

It's Time!—Renew Your Membership & Save 15%

# GSA TODAY

A PUBLICATION OF THE GEOLOGICAL SOCIETY OF AMERICA®

## **Dynamics of a large, restless, rhyolitic magma system at Laguna del Maule, southern Andes, Chile**



# SCIENCE EDITOR

## OPENINGS FOR 2016

GSA is soliciting applications and nominations for science co-editors for GSA books, GSA maps and charts, *GSA Bulletin*, *Geology*, and *Lithosphere* with four-year terms beginning 1 January 2016. Duties include: ensuring stringent peer review and expeditious processing of submissions; making final acceptance or rejection decisions after considering recommendations of reviewers; and maintaining excellent content through active solicitation of diverse and definitive manuscripts, books, or maps.

### POSITIONS AVAILABLE

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

**MAPS AND CHARTS** The GSA maps and charts editor reviews proposals for printed and digital maps and handles the peer review of submitted maps (and accompanying manuscripts in some cases). The successful candidate will have a wide range of interests and expertise in mapping techniques and standards.

**GSA BULLETIN** Research interests that best complement those of the continuing editors: Quaternary geology; geomorphology; volcanology; low-T geochemistry; thermochronology; structural geology; biogeochemistry; geobiology; paleobiology

**LITHOSPHERE** Research interests that best complement those of the continuing editors: Quaternary processes; tectonic geomorphology; low-T thermochronology; neotectonics; geochronology; isotope geochemistry

**GEOLOGY** Research interests that best complement those of the continuing editors: volcanology; petrology; sedimentology; geochemistry; (paleo)climate/atmosphere/(paleo)oceans; paleontology/geobiology; planetary geology; hydrology; geophysics

**GSA Books** ▶ 1 position

**Maps & Charts** ▶ 1 position

**GSA Bulletin** ▶ 1 position

**Lithosphere** ▶ 1 position

**Geology** ▶ 2 positions

### A SUCCESSFUL EDITOR WILL HAVE

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

### INTERESTED?

- ▶ Please submit a curriculum vitae and a letter describing why you are suited for the position to Jeanette Hammann, [jhammann@geosociety.org](mailto:jhammann@geosociety.org).
- ▶ To nominate another, submit a nomination letter and the person's written permission and CV.

Editors work out of their current locations at work or at home. GSA provides an annual stipend and funds for office expenses. Nominations or applications received by 1 February 2015 will be given first consideration.



## Featured Articles

**GSA TODAY** (ISSN 1052-5173 USPS 0456-530) prints news and information for more than 26,000 GSA member readers and subscribing libraries, with 11 monthly issues (April/May is a combined issue). *GSA TODAY* is published by The Geological Society of America<sup>®</sup> Inc. (GSA) with offices at 3300 Penrose Place, Boulder, Colorado, USA, and a mailing address of P.O. Box 9140, Boulder, CO 80301-9140, USA. GSA provides this and other forums for the presentation of diverse opinions and positions by scientists worldwide, regardless of race, citizenship, gender, sexual orientation, religion, or political viewpoint. Opinions presented in this publication do not reflect official positions of the Society.

© 2014 The Geological Society of America Inc. All rights reserved. Copyright not claimed on content prepared wholly by U.S. government employees within the scope of their employment. Individual scientists are hereby granted permission, without fees or request to GSA, to use a single figure, table, and/or brief paragraph of text in subsequent work and to make/print unlimited copies of items in *GSA TODAY* for noncommercial use in classrooms to further education and science. In addition, an author has the right to use his or her article or a portion of the article in a thesis or dissertation without requesting permission from GSA, provided the bibliographic citation and the GSA copyright credit line are given on the appropriate pages. For any other use, contact [editing@geosociety.org](mailto:editing@geosociety.org).

**Subscriptions: GSA members:** Contact GSA Sales & Service, +1-888-443-4472; +1-303-357-1000 option 3; [gsaservice@geosociety.org](mailto:gsaservice@geosociety.org) for information and/or to place a claim for non-receipt or damaged copies. **Nonmembers and institutions:** *GSA TODAY* is US\$88/yr; to subscribe, or for claims for non-receipt and damaged copies, contact [gsaservice@geosociety.org](mailto:gsaservice@geosociety.org). Claims are honored for one year; please allow sufficient delivery time for overseas copies. Periodicals postage paid at Boulder, Colorado, USA, and at additional mailing offices. Postmaster: Send address changes to GSA Sales & Service, P.O. Box 9140, Boulder, CO 80301-9140.

### GSA TODAY STAFF

**Executive Director and Publisher:** John W. Hess

**Science Editors:** **R. Damian Nance**, Ohio University Dept. of Geological Sciences, 316 Clippinger Laboratories, Athens, OH 45701, USA, [nance@ohio.edu](mailto:nance@ohio.edu); **Steven Whitmeyer**, James Madison University Dept. of Geology & Environmental Science, 800 S. Main Street, MSC 6903, Harrisonburg, VA 22807, USA, [whitmesj@jmu.edu](mailto:whitmesj@jmu.edu)

**Managing Editor:** K.E.A. "Kea" Giles, [kgiles@geosociety.org](mailto:kgiles@geosociety.org), [gsatoday@geosociety.org](mailto:gsatoday@geosociety.org)

**Graphics Production:** Margo McGrew

**Advertising (classifieds & display):** Ann Crawford, +1-800-472-1988 ext. 1053; +1-303-357-1053; Fax: +1-303-357-1070; [advertising@geosociety.org](mailto:advertising@geosociety.org); [acrawford@geosociety.org](mailto:acrawford@geosociety.org)

**GSA Online:** [www.geosociety.org](http://www.geosociety.org)

**GSA TODAY:** [www.geosociety.org/gsatoday/](http://www.geosociety.org/gsatoday/)

Printed in the USA using pure soy inks.



### SCIENCE:

#### 4 Dynamics of a large, restless, rhyolitic magma system at Laguna del Maule, southern Andes, Chile

Brad S. Singer, Nathan L. Andersen, H el ene Le M evel, Kurt L. Feigl, Charles DeMets, Basil Tikoff, Clifford H. Thurber, Brian R. Jicha, Carlos Cardona, Loreto C ordova, Fernando Gil, Martyn J. Unsworth, Glyn Williams-Jones, Craig Miller, Judy Fierstein, Wes Hildreth, and Jorge Vazquez



**Cover:** View southwest across Laguna del Maule, Chile, from near the summit of the vent for the Holocene rhyolite flows of Cari Launa at 3030 masl. The 1.2 km<sup>3</sup> of brown glassy lava comprising the central lakeshore in the middle of the photo is the late Holocene rhyolite coul ee of Las Nieblas, whose vent is 12.7 km away. The center of maximum uplift measured using InSAR geodesy is in the bay just to the right (north) of the Nieblas rhyolite. Nathan Andersen is collecting pumice blocks for geochemical and geochronological study. Photo by Brad Singer, 6 April 2013. See related article, p. 4–10.

### GROUNDWORK:

#### 44 How scientometry is killing science A.M. Cel al  eng r

## GSA News

- 12 Jack Hess: Thank You
- 13 Upcoming Award, Recognition & Grant Deadlines
- 14 Writing a Successful GSA Grant Proposal
- 15 2015 Student Research Grants
- 16 Preliminary Announcement and Call for Papers: GSA North-Central Section Meeting
- 18 GSA Member in the News
- 19 Second Announcement: GSA South-Central Section Meeting
- 21 New Publication Calendar for *GSA Today*
- 22 Second Announcement: GSA Southeastern Section Meeting
- 27 Second Announcement: GSA Northeastern Section Meeting
- 30 Geology—Past & Future REVISITED
- 32 GSA Foundation Update
- 33 Subaru VIP Member Benefit Ending
- 34 Geoscience Jobs & Opportunities

**Erratum:** In the October 2014 issue of *GSA Today* (v. 24, no. 10, p. 29) the date of death for James B. Thompson Jr. was given as 1 June 2014. The correct date of death for Dr. Thompson is 15 November 2011.

# Dynamics of a large, restless, rhyolitic magma system at Laguna del Maule, southern Andes, Chile

**Brad S. Singer\***, **Nathan L. Andersen**, **Hélène Le Mével**, **Kurt L. Feigl**, **Charles DeMets**, **Basil Tikoff**, **Clifford H. Thurber**, **Brian R. Jicha**, *University of Wisconsin–Madison, Dept. of Geoscience, Madison, Wisconsin 53706, USA*; **Carlos Cardona**, *Observatorio Volcanológico de los Andes del Sur (OVDAS) and SERNAGEOMIN, Chile, and Universidad de Concepción, Chile*; **Loreto Córdova**, **Fernando Gil**, *Observatorio Volcanológico de los Andes del Sur (OVDAS) and SERNAGEOMIN, Chile*; **Martyn J. Unsworth**, *University of Alberta, Dept. of Physics, 116 Street and 85 Ave., Edmonton, Alberta T6G 2R3, Canada*; **Glyn Williams-Jones**, **Craig Miller**, *Dept. of Earth Sciences, Simon Fraser University, 8888 University Drive, Burnaby, British Columbia V5A 1S6, Canada*; **Judy Fierstein**, **Wes Hildreth**, and **Jorge Vazquez**, *U.S. Geological Survey, 345 Middlefield Road, MS 977, Menlo Park, California 94025, USA*

## ABSTRACT

Explosive eruptions of large-volume rhyolitic magma systems are common in the geologic record and pose a major potential threat to society. Unlike other natural hazards, such as earthquakes and tsunamis, a large rhyolitic volcano may provide warning signs long before a caldera-forming eruption occurs. Yet, these signs—and what they imply about magma-crust dynamics—are not well known. This is because we have learned how these systems form, grow, and erupt mainly from the study of ash flow tuffs deposited tens to hundreds of thousands of years ago or more, or from the geophysical imaging of the unerupted portions of the reservoirs beneath the associated calderas. The Laguna del Maule Volcanic Field, Chile, includes an unusually large and recent concentration of silicic eruptions. Since 2007, the crust there has been inflating at an astonishing rate of at least 25 cm/yr. This unique opportunity to investigate the dynamics of a large rhyolitic system while magma migration, reservoir growth, and crustal deformation are actively under way is stimulating a new international collaboration. Findings thus far lead to the hypothesis that the silicic vents have tapped an extensive layer of crystal-poor, rhyolitic melt that began to form atop a magmatic mush zone that was established by ca. 20 ka with a renewed phase of rhyolite eruptions during the Holocene. Modeling of surface deformation, magnetotelluric data, and gravity changes suggest that magma is currently intruding at a depth of ~5 km. The next phase of this investigation seeks to enlarge the sets of geophysical and geochemical data and to use these observations in numerical models of system dynamics.

## INTRODUCTION

Caldera-scale rhyolitic volcanoes can rapidly deposit hundreds of cubic kilometers of ash over several million square kilometers, threatening people and agriculture at the scale of an entire continent (Sparks et al., 2005; Lowenstern et al., 2006; Self, 2006). Sooner or later, Earth will experience another eruption of this magnitude (Lowenstern et al., 2006; Self and Blake, 2008); consequently, there is a need to gather comprehensive information and create multi-scale models that realistically capture the dynamics leading to these destructive events. Most of our current understanding of this type of volcanic system has been gleaned from the study of eruptive products long after the catastrophic eruption, including voluminous ash flow deposits, such as the Bishop, Bandelier, Huckleberry Ridge, and Oruanui Tuffs (Lowenstern et al., 2006; Hildreth and Wilson, 2007; Bachmann and Bergantz, 2008; Wilson, 2008). The most recent rhyolitic “super-eruption” produced the Oruanui Tuff 26,500 years ago in New Zealand. Even in this relatively recent case, the geologic evidence has been partly obliterated by caldera-collapse, erosion, and burial (Wilson et al., 2005). Moreover, probing the present-day structures beneath a number of calderas using seismic tomography (e.g., Romero et al., 1993; Steck et al., 1998; Farrell et al., 2014) or other geophysical measures (e.g., Lowenstern et al., 2006; Battaglia et al., 2003; Tizzani et al., 2009) has not detected eruptible domains of crystal-poor melt in the shallow crust, nor has it captured the dynamics that preceded these large eruptions.

This paper focuses on the Laguna del Maule Volcanic Field, Chile, a large, potentially hazardous, rhyolitic magmatic system, where an alarming rate of surface uplift for the past seven years and concentrated swarms of shallow earthquakes prompted Observatorio Volcanológico de los Andes del Sur (OVDAS) to declare in March 2013 a yellow alert, signaling a potential eruption within months or years. Straddling the Andean range crest at 36° S (Fig. 1A), this volcanic field features: (1) 13 km<sup>3</sup> of rhyolite that erupted both explosively and effusively during the past 20 k.y.; (2) a zone of low electrical resistivity in the shallow crust below the deforming area; (3) widespread elevated CO<sub>2</sub> concentrations; and (4) a negative (~10 mGal) Bouguer anomaly and preliminary evidence for a positive dynamic gravity signal indicating mass addition.

The underlying magma system has been sampled by eruptions numerous times since its apparent inception in the late Pleistocene, including a dozen crystal-poor, glassy rhyolitic lavas during the Holocene. Linking the assembly and evolution of this

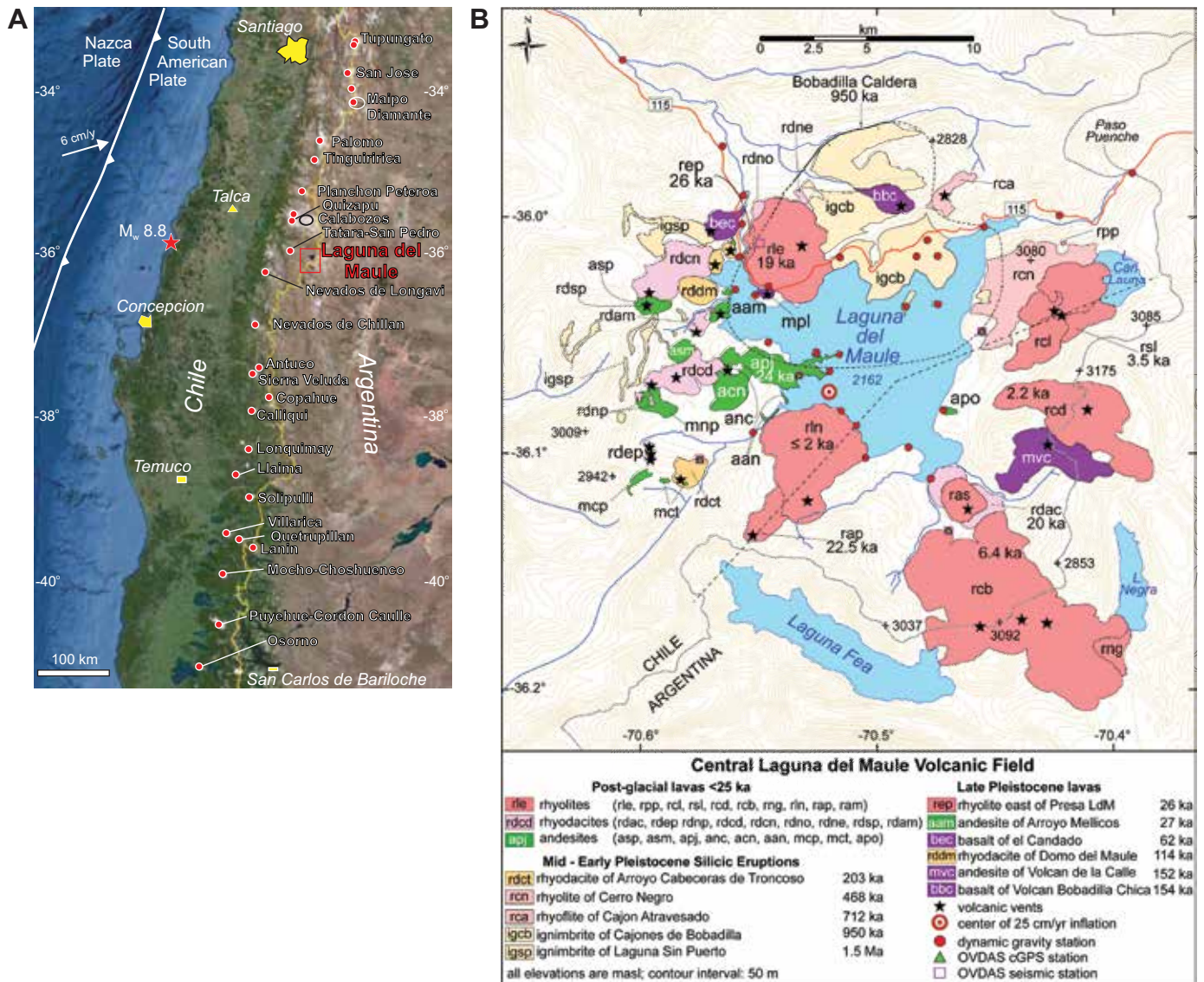


Figure 1. (A) Location of Laguna del Maule volcanic field. Andean Southern Volcanic Zone frontal arc volcanoes are red circles. Red star denotes epicenter of  $M_w$  8.8 earthquake of 27 Feb. 2010 (base from Google Earth). (B) Simplified map of Laguna del Maule volcanic field adapted from Hildreth et al. (2010). Ages of lava flows determined by  $^{40}\text{Ar}/^{39}\text{Ar}$  dating given in k.y.; many of these dates have been determined or revised recently (Andersen et al., 2013). The dam (la presa) at the northern outlet of the lake serves as a useful geographic reference.

large, youthful system on geologic time scales to magma-crust interactions over human time scales while it is actively growing is an exciting frontier for multidisciplinary research. Here we present initial findings, although the ultimate goal is to use these, together with seismic and other data yet to be acquired, in novel ways to create and test a unified computational model of how these hazardous systems operate.

