State Geological Survey, astumpf@illinois.edu.

T19. **Characterization of Karst of the Midwestern U.S.: Problems with Unstable Ground and Groundwater Quality:** Samuel V. Panno, Illinois State Geological Survey, s-panno@illinois.edu; Walton R. Kelly, Illinois State Water Survey, wkelly@illinois.edu.

T20. **Characterizing Water-Quality Changes through Continuous Monitoring:** Kelly Warner, USGS, klwarner@usgs.gov; Amy Gahala, USGS, agahala@usgs.gov.

T21. **Anthropogenic Impacts on Groundwater Quantity and Quality: From Field Data to Numerical Analyses:** Daniel Abrams, Illinois State Water Survey, dbabrams@illinois.edu; Henk Haitjema, Indiana Univ., haitjema@indiana.edu.

T22. **Geophysical Methods with Applications to Hydrogeology:** David Hart, Wisconsin Geological and Natural History Survey, djhart@wisc.edu; Kisa E. Mwakanyamale, Illinois State Geological Survey, kemwaks@illinois.edu.

T23. **The Geological Consequences of River Flood Magnitude: Ancient and Modern Examples:** Andrew C. Phillips, Illinois State Geological Survey, aphillps@illinois.edu; Jim Best, Univ. of Illinois at Urbana-Champaign, jimbest@illinois.edu.

T24. **Advances in River and Floodplain Morphodynamics: Physical, Ecological, and Human Processes:** Jessica Zinger, Univ. of Illinois at Urbana-Champaign, zinger1@illinois.edu; Quinn W. Lewis, Univ. of Illinois at Urbana-Champaign, qlewis2@illinois.edu.

T25. **Applied Geology: Environmental, Engineering, Hydrogeology, Geotechnical, and Applied Geophysics:** Terry R. West, Purdue Univ., trwest@purdue.edu.

T26. **Women and Geology: Who Are We, Where Have We Come From, and Where Are We Going?** Beth A. Johnson, Univ. of Wisconsin–Fox Valley, beth.a.johnson@uwc.edu.

T27. **Geoscience Outreach—50 Years of Innovation:** *Cosponsored by the Geological Outreach at Museums, Parks, & Surveys Group.* Lisa Anderson, Michigan State Univ. Extension, venner@mchsi.com; Peter Voice, Western Michigan Univ., peter.voice@wmich.edu.

T28. **Undergraduate Research (Posters):** *Cosponsored by the Geosciences Division–Council on Undergraduate Research.* Robert D. Shuster, Univ. of Nebraska–Omaha, rshuster@unomaha.edu.

T29. **Undergraduate Research: Multidisciplinary Geologic Systems:** *Cosponsored by the Geosciences Division–Council on Undergraduate Research.* Samuel Smidt, Michigan State Univ., smidtsam@msu.edu; Charles Carrigan, Olivet Nazarene Univ., ccarriga@olivet.edu.

T30. **The Contribution of Taphonomy for Understanding the Fossil Record:** Thomas A. Hegna, Western Illinois Univ., ta-hegna@wiu.edu.

T31. **Magmatic Processes of the Midwestern Proterozoic: Mid-Continent Rift to St. Francois Mountains:** Craig Lundstrom, Univ. of Illinois at Urbana-Champaign, lundstro@uiuc.edu.

T32. **Structure, Geophysics, and Tectonics of the Midcontinent, from Precambrian to Present:** Stephen Marshak, Univ. of Illinois at Urbana-Champaign, smarshak@illinois.edu; Seth Stein, Northwestern Univ., seth@earth.northwestern.edu.

T33. **Multidisciplinary Research Techniques in Geoarchaeology—Human Interaction with the Landscape:** Kristin M. Hedman, Illinois State Archaeological Survey, khedman@illinois.edu; Shane K. Butler, Illinois State Geological Survey, sbutler4@illinois.edu.

## FIELD TRIPS

For additional information, please contact field trip co-chairs Zak Lasemi, zlasemi@Illinois.edu, and Scott Elrick, elrick@illinois.edu, or check the meeting website.

### Pre-Meeting

1. **The Quaternary Geology of the Chicago Metropolitan Area: The Chicago Outlet, Valparaiso Moraine, Lake Michigan Lobe Chronology Revisited, and Kankakee Torrent Story:** Sat. and Sun., 16–17 April, 7 a.m.–4 p.m. Cost: US$175. Leaders: B. Brandon Curry, Illinois State Geological Survey, b-curry@illinois.edu; Oliver J. Caron, Illinois State Geological Survey, caron@illinois.edu.
2. **Fluorite Deposits within the Illinois-Kentucky Fluorspar District and How They Relate to the Hicks Dome Cryptoexplosive Feature:** Sat. and Sun., 16–17 April, 7:30 a.m.–5 p.m. Cost: US$165. Leaders: F. Brett Denny, Illinois State Geological Survey, fdenny@illinois.edu; Joe Devera, Illinois State Geological Survey, j-devera@illinois.edu; Mary Seid, Illinois State Geological Survey, maryseid@illinois.edu; Mike Lewsader, Illinois State Geological Survey, lewsader@illinois.edu.

3. **Quaternary Geology of the Upper Sangamon River Basin: Glacial, Post-Glacial, and Post-Settlement History:** Sun., 17 April, 8 a.m.–5 p.m. Cost: US$80. Leaders: David A. Grimley, Illinois State Geological Survey, dgrimley@illinois.edu; Alison Anders, Univ. of Illinois at Urbana-Champaign, amanders@illinois.edu; Andrew J. Stumpf, Illinois State Geological Survey, astumpf@illinois.edu.