## THE LAGUNA DEL MAULE VOLCANIC FIELD

### Geology, Geochronology, Geochemistry

The Laguna del Maule volcanic field is 230 km east of the epicenter of the  $M_w$  8.8 Maule earthquake of 27 February 2010, atop one of the most seismically and volcanically active subduction zones on Earth (Fig. 1A). Geologic mapping and  $^{40}\text{Ar}/^{39}\text{Ar}$  geochronology reveal that 350 km<sup>3</sup> of lavas and tuffs of basaltic to

rhyolitic composition erupted during the Pleistocene (Hildreth et al., 2010). Previous large-volume explosive silicic eruptions are recorded by a 1.5 Ma dacitic ignimbrite and a 950 ka rhyodacitic tuff associated with the Bobadilla caldera (Fig. 1B). Activity culminated in a spectacular concentric ring of 36 separate post-glacial silicic eruptions between 25 ka and perhaps as recently as 2 ka or later. These most recent eruptions were from 24 vents and produced 15 rhyodacite and 21 rhyolite coulées and lava domes. The vents encircle the 23.5 × 16.5 km lake basin, with the 36 silicic flows comprising 6.4 km<sup>3</sup> of mainly phenocryst-poor glassy lava covering >100 km<sup>2</sup> of the 300 km<sup>2</sup> basin (Fig. 1B). Pumice and ash fall deposits associated with the explosive phase of each rhyolitic eruption are preserved in Argentina and likely are equal in volume to these lava flows (Fierstein et al., 2013). This is the greatest concentration of post-glacial rhyolite in the Andes. The only comparable Holocene rhyolite flare-up globally comprises >4 km<sup>3</sup>



of rhyolite lava and tephra that occur along the 15 km Mono Craters chain in California (Hildreth, 2004). Building on Hildreth et al. (2010) and Singer et al. (2000), ongoing efforts to determine the ages of youngest lavas using the  $^{40}\text{Ar}/^{39}\text{Ar}$  method and distal ash

beds using  $^{14}\text{C}$  indicate that silicic volcanism is concentrated in two phases separated by a 5–10 k.y. period during which eruptions were relatively small and less frequent (Andersen et al., 2013; Fierstein et al., 2013) (Fig. 2). Coincident with deglaciation, phase 1 began with the eruption of the rhyolite east of Presa Laguna del Maule (unit *rep*; Fig. 1B). Following this eruption, numerous andesitic flows and rhyodacitic domes were erupted, primarily along the western shore of the lake. Phase 1 culminated in the eruption of two high-silica rhyolite flows at 22.5 and 19 ka—respectively, the rhyolite of Arroyo Palacios (unit *rap*) and the Espejos Rhyolite (unit *rle*). Phase 2 began in the Holocene with the eruption of the earliest Barrancas complex (unit *rcb*) at the southeastern end of the lake (Figs. 1B and 2B). Rhyolitic eruptions continue into the late Holocene in the southern and eastern basin at the Cari Launa (units *rsl*, 3.5 ka, and *rcl*), Divisoria (unit *rcd*, 2.2 ka), and Nieblas (unit *rln*) eruptive centers. The eruption rate increased with time, with the phase 2 average nearly double that of phase 1 (Fig. 2C).

The post-glacial magma compositions are remarkably co-linear in variation diagrams, reflecting the strong imprint of crystal fractionation (Hildreth et al., 2010). However, the post-glacial eruptions do not record a monotonic trend toward more evolved compositions. While phase 2 eruptions are dominantly rhyolitic, several andesitic, rhyodacitic, and mixed eruptions occurred on the western periphery of the basin, including the mid- to late-Holocene succession of a rhyodacite lava (*rdcn*), andesite scoria (*asm*), and a rhyodacite dome (*rdsp*), each erupted from a contiguous vent system in the northwestern part of the basin (Fig. 1B) (Hildreth et al., 2010). Moreover, the rhyolite lavas display coherent temporal trends in trace element compositions (Figs. 2D–2F), reflected in coeval rhyolites on opposite sides of the lake having nearly identical major and trace element compositions.

Whereas there have been few mafic eruptions in the past 20 k.y., textural and chemical evidence that mafic magma has intruded to shallow depths is clear. Quenched inclusions of basaltic andesite are common in the early post-glacial rhyodacites (Fig. 2G), indicating physical interactions between hot mafic magma and cooler silicic magmas. While the rhyolite lavas are notably free of such inclusions, the 100 °C range and temporal trend in pre-eruptive magma storage temperatures are consistent with reheating of the silicic system by recent mafic intrusion (Fig. 2A). Reconnaissance measurements of soil gas have revealed emissions of  $\text{CO}_2$  of between 0.5% and 1.0% (vol.) throughout the basin and up to 7% (vol.) along the northern lakeshore. Because the solubility of  $\text{CO}_2$  in rhyolite is limited (e.g., Lowenstern et al., 2006), these findings suggest that the inflation may reflect intrusion of mafic magma.

Phenocrysts in large silicic ash flow tuffs reveal magma residence times up to several hundred thousand years (Costa, 2008; Reid, 2008; Simon et al., 2008; Wotzlaw et al., 2013). However, these estimates are complicated by diverse crystal populations, including autocrysts that crystallized from the erupted melt, antecrysts that may have grown from earlier melts, and xenocrysts from wallrocks (Charlier et al., 2004; Cooper and Reid, 2008). Using a sensitive high-resolution ion microprobe–reverse geometry (SHRIMP-RG) instrument and secondary ion mass spectrometry,  $^{230}\text{Th}/^{238}\text{U}$  disequilibrium dates were obtained from the outer surfaces of zircons in the <2 ka Nieblas rhyolite (Andersen et al., 2013). Model ages range from ca. 2 ka to 42 ka, demonstrating

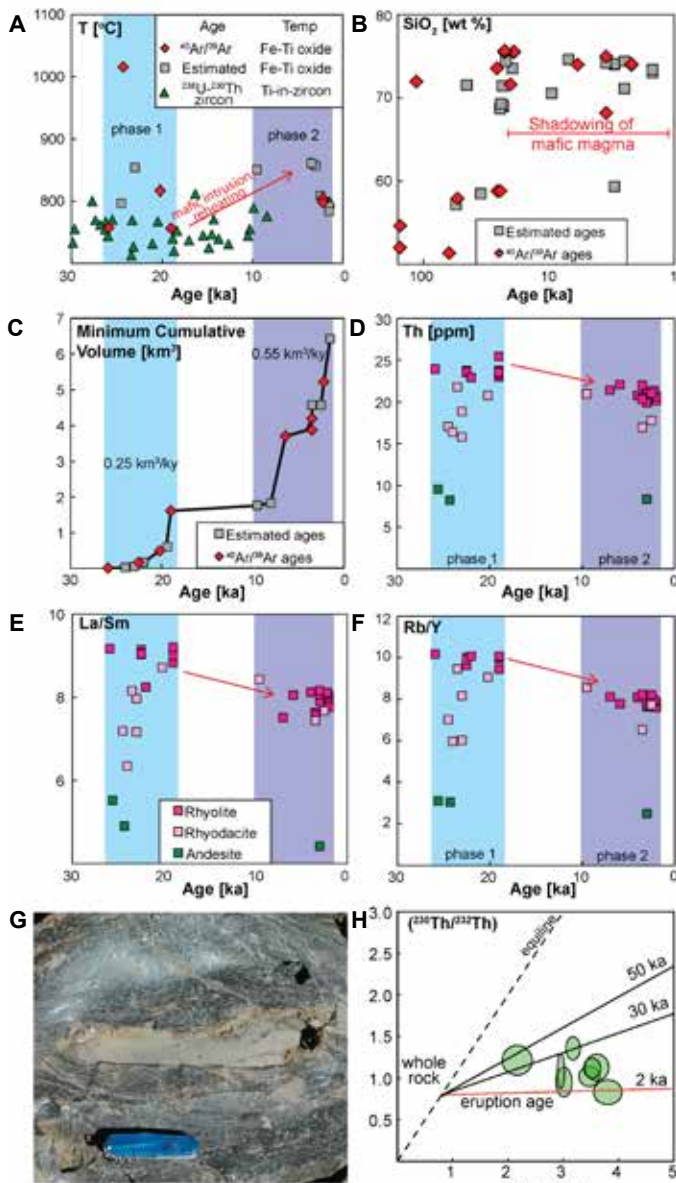


Figure 2. (A) Post-glacial variation of magma temperature. Temperatures associated with  $^{40}\text{Ar}/^{39}\text{Ar}$  or estimated eruption ages are determined by two-oxide thermometry (Ghiorso and Evans, 2008) while zircon  $^{238}\text{U}/^{230}\text{Th}$  ages are associated with Ti-in-zircon temperatures (Ferry and Watson, 2007). (B).  $\text{SiO}_2$  content of Laguna del Maule lavas for the past 160 k.y.; note the different x-axis scale versus the other panels. Previously common mafic eruptions are rare and peripheral since the 19 ka Espejos eruption. (C) The cumulative volume of post-glacial silicic lava. Plotted data and rates are minimums because they do not account for tephra fall preserved in Argentina. (D–F) Trace element compositions of the post-glacial lavas display spatially independent, temporally coherent chemical evolution consistent with an integrated, relatively homogeneous source reservoir. Symbols are as listed in panel E. (G) Quenched basaltic andesite inclusion in the rhyodacite of Colada Dendri-forme (*rdcd*). (H)  $^{230}\text{Th}/^{238}\text{U}$  equiline plot of data from euhedral surfaces of zircon in Nieblas rhyolite pumice. The red 2 ka isochron corresponds to the estimated eruption age. Black 30 and 50 ka isochrons are for reference. Isochrons calculated using the whole-rock Nieblas rhyolite  $^{238}\text{U}/^{230}\text{Th}$  composition.

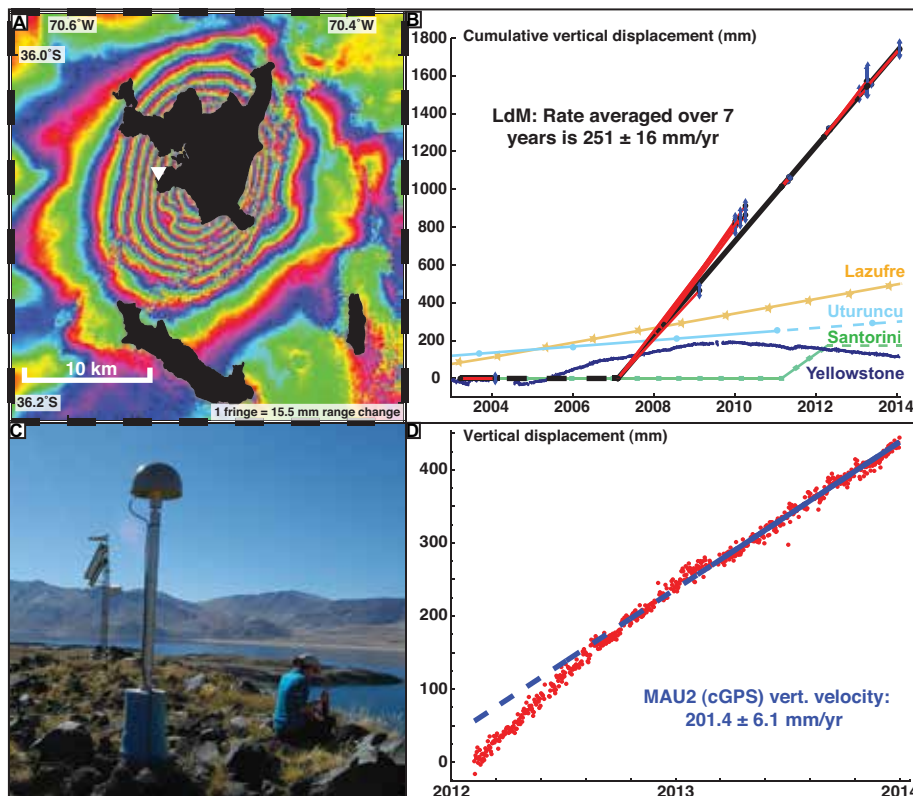


Figure 3. (A) InSAR interferogram spanning 14 Apr. 2013 to 25 Jan. 2014. One fringe denotes 15.5 mm of range change between satellite and ground. (B) Time series of vertical uplift calculated from InSAR models using ENVISAT, ALOS, and TerraSAR-X data between 2003 and 2014 (Feigl et al., 2014 [up to 2012]). Yellowstone cGPS data are shown for comparison at station WLMY (Chang et al., 2010). Other curves are estimated from GPS and InSAR results at Lazufre and Uturuncu (Pearse and Lundgren, 2013; Henderson and Pritchard, 2013) and Santorini (Newman et al., 2012; Parks et al., 2012). Dashed lines extrapolated based on personal communication with these authors. (C) View east from the MAU2 cGPS station and the most rapidly deforming area on the west side of Laguna del Maule (photo by L. Cordova, March 2012). (D) Time series between 2012 and 2014 of relative vertical displacement for cGPS station MAU2 with respect to South America and the best-fitting velocity (blue line).

zircon residence and assembly of the system over as much as 40 k.y. (Fig. 2H).

### Geodetic and Geophysical Evidence of Current Processes, Unrest, and System Structure

The Laguna del Maule volcanic field is currently deforming at an exceptionally high rate. Using interferometric analysis of synthetic aperture radar (InSAR) data, Fournier et al. (2010) found the rate of surface deformation to be negligible from January 2003 to February 2004, but that inflation accelerated rapidly between 2004 and 2007. Using InSAR data acquired between 2007 and 2012, Feigl et al. (2014) found uplift rates exceeding 280 mm/yr (Fig. 3). Feigl et al. (2014) modeled the source as a  $9.0 \times 5.3$  km inflating sill at a depth of 5.2 km, assuming a rectangular dislocation in a half space with uniform elastic properties. From January 2004 to April 2012, the total increase in volume was  $0.15 \text{ km}^3$ . The high rate of deformation is confirmed by continuous Global Positioning System (cGPS) measurements at five OVDAS stations between 2012 and 2014 (Fig. 3) (Le Mével et al., 2013; Feigl et al., 2014). During this ongoing episode of unrest, the rate of deformation at Laguna del Maule has been among the highest ever measured at a volcano that is not actively erupting. For example, the remarkable inflation episodes at Yellowstone (Chang et al., 2010) and Santorini (Newman et al., 2012) calderas occurred at rates 2–5 times slower than at Laguna del Maule (Fig. 3). Uplift at Uturuncu volcano, in the Central Andes above the vast and deep Altiplano Puna magma body, is an order of magnitude slower than at Laguna del Maule (Henderson and Pritchard, 2013; del Potro et al., 2013). The inferred rate of magma intrusion at Laguna del Maule of  $0.03 \text{ km}^3/\text{kyr}$  is twice that at Santorini (Parks et al., 2012).

The electrical resistivity of crustal rocks is sensitive to temperature, fluid content, and the degree of hydrothermal alteration (Unsworth and Rondenay, 2013). The resistivity structure around Laguna del Maule was investigated with commercial magnetotelluric (MT) surveys commissioned for geothermal exploration by Alterra Power in 2009–2011. A subset of these MT data have been used to create both 2-D and 3-D inversion models. The 3-D inversion used the algorithm of Siripunvaraporn et al. (2005), and a representative model is shown in Figure 4. It shows a zone of low resistivity under the western half of Laguna del Maule at a depth of  $\sim 5$  km below the surface. This feature likely represents a magma body and an associated hydrothermal system (Fig. 4). The resistivity values of this feature are consistent with a zone of 10%–20% rhyolitic melt with the water and  $\text{Na}_2\text{O}$  concentrations determined from the recently erupted rhyolites (Pommier and Le Trong, 2011) (Fig. 2). The location agrees very well with the inflation source inferred from the geodetic data (Fig. 3).