### Post-Meeting

4. **The Grover Gravel, St. Louis County, Missouri: Evidence for a Complex History, Volcanic Eruptions, and Early Glaciations:** Wed., 20 April, 7 a.m.–6:30 p.m. Cost: US$55. Leaders: Charles W. Rovey, Missouri State Univ., charlesrovey@missouristate.edu; Mike Siemens, Missouri State Geological Survey, mike.siemens@dnr.mo.gov; Greg Balco, Berkeley Geochronology Center, balcs@bgc.org.
5. **19 ka–13 ka Glacial Meltwater Discharge Archives in the Middle Illinois River Valley: Climate and Timing Implications:** Wed., 20 April, 7:30 a.m.–5:30 p.m. Cost: US$80. Leaders: Hong Wang, Illinois State Geological Survey, hongwang@illinois.edu; Andrew J. Stumpf, Illinois State Geological Survey, astumpf@illinois.edu; B. Brandon Curry, Illinois State Geological Survey, b-curry@illinois.edu; Timothy G. Fisher, Univ. of Toledo, timothy.fisher@utoledo.edu.
6. **Braided Rivers and Other Cambrian Environments of Southeastern Missouri: Sizing up Depositional Systems from Pore Scale to Regional Scale:** *Cosponsored by the Center for Geologic Storage of $CO_2$.* Wed. and Thurs., 20–21 April, 7:30 a.m.–5 p.m. Cost: US$185. Leaders: Jim Best, University of Illinois, jimbest@illinois.edu; David Dominic, Wright State University, david.dominic@wright.edu; Robert Ritzi, Wright State University, robert.ritzi@wright.edu; Charles Monson, Illinois State Geological Survey, cmonson@illinois.edu; Nathan Webb, Illinois State Geological Survey, ndwebb2@illinois.edu.
7. **Silurian Chronostratigraphy of Northeastern Illinois:** Wed., 20 April, 7:30 a.m.–6 p.m. Cost: US$55. Leaders: Donald G. Mikulic, Illinois State Geological Survey, mikulic@illinois.edu; Joanne Kluessendorf, Weis Earth Science Museum, joanne.kluessendorf@uwc.edu.
8. **Illinois Basin–Decatur Project (IBDP): A Large-Scale $CO_2$ Sequestration Project in a Deep Saline Reservoir:** *Cosponsored by the Center for Geologic Storage of $CO_2$.* Wed., 20 April, 7:30 a.m.–1 p.m. Cost: US$55. Leaders: Edward Mehnert, Illinois State Geological Survey, emehnert@illinois.edu; Hongbo Shao, Illinois State Geological Survey, hbshao@illinois.edu.
9. **Project-Based Field Trips to the Starved Rock Area for Geoscience Educators:** Wed., 20 April, 8 a.m.–6 p.m. Cost: US$85. Leaders: Kristin Huysken, Indiana Univ. Northwest, khuysken@iun.edu; Erin P. Argyilan, Indiana Univ. Northwest, eargyila@iun.edu; Robert Votaw, Indiana Univ. Northwest, cpvotaw@gmail.com.

## OPPORTUNITIES FOR STUDENTS

For mentor program and career workshop descriptions and On To the Future information, see p. 19.

### Mentor Programs

**Roy J. Shlemon Mentor Program in Applied Geoscience Luncheon:** Mon., 18 April

**John Mann Mentors in Applied Hydrogeology Program Luncheon:** Tues., 19 April

### Geoscience Career Workshops

**Geoscience Career Workshop Part 1: Career Planning and Informational Interviewing:** Mon., 18 April, 8–9 a.m.

**Geoscience Career Workshop Part 2: Geoscience Career Exploration:** Mon., 18 April, 9–10 a.m.

**Geoscience Career Workshop Part 3: Cover Letters, Résumés, and CVs:** Tues., 19 April, 9–10 a.m.

### Presentation Awards

Awards for the best student posters and papers are supported by the GSA North-Central Section and by the Great Lakes Section–SEPM (Society for Sedimentary Geology). To be eligible, students must be lead authors and presenters and should be capable of answering detailed questions about their research.

### Travel Grants

**Application deadline:** 14 March

Students who are GSA members and who register for the meeting are eligible to apply for student travel grants. For further information see **www.geosociety.org/grants/ncgrant.htm.**

## LOCAL COMMITTEE

**General Chair:** Steve Brown, steebrow@illinois.edu

**Chair Assistant:** Tammy Montgomery, tmntgmry@illinois.edu

**Vice-Chair:** Yu-Feng Forrest Lin, yflin@illinois.edu

**Technical Program Co-Chairs:** Hue-Hwa Hwang and Dave Larson, NCGSA16-tech@isgs.illinois.edu

**Field Trip Co-Chairs:** Scott Elrick and Zak Lasemi, NCGSA16-trip@isgs.illinois.edu

**Exhibits:** Renaé Strawbridge, NCGSA16-Exhibits@isgs.illinois.edu

**Sponsorship:** Dana Labotka, NCGSA16-Sponsors@isgs.illinois.edu

**Student Programs and Volunteers:** Shane Butler, NCGSA16-Students@isgs.illinois.edu

**Audiovisual:** Mark Yacucci, yacucci@illinois.edu

**Special Events, Workshops, and Short Courses:** Charles Monson, cmonson@illinois.edu

**Local Logistics:** Kathy Henry, kmhenry@illinois.edu

**Graphics:** Dee Lund, dlund@illinois.edu

**Other:** Joan Crockett, jcrocket@illinois.edu; Laura Keefer, lkeefer@illinois.edu

Second Announcement and Call for Papers

# ROCKY MOUNTAIN SECTION

**68th Annual Meeting of the Rocky Mountain Section, GSA**
**Moscow, Idaho, USA**
**18–19 May 2016**

**www.geosociety.org/Sections/rm/2016mtg/**

## LOCATION

Moscow, Idaho, USA, is located in the beautiful Palouse region of north-central Idaho. It is an ideal base for exploring the lavas of the Columbia River Basalts, granites of the Idaho Batholith, tremendous flood features of the Channeled Scablands, metamorphic Precambrian Belt rocks, agriculturally rich tephra-influenced loess soils, and the breathtaking landscape features of this tectonically active region.

## REGISTRATION

**Early registration deadline:** 11 April
**Cancellation deadline:** 18 April

REGISTRATION FEES (all fees are in U.S. dollars)

| | Early | | Standard | |
|---|---|---|---|---|
| | Full | 1 Day | Full | 1 Day |
| Professional member | $190 | $100 | $230 | $110 |
| Professional member 70+ | $70 | $55 | $70 | $60 |
| Professional nonmember | $210 | $160 | $240 | $200 |
| Student member | $50 | $30 | $60 | $40 |
| Student nonmember | $60 | $45 | $80 | $65 |
| K–12 teacher | $50 | $25 | $60 | $30 |
| Guest/spouse | $45 | $45 | $55 | $55 |
| Field Trip/Short Course only | $30 | n/a | $30 | n/a |

## ACCOMMODATIONS

**Reservation deadline:** 15 April

A block of rooms has been reserved for meeting attendees at the Best Western University Inn, located just north of the Univ. of Idaho campus at 1516 Pullman Road (State Hwy 8), +1-800-325-8765. Room rate: $109.99, plus tax, for up to 4 guests; please mention the GSA room block.

## CALL FOR PAPERS

**Abstract deadline:** 1 March

Submit your abstract online at **www.geosociety.org/Sections/rm/2016mtg/.** Fee: US$15 for students; US$20 for all others. If you cannot submit an abstract online, please contact Heather Clark, +1-303-357-1018, hclark@geosociety.org.

## TECHNICAL SESSIONS

### Theme Sessions

T1. **Megafloods, Paleohydrology, and Fluvial Processes on Earth and Beyond: In Recognition of the Scientific Contributions of Victor R. Baker:** Jim O'Connor, USGS, oconnor@usgs.gov; Virginia Gulick, NASA Ames/SETI Institute, virginia.c.gulick@nasa.gov; Lisa Ely, Central Washington Univ., ely@geology.cwu.edu; Brian Yanites, Univ. of Idaho, byanites@uidaho.edu.

T2. **Quaternary Geochronology and Mapping: Applications to Geomorphic Problems in the Intermountain Western North America:** Cal Ruleman, USGS, cruleman@usgs.gov; Shannon Mahan, USGS, smahan@usgs.gov.

T3. **(Bio)Geochemical Processes in Soils:** Carmen Nezat, Eastern Washington Univ., cnezat@ewu.edu; Abir Biswas, Evergreen State College, biswasa@evergreen.edu.

T4. **Paleogene-Neogene (?) Gravels of the Interior Plains of Western North America:** Dale Leckie, Univ. of Calgary, leckied@shaw.ca; Andrew Leier, Univ. of South Carolina, aleier@geol.sc.edu.

T5. **Source to Sink, Proterozoic to Today: Erosion, Sediment Transport, and the Stratigraphic Record of Surface Processes:** Robert Mahon, Univ. of Wyoming, mahon1@uwyo.edu; Claire Lukens, Univ. of Wyoming, clukens@uwyo.edu; Paul Link, Idaho State Univ., linkpaul@isu.edu.

T6. **Lagerstätten through Time and Space:** Julien Kimmig, Univ. of Saskatchewan, jkimmig@gmail.com; Amy Singer, Univ. of Montana, amy.singer@umontana.edu.

T7. **Late Paleozoic Ice Age: Gondwana Systems and Proxies in the U.S. Cordillera:** Peter Isaacson, Univ. of Idaho, isaacson@uidaho.edu.

T8. **Volcanic Hazards: Products, Processes, and Perspectives:** Brittany Brand, Boise State Univ., brittanybrand@boisestate.edu; Shannon Kobs Nawotniak, Idaho State Univ., kobsshan@isu.edu.

T9. **Seismic and Landslide Hazards in the Inland Northwest:** Suzette Payne, Idaho National Laboratory, suzette.payne@inl.gov; Bill Phillips, Idaho Geologic Survey, phillips@uidaho.edu; Daisuke Kobayashi, Univ. of Idaho, dice.k.koba@gmail.com.

T10. **Energy Resources and New Plays in Western North America:** John Welhan, Idaho Geologic Survey, weljohn@isu.edu; Ed Ratchford, Idaho Geologic Survey, edratchford@uidaho.edu; Jerry Fairley, Univ. of Idaho, jfairley@uidaho.edu; Renee Breedlovestrout, Idaho Geologic Survey, reneeb@uidaho.edu.

T11. **Mineral Deposits and Metallogeny of Western North America:** Chris Dail, Midas Gold, dail@midasgoldinc.com; Eric Jones, Thunder Mountain Gold; Lauren Perreault, HDR; Virginia Gillerman, Idaho Geologic Survey, edratchford@uidaho.edu.

T12. **Geologic Setting and Hydrogeology of the Columbia River Basalt Group and the Snake River Plain:** Attila Folnagy, Montana DNRC, afolnagy@mt.gov; Tom Wood, Univ. of Idaho, twood@uidaho.edu.

T13. **Cenozoic Volcanism in the Inland Northwestern United States:** John Wolff, Washington State Univ., jawolff@wsu.edu; Scott Boroughs, Washington State Univ., geoentoptics@

gmail.com; Jesse Mosolf, Montana Tech, jmosolf@mtech.edu; Bill Bonnichsen, Univ. of Idaho, billb@uidaho.edu.

T14. **Geochronology of Igneous Processes:** Vince Isakson, Boise State Univ., vincentisakson@u.boisestate.edu; Mark Schmitz, Boise State Univ., markschmitz@boisestate.edu.

T15. **Geologic Evolution of Accretion-Related Orogenic Belts and Associated Elements of the Central North American Cordillera:** Keith Gray, Wichita State Univ., k.gray@wichita.edu; Keegan Schmidt, Lewis Clark State College, klschmidt@lcsc.edu.

T16. **Constraints on the Formation, Assembly, and Evolution of Precambrian Rocks in the Rockies:** Julie Baldwin, Univ. of Montana, julie.baldwin@umontana.edu; Jeff Vervoort, Washington State Univ., vervoort@wsu.edu; Da Wang, Washington State Univ., binglian454@gmail.com.

T17. **Planetary Science: Insights from Remote Sensing, Field, and the Laboratory:** Deepak Dhingra, Univ. of Idaho, deepdpes@uidaho.edu.

T18. **Undergraduate Geologic and Multidisciplinary Research: Faculty Examples and Student Experiences in the Field:** Chad Pritchard, Eastern Washington Univ., cpritchard@ewu.edu.

## FIELD TRIPS

For additional information, please see the meeting website or contact field trip co-chairs Reed Lewis, reedl@uidaho.edu, or Keegan Schmidt, klschmidt@lcsc.edu.

### Pre-Meeting

1. **Pleistocene Megaflood Landscapes of the Channeled Scabland:** Sun.–Tues., 15–17 May. Leaders: Victor Baker, Bruce Bjornstad, David Gaylord.
2. **The Columbia River Basalt Group of Western Idaho and Eastern Washington—Dikes, Vents, Flows, and Tectonics along the Eastern Margin of the Flood Basalt Province:** Mon.–Tues., 16–17 May. Leaders: Stephen Reidel, Victor Camp, Barton Martin, Terry Tolan, John Wolff.
3. **Miocene Fossils in the Clarkia Area: Classic Lagerstätten:** Tues., 17 May. Leaders: Bill Rember; Bridget Wade.
4. **Geology of the Wallowa Terrane in the Northern Part of Hells Canyon:** Tues., 17 May. Leaders: Keegan Schmidt, Tracy Vallier.
5. **Metamorphic History of the Belt Supergroup and Underlying Paleoproterozoic Basement Rocks in the Western Part of the Clearwater Complex:** Tues., 17 May. Leaders: Julie Baldwin, Reed Lewis, Jeff Vervoort.

### Post-Meeting

6. **Miocene to Pleistocene Volcanism of the Yellowstone Hotspot: Western and Central Snake River Plain:** Fri.–Mon., 20–23 May. Leaders: Scott Boroughs, Bill Bonnichsen, Martha Godchaux, John Wolff.
7. **Geologic and Anthropogenic History of the Palouse Falls Area: Floods, Fractures, Clastic Dikes, and the Receding Falls:** Fri., 20 May. Leaders: Chad Pritchard, Larry Cebula.
8. **Geology and Geologic History of the Moscow-Pullman Basin, Idaho and Washington, from Late Grande Ronde to Late Saddle Mountains Time:** Fri., 20 May. Leaders: John Bush, Dean L. Garwood, Pamela Dunlap.
9. **Accretionary Tectonics of West-Central Idaho and Relationships to the Greater Rocky Mountain Orogen:** Fri.–Sun., 20–22 May. Leaders: Keegan Schmidt, Keith Gray, Reed Lewis.
10. **Pre-Belt Basement Tour: Late Archean–Early Proterozoic Rocks of the Cougar Gulch Area, Southern Priest River Complex:** Fri., 20 May. Leaders: Andy Buddington, Da Wang, P. Ted Doughty.
11. **Precious and Base Metal Deposits of the Coeur d'Alene Mining District:** Fri.–Sat., 20–21 May. Leaders: Chris Dail, Sadae Lortz, John Etienne, Virginia Gillermany, Grant Brackebusch, Dan Hussey, Kathryn Dehn, Aaron Gross.