In the area of maximum uplift along the southwestern shores of Laguna del Maule, 30-m-thick outcrops of Late Pleistocene diatomaceous lacustrine sediments are weakly tilted, cut by numerous normal faults with centimeters of offset, and may reflect long-term uplift over decades (Hildreth et al., 2010; Andersen et al., 2013). These observations are consistent with the radial pattern of deformation observed geodetically.

Of 223 located earthquakes in the vicinity of Laguna del Maule recorded by the five OVDAS seismometers between April 2011 and January 2014, 154 (69%) are shallower than 5 km, and 91% of these had a local magnitude  $\leq 2$ , with most occurring beneath the recent Nieblas (*rln*) and Barrancas (*rcb*) rhyolite vents, along the periphery of the uplifting region (Fig. 5). Both



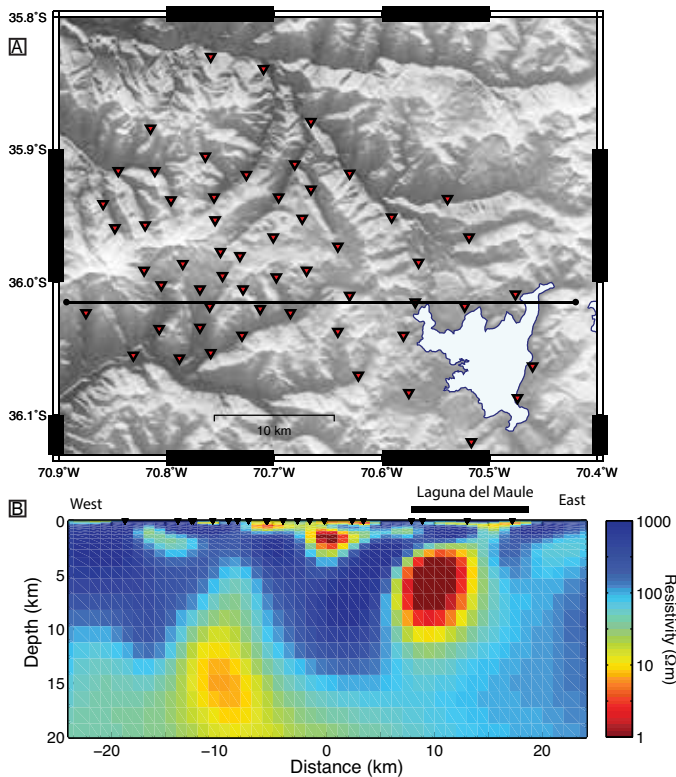


Figure 4. (A) Locations of 56 broadband magnetotelluric (MT) stations measured during a geothermal study by Alterra Power. (B) An east-west slice of a 3-D electrical resistivity model obtained by inversion of these MT data. Location of slice shown in (A). MT data were inverted in frequency band 100–0.01 Hz and have a statistically acceptable root-mean-square fit of 1.8.

short-period volcano-tectonic (VT) and long-period earthquakes are concentrated in these zones. On 11–12 January 2013 OVDAS recorded a swarm of 240 VT earthquakes of  $M \leq 1.3$  located ~9 km SW of the lake at depths shallower than 5 km (Fig. 5). This earthquake swarm may have resulted from pressurization of fluids and faults distal to an intruding body of magma (e.g., Manga and Brodsky, 2006).

To evaluate the mass changes at depth—and constrain the contribution of fluids and/or magma to the uplift signal—we are also conducting a dynamic gravity study in order to evaluate temporal changes. Using three gravimeters, a network of 37 stations (Fig. 1B) was installed in April 2013 and re-occupied in January 2014. Preliminary results suggest widespread positive residual gravity changes ( $>30 \mu\text{Gal}$ ) throughout the lake basin during the ten months between occupations. A  $-10 \text{ mGal}$  gravity low exists along the western margin of the lake, as delineated by the reconnaissance study of Honores (2013). Our dynamic gravity network will also expand this Bouguer survey to help delineate the magma body below the lake.

#### CURRENT HYPOTHESES, CONCLUSIONS, AND FUTURE WORK

The “magmatic mush” model of Hildreth (2004) and Hildreth and Wilson (2007) was developed to explain volcanological, petrological, and structural observations of the Long Valley magma system from which the compositionally and thermally

zoned crystal-poor rhyolite of the  $650 \text{ km}^3$  Bishop Tuff erupted at 767 ka. In this model, the magma system comprises a relatively thin boundary layer of granitoid that solidified against the country rocks, inboard of which is a rigid “sponge” of mainly crystals with minor interstitial melt. Within this rigid zone is an extensive reservoir of crystal-rich mush that is maintained in a partially molten state via fluxing of heat and mafic magma through the basal parts of the crustal reservoir. The amalgamation of melt-rich lenses near the roof creates a low-density barrier that blocks the ascent of mafic magma to the surface (Hildreth, 2004). The crystal-poor, melt-dominated zone near the roof of such a system is a magma chamber that may be tapped to feed rhyolitic eruptions.

Our observations—including the basin-wide, temporally correlated, chemical evolution; the distribution of silicic vents ringing the lake basin during the past 25 k.y. (Fig. 1B); the juxtaposition of peripheral mafic and bimodal eruptions with the central ring of rhyolites that are devoid of mafic inclusions; the high rate of surface deformation; MT evidence of a large body of fluid at a depth of 5 km; the concentration of shallow earthquakes; zircon phenocrysts that record ~40 k.y. of magma residence; and changes in gravity—collectively support the working hypothesis in Figure 6. We propose that the silicic vents have tapped crystal-poor, rhyolitic melt that segregated from an extensive crystal-rich mush zone that had become established beneath much of the basin by ca. 20 ka, as indicated by eruption of units *rle*, *rap*, *rdac*, and *ras* (Fig. 1B). Crystal-poor melt later fueled the Holocene rhyolite eruption of units *rsl*, *rcl*, *rcl*, *rng*, *rcb*, and *rln*. What remains unclear is whether a crystal-poor rhyolitic melt layer that intercepts mafic recharge magma at deep levels currently caps the entire magmatic system or, alternatively, if the current unrest reflects a singular intrusive event rebuilding toward such a configuration.

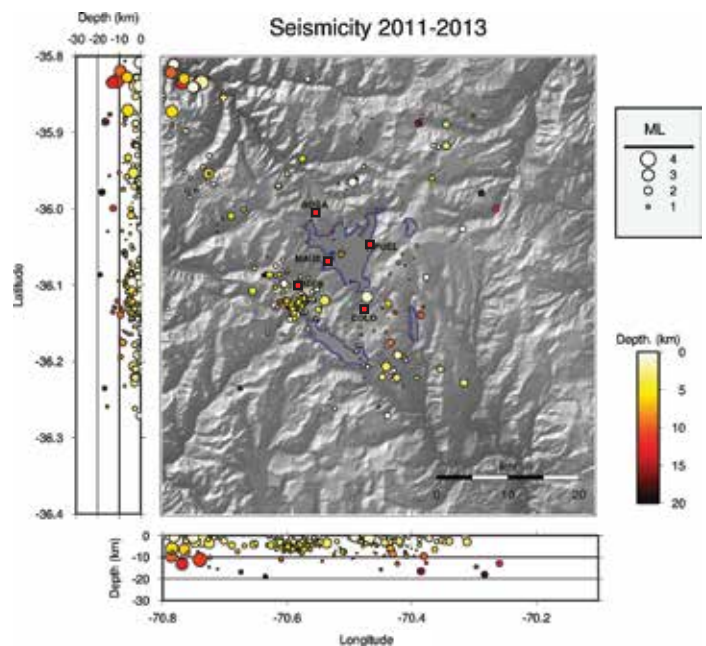


Figure 5. Located earthquakes recorded by OVDAS network of five seismic stations (red squares: BOBA, COLO, MAU2, NIEB, and PUEL) from April 2011 to January 2014.



The model of Jellinek and DePaolo (2003) relates magma supply, wallrock viscosity, and the volume of eruptible magma in a chamber. For the Laguna del Maule system, we estimate a recurrence interval of one dike-fed eruption every ~1000 years to generate the 24 silicic vents and take this as the elastic pressurization time  $t_e$ . Constraints on the long-term magma supply rate,  $Q$ , are as follows: The minimum value of  $Q$  of  $0.0005 \text{ km}^3/\text{yr}$  assumes an eruptive volume of  $13 \text{ km}^3$  of silicic magma over the past 25 k.y. that includes an estimate of tephra volume equal to that of the lavas (Fierstein et al., 2013). The maximum value of  $Q$  of  $0.03 \text{ km}^3/\text{yr}$  is based on the model of an inflating sill needed to drive the ongoing deformation by Feigl et al. (2014). These parameters suggest that the magma body (melt + mush) supplying rhyolite into dikes that have erupted has a volume of at least  $100 \text{ km}^3$  and more likely several hundred cubic kilometers (see figure 6 in Jellinek and DePaolo, 2003). As the magma body takes on a flattened, disc-shaped form via lateral spreading, hoop stresses concentrate at the intrusion's edges, allowing dikes to form around its periphery—consistent with the spatial distribution of vents at Laguna del Maule (Jellinek and DePaolo, 2003).

Testing the hypothesis outlined in Figure 6 using a variety of geophysical, geochemical, and computational approaches is now an important goal of our team, and it is highlighted at <http://geoscience.wisc.edu/rhyolitic/>. For example, using an array of temporary seismometers to augment the OVDAS network, passive source seismology can provide both (a) a synoptic image of the seismic structure of the crust, and (b) evidence for temporal change in the magmatic system. The electrical resistivity survey by Alterra Power was planned to image the geothermal system northwest of Laguna del Maule. These data clearly detect the low resistivity body beneath the lake (Fig. 4) that is likely an accumulation of melt. However, the station spacing is insufficient to define the geometry of this magma body. A dense array of MT stations within the basin would allow the 3-D geometry of the magma body to be better defined and give more robust estimates of the resistivity that can lead to improved constraints on the quantity and composition of magma. Similarly, as station density is increased, further changes in the gravity field may be detected at a spatial resolution that can resolve fluid/magma pathways, the geometry of the magma reservoir, and whether the source responsible for the uplift is intruding magma or lower density hydrothermal fluid. Continuing the InSAR and GPS measurements will ensure that changes in seismicity or the gravity field are measured coevally with the deformation. Studies of trace element zoning in phenocrysts in the rhyolites are under way, in parallel with expanded  $^{230}\text{Th}/^{238}\text{U}$  dating of zircons, to constrain the number, extent, and timing of mixing events between mafic and silicic magmas, and the longevity of the silicic reservoir. Quantifying the flux and isotopic composition of diffuse  $\text{CO}_2$  would help gauge the addition of any basaltic magma. Mapping of fault displacements in the uplifted lacustrine sediments may help quantify long-term deformation rates. These sets of geophysical and geochemical observations will be used in numerical models at a variety of scales, including micro- and meso-scale magma chamber simulations linked directly to a macro-scale finite element model of crustal deformation. The aim is to create a unified model of magmatic system dynamics using Laguna del Maule as the example.

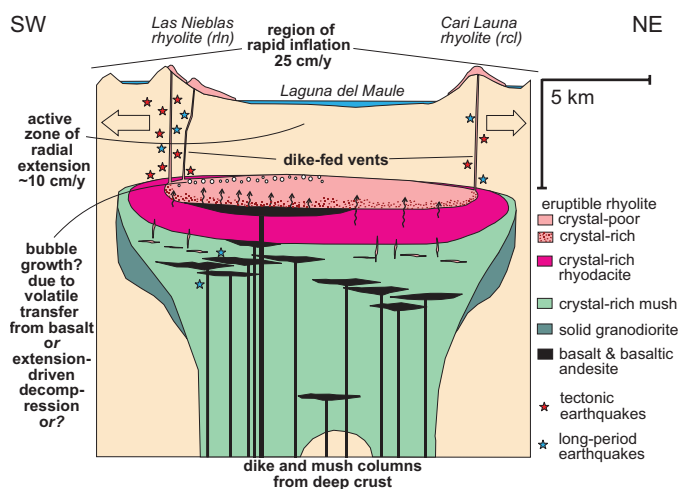


Figure 6. Hypothesized magmatic system feeding the crystal-poor rhyolitic eruptions encircling Laguna del Maule (adapted from Hildreth, 2004). Section is SW-NE along bent line in Figure 1B. Observations support inferences shown here, including: (1) rapid uplift, (2) shallow earthquakes, (3) active intrusion of mafic magma at 5 km depth, and (4) normal faulting and geodetic data that record extension.

## ACKNOWLEDGMENTS

Hildreth and Fierstein were supported by the U.S. Geological Survey and Servicio Nacional de Geología y Minería of Chile, leading to the map on which Fig. 1B is based and the eruptive history in Boletín 63. Support includes NSF RAPID grant EAR-1322595, NASA grant NNX12AO37G, a student research grant from the Geological Society of America, and Canadian NSERC Discovery and Mitacs-Accelerate grants. The 3-D MT inversion was performed on the high performance cluster developed by Compute Canada/Westgrid using an algorithm provided by Weerachai Siripunvaraporn. We thank Catherine Hickson and Alterra Power for sharing MT data. The “Alcalde del Mar,” don Luis Torres, is thanked for hospitality and assistance in safely navigating the windswept Laguna. We are grateful for assistance from Neal Lord, Tor Stetson-Lee, Erin Birsic, Nico Garibaldi, Meagan Ankney, Brian Beard, Clark Johnson, and Marsha Lidzbarski. Comments by Calvin Miller and two anonymous reviewers improved the manuscript.

## REFERENCES CITED

- Andersen, N.L., Singer, B.S., Jicha, B.R., Fierstein, J., and Vazquez, J.A., 2013, The development of a restless rhyolite magma chamber at Laguna del Maule, Chile: American Geophysical Union Fall Meeting abstract V51C-2676.
- Bachmann, O., and Bergantz, G.W., 2008, Rhyolites and their source mushes across tectonic settings: *Journal of Petrology*, v. 49, p. 2277–2285, doi: 10.1093/petrology/egn068.
- Battaglia, M., Segall, P., and Roberts, C., 2003, The mechanics of unrest at Long Valley Caldera, California. 2. Constraining the nature of the source using geodetic and micro-gravity data: *Journal of Volcanology and Geothermal Research*, v. 127, no. 3–4, p. 219–245, doi: 10.1016/S0377-0273(03)00171-9.
- Chang, W.L., Smith, R.B., Farrell, J., and Puskas, C.M., 2010, An extraordinary episode of Yellowstone caldera uplift, 2004–2010, from GPS and InSAR observations: *Geophysical Research Letters*, v. 37, L23302, doi: 10.1029/2010GL045451.
- Charlier, B.L.A., Wilson, C.J.N., Lowenstern, J.B., Blake, S., Van Calsteren, P.W., and Davidson, J.P., 2004, Magma generation at a large, hyperactive silicic volcano (Taupo, New Zealand) revealed by U-Th and U-Pb systematics in zircons: *Journal of Petrology*, v. 46, p. 3–32, doi: 10.1093/petrology/egh060.
- Cooper, K.M., and Reid, M.R., 2008, Uranium-series crystal ages: *Reviews in Mineralogy and Geochemistry*, v. 69, p. 479–544, doi: 10.2138/rmg.2008.69.13.

- Costa, F., 2008, Residence times of silicic magmas associated with calderas: *Developments in Volcanology*, v. 10, p. 1–55, doi: 10.1016/S1871-644X(07)00001-0.
- del Potro, R., Diez, M., Blundy, J., Gottsmann, J., and Camacho, A., 2013, Diapiric ascent of silicic magma beneath the Bolivian Altiplano: *Geophysical Research Letters*, v. 40, p. 2044–2048, doi: 10.1002/grl.50493.
- Farrell, J., Smith, R.B., Husen, S., and Diehl, T., 2014, Tomography from twenty-six years of seismicity reveals the spatial extent of the Yellowstone crustal magma reservoir extends well beyond the Yellowstone caldera: *Geophysical Research Letters*, v. 41, doi: 10.1002/2014GL059588.
- Feigl, K.L., Le Mével, H., Ali, S.T., Cordova, L., Andersen, N.L., DeMets, C., and Singer, B.S., 2014, Rapid uplift in Laguna del Maule volcanic field of the Andean Southern Volcanic Zone (Chile) 2007–2012: *Geophysical Journal International*, v. 196, p. 885–901, doi: 10.1093/gji/ggt438.
- Ferry, J.M., and Watson, E.B., 2007, New thermodynamic models and revised calibrations for the Ti-in-zircon and Zr-in-rutile thermometers: *Contributions to Mineralogy and Petrology*, v. 154, p. 429–437, doi: 10.1007/s00410-007-0201-0.
- Fierstein, J., Sruoga, P., Amigo, A., Elissondo, M., and Rosas, M., 2013, Tephra in Argentina establishes postglacial eruptive history of Laguna del Maule volcanic field in Chile: IAVCEI 2013 Scientific Assembly abstract 3A2\_3F-O11, 23 July.
- Fournier, T.J., Pritchard, M.E., and Riddick, S.N., 2010, Duration, magnitude, and frequency of subaerial volcano deformation events: New results from Latin America using InSAR and global synthesis: *Geochemistry Geophysics Geosystems*, v. 11, doi: 10.1029/2009GC002558.
- Ghiorso, M.S., and Evans, B.W., 2008, Thermodynamics of rhombohedral solid solutions and a revision of the Fe-Ti two-oxide geothermometer and oxygen-barometer: *American Journal of Science*, v. 308, p. 957–1039, doi: 10.2475/09.2008.01.
- Henderson, S.T., and Pritchard, M.E., 2013, Decadal volcanic deformation of the Central Andes Volcanic Zone revealed by InSAR time series: *Geochemistry Geophysics Geosystems*, v. 14, p. 1358–1374, doi: 10.1002/ggge.20074.
- Hildreth, W., 2004, Volcanological perspectives on Long Valley, Mammoth Mountain, and Mono Craters: Several contiguous but discrete systems: *Journal of Volcanology and Geothermal Research*, v. 136, p. 169–198, doi: 10.1016/j.jvolgeores.2004.05.019.
- Hildreth, W., and Wilson, C.J.N., 2007, Compositional zoning of the Bishop Tuff: *Journal of Petrology*, v. 48, p. 951–999, doi: 10.1093/petrology/egm007.
- Hildreth, W., Godoy, E., Fierstein, J., and Singer, B., 2010, Laguna del Maule Volcanic Field: Eruptive history of a Quaternary basalt-rhyolite distributed vent volcanic field on the Andean range crest in central Chile: Santiago, Chile, Servicio Nacional de Geología y Minería, Boletín v. 63, 145 p.
- Honores, C.C., 2013, Estudio del la deformación de la caldera Laguna del Maule [M.Sc. thesis]: Universidad de Chile, Santiago, Chile, Facultad de Ciencias Físicas y Matemáticas, Departamento de Geofísica, 79 p.
- Jellinek, A.M., and DePaolo, D.J., 2003, A model for the origin of large silicic magma chambers: Precursors of caldera-forming eruptions: *Bulletin of Volcanology*, v. 65, p. 363–381, doi: 10.1007/s00445-003-0277-y.
- Le Mével, H., Cordova, L., Ali, S.T., Feigl, K.L., DeMets, C., Williams-Jones, G., Tikoff, B., and Singer, B.S., 2013, Unrest within a large rhyolitic magma system at Laguna del Maule volcanic field (Chile) from 2007 through 2013: Geodetic measurements and numerical models: AGU Fall Meeting Abstracts, v. 1, p. 2728.
- Lowenstern, J.B., Smith, R.B., and Hill, D.P., 2006, Monitoring super-volcanoes: Geophysical and geochemical signals at Yellowstone and other large caldera systems: *Philosophical Transactions of the Royal Society of London Series A-Mathematical Physical and Engineering Sciences*, v. 364, p. 2055–2072.
- Manga, M., and Brodsky, E., 2006, Seismic triggering of eruptions in the far field: Volcanoes and geysers: *Annual Review of Earth and Planetary Sciences*, v. 34, p. 263–291, doi: 10.1146/annurev.earth.34.031405.125125.
- Newman, A.V., Stiros, S., Feng, L.J., Psimoulis, P., Moschas, F., Saltogianni, V., Jiang, Y., Papazchos, C., Panagiotopoulos, D., Karagianni, E., and Vamcakaris, D., 2012, Recent geodetic unrest at Santorini Caldera, Greece: *Geophysical Research Letters*, v. 39, doi: 10.1029/2012GL051286.
- Parks, M.M., Biggs, J., England, P., Mather, T.A., Nomikou, P., Palamartchouk, K., Papanikoalaou, X., Paradissis, D., Parsons, B., Pyle, D.M., Raptakis, C., and Zacharis, V., 2012, Evolution of Santorini volcano dominated by episodic and rapid fluxes of melt from depth: *Nature Geoscience*, v. 5, p. 749–754, doi: 10.1038/ngeo1562.
- Pearse, J., and Lundgren, P., 2013, Source model of deformation at Lazufre volcanic center, central Andes, constrained by InSAR time series: *Geophysical Research Letters*, v. 40, p. 1059–1064, doi: 10.1002/grl.50276.
- Pommier, A., and Le Trong, E., 2011, SIGMELTS: A web portal for electrical conductivity calculations in geosciences: *Computers & Geosciences*, v. 37, p. 1450–1459, doi: 10.1016/j.cageo.2011.01.002.
- Reid, M.R., 2008, How long does it take to supersize an eruption?: *Elements*, v. 4, p. 23–28, doi: 10.2113/GSELEMENTS.4.1.23.
- Romero, A.E., McEvilly, T.V., Majer, E.L., and Michelini, A., 1993, Velocity structure of the Long Valley caldera from the inversion of local earthquake P-travel and S-travel times: *Journal of Geophysical Research*, v. 98, p. 19,869–19,879, doi: 10.1029/93JB01553.
- Self, S., 2006, The effects and consequences of very large explosive volcanic eruptions: *Philosophical Transactions of the Royal Society of London. Series A, Mathematical and Physical Sciences*, v. 364, p. 2073–2097.
- Self, S., and Blake, S., 2008, Consequences of explosive supereruptions: *Elements*, v. 4, p. 41–46, doi: 10.2113/GSELEMENTS.4.1.41.
- Simon, J.I., Renne, P.R., and Mundil, R., 2008, Implications of pre-eruptive magmatic histories of zircons for U-Pb geochronology of silicic extrusions: *Earth and Planetary Science Letters*, v. 266, p. 182–194, doi: 10.1016/j.epsl.2007.11.014.
- Singer, B., Hildreth, W., and Vinze, Y., 2000, <sup>40</sup>Ar/<sup>39</sup>Ar evidence for early deglaciation of the central Chilean Andes: *Geophysical Research Letters*, v. 27, p. 1663–1666, doi: 10.1029/1999GL011065.
- Siripunvaraporn, W., Egbert, G.D., Lenbury, Y., and Uyeshima, M., 2005, Three-dimensional magnetotelluric inversion: Data subspace method: *Physics of the Earth and Planetary Interiors*, v. 150, p. 3–14, doi: 10.1016/j.pepi.2004.08.023.
- Sparks, S.J., Self, S., Grattan, J., Oppenheimer, C., Pyle, D., and Rymer, H., 2005, Super-eruptions: Global effects and future threats: Report of a Geological Society of London Working Group: London, The Geological Society, 24 p.
- Steck, L.K., Thurber, C.H., Fehler, M.C., Lutter, W.J., Roberts, P.M., Baldrige, W.S., Stafford, D.G., and Sessions, R., 1998, Crust and upper mantle P wave velocity structure beneath Valles caldera, New Mexico: Results from the Jemez teleseismic tomography experiment: *Journal of Geophysical Research—Solid Earth*, v. 103, p. 24,301–24,320, doi: 10.1029/98JB00750.
- Tizzani, P., Battaglia, M., Zeni, G., Atzori, S., Bernardino, P., and Lanari, R., 2009, Uplift and magma intrusion at Long Valley Caldera from InSAR and gravity measurements: *Geology*, v. 37, p. 63–66, doi: 10.1130/G25318A.1.
- Unsworth, M.J., and Rondenay, S., 2013, Mapping the distribution of fluids in the crust and lithospheric mantle utilizing geophysical methods, *in* Harlov, D.E., and Austrheim, H., eds., *Metasomatism and the Chemical Transformation of Rock: The Role of Fluids in Crustal and Upper Mantle Processes Series, Lecture Notes in Earth System Sciences*, Berlin, Springer-Verlag, p. 535–598, doi: 10.1007/978-3-642-28394-9\_13.
- Wilson, C.J.N., 2008, Supereruptions and supervolcanoes: Processes and products: *Elements*, v. 4, p. 29–34, doi: 10.2113/GSELEMENTS.4.1.29.
- Wilson, C.J.N., Blake, S., Charlier, B.L.A., and Sutton, A.N., 2005, The 26.5 ka Oruanui Eruption, Taupo Volcano, New Zealand: Development, characteristics, and evacuation of a large rhyolitic magma body: *Journal of Petrology*, v. 47, p. 35–69, doi: 10.1093/petrology/egi066.
- Wotzlaw, J.-F., Schaltegger, U., Frick, D.A., Dungan, M.A., Gerdes, A., and Gunther, D., 2013, Tracking the evolution of large-volume silicic magma reservoirs from assembly to supereruption: *Geology*, v. 41, p. 867–870, doi: 10.1130/G34366.1.

Manuscript received 12 Mar. 2014; accepted 5 June 2014. ✱



 AMERICAN MUSEUM OF NATURAL HISTORY  
**MASTER OF ARTS IN TEACHING PROGRAM**



## Change lives. Teach science.

Learn to teach Earth and Space science with the American Museum of Natural History in New York City!

- Apply for a FULLY PAID fellowship in a program that prepares you to teach Earth science in middle and high schools in New York City and New York State.
- Learn to teach in museum and school settings with the support of teacher education faculty and experienced residency school mentors.
- Benefit from the Museum's world-class collections and laboratories as you study and conduct research with renowned scientists.
- Share your passion for science and learning by teaching in high-needs schools after graduation with continued professional and financial support.

The Master of Arts in Teaching Urban Residency Program at the American Museum of Natural History in New York City invites you to change lives and make a difference by teaching science! We are seeking students from diverse life and career experiences, including recent college graduates, veterans, volunteer corp participants, and career changers. Apply now online to start your new life inspiring the next generation of scientists.

Join us for an informational webinar or open house at the Museum! Details at [amnh.org/mat](http://amnh.org/mat)

With deepest appreciation, the Museum acknowledges Kathryn W. Davis for her generous founding support.



The MAT program is also supported by the New York State Education Department and by the National Science Foundation under Grant numbers DRL-119444 and DUE-1340006.

Additional support has been provided by the Booth Ferris Foundation.

[amnh.org/mat](http://amnh.org/mat) | [mat@amnh.org](mailto:mat@amnh.org) | (212) 313-7464 | [@amnh](https://twitter.com/amnh) | [facebook.com/amnhmat](https://facebook.com/amnhmat)



John (Jack) W. Hess  
GSA Executive Director

Thank You  
for Allowing Me to be  
Your Executive Director  
for the Past 13 Years

Fellow GSA members and friends, it was with mixed emotions that I submitted my resignation to President Hap McSween on 1 July 2014. My last day will be Friday, 2 Jan. 2015. It is time for change, for me and the Society. I have served as your Executive Director for 13 exciting and sometimes challenging years. As I looked back over the years, the Society has accomplished a lot by all of us working together. We righted the ship financially, opened a Geoscience Policy office in Washington, D.C., increased our global engagement, enhanced our education and outreach activities, grew the number of presented abstracts at our Annual Meetings, strengthened our commitment to inclusion and diversity in our profession, launched two new journals, jumped into social media with both feet, made GSA and GSA Foundation a fully functioning team, and started down the path to changing the Society's publishing model to Gold Open Access.

Taking on the GSA Executive Director position after 27 years with the Desert Research Institute in Nevada was a life changing experience. I leave the GSA Executive Director position after 13 years of learning the association world, more fully engaging in public policy, and spending countless hours of travel domestically and internationally to raise the visibility of GSA and its wonderful programs, and to build strong relationships around the globe. It has been an experience that I would not trade for anything.

The Society has grown in many ways during my time as Executive Director. Membership has increased 55% to 26,400, the number of Divisions has grown from 13 to 18, Interdisciplinary Interest Groups have been created, and the number of Associated Societies has increased from 27 to 70, with several more pending. We have done this while slowly growing the GSA budget and staff in a way that has enabled GSA to weather the economic downturn and slow recovery over the past six years.

As I write this letter, a search is under way for my replacement. The hope is to have someone named by the end of December and on board shortly after the first of the year.

I am planning to build upon my commitment to GSA by soon occupying a different chair. On 26 Jan. 2015, after a three-week vacation, I will begin serving as the GSA Foundation President (part-time). Thus, I will continue to engage in GSA leadership, meetings, and other programs, plus continue to interact with all of you in a different role of working to increase the funds that the Foundation provides to the Society for its many varied programs.

I wish all of you and GSA the very best in the future. GSA and the GSA Foundation are embarking on an exciting experiment with a change in GSA's publishing paradigm. We will all look back at this time in GSA's history as a significant turning point for the Society.

Thank you for all that you have done and will do to support the Society and the Foundation.

**Jack Hess**, GSA Executive Director, December 2014

A handwritten signature in black ink, appearing to read "Jack Hess". The signature is fluid and cursive, written in a professional style.





# Upcoming Award, Recognition & Grant Deadlines



For details on the following awards and grants, see the October *GSA Today* or go to [www.geosociety.org/awards/nominations.htm](http://www.geosociety.org/awards/nominations.htm). Information and nomination forms can also be obtained from GSA Grants and Awards, P.O. Box 9140, 3300 Penrose Place, Boulder, CO 80301-9140, USA, +1-303-357-1028, [awards@geosociety.org](mailto:awards@geosociety.org).

## 2015 GSA Medals and Awards

- Penrose Medal
- Day Medal
- Young Scientist Award (Donath Medal)
- GSA Public Service Award
- Bromery Award for Minorities
- GSA Distinguished Service Award
- Doris M. Curtis Outstanding Woman in Science Award
- Geologic Mapping Award
- Honorary Fellow

**Nomination deadline:** 1 Feb. 2015.

## GSA Fellowship

Elevation to GSA Fellowship is an honor bestowed on the best of our profession at each spring GSA Council meeting. **GSA Fellows** may support two nominees each year but only **one** as a primary nominator, and **GSA members** who are not Fellows may be secondary nominators for up to **two** nominees.

**Nomination deadline:** 1 Feb. 2015.

## AGI Medal in Memory of Ian Campbell

The AGI Medal in Memory of Ian Campbell recognizes singular performance in and contribution to the profession of geology. To submit a nomination, go to [www.agiweb.org/direct/awards.html](http://www.agiweb.org/direct/awards.html).

**Nomination deadline:** 1 Feb. 2015.

## AGI Marcus Milling Legendary Geoscientist Medal

The Marcus Milling Legendary Geoscientist Medal is given to a recipient with consistent contributions of high-quality scientific achievements and service to the Earth sciences having lasting, historic value; who has been recognized for accomplishments in field(s) of expertise by professional societies, universities, or other organizations; and is a senior scientist nearing completion or has completed full-time regular employment. To submit a nomination, go to [www.agiweb.org/direct/awards.html](http://www.agiweb.org/direct/awards.html).

**Nomination deadline:** 1 Feb. 2015.

## 2015 National Awards

- **William T. Pecora Award:** <http://remotesensing.usgs.gov/pecora.php>.
- **National Medal of Science:** [www.nsf.gov/od/nms/medal.jsp](http://www.nsf.gov/od/nms/medal.jsp).
- **Vannevar Bush Award:** [www.nsf.gov/nsb/awards/bush.jsp](http://www.nsf.gov/nsb/awards/bush.jsp).
- **Alan T. Waterman Award:** [www.nsf.gov/od/waterman/waterman.jsp](http://www.nsf.gov/od/waterman/waterman.jsp).
- **G.K. Warren Prize:** [www.nasonline.org/site/PageServer?pagename=AWARDS\\_warren](http://www.nasonline.org/site/PageServer?pagename=AWARDS_warren).

**Nomination deadlines** vary.

## John C. Frye Environmental Geology Award

In cooperation with the Association of American State Geologists and supported by endowment income from the GSA Foundation's John C. Frye Memorial Fund, GSA makes an annual award for the best paper on environmental geology published either by GSA or by a state geological survey.