## OPPORTUNITIES FOR STUDENTS

For mentor program and career workshop descriptions and On To the Future information, see p. 19.

### Mentor Programs

**Roy J. Shlemon Mentor Program in Applied Geoscience Luncheon:** Wed., 18 May

**John Mann Mentors in Applied Hydrogeology Program Luncheon:** Thurs., 19 May

### Career Workshops

**Geoscience Career Workshop Part 1: Career Planning and Informational Interviewing:** Wed., 18 May, 8–9 a.m.

**Geoscience Career Workshop Part 2: Geoscience Career Exploration:** Wed., 18 May, 9–10 a.m.

**Geoscience Career Workshop Part 3: Cover Letters, Résumés and CVs:** Thurs., 19 May, 9–10 a.m.

### Travel Grants

**Deadline to apply:** 11 Apr. 2016

The GSA Foundation has funds available for student travel grants. Apply at www.geosociety.org/Sections/rm/2016mtg/; for more information, contact Kevin Mahan, mahank@colorado.edu.

## LOCAL COMMITTEE

**Meeting Co-Chairs:** Leslie Baker, lbaker@uidaho.edu, and Brian Yanites, byanites@uidaho.edu

**Technical Program Chairs:** Tom Williams, tonw@uidaho.edu, and Peter Isaacson, isaacson@uidaho.edu

**Field Trip Chairs:** Reed Lewis, reedl@uidaho.edu, and Keegan Schmidt, klschmidt@lcsc.edu

**Student Volunteer Coordinator:** Cary Lindsey, caryrlindsey@gmail.com

**Judging Coordinator:** Judy Parrish, jparrish@uidaho.edu

**Industry Liaison:** Ed Ratchford, edratchford@uidaho.edu

# GSA Education & Outreach Programs: 2016 Section Meetings

## ON TO THE FUTURE (OTF)

Stop by the GSA Foundation booth at your Section Meeting's Welcome Reception to find out about applying to OTF, which provides travel support to students underrepresented in the geosciences to attend their first GSA Annual Meeting (the next one is 25–28 Sept. 2016 in Denver, Colorado, USA).

## CAREER WORKSHOPS

**Geoscience Career Workshop Part 1**: Career Planning and Informational Interviewing: Job-hunting begins with career planning, and this workshop will help you get started with an introduction to informational interviewing.

**Geoscience Career Workshop Part 2**: Geoscience Career Exploration: How much do geologists make? What are the pros and cons of working in academia, government, and industry? Get those answers and more in this career exploration workshop.

**Geoscience Career Workshop Part 3 (day 2)**: Cover Letters, Résumés, and CVs: How do you prepare a cover letter? Does your résumé need a good edit? Use this opportunity to learn the dos and don'ts of putting together the kind of résumés and cover letters employers want to see.

## MENTOR PROGRAMS

The Roy J. Shlemon Mentor Program in Applied Geoscience and the John Mann Mentors in Applied Hydrogeology Program offer students the opportunity to meet with geoscience mentors who work in the applied sector. These luncheon events are so popular that space is limited—plan to arrive early because lunch is first-come, first-served. Questions? Contact Jennifer Nocerino at jnocerino@geosociety.org.

### South-Central Section

*Baton Rouge, Louisiana, USA*
Shlemon Applied Geoscience Luncheon: Mon., 21 March
Mann Applied Hydrogeology Luncheon: Tues., 22 March

### Northeastern Section

*Albany, New York, USA*
Shlemon Applied Geoscience Luncheon: Mon., 21 March
Mann Applied Hydrogeology Luncheon: Tues., 22 March

### Southeastern Section

*Columbia, South Carolina, USA*
Shlemon Applied Geoscience Luncheon: Thurs., 31 March
Mann Applied Hydrogeology Luncheon: Fri., 1 April

### Cordilleran Section

*Ontario, California, USA*
Shlemon Applied Geoscience Luncheon: Mon., 4 April
Mann Applied Hydrogeology Luncheon: Tues., 5 April

### North-Central Section

*Champaign, Illinois, USA*
Shlemon Applied Geoscience Luncheon: Mon., 18 April
Mann Applied Hydrogeology Luncheon: Tues., 19 April

### Rocky Mountain Section

*Moscow, Idaho, USA*
Shlemon Applied Geoscience Luncheon: Wed., 18 May
Mann Hydrogeology Luncheon: Thurs., 19 May

# ROCK STARS

Bob Garrels conducting fieldwork in the late 1930s or early 1940s. Photo courtesy Cynthia Garrels.

## Robert M. Garrels

***Lee R. Kump,*** *Dept. of Geosciences, The Pennsylvania State University, University Park, Pennsylvania 16802, USA, lkump@psu.edu*

An obvious way to begin this article would have been, "It's hard to imagine a more influential geochemist than Robert Minard Garrels," but one of many pieces of advice Garrels (1916–1988) gave his students was, "If you find yourself saying 'it's hard to imagine …' imagine harder!" Imagining hard is what characterized Garrels' approach to the earth sciences.

Garrels' contributions to the fields of geology and geochemistry are immense, for which he received many honors. With Mary Thompson, he pioneered the use of the ion-pairing model to understand the behavior of the elements in seawater. With William Krumbein (1952) and later Charles Christ, he explained, through many examples, how redox potential (Eh) and acidity (pH) can be used to characterize natural environments and to predict the minerals that occur stably in them. With Fred Mackenzie he proposed that seawater chemistry was strongly affected by equilibria with newly formed silicate minerals (the concept of *reverse weathering*). The collaboration with Mackenzie led to a series of papers and a 1971 textbook, *Evolution of Sedimentary Rocks*, which reinvigorated the concept of global cycling of the elements. Garrels came to imagine that the chemistry of the oceans and atmosphere were in a dynamically steady state rather than in equilibrium, and this led to a series of papers that transformed these ideas into ordinary differential equations (box models), as classically presented in the BLAG model (for Berner, Lasaga, and Garrels; Berner et al., 1983). His textbooks are classics, and his publications impactful, still to be mined for treasured insights.