**Nomination deadline:** 31 March 2015.

## 2015 Student Research Grants

Applications will be accepted online only beginning early December. Paper applications or letters will not be accepted.

**Submission deadline:** 2 Feb. 2015 at 5 p.m. (MST) to [www.geosociety.org/grants/gradgrants.htm](http://www.geosociety.org/grants/gradgrants.htm).

## 2015 Post-Doctoral Research Awards

The following post-doc research awards are available. Learn more at [www.geosociety.org/grants/postdoc.htm](http://www.geosociety.org/grants/postdoc.htm).

**Application deadline:** 1 Feb. 2015.

- The **Gladys W. Cole Memorial Research Award** for research on the geomorphology of semiarid and arid terrains in the United States and Mexico is awarded annually to a GSA member or Fellow between 30 and 65 years of age who has published one or more significant papers on geomorphology.
- The **W. Storrs Cole Memorial Research Award** for research on invertebrate micropaleontology is awarded annually to a GSA member or Fellow between 30 and 65 years of age who has published one or more significant papers on micropaleontology.

# Writing a Successful GSA Grant Proposal

Each year, GSA funds approximately half of the proposed graduate student research grants it receives. In addition to providing our graduate student members with the means to complete their research, this program gives them an introduction to the all-important skill of proposal writing. Here, we provide some suggestions to help the next generation of scientists develop this skill. To augment this piece, consult resources at [www.geosociety.org/grants/ap\\_tips.htm](http://www.geosociety.org/grants/ap_tips.htm), and look for our workshop at next year's GSA Annual Meeting.

As with all grant proposals, GSA has rules that you need to read and follow if you hope to get funded. Before you begin writing, read the policies and procedures at [www.geosociety.org/grants/gradgrants.htm](http://www.geosociety.org/grants/gradgrants.htm). Note the deadline—NO LATE SUBMISSIONS! Also note the eligibility requirements and what items are permitted in your budget.

Your proposal will be evaluated on six factors: how well you address each of the four sections, your figure, and the overall writing in your proposal. The four sections ask you to:

1. Present the problem, hypotheses, and overall project objectives;
2. Discuss the scientific and, if appropriate, societal importance of your project;
3. State your research plan and how it will test your hypotheses; and
4. Provide an itemized budget with detailed justification for each item.

The core task of your proposal is to identify a real scientific question or problem, develop hypotheses, convince the reviewers that it is an important problem worthy of funding, that you have a plan for testing your hypotheses, and that you have carefully identified the costs involved in conducting your study. The vast majority of funded studies follow the scientific method (i.e., problem identification, propose hypotheses, develop/conduct tests, and evaluate hypotheses based on results). A subordinate number involve discrete solutions to a problem (e.g., probability of an area/facility being inundated by lava as part of a volcanic hazard assessment). In either case you must clearly relate why and to whom the results of your study will be important. The best proposals focus on a scientific problem rather than starting with a specific field area. The motivation for your study cannot simply be “because nobody has studied this before.”

Your research plan must describe in detail the steps you will take to address your question. A common mistake here is the lack of connection between problem/hypotheses from the first two sections and the tasks proposed in this section. Because your

planned study should test a hypothesis, state clearly how your proposed research will accomplish this task. This can be as simple as “Since the goal of this study is to determine if this fault was active during the Sevier Orogeny or Miocene extension, I will determine U/Pb zircon ages of intrusions emplaced concomitant with slip on the fault.”

Show that your work plan is carefully thought out, with methods that are necessary and sufficient to address the problem. Provide specific details: If you are mapping, what features, where, and at what scale? If collecting or analyzing samples, what, how many, with what methods or equipment? The scope of work must also be reasonable for the time frame you propose.

In many proposals, the budget section is treated as an afterthought. Nothing could be further from the truth; one of the easiest means of being denied funding is to include disallowed items in your budget. Your budget should be as explicit and realistic as possible. Determine the actual costs in detail (e.g., sample analysis, campsite and vehicle rentals, airfare, and baggage fees) and provide them on a per-sample/day/night/mile basis. Justify every item listed in the budget.

Perhaps the most important part of your proposal is your figure. This is your chance to present a figure that can explain what would require paragraphs of text. Location maps and photos of the fossil/mineral/etc. you are working on are great, but is it the best use of your figure? The strongest proposals tend to use multi-box figures illustrating the concepts to be tested in their studies. Design a figure specifically for your study. Be sure your graphics are clear, high resolution, and use text that is legible at a normal, full-page viewing scale. A well-written caption is also very helpful. Include legends and scale bars, and use colors and annotations that make the figure intuitive to understand.

Finally, take care with the proposal's language and writing style. Start paragraphs with strong topic sentences and keep the rest of the paragraph on topic. Avoid unnecessary technical jargon—the reviewers are professional earth scientists but may be outside of your study's discipline. Explain and minimize acronyms (three or fewer). Check and re-check grammar and spelling. Check the math in your budget. Cite the work of others properly (the reviewers might have published on your topic!), using the superscripted reference numbering system to save space. And make sure that you have addressed the topic of each section and connected them logically to each other (problem/hypotheses-importance-research plan-budget/justification).

Constructing a solid proposal not only improves your chance of receiving GSA funds, it also sets the stage for a successful research plan to generate interesting and useful results that the scientific community will want to see.

Good luck!

*Paul H. Wetmore and Amy Draut East, GSA Committee on Research Grants*



# 2015 Student Research Grants

**Submission deadline:** 2 February 2015 at 5 p.m. MST

GSA is proud to offer research grants to its highly qualified student members. The primary role of the GSA research grants program is to provide partial support of master's and doctoral thesis research in the geological sciences for graduate students enrolled in universities in the United States, Canada, Mexico, and Central America. In 2014, US\$683,535 was awarded to 401 graduate students (52% of the 774 who applied), with an average grant of US\$1,680.

Students may receive a total of two GSA graduate student grants in their entire academic career, regardless of what program they are currently enrolled in. The maximum award per grant is US\$2,500.

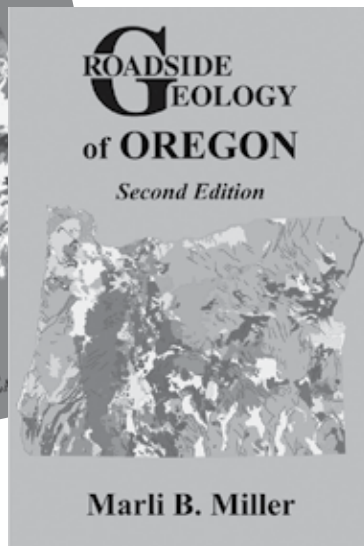
The GSA student research grant application process is available online only at [www.geosociety.org/grants/gradgrants.htm](http://www.geosociety.org/grants/gradgrants.htm); no paper applications or letters will be accepted.



**ExxonMobil**



For further information, call +1-303-357-1028, or e-mail [awards@geosociety.org](mailto:awards@geosociety.org).



## *New Color Editions of Two Classic Roadside Geologies*

### **ROADSIDE GEOLOGY OF ALASKA** *Second Edition*

CATHY CONNOR

Alaska, with the highest peak in North America, extensive glaciers, and breathtaking fjords, is a state full of superlatives. Discover how all these features developed in the new edition of our Alaska guide.

328 pages • 6x9 • full-color illustrations  
\$26.00, paper • Item #245

### **ROADSIDE GEOLOGY OF OREGON** *Second Edition*

MARLI B. MILLER

Oregon's list of geologic superstars is long: it includes Crater Lake, Mt. Hood, the Columbia River Gorge, and more. Learn about them all with this new edition of a classic Roadside guide.

400 pages • 6x9 • full-color illustrations  
\$26.00, paper • Item #246

**MP Mountain Press**  
PUBLISHING COMPANY

P.O. Box 2399 • Missoula, MT 59806 • 406-728-1900  
800-234-5308 • [info@mtnpublish.com](mailto:info@mtnpublish.com)  
[www.mountain-press.com](http://www.mountain-press.com)

## Preliminary Announcement and Call for Papers

# NORTH-CENTRAL SECTION

49th Annual Meeting of North-Central Section, GSA  
Madison, Wisconsin, USA  
19–20 May 2015

[www.geosociety.org/Sections/nc/2015mtg/](http://www.geosociety.org/Sections/nc/2015mtg/)



Monona Terrace Community and Convention Center.

## *From the Proterozoic to the Anthropocene: All the Right Stuff*

### LOCATION

The 49th annual meeting of GSA's North-Central Section will take place in the Frank Lloyd Wright–designed Monona Terrace Community and Convention Center in Madison, Wisconsin, USA. The meeting will feature technical sessions and field trips that highlight the geologic diversity of the region, from the Precambrian Baraboo Hills, to Paleozoic sedimentary rocks exposed in the nearby Driftless Area, to glacial features along the Ice Age Trail, to effects of recent human activities on Earth's water and mineral resources, and to new approaches to analysis of geoscience data and educating the next generation of geoscientists.

### REGISTRATION

Meeting registration will open in early February. The deadline for early registration is 13 April 2015.

### CALL FOR PAPERS

**Abstract deadline:** 17 Feb. 2015

Submit your abstract online at [www.geosociety.org/Sections/nc/2014mtg/techprog.htm](http://www.geosociety.org/Sections/nc/2014mtg/techprog.htm). Abstract submission fees: US\$10 for students; US\$15 for all others. If you cannot submit an abstract online, please contact Heather Clark, +1-303-357-1018, [hclark@geosociety.org](mailto:hclark@geosociety.org).

In addition to Theme Sessions, we are soliciting abstracts for general sessions in the following areas: geochemistry, economic geology, paleontology, geoarchaeology, geophysics and geodynamics, structural geology, limnogeology, Quaternary geology, sedimentology, and stratigraphy. Please direct questions on these sessions to the technical program co-chairs: Michael Cardiff, [cardiff@wisc.edu](mailto:cardiff@wisc.edu), and Eric Carson, [eric.carson@uwex.edu](mailto:eric.carson@uwex.edu).

### Theme Sessions

- T1. **Precambrian Geology of the Great Lakes Region.** Samuel R. Castonguay, Univ. of Wisconsin–Eau Claire, [castonsr@uwec.edu](mailto:castonsr@uwec.edu); Esther K. Stewart, Wisconsin Geological & Natural History Survey.
- T2. **Shortening, Shearing and Stretching the Midcontinent: Geologic and Geophysical Records of Proterozoic Tectonics.** Stephen Marshak, Univ. of Illinois at Urbana-Champaign, [smarshak@illinois.edu](mailto:smarshak@illinois.edu); Marcia Bjornerud, Lawrence Univ.; John P. Craddock, Macalester College; Dyanna M. Czeck, Univ. of Wisconsin–Milwaukee; Laurel B. Goodwin, Univ. of Wisconsin–Madison; L. Gordon Medaris Jr., Univ. of Wisconsin–Madison; Carol Ormand, SERC–Carleton College.
- T3. **Quantitative Approaches in Stratigraphy and Paleontology: Where Are We Going, and How Will We Get There?** Stephen Meyers, Univ. of Wisconsin–Madison, [smeyers@geology.wisc.edu](mailto:smeyers@geology.wisc.edu); Shanan Peters, Univ. of Wisconsin–Madison.
- T4. **Bridging the Gap between Empirical and Model-Driven Views of Geologic History: New Tools and Approaches.** Patrick I. McLaughlin, Wisconsin Geological & Natural History Survey, [patrick.mclaughlin@uwex.edu](mailto:patrick.mclaughlin@uwex.edu); Jay Zambito, Wisconsin Geological & Natural History Survey; Poul Emsbo, U.S. Geological Survey.
- T5. **Coming Full Circle: From Diagenesis to Modern Aquifer Chemistry—Exploring the Role of Water-Rock Interactions over Time.** John Luczaj, Univ. of Wisconsin–Green Bay, [luczajj@uwgb.edu](mailto:luczajj@uwgb.edu).
- T6. **A Centennial Celebration of USGS Monograph 53: Glacial Geology of the Great Lakes Region.** Alan Kehew, Western Michigan Univ., [alan.kehew@wmich.edu](mailto:alan.kehew@wmich.edu); Kevin Kincare, U.S. Geological Survey.
- T7. **Quaternary Time Machine: Methods and Analyses of Soils and Sediments Reveal Secrets of Past Environments.** Maija Sipola, Minnesota State Univ.–Mankato, [maija.sipola@mnsu.edu](mailto:maija.sipola@mnsu.edu); Kat Rocheford, Univ. of Iowa.
- T8. **Non-Glacial Quaternary Research in the Great Lakes Region.** Henry Loope, Indiana Geological Survey, [hloope@indiana.edu](mailto:hloope@indiana.edu); Andy Breckenridge, Univ. of Wisconsin–Superior.
- T9. **Quaternary Paleoecology of the Upper Midwest.** Carrie Eaton, Univ. of Wisconsin–Madison, [carrie@geology.wisc.edu](mailto:carrie@geology.wisc.edu); Matthew Hill, Iowa State Univ.
- T10. **Great Lakes Shorelines: Geomorphology, Quaternary History, and Modern Processes.** J. Elmo Rawling III, Wisconsin Geological & Natural History Survey, [elmo.rawling@uwex.edu](mailto:elmo.rawling@uwex.edu); Erin P. Argyilan, Indiana Univ.–Northwest.
- T11. **Geomorphology, Hydrology, and Critical Zone Processes in the Anthropocene.** Alison M. Anders, Univ. of Illinois, [amanders@illinois.edu](mailto:amanders@illinois.edu); E. Arthur Bettis III, Univ. of Iowa.
- T12. **Lowland and Wetland Flooding under Changing Climate and Regulatory Conditions.** Kyle Fredrick, California Univ. of Pennsylvania, [fredrick@calu.edu](mailto:fredrick@calu.edu); John Skalbeck, Univ. of Wisconsin–Parkside.
- T13. **Impacts of Urbanization on the Quality and Quantity of Water Resources.** Madeline Gotkowitz, Wisconsin Geological & Natural History Survey, [madeline.gotkowitz@uwex.edu](mailto:madeline.gotkowitz@uwex.edu); Walt Kelly, Illinois State Water Survey.

- T14. **Frac Sand in the Midwest: Geology, Mining, Reclamation, and Environmental Issues.** Kent Syverson, Univ. of Wisconsin–Eau Claire, syverskm@uwec.edu; Holly Dolliver, Univ. of Wisconsin–River Falls.
- T15. **Cultural Geology and Geomorphology: Millstones, Dimension Stones, Capitol Buildings, Heritage Stone, and More.** *Cosponsored by the Heritage Stone Task Group of the International Union of Geological Sciences.* Joe Hannibal, Cleveland Museum of Natural History, jhanniba@cmnh.org; L. Brad Shotwell, Wiss, Janney, Elstner Associates.
- T16. **Applied Geology: Environmental, Engineering, Hydrogeology, Geotechnical, and Applied Geophysics.** Terry R. West, Purdue Univ., trwest@purdue.edu.
- T17. **New Advances in the Use of GIS in Geologic Mapping and Analysis (Posters).** Stephen Crabtree, Univ. of Minnesota–Morris, crabt012@morris.umn.edu.
- T18. **From Virtual to Real and Back Again: Emerging 3-D Applications in Paleontology.** Joseph E. Peterson, Univ. of Wisconsin–Oshkosh, petersoj@uwosh.edu; Christopher R. Noto, Univ. of Wisconsin–Parkside.
- T19. **Teaching and Learning Earth Science: K–16 Educational Pedagogy.** Katie Lewandowski, Eastern Illinois Univ., kjlewandowski@eiu.edu; Carolyn R. Sparks, Northwest Missouri State Univ.
- T20. **Geology in the Classroom and the Community: Reaching a Broader Audience.** Mike Phillips, Illinois Valley Community College, mike\_phillips@ivcc.edu.
- T21. **Geoheritage and Place-Based Education.** Erika Vye, Michigan Tech Univ., ecvye@mtu.edu; Emily Gochis, Michigan Tech Univ., William Rose, Michigan Tech Univ.
- T22. **Thinking outside the Display Case: Innovative Geological Outreach at Museums, Parks, and Surveys.** Joanne Kluessendorf, Weis Earth Science Museum, joanne.kluessendorf@uwc.edu; M. Carol McCartney, Wisconsin Geological & Natural History Survey.
- T23. **Earth Science Week Activities and Events.** Katie Lewandowski, Eastern Illinois Univ., kjlewandowski@eiu.edu.
- T24. **Student Research (Posters).** *Cosponsored by the Council on Undergraduate Research Geoscience Division.* Robert R. Shuster, Univ. of Nebraska–Omaha, rshuster@unomaha.edu.
- T25. **New Insights into the Midcontinent Rift and Continental Rifting.** Seth Stein, Northwestern University, seth@earth.northwestern.edu; Carol Stein, Univ. of Illinois–Chicago, cstein@uic.edu.

## FIELD TRIPS

For additional information, please contact the field trip co-chairs: Phil Brown, pbrown@geology.wisc.edu, and Esther Stewart, esther.stewart@uwex.edu.

**Quaternary Geology along the Southwest Margin of the Green Bay Lobe (Including a Hike on the Ice Age National Scenic Trail).** David Mickelson, Univ. of Wisconsin–Madison, mickelson@geology.wisc.edu; John Attig, Wisconsin Geological & Natural History Survey, jwattig@wisc.edu; Eric Carson, Wisconsin Geological & Natural History Survey, eric.carson@uwex.edu.

**Late Cenozoic Evolution of the Lower Wisconsin River Valley.** Eric Carson, Wisconsin Geological & Natural History Survey,

eric.carson@uwex.edu; Elmo Rawling III, elmo.rawling@uwex.edu.

**Cultural Geology of Beloit: Geological Aspects of Mills, Mounds, and Historic Dimension Stone.** Joe Hannibal, Cleveland Museum of Natural History, jhanniba@cmnh.org.

**Dimension Stone in the 21st Century: Reconnaissance, Selection, and Fabrication of Dimension Stone Elements for New Structures and for Rehabilitation of Historic Structures.** Brad Shotwell, bshotwell@wje.com; Jim Durham, jdurham@quarrastone.com.

**What's New at Baraboo? A Field Trip for Educators.** Laurel B. Goodwin, Univ. of Wisconsin–Madison; laurel@geology.wisc.edu; Marcia Bjornerud, Lawrence Univ., marcia.bjornerud@lawrence.edu; John P. Craddock, Macalester College, craddock@macalester.edu; Dyanna M. Czeck, Univ. of Wisconsin–Milwaukee, dyanna@uwm.edu; Robert H. Dott Jr., Univ. of Wisconsin–Madison, rdott@geology.wisc.edu; Stephen Marshak, Univ. of Illinois at Urbana-Champaign, smarshak@illinois.edu; Carol Ormand, SERC–Carleton College, cormand@geology.wisc.edu.

**Cliffs, Crater, and Culture: The Geology of Wisconsin's Door Peninsula.** Joanne Kluessendorf, Weis Earth Science Museum, joanne.kluessendorf@uwc.edu; Donald G. Mikulic, Illinois State Geological Survey, mikulic@illinois.edu.

**Cambrian and Ordovician Stratigraphy of Southwestern Wisconsin.** Jay Zambito, Wisconsin Geological & Natural History Survey, jay.zambito@uwex.edu; Pat McLaughlin, Wisconsin Geological & Natural History Survey, patrick.mclaughlin@uwex.edu.

## ACCOMMODATIONS

A block of rooms has been reserved at the Hilton Madison Monona Terrace, 9 East Wilson Street, Madison WI 53703, USA, connected via bridge to the Monona Terrace Community and Convention Center. Group room rates range from US\$149 to US\$359 plus tax. To make your reservation, call +1-866-403-8838 or follow the link at [www.geosociety.org/Sections/nc/2015mtg/](http://www.geosociety.org/Sections/nc/2015mtg/). Use code “NCRC” when making your reservation to ensure that you are booked into the specially priced GSA block.



Madison, Wisconsin, USA. Photo courtesy GMCVB.



## OPPORTUNITIES FOR STUDENTS

### Presentation Awards

Awards for best student posters and papers are supported by the GSA North-Central Section and by SEPM (Society for Sedimentary Geology).

### On To the Future (OTF)

Stop by the GSA Foundation booth at the Welcome Reception to ask an onsite representative 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 1–4 Nov. 2015 in Baltimore, Maryland, USA).

### Mentor Programs

Cosponsored by the GSA Foundation. For more information, contact Jennifer Nocerino at [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).

#### Roy J. Shlemon Mentor Program in Applied Geoscience.

Tues., 19 May, lunchtime. Students will have the opportunity to discuss career prospects and challenges with professional geoscientists from multiple disciplines over a FREE lunch. Learn more at [www.geosociety.org/mentors/shlemon.htm](http://www.geosociety.org/mentors/shlemon.htm).

#### John Mann Mentors in Applied Hydrogeology Program.

Wed., 20 May, lunchtime. Students interested in applied hydrogeology or hydrology as a career will have the opportunity to network with professionals in these fields over a FREE lunch. Learn more at [www.geosociety.org/mentors/mann.htm](http://www.geosociety.org/mentors/mann.htm).

### Geoscience Career Workshops

Cosponsored by the GSA Foundation. For more information, contact Jennifer Nocerino at [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).

#### Part 1: Career Planning and Informational Interviewing.

Tues., 19 May, 8 a.m.–9 a.m. Your job-hunting process should begin with career planning, not when you apply for jobs. This workshop will help you begin this process and will introduce you to *informational interviewing*.

**Part 2: Geoscience Career Exploration.** Tues., 19 May, 9 a.m.–10 a.m. What do geologists in various sectors earn? What do they do? What are the pros and cons to working in academia, government, and industry? Workshop presenters, and when possible, professionals in the field, will address these issues.

**Part 3: Cover Letters, Résumés, and CVs.** Wed., 20 May, 9 a.m.–10 a.m. How do you prepare a cover letter? Does your résumé need a good edit? Whether you are currently in the job market or not, learn how to prepare the best résumé possible. You will review numerous résumés helping you to learn important résumé dos and don'ts.

## LOCAL COMMITTEE


**General Chair:** Jean Bahr, [jmbahr@geology.wisc.edu](mailto:jmbahr@geology.wisc.edu)

**Vice-Chair, Exhibits, Sponsorship:** M. Carol McCartney, [carol.mccartney@uwex.edu](mailto:carol.mccartney@uwex.edu)

**Technical Program Co-Chairs:** Michael Cardiff, [cardiff@wisc.edu](mailto:cardiff@wisc.edu); Eric Carson, [eric.carson@uwex.edu](mailto:eric.carson@uwex.edu)

**Field Trip Co-Chairs:** Phil Brown, [pbrown@geology.wisc.edu](mailto:pbrown@geology.wisc.edu); Esther Stewart [esther.stewart@uwex.edu](mailto:esther.stewart@uwex.edu)

**Student Poster Awards:** J. Elmo Rawling, [elmo.rawling@uwex.edu](mailto:elmo.rawling@uwex.edu)



**Recent, Rare, and Out-of-Print Books**

GEOSCIENCE, PALEONTOLOGY, MINERALOGY,  
MINING HISTORY, ORE DEPOSITS,  
USGS AND USBM PUBLICATIONS, PETROLEUM,  
SURFACE PROCESSES AND EXTRACTIVE METALLURGY

<http://booksgeology.com>

[MSBOOKS@BOOKSGEOLOGY.COM](mailto:MSBOOKS@BOOKSGEOLOGY.COM)

**WE PURCHASE BOOKS AND ENTIRE COLLECTIONS**  
MS Book and Mineral Company  
P.O. Box 6774, Lake Charles, LA 70606-6774 USA

## GSA Member in the News

GSA Fellow **Sean C. Solomon** has been awarded the National Medal of Science, the nation's highest honor for achievement and leadership in advancing science. Solomon will receive his medal at a White House ceremony with President Barack Obama later this year. Solomon is director of Columbia University's Lamont-Doherty Earth Observatory and principal investigator of NASA's mission to Mercury. Learn more at [www.ldeo.columbia.edu/news-events/lamont-doherty-director-awarded-national-medal-science](http://www.ldeo.columbia.edu/news-events/lamont-doherty-director-awarded-national-medal-science).

## Second Announcement

# SOUTH-CENTRAL SECTION

49th Annual Meeting of the South-Central Section, GSA  
Stillwater, Oklahoma, USA  
19–20 March 2015

[www.geosociety.org/sections/sc/2015mtg/](http://www.geosociety.org/sections/sc/2015mtg/)



Byrds Mill Spring, the largest spring in Oklahoma, provides drinking water for the city of Ada, Oklahoma, USA. Photo by Kyle Spears.

## *Geosciences at the Crossroads of America: Integrating Geosciences to Address Complex Problems*

### LOCATION

The 49th annual meeting of GSA's South-Central Section will take place in Stillwater, Oklahoma, USA, in the student union building at Oklahoma State University (OSU). OSU has provided an intersection of geologic disciplines since the inception of its Boone Pickens School of Geology, with a history in petroleum, water, and agriculture. Our meeting is during the spring break for the campus, giving us the run of the largest student union in the world.

### REGISTRATION

**Early registration deadline:** 17 Feb. 2015

**Cancellation deadline:** 23 Feb. 2015

For further information or if you need special accommodations, please contact Sandy Earls at [sandy.earls@okstate.edu](mailto:sandy.earls@okstate.edu).

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

	Early		Standard	
	Full mtg.	1 day	Full mtg.	1 day
Professional Member	\$150	\$100	\$200	\$150
Professional Member 70+	\$100	\$50	\$150	\$100
Professional Nonmember	\$170	\$120	\$220	\$170
Student Member	\$50	\$40	\$100	\$65
Student Nonmember	\$70	\$60	\$120	\$85
K–12 Teacher	\$50	\$40	\$100	\$65
Guest/Spouse	\$35	n/a	\$45	n/a
Field Trip/Short Course only	\$35	n/a	\$45	n/a

### CALL FOR PAPERS

**Abstract deadline:** 16 Dec. 2014

Submit your abstract online at [www.geosociety.org/sections/sc/2015mtg](http://www.geosociety.org/sections/sc/2015mtg). Abstract submission fees: US\$10 for students; US\$15 for all others.

### Hot Topic Event

**Hydraulic Fracturing: Communicating Risks.** *Cosponsored by the OSU Hydraulic Fracturing Evaluation and Communication Team.* Chairs: Larry Sanders, Gina Peek, and Karen Neurohr, Oklahoma State Univ. As one of the newer technologies in geology, risk management of hydraulic fracturing has found a number of factors to consider and communication of those risks poses its own difficulties.

### Symposia

- S1. Mississippian Sedimentology and Sequence Stratigraphy of the Mid-Continent from Outcrop and Subsurface Studies.** Michael Grammer, [michael.grammer@okstate.edu](mailto:michael.grammer@okstate.edu), Oklahoma State Univ.; Jim Puckette, [jim.puckette@okstate.edu](mailto:jim.puckette@okstate.edu), Oklahoma State Univ.; Darwin Boardman, [darwin.boardman@okstate.edu](mailto:darwin.boardman@okstate.edu), Oklahoma State Univ.; Jay Gregg, [jay.gregg@okstate.edu](mailto:jay.gregg@okstate.edu); Oklahoma State Univ.
- S2. Sequence Stratigraphy and High Resolution Biostratigraphy of the Pennsylvanian Subsystem.** Darwin Boardman, [darwin.boardman@okstate.edu](mailto:darwin.boardman@okstate.edu), Oklahoma State Univ.; John Pope, [jppope@nwmissouri.edu](mailto:jppope@nwmissouri.edu), Northwest Missouri State Univ.; W. Lynn Watney, [lwatney@kgs.ku.edu](mailto:lwatney@kgs.ku.edu), Kansas Geological Survey; Jim Puckette, [jim.puckette@okstate.edu](mailto:jim.puckette@okstate.edu), Oklahoma State Univ.

### Theme Sessions

- T1. East African Rift, Southern Oklahoma Aulacogen, Rio Grande Rift, and Other Continental Rifts: A Tribute to the Career of G. Randy Keller.** Mohamed Abdelsalam, [mohamed.abdel\\_salam@okstate.edu](mailto:mohamed.abdel_salam@okstate.edu), Oklahoma State Univ.; Estella Atekwana, [estella.atekwana@okstate.edu](mailto:estella.atekwana@okstate.edu), Oklahoma State Univ.; Asish Basu, [abasu@uta.edu](mailto:abasu@uta.edu), Univ. of Texas at Arlington; Kevin Mickus, [kevinmickus@missouristate.edu](mailto:kevinmickus@missouristate.edu), Missouri State Univ.; Robert Stern, [rjstern@utdallas.edu](mailto:rjstern@utdallas.edu), Univ. of Texas at Dallas.
- T2. Geological Carbon Sequestration: Understanding Physical, Chemical, and Biological Processes.** Jack Pashin, [jack.pashin@okstate.edu](mailto:jack.pashin@okstate.edu), Oklahoma State Univ.; Matt Kirk, [mfkirk@k-state.edu](mailto:mfkirk@k-state.edu), Kansas State Univ.

- T3. **New Insights on the Architecture of the Gulf Coast Margin.** Raphael Gottardi, rxg0121@louisiana.edu, Univ. of Louisiana at Lafayette; Gary Kinsland, gkinsland@louisiana.edu, Univ. of Louisiana at Lafayette.
- T4. **Evaporite Karst in the Greater Permian Basin of Texas, New Mexico, Oklahoma, Kansas, and Colorado.** Kenneth Johnson, ksjohnson@ou.edu, Oklahoma Geological Survey. *Cosponsored by the GSA Hydrogeology Division.*
- T5. **Recent Advances in the Geological Evolution of the Southern Oklahoma Aulacogen.** *Cosponsored by the Geochemical Society; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division.* Matthew Brueseke, brueseke@ksu.edu, Kansas State Univ.; Jonathan Price, jonathan.price@mwsu.edu, Midwestern State Univ.; Richard Hanson, r.hanson@tcu.edu, Texas Christian Univ.
- T6. **Geochemical Characterization of Dynamic Sedimentary Systems.** Tracy Quan, tracy.quan@okstate.edu, Oklahoma State Univ.; Natascha Riedinger, natascha.riedinger@ucr.edu, Univ. of California Riverside and Oklahoma State Univ.; Eliot Atekwana, eliot.atekwana@okstate.edu, Oklahoma State Univ.
- T7. **Subsurface Fluids and Induced Seismicity.** Katie Keranen, Cornell Univ. *Cosponsored by the GSA Hydrogeology Division.*
- T8. **Ouachita-Marathon Fold-Thrust Belt and Foreland Basins: Their Tectonics, Structural Geology, Sedimentology, and Hydrocarbon Potential.** Ibrahim Çemen, icemen@as.ua.edu, Univ. of Alabama; Jim Puckette, jim.puckette@okstate.edu, Oklahoma State Univ.; Darwin Boardman, darwin.boardman@okstate.edu, Oklahoma State Univ.
- T9. **Karst Hydrogeology.** Joe Myre, joemyre@gmail.com, Univ. of Arkansas; Katherine Kneirim, katherine.kneirim@gmail.com, Univ. of Arkansas. *Cosponsored by the GSA Hydrogeology Division.*
- T10. **Energy-Water Nexus.** Kyle Murray, kyle.murray@ou.edu, Oklahoma Geological Survey. *Cosponsored by the GSA Hydrogeology Division.*
- T11. **Undergraduate Research (Posters).** Joseph Donoghue, Oklahoma State Univ.; Diane Smith, Trinity Univ. *Cosponsored by the Council on Undergraduate Research.*

## FIELD TRIPS

For additional information, please check the website.

## Premeeting

**High-Resolution Sequence Stratigraphy of the Pennsylvanian of the North American Midcontinent.** Sat.–Tues., 14–17 March. Darwin Boardman, darwin.boardman@okstate.edu, Oklahoma State Univ.; John Pope, jppope@nwmissouri.edu, Northwest Missouri State Univ.; W. Lynn Watney, lwatney@kgs.ku.edu, Kansas Geological Survey; Jim Puckette, jim.puckette@okstate.edu, Oklahoma State Univ.

**Geology of the Wichita Mountains.** Wed., 18 March. Charles Gilbert, Univ. of Oklahoma (emeritus).

## Postmeeting

**Hydrogeology of the Arbuckle Simpson Aquifer and EPA Tour/Hydrodays.** *Cosponsored by The Nature Conservancy; GSA Hydrogeology Division.* Fri.–Sat., 20–21 March. Todd Halihan, todd.halihan@okstate.edu, Oklahoma State Univ.; Randall Ross, ross.randall@epamail.epa.gov, U.S. Environmental Protection Agency; Jona Tucker, jtucker@tnc.org, The Nature Conservancy.