What made Bob Garrels so uniquely able to see order in the chaos of nature and to present it in a way that was accessible even to less chemically oriented geologists? Like so many of us, his early experiences and great mentors along the way had tremendous influence. His father was a chemical engineer who worked for a chemical company that used local salt and limestone in its processes. Garrels credits his father's interest and the local salt deposits and fossil-rich rocks as factors that set him on the path toward a career in earth science. A neighbor who excelled in astronomy took the time to instill a sense of wonder about the universe in young Garrels and his friends. Bob liked to play with his mother's lye (which she used for making soap) because it felt so slippery, and he learned the hard lesson that bases can be as caustic as acids when his fingernails fell off. At Michigan, where he obtained his undergraduate degree, Garrels was turned off to chemistry by a poor teacher and settled on geology.

Upon graduation in 1937, Garrels found that continuing on for an advanced degree at Northwestern paid almost as well as available jobs and took the offer of a teaching assistantship in the geology department. Having taken all the geology courses offered, he enrolled in chemistry courses, which "to [his] amazement, [were] fascinating and useful" (quoted in Berner, 1992). From a geology professor, John T. Stark, he learned to question tacit assumptions and to adopt the position of devil's advocate, an approach he is said to have used with great pleasure. He learned from a chemistry professor (F.T. Gucker Jr.) not to underestimate students, but rather to challenge them with problems that seemed beyond their abilities, and to "make [them] understand that it was unthinkable for [the students] not to solve them." To Garrels own students' immediate dismay but enduring benefit, they experienced this teaching pedagogy many times in the geochemistry classroom.

Garrels moved many times during his career (Sloss and Berner, 1989). After receiving his Ph.D. in 1941, he remained at Northwestern until 1952, excepting a one-year stint in the military mapping beaches in the Pacific. He left Northwestern for the U.S. Geological Survey to work on the geochemistry of uranium, an element of great interest in the post-war atomic age and Cold War, but longed for a return to academic life and so in 1955 accepted a position at Harvard. In 1965, fleeing the administrative duties of department chairman, he returned to Northwestern. Four years later, he moved to Scripps, then two years later to the University of Hawaii, then two years later back to Northwestern for five years, and finally to the University of South Florida.

Garrels always welcomed new ideas, and because of this he struck up a deep friendship with James Lovelock, originator of the controversial "Gaia Hypothesis" that imagines Earth as a living organism, able to regulate important state variables such as temperature and ocean composition. Lovelock wanted to test his

Gaia concept on a geochemist, and Garrels was one of the few willing to listen. Lovelock considered the global geochemical cycling models "sterile," without adequate accommodation for the interactions with living organisms. Garrels argued that the biota were implicit in aspects of the model (e.g., in the burial of organic matter that created a net flux of oxygen to the atmosphere). But Lovelock was looking for more, for regulatory mechanisms (feedbacks) that recognized the importance of organisms in controlling what the geochemists were treating as largely inorganic processes (e.g., chemical weathering). The ensuing decades have witnessed an explosion of research on biotic influences on "geologic" processes.

Garrels' understanding of and concern for the environment was expressed in a seminal publication with Mackenzie and Garrels' second wife, Cynthia A. Hunt (Garrels et al., 1975) that presaged our current realization that we live in the "Anthropocene," an era of geological relevance in which humans have modified the environment at a global scale. He pondered the "world without us," wondering how long it would take to erase the presence of mankind on the planet. Among other unpublished observations he made in his later years were the correspondence between the age of sidewalks and the extent of their re-carbonation through reaction with carbonic acid in rainwater, and of the variety of minerals precipitated on copper roofs and how they reflected the regional deposition of various pollutants. Mason jar experiments aimed at determining siderite solubility and copper-sulfate-chloride solution interactions with biogenic calcite moved with his last student, Terri Woods, to East Carolina University, where they served as the basis for student research.

Garrels had diverse interests. He was an athlete who briefly held the world masters records in the high jump and triple jump; he was an avid tennis player; and he favored ping-pong over extended discussions of science with his students if forced to choose (although both could be conducted simultaneously, on Fridays with beer in hand). He developed an algorithm to calculate how many gin and tonics one deserved after a swim in the ocean, depending on the strength and direction of the tide (it turned out to be an exponential function; Berner, 1992). And he was a poet. His "Cycle of P" has been reprinted often (see https://en.wikipedia.org/wiki/Robert_Garrels), but less well known is a shorter poem:

*The P Song*
*Pollutia*
Cycle me, cycle me, you know where
Into the oceans and through the air
And if you don't cycle me in the right place
I'll weed up your rivers and eutroph your lakes.

Bob Garrels enjoyed life. He valued collaboration and companionship, and he was curious and imaginative. He had a great sense of humor, he was fair and humble, and he was surprisingly approachable for a scientist of his stature. I recall a group of us as graduate students approaching him at the beginning of TGIF and timidly alerting him to the fact that we had discovered an error in a classic paper. Garrels response was "oh, that's too bad—anyone want to play ping-pong?"

Garrels was truly a rock star, and his legacy exists in the creative way we view the operation of Earth as a system today.

## REFERENCES CITED


Berner, R.A., 1992, Robert Minard Garrels: A biographical memoir: Washington, D.C., The National Academies Press, p. 195–212, http://www.nap.edu/read/2037/chapter/11#206.

Berner, R.A., Lasaga, A.C., and Garrels, R.M., 1983, The carbonate-silicate geochemical cycle and its effect on atmospheric carbon dioxide over the past 100 million years: American Journal of Science, v. 253, p. 641–683.

Garrels, R.M., and Mackenzie, F.T., 1971, Evolution of Sedimentary Rocks: New York, W.W. Norton, 397 p.

Garrels, R.M., Mackenzie, F.T., and Hunt, C., 1975, Chemical Cycles and the Global Environment: Assessing Human Influences: Los Altos, California, William Kaufmann Inc., 206 p.

Krumbein, W.C., and Garrels, R.M., 1952, Origin and classification of chemical sediments in terms of pH and oxidation-reduction potentials: The Journal of Geology, v. 60, no. 1, p. 1–33.

Sloss, L.L., and Berner, R.A., 1989, Memorial to Robert M. Garrels, 1916–1988: Boulder, Colorado, Geological Society of America Memorials, v. 20, p. 5–10.


*The "Rock Stars" series is produced by GSA's History and Philosophy of Geology Division.*

# 2015 Outstanding Earth Science Teacher (OEST) Awards

The National Association of Geoscience Teachers (NAGT) has announced the 2015 OEST Awards. This annual award recognizes excellence in earth-science teaching at the pre-college level. GSA awards the section recipients US$500 in travel money to attend a GSA meeting, US$500 for classroom supplies, and complimentary membership in GSA for three years. State winners receive a one-year complimentary GSA membership.