**Meramecian and Chesterian (Visean) of Northeastern Oklahoma: Conodont Biostratigraphy and Revised Regional Stratigraphic.** Sat.–Sun., 21–22 March. Cory Godwin, cory.godwin@okstate.edu, Oklahoma State Univ.; Darwin Boardman, darwin.boardman@okstate.edu, Oklahoma State Univ.; Michael Grammer, michael.grammer@okstate.edu, Oklahoma State Univ.; Jim Puckette, jim.puckette@okstate.edu, Oklahoma State Univ.

## Short Courses

**Mid-Continent Conventional and Unconventional Reservoirs—CORE WORKSHOP.** Wed., 18 March. Michael Grammer, michael.grammer@okstate.edu, Oklahoma State Univ.; Jack Pashin, jack.pashin@okstate.edu, Oklahoma State Univ.; Jim Puckette, jim.puckette@okstate.edu, Oklahoma State Univ.; Darwin Boardman, darwin.boardman@okstate.edu, Oklahoma State Univ.; Jay Gregg, jay.gregg@okstate.edu, Oklahoma State Univ.

**A Holistic Approach to Groundwater Resource Development and Management.** *Cosponsored by Professional Engineering Consultants, P.A., Thornhill Group, Inc.; GSA Hydrogeology Division.* Wed., 18 March. James Roberts, james.roberts@pec1.com, Professional Engineering Consultants P.A.; Michael Thornhill, mthornhill@tgi-water.com, Thornhill Group Inc.; Stanley Paxton, spaxton@usgs.gov, U.S. Geological Survey; Todd Halihan, todd.halihan@okstate.edu, Oklahoma State Univ.

**Introduction to Carbonate Diagenesis,** Sat., 21 March.

Jay Gregg, jay.gregg@okstate.edu, Oklahoma State Univ.

**Petra Basic Overview.** Sat., 21 March. Stacy Hendrickson, IHS Energy–The Americas; Larry Gerken, larry.gerken@ihs.com, IHS Energy–The Americas.

## ACCOMMODATIONS

**Housing deadline:** 25 Feb. 2015

GSA has reserved blocks of rooms at three locations in Stillwater: (1) Best Western Plus Cimarron Hotel, 315 N. Husband Street, Stillwater, OK 74075, USA; room rate: US\$77, plus tax; call +1-405-372-2878 to make a reservation; (2) Fairfield Inn and Suites Stillwater, 418 E. Hall of Fame Ave., Stillwater, OK 74075, USA; room rate: US\$99, plus tax; call +1-405-372-6300 to make a reservation; and (3) Atherton Hotel, H103 Oklahoma State University Student Union, Stillwater, OK 74078, USA; room rate: \$98, plus tax; call +1-405-744-6835 to make a reservation. For all locations, please be sure to mention you are attending the GSA South-Central Meeting.



## OPPORTUNITIES FOR STUDENTS

### On To the Future (OTF)

Stop by the GSA Foundation booth at the Welcome Reception to ask an onsite representative 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 1–4 Nov. 2015 in Baltimore, Maryland, USA).

### Mentor Programs

Sponsored by the GSA Foundation. For more information, contact Jennifer Nocerino at [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).

### Roy J. Shlemon Mentoring Luncheon for Applied Science.

Thurs., 19 Mar., lunchtime. Students will have the opportunity to discuss career prospects and challenges with professional geoscientists from multiple disciplines over a FREE lunch. Learn more at [www.geosociety.org/mentors/shlemon.htm](http://www.geosociety.org/mentors/shlemon.htm).

### John Mann Mentoring Luncheon for Applied Hydrogeology.

Fri., 20 Mar., lunchtime. Students interested in applied hydrogeology or hydrology as a career will have the opportunity to network with professionals in these fields over a FREE lunch. Learn more at [www.geosociety.org/mentors/mann.htm](http://www.geosociety.org/mentors/mann.htm).

### Geoscience Career Workshops

Sponsored by the GSA Foundation. For more information, contact Tahlia Bear at [tbear@geosociety.org](mailto:tbear@geosociety.org).

#### Part 1: Career Planning and Informational Interviewing.

Thurs., 19 Mar., 8 a.m.–9 a.m. Your job-hunting process should begin with career planning, not when you apply for jobs. This workshop will help you begin this process and will introduce you to *informational interviewing*.

**Part 2: Geoscience Career Exploration.** Thurs., 19 Mar., 9 a.m.–10 a.m. What do geologists in various sectors earn? What do they do? What are the pros and cons to working in academia, government, and industry? Workshop presenters, and when possible, professionals in the field, will address these issues.

**Part 3: Cover Letters, Résumés, and CVs.** Fri., 20 Mar., 9 a.m.–10 a.m. How do you prepare a cover letter? Does your résumé need a good edit? Whether you are currently in the job market or not, learn how to prepare the best résumé possible. You will review numerous résumés helping you to learn important résumé dos and don'ts.

### Travel Grants

**Deadline to apply:** 17 Feb. 2015

The GSA Foundation has funds available for student travel grants. To qualify, you must be (1) the senior author and presenter of the paper; (2) a current student member of the South-Central Section; and (3) registered for the meeting. Apply at [www.geosociety.org/Sections/sc/2015mtg/](http://www.geosociety.org/Sections/sc/2015mtg/); for more information, contact Jay Sims, [wmjaysims@gmail.com](mailto:wmjaysims@gmail.com).

## LOCAL COMMITTEE

**General Chair:** Todd Halihan, [todd.halihan@okstate.edu](mailto:todd.halihan@okstate.edu)

**Technical Program Chair:** Jack Pashin, [jack.pashin@okstate.edu](mailto:jack.pashin@okstate.edu)

**Field Trip Chair:** Darwin Boardman, [darwin.boardman@okstate.edu](mailto:darwin.boardman@okstate.edu)

**Student Volunteer Coordinator:** Tracy Quan, [tracy.quan@okstate.edu](mailto:tracy.quan@okstate.edu)

**Judging Coordinator:** Joseph Donoghue, [joseph.donoghue@okstate.edu](mailto:joseph.donoghue@okstate.edu)

**Industry Liaison:** Anna Cruse, [acruse@sampson.com](mailto:acruse@sampson.com)

## New Publication Calendar for *GSA Today*

*GSA Today* is published 11 times per year, and this won't change. What will change is that the March issue will now be combined with April, and we will have an independent May issue (instead of March). So look for your first dedicated Annual Meeting issue in May this coming year.



2015																																																													
January											February											March											April																												
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S																				
1	2	3				1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

As always, *GSA Today* is open-access online at [www.geosociety.org/gsatoday/](http://www.geosociety.org/gsatoday/).

## Second Announcement

# SOUTHEASTERN SECTION

64th Annual Meeting of the Southeastern Section, GSA  
Chattanooga, Tennessee, USA  
19–20 March 2015

[www.geosociety.org/Sections/se/2015mtg/](http://www.geosociety.org/Sections/se/2015mtg/)



The Hunter Museum rests on a bluff of Cambro-Ordovician Knox Group carbonate overlooking the Tennessee River. Photo courtesy of the Chattanooga Convention & Visitors Bureau.

## LOCATION

Widely known as “The Scenic City,” Chattanooga owes this distinction to its geologic setting. The city lies along the Tennessee River, among the valleys and ridges of the southern Appalachian fold-and-thrust belt, and within view of the Cumberland Plateau and Blue Ridge. Its name derives from “cató,” the Muskogean word for “rock,” giving due emphasis to the geology of the area and the ideal setting it provides for this meeting.

## REGISTRATION

**Early registration deadline:** 17 Feb. 2015

**Cancellation deadline:** 23 Feb. 2015

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

	Early		Standard	
	Full mtg.	1 day	Full mtg.	1 day
Professional Member	\$220	\$130	\$250	\$155
Professional Nonmember	\$240	\$155	\$275	\$175
Student Member	\$85	\$65	\$100	\$75
Student Nonmember	\$100	\$90	\$130	\$100
K–12 Teacher	\$45	\$40	\$55	\$45
Guest/Spouse	\$45	n/a	\$55	n/a
Field Trip/Short Course only	\$40	n/a	\$45	n/a

## ACCOMMODATIONS

**Hotel registration deadline:** 25 Feb. 2015

A block of rooms has been reserved at the Chattanooga Hotel and Conference Center, 1201 Broad Street, Chattanooga, TN 37402, USA. Room rates start at US\$129, single or double, plus tax. To make your reservation, please call the Chattanooga at +1-800-619-0018 and be sure to ask for the GSA Southeastern Section room block to get the meeting rate.

## TRAVEL

Chattanooga is centrally located in the Southeastern Section and will be a convenient interstate drive for most attendees. The city is also served by the Chattanooga Airport (CHA), with daily flights to and from Atlanta, Charlotte, and Washington, D.C.

Although most of the downtown area is within a reasonable walk of the Chattanooga Hotel, CARTA’s free electric shuttle service provides a convenient alternative, as does Chattanooga’s bicycle transit system. *A map and guide to Chattanooga’s downtown area, showing the electric shuttle route and bicycle transit stations, is available at [www.gocarta.org/maps/shuttlemap.pdf](http://www.gocarta.org/maps/shuttlemap.pdf).*

## TECHNICAL PROGRAM

**Abstract deadline:** 9 Dec. 2014

Please submit your abstract online at [www.geosociety.org/Sections/se/2015mtg/techprog.htm](http://www.geosociety.org/Sections/se/2015mtg/techprog.htm). An abstract submission fee of US\$10 for students and US\$15 for professionals is required.

## FIELD TRIPS

### Pre-Meeting

**Exploring the Origins of Modern Topographic Relief in the Southern Appalachians: An Excursion through the Transient Landscape of the Cullasaja River Basin, North Carolina.** Wed., 18 Mar. US\$95. Principal organizer: Sean Gallen, Univ. of Michigan, Ann Arbor. Co-organizer: Karl W. Wegmann, North Carolina State Univ.

**Structural Geology and Paleozoic Tectonics of the Nashville Dome, Tennessee.** Wed., 18 Mar. US\$110. Principal organizer: Mark Abolins, Middle Tennessee State Univ.

### Post-Meeting

**Sequence Stratigraphy, Invertebrate Fauna and Ichnofacies of the Silurian Red Mountain Formation, Birmingham, Alabama, to Chattanooga, Tennessee.** Fri.–Sun., 20–22 Mar. US\$250 for full trip; US\$140 for one day\* only. Principal organizer: Tim Chowns, Univ. of West Georgia. Co-organizer: Andrew Rindsberg, Univ. of West Alabama. The cost includes accommodations for two nights with breakfast, transport, and a box lunch Sunday. Other meals (dinners & lunch on Saturday) are not included. Lunch Saturday will be at the Irondale Café. For dinner, numerous restaurants are available close to the motel. \*Participants living close to Birmingham may wish to opt for a one-day field trip on Saturday. Registration will include transportation but not accommodations or meals. One-day participants should arrive at the Holiday Inn Express in Trussville by 7.45 a.m.

**A Laurentian Margin Back-Arc: The Ordovician Wedowee-Emuckfaw-Dahlonga Basin.** Fri.–Sun., 20–22 Mar.

US\$250. Principal organizer: Clinton Barineau, Columbus State Univ. Co-organizers: James F. Tull, Florida State Univ.; and Christopher Holm-Denoma, USGS.

**Coal Mining Impacts and Remediation in the Chattanooga Region.** Sat., 21 Mar. US\$60. Principal organizer: Gregory Brodie, Univ. of Tennessee at Chattanooga.

**Evolution and the Evidence around Dayton, Tennessee.** Sat., 21 Mar. US\$60. Principal organizer: William Witherspoon. Co-organizers: Michael Gibson, Univ. of Tennessee at Martin; and Don Byerly, Univ. of Tennessee at Knoxville.

**Geology and Water Use History atop the Cumberland Plateau.** Sat., 21 Mar. US\$35. Principal organizers: Martin Knoll, Univ. of the South; Bran Potter, Univ. of the South.

**Sedimentary Architecture of Basinal Fort Payne (Mississippian) Deposits: Mixed Carbonate-Clastic Channels and Waulsortian-Like Mounds.** Sat., 21 Mar. US\$75. Co-organizers: Larry Knox, Tennessee Technological Univ.; Jeannette Wolak, Tennessee Technological Univ.

**Geology and Tectonic Development of Sequatchie Valley, Tennessee.** Sat., 21 Mar. US\$145. Principal organizers: Bob Hatcher, Univ. of Tennessee–Knoxville; Bob Milici, USGS emeritus.

## EXHIBITORS

View exhibitor information at [www.geosociety.org/Sections/se/2015mtg/](http://www.geosociety.org/Sections/se/2015mtg/) and reserve your space now. Please contact the exhibits coordinator, Kevin Hon, at [khon@smeinc.com](mailto:khon@smeinc.com) for more information.

## OPPORTUNITIES FOR STUDENTS

### On To the Future (OTF)

Stop by the GSA Foundation booth at the Welcome Reception to ask an onsite representative 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 1–4 Nov. 2015 in Baltimore, Maryland, USA).

### Mentor Programs

Sponsored by the GSA Foundation. For more information, contact Jennifer Nocerino at [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).

**Roy J. Shlemon Mentoring Luncheon for Applied Science.** Thurs., 19 Mar., lunchtime. Students will have the opportunity to discuss career prospects and challenges with professional geoscientists from multiple disciplines over a FREE lunch. Learn more at [www.geosociety.org/mentors/shlemon.htm](http://www.geosociety.org/mentors/shlemon.htm).

**John Mann Mentoring Luncheon for Applied Hydrogeology.** Fri., 20 Mar., lunchtime. Students interested in applied hydrogeology or hydrology as a career will have the opportunity to network with professionals in these fields over a FREE lunch. Learn more at [www.geosociety.org/mentors/mann.htm](http://www.geosociety.org/mentors/mann.htm).

## Geoscience Career Workshop

Sponsored by the GSA Foundation. For more information, contact Jennifer Nocerino at [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).

**Part 1: Career Planning and Informational Interviewing.** Thurs., 19 Mar., 8 a.m.–9 a.m. Your job-hunting process should begin with career planning, not when you apply for jobs. This workshop will help you begin this process and will introduce you to *informational interviewing*.

**Part 2: Geoscience Career Exploration.** Thurs., 19 Mar., 9 a.m.–10 a.m. What do geologists in various sectors earn? What do they do? What are the pros and cons to working in academia, government, and industry? Workshop presenters, and when possible, professionals in the field, will address these issues.

**Part 3: Cover Letters, Résumés, and CVs.** Fri., 20 Mar., 9 a.m.–10 a.m. How do you prepare a cover letter? Does your résumé need a good edit? Whether you are currently in the job market or not, learn how to prepare the best résumé possible. You will review numerous résumés helping you to learn important résumé dos and don'ts.

## Outstanding Undergraduate Research Poster Award

We encourage undergraduate students to present their research as a poster under the “Undergraduate Research Posters” session (T5). An award, cosponsored by the Council on Undergraduate Education Geoscience Division, will be presented for the best undergraduate research poster.

## EVENTS

**Welcome Reception.** Wed., 18 March, 7–9 p.m., Chattanooga Ballroom. Enjoy light hors d'oeuvres and one complimentary drink and exhibitors' displays while meeting with friends and colleagues.

**Map Blast.** Thurs., 19 March, 7–9 p.m., outside the Chattanooga Ballroom. Meeting attendees are welcome to bring, post, and discuss newly published, unpublished, and in-progress maps at this informal session.

## LOCAL COMMITTEE

**General Chair: Jon Mies**, [jonathan-mies@utc.edu](mailto:jonathan-mies@utc.edu)

**Technical Program Chair: Amy Brock-Hon**, [amy-brock-hon@utc.edu](mailto:amy-brock-hon@utc.edu)

**Technical Program Co-Chair: Mark Steltenpohl**, [steltmg@auburn.edu](mailto:steltmg@auburn.edu)

**Field Trip Chair: Ann Holmes**, [ann-holmes@utc.edu](mailto:ann-holmes@utc.edu)

**Field Trip Co-Chairs: Michael Gibson**, [mgibson@utm.edu](mailto:mgibson@utm.edu); **Chuck Trupe**, [chtrupe@GeorgiaSouthern.edu](mailto:chtrupe@GeorgiaSouthern.edu)

**Exhibits Coordinator: Kevin Hon**, [khon@smeinc.com](mailto:khon@smeinc.com)

**Student Volunteer Coordinator: Claire Landis**, [claire-landis@utc.edu](mailto:claire-landis@utc.edu)





THE  
GEOLOGICAL  
SOCIETY  
OF AMERICA®

# Renew your GSA MEMBER

Journal Subscriptions • Division Memberships

**Publish & Present Research**  
**Premier Journals**  
**GSA Meetings**

**Member Only Discounts**  
**Meetings**  
**Journals**  
**Online Store** (30% off most items)

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

P.O. Box 9140, Boulder, CO 80301-9140, USA • Phone: +1-303-357-1000, option 3 •



# MEMBERSHIP

**SAVE  
15%\***  
off membership dues  
Renew by  
15 December 2014

Section Affiliations • GSA Foundation Support

17 Geoscience Divisions  
Public Policy Updates

## Students & Recent Grads

- Free Online Journals
- Student Research Funding
- Paid Internships—GeoCorp™ America
- Career Resources—Networking & Programs

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

\* Discount applies to those in high income country/territory economies.