## SECTION WINNERS

### Central Section

**Michele Svoboda**
Mill Creek Middle School
Comstock Park, Michigan, USA

### Eastern Section

**John Russell**
Columbia Secondary School
New York, New York, USA

### Far Western Section

**Ryan Hollister**
Turlock High School
Turlock, California, USA

### New England Section

**Rodney Ward**
Christa McAuliffe Charter School
Framingham, Massachusetts, USA

### North Central Section

**Ann Anderson**
Belle Fourche Middle School
Belle Fourche, South Dakota, USA

### Pacific Northwest Section

**Andrew Bagley**
Shorewood High School
Shoreline, Washington, USA

### Southeastern Section

**Susan Oltman**
Kittredge Magnet School
Atlanta, Georgia, USA

### Southwest Section

**Rob Reisener**
Cactus Shadows High School
Cave Creek, Arizona, USA

## STATE WINNERS

### Alabama

**Michelle Peterson**
Council Traditional School
Mobile, Alabama, USA

### Florida

**Christine Danger**
Hillsborough County Public Schools
Tampa, Florida, USA

### Georgia

**Susan Oltman**
Kittredge Magnet School
Atlanta, Georgia, USA

### Idaho

**Ken Berger**
Moscow High School
Moscow, Idaho, USA

### Illinois

**Joe Schoen**
Geneva High School
Geneva, Illinois, USA

### Indiana

**Heather A. Hall**
Rensselaer Central Middle School
Rensselaer, Indiana, USA

### Iowa

**Brandon Fritz**
Williamsburg High School
Williamsburg, Iowa, USA

### Louisiana

**Lisa Swenson**
Isidore Newman School
New Orleans, Louisiana, USA

### New York

**Ken Abbott**
Grand Avenue Middle School
Bellmore, New York, USA

### North Carolina

**Rebekah Fuerst**
Parkwood Middle School
Monroe, North Carolina, USA

### Ohio

**Beth A. Holmes**
Etna Elementary
Pataskala, Ohio, USA

### Oregon

**Christopher R. Carlton**
Nyssa Middle School
Nyssa, Oregon, USA

### Pennsylvania

**Blake Colaianne**
Dallastown Area High School
Dallastown, Pennsylvania, USA

### South Carolina

**Jennifer Bowling Pitman**
Anderson Mill Elementary
Moore, South Carolina, USA

### Wisconsin

**Adam J. Keeton**
North High School
Eau Claire, Wisconsin, USA

The National Association
of Geoscience Teachers (NAGT)

# Why GSA Membership Is Important to Me

## *And to Colleagues in Applied Geoscience Fields*

Jonathan G. Price

I have appreciated my membership in GSA primarily because of the science—the peer-reviewed literature in GSA's journals and special publications, the new work presented at GSA Annual and Section Meetings, and the exchange of information and ideas on field trips and at specialty meetings.

Most of my career has been in areas of applied geoscience (mineral exploration, mining, and state geological survey work related to mineral and energy resources, natural hazards, and environmental issues). I have found GSA field trips to be particularly helpful. For example, associated with the GSA Annual Meeting in San Antonio, Texas, Chris Henry, Don Parker, Dan Barker, and I co-led a field trip about the igneous geology of Trans-Pecos Texas. About half of the attendees were individuals whom we invited, specifically because they were experts either on the types of rocks or the geographic area that we visited. We learned a tremendous amount on that trip, because those experts and other geoscientists who attended gave us new perspectives on the rocks that we had been studying for years.

Another example was seeing first-hand the evidence that John Warme showed us about the Alamo Breccia and Devonian impact (pretty much dead-center on Area 51 in Nevada) during a field trip associated with a combined Cordilleran–Rocky Mountain Section Meeting. I expect that most of my colleagues in applied areas of geoscience would agree that they look to GSA primarily for the quality of science. Because of a disciplinary or business focus, they also go to the meetings of many of GSA's Associated Societies; in my case, these have primarily been the Society of Economic Geologists (SEG); the Society for Mining, Metallurgy, Exploration (SME); the Association of American State Geologists (AASG); the American Institute of Professional Geologists (AIPG); and, occasionally, American Association of Petroleum Geologists (AAPG) and the Association of Environmental & Engineering Geologists (AEG).

The networking opportunities offered at GSA meetings and on GSA field trips are another major draw for us to be members.

**Jonathan G. Price**
GSA President, 2015–2016
*GSA member since 1974; GSA Fellow since 1989*

# 2016 Field Camp Awards

Jenna Zechmann, National Park Service, Tahoma, Washington, USA.

## Field Camp Scholar Award

***Who should apply?*** Undergraduate students

**Deadline to apply:** 16 April

This year's field award will provide US$2,000 each to 20 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:** 16 April

**Camp dates:** 7–14 August 2016

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, USA, 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:** 16 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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https://rock.geosociety.org/eo/

**CALL FOR COMMITTEE SERVICE**

✔ Your Science
✔ Your Colleagues
✔ Your Society

# *Impact the Future of Geoscience*

## 2017–2018 VACANCIES

**Deadline to apply or submit nominations:** 15 June

If you are looking for the opportunity to work toward a common goal, a place to network with other geoscientists, or a way to make a difference for GSA and the larger geoscience community—then we invite you to volunteer (or nominate a fellow GSA Member) to serve on a GSA Committee or as a GSA representative to another organization. Learn more at **www.geosociety.org/aboutus/committees/.** You can also watch our committees YouTube video at **https://youtu.be/1k3V4gVOV7k.**

| COMMITTEE | Number of Vacancies | Length of Term |
|---|---|---|
| **Annual Program Committee** | two | 4 years |
| **Arthur L. Day Medal Award (E, T)** | two | 3 years |
| **Diversity in the Geosciences (E, M)** | two | 3 years |
| **Education (B, E M)** | four | 4 years |
| **Geologic Mapping Award (E)** | one | 3 years |
| **Geology and Public Policy (B, E, M)** | two | 3 years |
| **GSA International (M, E)** | three | 4 years |
| **Joint Technical Program (E)** | one | 2 years |
| **Membership (B) Academia** | three | 3 years |
| **Nominations (B, E)** | two | 3 years |
| | one | 2 years |
| **Penrose Conferences and Field Forums (E)** | one | 3 years |
| **Penrose Medal Award (E)** | two | 3 years |
| **Professional Development (E)** | two | 3 years |
| **GSA Public Service Award (E)** | two | 3 years |
| **Publications** | one | 4 years |
| **Research Grants (B, T)** | eight | 3 years |
| **Research Grants Alternates (B, T) (if needed)** | five | 3 years |
| **Student Advisory Council** (must be a GSA Section or Division member) | | 2 years |
| **Young Scientist Award (Donath Medal) (E)** | two | 3 years |
| | | |
| **OTHER ORGANIZATION** | **Number of Vacancies** | **Length of Term** |
| **GSA Conferee to the AAPG Publication Pipeline Committee (M, possibly B)** | one | 3 years |

B—Meets in Boulder or elsewhere
E—Communicates by phone or electronically
M—Meets at the Annual Meeting
T—Extensive time commitment required during application review period (15 Feb.–15 Apr. 2017)

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## NOW AT GSA: Your Time to Shine

Volunteer or nominate a colleague to serve as a GSA Officer, Councilor, or committee member. Deadline: **15 June** (terms begin July 2017). Student members are especially encouraged to bring their unique points of view to GSA leadership.

**Links to Learn More**

**Officers & Councilors:** www.geosociety.org/aboutus/officers.htm

**Committees:** www.geosociety.org/aboutus/committees

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# ELECTIONS: GSA OFFICERS and COUNCILORS

### GSA ELECTIONS BEGIN 11 MARCH 2016

GSA's success depends on you—its members—and the work of the officers serving on GSA's Executive Committee and Council. Members will receive instructions for accessing a member-only electronic ballot via our secure website, and biographical information on the nominees will be online for review at that time. Paper versions of both the ballot and candidate information will also be available upon request. Contact Susan Lofton, slofton@geosociety.org, for more information. Ballots must be submitted electronically, faxed to GSA Headquarters, or postmarked by **10 April 2016.**

### 2016 OFFICER NOMINEES

| PRESIDENT | VICE PRESIDENT/PRESIDENT-ELECT | TREASURER |
|---|---|---|
| (July 2016–June 2017) | (July 2016–June 2017) | (continuing term, July 2016–June 2017) |
| **Claudia I. Mora** | **Isabel Montanez** | **Bruce R. Clark** |
| Los Alamos National Laboratory | University of California Davis | The Leighton Group Inc. |
| Los Alamos, New Mexico, USA | Davis, California, USA | Irvine, California, USA |
| *We congratulate our incoming president!* | | |

### 2016 COUNCIL NOMINEES

| COUNCILOR POSITION 1 | COUNCILOR POSITION 2 | COUNCILOR POSITION 3 |
|---|---|---|
| (July 2016–June 2020) | (July 2016–June 2020) | (July 2016–June 2020) |
| **Ed Harvey** | **Mark Little** | **Donna L. Whitney** |
| National Park Service | University of North Carolina | University of Minnesota |
| Denver, Colorado, USA | Chapel Hill, North Carolina, USA | Minneapolis, Minnesota, USA |
| **Second candidate to be confirmed** | **Dave Szymanski** | **Marjorie A. Chan** |
| | Bentley University | University of Utah |
| | Waltham, Massachusetts, USA | Salt Lake City, Utah, USA |

**Ballots must be submitted electronically or postmarked by** 10 April 2016.

# Geoscience Jobs & Opportunities

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.
Rates are in U.S. dollars.

| Classification | Per Line for 1st month | Per line each addt'l month (same ad) |
|---|---|---|
| Positions Open | $9.20 | $8.95 |
| Fellowship Opportunities | $9.20 | $8.95 |
| Opportunities for Students | | |
| First 25 lines | $0.00 | $5.00 |
| Additional lines | $5.00 | $5.00 |

## Positions Open

**ASSISTANT PROFESSOR**
**STRATEGIC NATURAL MINERAL,**
**ECONOMIC GEOLOGY,**
**MISSOURI UNIVERSITY OF**
**SCIENCE AND TECHNOLOGY**

The Department of Geosciences and Geological and Petroleum Engineering invites applications for a full-time tenure-track faculty position in economic geology–strategic natural mineral resources, at the Assistant Professor level, to begin August 2016. The successful candidate will be expected to develop an active externally-funded research program that investigates processes related to ore genesis, mineral resources, ore deposit exploration, and demonstrate a commitment to interdisciplinary research. We seek individuals who will integrate their research with excellence in teaching at both the graduate and undergraduate levels. Teaching responsibilities will include service courses as well as courses in the individual's area of expertise. The Department currently has 20 full-time faculty, and 318 undergraduate and 241 graduate degree-seeking students with established B.S., M.S., and Ph.D. programs in Geology & Geophysics, Petroleum Engineering, and Geological Engineering. Closely associated departments include Mining Engineering and Environmental Engineering. Local area establishments with potential collaborative research opportunities include the U.S. Geological Survey (Mid-continent Geospatial Mapping Center), Missouri Department of Natural Resources, Fort Leonard Wood (U.S. Army), the Missouri S&T Rock Mechanics and Explosives Research Center (RMERC), Materials Research Center (MRC), and Energy Research and Development Center (ERDC). Visit our department web pages for more information on faculty and research (http://gse.mst.edu/). Questions regarding this position should be directed to the chair of the search committee, Dr. David Wronkiewicz (wronk@mst.edu).

A Ph.D. in Geology and/or Geophysics is required. The final candidate is required to provide an official transcript showing completion of the terminal degree listed in the application materials submitted. A copy of transcripts must be provided prior to the start of employment. In addition, the final candidate may be required to verify other credentials listed in application materials. Failure to provide the official transcript or other required verification may result in the withdrawal of the job offer.

Applications must include a letter describing interests and possible contributions to our programs, curriculum vita, statements of teaching interests and research goals, up to five reprints of published work, and the names and contact information of three referees. Review of applications will begin on February 15, 2016 and continue until the search is completed.

All application materials including resume/vita, cover letter, reference letters, portfolio, etc., must include the position reference number in order to be processed and must be submitted electronically to http://hraadi.mst.edu/hr/employment. Acceptable electronic formats are PDF and Word.

Missouri University of Science and Technology Human Resource Office Position Reference Number #00065394(Geoscientist).

Missouri University of Science and Technology is an affirmative action/equal opportunity employer.

**DIRECTOR AND STATE GEOLOGIST**
**DEPARTMENT OF KENTUCKY**
**GEOLOGICAL SURVEY**
**UNIVERSITY OF KENTUCKY**

The University of Kentucky is seeking experienced applicants for the senior level faculty position of Director and State Geologist at the Kentucky Geological Survey. For more information or to contact the search committee about the position, go to kgs.uky.edu/StateGeologist. The minimum requirements for the position are a Ph.D. and 10 years of related experience in geology. Applicants should have excellent communication skills, an active research program, and management experience in an equivalent organization. A diverse background in government, industry, and academia is desirable.

This position is open until filled; the Search Committee will begin reviewing applications in early February 2016. Salary is commensurate with education, experience and qualifications.

To apply for requisition #FE00397, a UK Employment Application must be submitted at www.uky.edu/ukjobs. Apply directly at http://ukjobs.uky.edu/postings/88097. If you have any questions, contact HR/Employment, phone +1-859-257-9555, press 2, or email ukjobs@email.uky.edu. The University of Kentucky is an Equal Opportunity Employer and is committed to a policy of providing equal employment opportunities to all candidates.

# GEOCORPS™ AMERICA

## Summer 2016

**Application deadline:** 29 February

GSA is now accepting applications for paid, short-term geoscience opportunities on public lands throughout the United States. All levels of geoscientists—students, educators, professionals, retirees, and others—are encouraged to apply.

***Learn more at***

www.geosociety.org/geocorps | www.facebook.com/GeoCorps


# 35th International Geological Congress (IGC)

## Mentoring & Travel Grant Program

Cape Town, South Africa ✷ 27 Aug.–4 Sept. 2016

**Application deadline:** 20 Feb.

GSA is accepting applications at https://rock.geosociety.org/eo/ for this program. Students and early career scientists (within seven years of receiving their Ph.D.) are welcome to apply. Applicants must be residents or citizens of the United States and be enrolled in or employed at a U.S. institution.

*This program is organized in collaboration with the GSA Foundation, the U.S. National Committee for Geological Sciences (of the National Academy of Sciences), and the American Geosciences Institute.*

**Questions?**

Please contact Jennifer Nocerino at jnocerino@geosociety.org or check the website at **https://rock.geosociety.org/eo/.**

**www.35igc.org**

**John W. (Jack) Hess,** *GSA Foundation President*

As GSA looks to the future, a strong value has been placed on engaging a diversity of perspectives and experiences that will help build a more dynamic and innovative geoscience community in our membership and beyond. GSA's **On To the Future** (OTF) Program is the premier program supporting emerging geoscientists from diverse backgrounds to attend their first GSA Annual Meeting. OTF accomplishments include the following:

- Supporting more than 350 students to attend their first GSA professional meeting, with more than 50% of students from first-generation families and 67% from minority backgrounds;
- Connecting students with key GSA leaders to learn about field camps, internships, research awards, and opportunities to play a role in GSA leadership; and
- Matching students with mentors in their chosen fields for advice about effectively navigating the meeting, creating new networks, and learning about future education and career options.

Through your donation to OTF, you will help build a diverse and robust geoscience community of leaders. With your contribution, GSA hopes to continue to provide a rich and lasting experience for students like graduate student Anibal Hernandez:

"Thank you to all the people that let us participate in this great conference. I learned a lot about topics I've never heard or read before. This conference changed my mind and I've seen a lot of possibilities that I can do for research in a near future."

GSA hopes that you will consider supporting the OTF program and help provide an enriching and transformative experience that will propel and further engage diverse students in the geosciences.

## THANK YOU TO THE 2015 ON TO THE FUTURE MENTOR VOLUNTEERS

Pranoti Asher
Christopher Atchison
Greg Baker
Rodey Batiza
David Borrok
Davida Buehler
Matt Carter
Darrel Cowan
Matt Dawson
Carol de Wet
Paul Doss
Lucy Edwards
Margaret Eggers
Robert Finkelman
Ben Frieman
Jane Hammarstrom
Mary Hubbard
Miquela Ingalls
Alexandra Isern
Claudia Johnson
Patricia Kelley
Nazrul Khandaker
Jonathan Knapp
Will Levandowski
Xiao-Ming Liu
Emma Locatelli
Nicole Lunning
Nancy McMillan
Joseph Meert
Chris Murray
Judy Parrish
Charity Phillips-Lander
Kathleen Ritterbush
Sarah Roeske
Justin Samuel
Allison Severson
Ginny Sisson
Trisha Smrecak
Chynna Spangle
John Steinmetz
Robert Sterrett
Alexander Stewart
Douglas Thompson
Kelsi Ustipak
David Voorhees
Matthew Vrazo
John Wakabayashi
Wes Ward
Emily Wild
Margaret Yacobucci
Susan Zimmerman

**For program information or to mentor in the future, contact** Tahlia Bear, tbear@geosociety.org.

# 2016 GSA
# Section Meetings

**SOUTH-CENTRAL**
21–22 March
Hilton Baton Rouge Capitol Center,
Baton Rouge, Louisiana, USA

**NORTHEASTERN**
21–23 March
Albany Convention Center,
Albany, New York, USA

**SOUTHEASTERN**
31 March–1 April
Columbia Metropolitan Convention Center,
Columbia, South Carolina, USA

**CORDILLERAN**
4–6 April
Ontario Convention Center,
Ontario, California, USA

**NORTH-CENTRAL**
18–19 April
I-Hotel and Conference Center,
Champaign, Illinois, USA

**ROCKY MOUNTAIN**
18–19 May
University of Idaho,
Moscow, Idaho, USA

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**www.geosociety.org/sections**

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# Move2016 is available now

move™

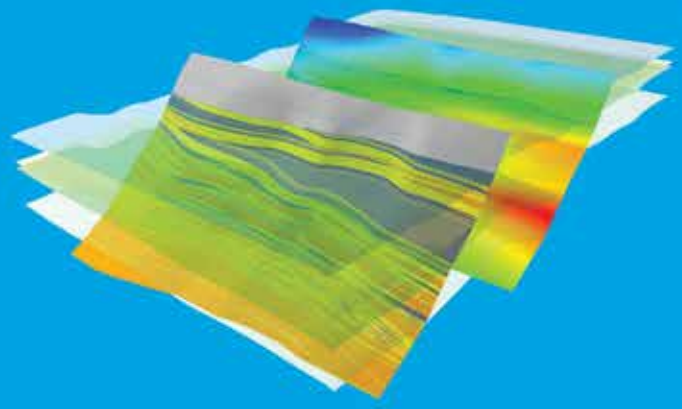
## New modules for understanding faults

### Fault Analysis

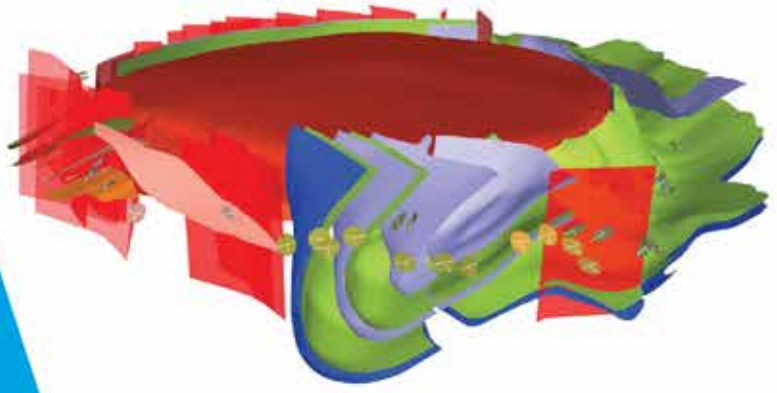
Quantitative analysis of fault throw, juxtaposition and seal through geological time

### Fault Response Modelling

Boundary element modelling to simulate displacement on faults, and geomechanical analysis of surrounding fracture systems



## New to 2D & 3D Kinematic Modelling



### Improved 3D Model Building for Complex Surfaces

Build more accurate overturned horizon and fault meshes from points or interpretation data

### Thermal Subsidence Modelling

More realistic sequential restorations of passive margins

### Non-Planar Trishear

New algorithm implemented in 2D Move-on-Fault and the Construct Horizons from Fault

For more information visit: www.mve.com/move-latest

T: +44 (0)141 332 2681 E: info@mve.com



midland valley