Toll-free: +1-888-443-4472 • Fax: +1-303-357-1071 • E-mail: [gsaservice@geosociety.org](mailto:gsaservice@geosociety.org)



# 2015 Calendar

ONLY  
\$9.95

## Geomarvels

This 12-month, 11" × 14" calendar showcases awe-inspiring landscapes. Photographs were selected from award-winning and exceptional submissions to the 2013 GSA Annual Meeting Photo Exhibition in Denver, Colorado. Featuring breathtaking photographs of a Grand Canyon storm (Arizona), Khumbu (Nepal), a Snowdon Peak sunrise (Colorado), and Double-O Arch (Utah), this stunning calendar will spruce up your home or office.

CAL2015, 11" × 14" calendar | \$9.95 (sorry, no additional discount)



### SPECIAL FEATURES

- ▶ Dates of many noteworthy eruptions and earthquakes
- ▶ Birthdates of famous geoscientists
- ▶ Calendar of GSA events, meetings, and deadlines
- ▶ Links for free downloads and exciting GSA products

**GSA SALES AND SERVICE** P.O. Box 9140, Boulder, CO 80301-9140, USA  
+1.303.357.1000, option 3 • toll-free +1.888.443.4472 • fax +1.303.357.1071

SHOP ONLINE ▶ [rock.geosociety.org/store/](http://rock.geosociety.org/store/)

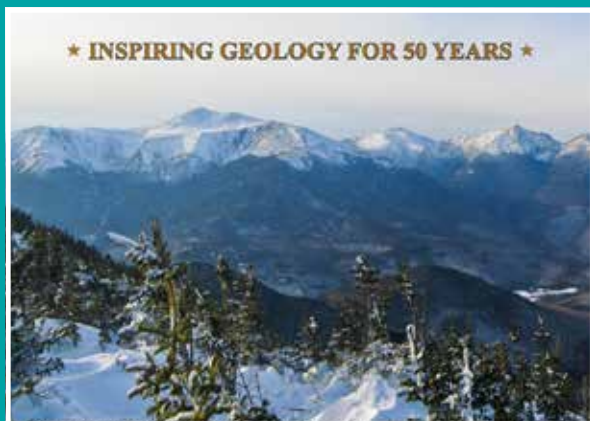


## Second Announcement

# NORTHEASTERN SECTION

50th Annual Meeting of the Northeastern Section, GSA  
Bretton Woods, New Hampshire, USA  
23–25 March 2015

[www.geosociety.org/Sections/ne/2015mtg/](http://www.geosociety.org/Sections/ne/2015mtg/)



## *Celebrating the Section's Golden Anniversary*

### LOCATION

This meeting of the Northeastern Section will celebrate its Golden Anniversary and will do so by returning to The Omni-Mount Washington Resort “by popular demand.” As those who attended in 2013 already know, the venue is unlike any before, and with its help, the meeting will be an informative, unusual, not-to-be-missed occasion for professionals and students alike.

### REGISTRATION

**Deadline:** 17 Feb. 2015

**Cancellation deadline:** 23 Feb. 2015

Interest in this meeting is rapidly developing and early registration and accommodation reservations are strongly recommended.

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

	Early		Standard	
	Full mtg.	1 day	Full mtg.	1 day
Professional Member	\$180	\$130	\$225	\$150
Professional Member 70+	\$100	\$80	\$130	\$100
Professional Nonmember	\$200	\$150	\$250	\$185
Student Member	\$55	\$45	\$75	\$65
Student Nonmember	\$65	\$55	\$85	\$75
K–12 Teacher	\$65	\$50	\$85	\$60
Guest/Spouse	\$50	\$30	\$60	\$35
Field Trip/Short Course only	\$40	n/a	\$45	n/a

### ACCOMMODATIONS

**Reservation deadline:** 27 Feb. 2015

Blocks of specially priced rooms and townhomes have been reserved for professionals, students, groups of both, and families. These rates (which do not include 9% New Hampshire tax) are available from Fri., 20 March, through Thurs., 26 March. The Omni–Mount Washington Resort is also offering the following benefits to those reserving rooms: complimentary wireless Internet; complimentary self- or valet parking; 10% discount to ski/snowboard at Bretton Woods; complimentary 24/7 on-demand/on-resort van transportation; dining at 10 on-resort restaurants and “Grab & Go” breakfast & lunch kiosks.

- **Individual rooms for professionals** at US\$156 per room/night can be reserved by calling +1-800-258-0330 and referring to the “NEGSA Meeting” or by going online at [omnihotels.com](http://omnihotels.com) and using the code **031815GEOLOGICA**.
- **Individual rooms for students** at US\$95 per room/night (single or double); US\$115 per room/night (triple); or US\$135 per room/night (quad) **can only be reserved by contacting** Melissa Lombard, meeting housing coordinator, at [melissalombard@alum.rpi.edu](mailto:melissalombard@alum.rpi.edu).
- **Townhomes for professional, student, and family groups** at US\$309 per night (2-bedroom); US\$409 per night (3-bedroom); US\$509 per night (4-bedroom); and US\$609 per night (5-bedroom) **can only be reserved by contacting** Melissa Lombard, meeting housing coordinator, at [melissalombard@alum.rpi.edu](mailto:melissalombard@alum.rpi.edu).

### CALL FOR PAPERS

**Abstract deadline:** 9 Dec. 2014

Please submit your abstract online at [www.geosociety.org/Sections/ne/2015mtg/](http://www.geosociety.org/Sections/ne/2015mtg/). An abstract submission fee of US\$10 for students and US\$15 for professionals is required. If you cannot submit your abstract online, contact Heather Clark, +1-303-357-1018, [hclark@geosociety.org](mailto:hclark@geosociety.org).

### Symposia

- S1. **Contributions to New England Stratigraphy & Structure: In Honor of Robert Moench & Douglas Rankin.** Greg Walsh, U.S. Geological Survey, [gwalsh@usgs.gov](mailto:gwalsh@usgs.gov); Wally Bothner, Univ. of New Hampshire, [wally.bothner@unh.edu](mailto:wally.bothner@unh.edu); Mark Van Baalen, Harvard Univ., [m vb@harvard.edu](mailto:mvb@harvard.edu).
- S2. **Coastal and Glacial Processes from Alaska to New England: In Honor of Jon Boothroyd.** Bryan Oakley, Eastern Connecticut State Univ., [oakleyb@easternct.edu](mailto:oakleyb@easternct.edu); Mark Borrelli, Center for Coastal Studies, [m borrelli@coastalstudies.org](mailto:m borrelli@coastalstudies.org).
- S3. **Climate Change in Space & Time: An Update.** P. Thompson Davis, Bentley Univ., [pdavis@bentley.edu](mailto:pdavis@bentley.edu); Jeremy Skakun, Boston College, [jeremy.shakun@bc.edu](mailto:jeremy.shakun@bc.edu).
- S4. **Contributions of Cosmogenic-Nuclide Geochronology to Glacial Geology and Geochronology in northeastern North America—and Vice Versa.** Greg Balco, Berkeley Geochronology Center, [balco@bgc.org](mailto:balco@bgc.org); John Gosse, Dalhousie Geochronology Centre, [john.gosse@dal.ca](mailto:john.gosse@dal.ca).

## Theme Sessions

- T1. **Updating the Orogen: Along-Strike Tectonic Correlations and Comparisons in the Northeastern Appalachians.** Jon Kim, Vermont Geological Survey, geojon710@msn.com; Craig Dietsch, Univ. of Cincinnati, dietscc@ucmail.uc.edu.
- T2. **Northeastern North American Volcanic Successions and Their Tectonic Context.** Sheila Seaman, Univ. of Massachusetts, sjs@geo.umass.edu; Christopher Koteas, Norwich Univ., gkoteas@norwich.edu.
- T3. **Terrane Forensics—Where Did They Come From and Which Are Related?** Sandra Barr, Acadia Univ., sandra.barr@acadiu.ca; Scott Samson, Syracuse Univ., sdsamson@syr.edu.
- T4. **Ages and Origins of Intrusive Rocks in the New England Appalachians.** Dyk Eusden, Bates College, deusden@bates.edu; Dwight Bradley, U.S. Geological Survey, dbradley@usgs.gov.
- T5. **The Role of Interacting Processes in Deformation.** Jeff Marsh, Queens College, jhmarsh@gmail.com; Chris Gerbi, Univ. of Maine, christopher.gerbi@maine.edu; Scott Johnson, Univ. of Maine, johnsons@maine.edu.
- T6. **Retracing the Steps of Northeastern U.S. Geologists in the Past 50 Years.** Jeri Jones, Jones Geological Services, jonesgeo@comcast.net.
- T7. **Hartford Basin through Time.** Stephen Nathan, Eastern Connecticut State Univ., nathans@easternct.edu; Peter Drzewiecki, Eastern Connecticut State Univ., drzewieckip@easternct.edu.
- T8. **Advances in Pleistocene Geology: Northeastern U.S. and Eastern Canada.** Serge Occhietti, Université du Québec à Montréal, occhietti.serge@uqam.ca; George Springston, Norwich Univ., gsprings@norwich.edu; Woodrow Thompson, Maine Geological Survey, woodrow.b.thompson@maine.gov.
- T9. **New Perspectives on Paleoclimate from Advances in Glacial Geology.** Meredith Kelly, Dartmouth College, meredith.kelly@dartmouth.edu; Alice Doughty, Dartmouth College, alice.doughty@dartmouth.edu; Margaret Jackson, Dartmouth College, margaret.s.jackson.gr@dartmouth.edu.
- T10. **Holocene Paleoclimate Perspectives on Present-Day Arctic Change.** Erich Osterberg, Dartmouth College, erich.osterberg@dartmouth.edu; Karl Kreutz, Univ. of Maine, karl.kreutz@maine.edu; Lisa Doner, Plymouth State Univ., ladoner@plymouth.edu.
- T11. **Limnological Records in Past, Present, and Future Climates.** Lisa Doner, Plymouth State Univ., ladoner@plymouth.edu; Julia Daly, Univ. of Maine, julia.daly@maine.edu; Bradford Hubeny, Salem State Univ., bhubeny@salemstate.edu.
- T12. **Pleistocene to Anthropocene Landscape Evolution in the Northeastern U.S.** Will Ouimet, Univ. of Connecticut, william.ouimet@uconn.edu; Noah Snyder, Boston College, noah.snyder@bc.edu.
- T13. **Using Ground-Penetrating Radar to Investigate Near-Surface Geology and Sedimentary Records of Environmental Change.** Steven Arcone, U.S. Army Cold Regions Research & Engineering Laboratory, steven.a.arcone@erdc.dren.mil; James Hyatt, Eastern Connecticut State Univ., hyattj@easternct.edu.
- T14. **Archeological Advances in the Northeastern U.S. and Adjacent Canada.** Steve Pollock, Univ. of Southern Maine, pollock@usm.maine.edu.
- T15. **Applied Geology in New England: Case Histories of Problems Solved.** Richard Lane, New Hampshire Dept. of Transportation; Krystle Pelham, New Hampshire Dept. of Transportation, kpelham@dot.state.nh.us.
- T16. **Coastal and Nearshore Environments of the Northeast.** Dan Belknap, Univ. of Maine, belknap@maine.edu; Joe Kelly, Univ. of Maine, jtkelley@maine.edu.
- T17. **Ecohydrology Science and Sustainability.** Sean Smith, Univ. of Maine, ssmith@maine.edu; Andrew Reeve, Univ. of Maine, asreeve@maine.edu; Ciaran Harman, Johns Hopkins Univ., charman@hu.edu.
- T18. **Fossils in New England: Recent Discoveries and Reinterpretations.** William Clyde, University of New Hampshire, will.clyde@unh.edu.
- T19. **The New England Continental Shelf.** Larry Ward, Univ. of New Hampshire, lgward@ccom.unh.edu.
- T20. **Evolution of Minerals in Diverse Environments: Geobiological and Geochemical Aspects.** Dawn Cardace, Univ. of Rhode Island, dawn.cardace@gmail.com; Amanda Olsen, Univ. of Maine, amanda.a.olsen@maine.edu.
- T21. **Life Cycle of Produced Water from Hydraulic Fracturing of Marcellus and Utica Shales.** Devon Renock, Dartmouth College, devon.j.renock@dartmouth.edu; Nathaniel Warner, Dartmouth College, nathaniel.r.warner@dartmouth.edu.
- T22. **State and Fate of Urban Watersheds in the Northeast.** Jonathan Gourley, Trinity College, jonathan.gourley@trincoll.edu; Suzanne O'Connell, Wesleyan Univ., soconnell@wesleyan.edu.
- T23. **Morphological and Hydrological Responses of Salt Marshes to Anthropogenic and Natural Stressors.** Beverly Johnson, Bates College, bjohnso3@bates.edu; Kristin Wilson, National Estuarine Research Reserve, krwills@gmail.com.
- T24. **Groundwater in the Shallow Coastal Aquifers of the Northeast.** Denis LeBlanc, U.S. Geological Survey, dleblanc@usgs.gov.
- T25. **River Restoration in New England.** Frank Magilligan, Dartmouth College, magilligan@dartmouth.edu; Carl Renshaw, Dartmouth College, rensaw@dartmouth.edu; Anne Lightbody, Univ. of New Hampshire, anne.lightbody@unh.edu.
- T26. **Advances in Topobathymetric Mapping, Models, and Applications.** John Brock, U.S. Geological Survey, brock@usgs.gov; C. Wayne Wright, U.S. Geological Survey, wwright@usgs.gov.
- T27. **Potential for Geothermal Energy in New England.** Matt Davis, Univ. of New Hampshire, matt.davis@unh.edu; Rick Chormann, New Hampshire State Geologist; frederick.chormann@des.nh.gov; Steve Mabee, Massachusetts State Geologist, sbmabee@geo.umass.edu.
- T28. **Disruptive Technology and Geoscience Education.** Declan DePaor, Old Dominion Univ., ddepaor@odu.edu; Steve Whitmeyer, James Madison Univ., whitmesj@jmu.edu; Callan Bentley, Northern Virginia Community College, cbentley@nvcc.edu.
- T29. **Innovative and Multidisciplinary Approaches to Geoscience Education.** Jennifer Hanselman, Westfield State

Univ., [jhanselman@westfield.ma.edu](mailto:jhanselman@westfield.ma.edu); Jennifer Sliko, Penn State Univ.–Harrisburg, [jls1093@psu.edu](mailto:jls1093@psu.edu).

- T30. **Application of Digital Terrain Analysis in Geology, Hydrology, and Geoarchaeology.** Rick Chormann, New Hampshire State Geologist, [frederick.chormann@des.nh.gov](mailto:frederick.chormann@des.nh.gov).
- T31. **Hydrogeology at Hubbard Brook Experimental Forest: Landscape Patterns and Hydrologic Processes.** Scott Bailey, U.S. Forest Service, [swbailey@plymouth.edu](mailto:swbailey@plymouth.edu).
- T32. **Pegmatite Processes and Problems.** Paul Tomascak, SUNY-Oswego, [paul.tomascak@oswego.edu](mailto:paul.tomascak@oswego.edu); Marin Lupulescu, New York State Museum, [mlupules@mail.nysed.gov](mailto:mlupules@mail.nysed.gov).

## FIELD TRIPS

**Mount Washington: Its Summit & Observatory.** Michelle Cruz, Mount Washington Observatory, [mcruz@mountwashington.org](mailto:mcruz@mountwashington.org); Mark Van Baalen, Harvard Univ., [mvb@harvard.edu](mailto:mvb@harvard.edu); Timothy Allen, Keene State College, [tallen@keene.edu](mailto:tallen@keene.edu). Sat., 21 Mar., 7 a.m.; and Sun., 22 Mar., 7 a.m. Observatory member: US\$225; observatory non-member: US\$265. Departs from Mt. Washington Auto Road Base.

**Bedrock Geology and Tectonics of the Presidential Range on Nordic Skis.** J. Dykstra Eusden, Bates College, [deusden@bates.edu](mailto:deusden@bates.edu). Sat., 21 Mar., 8:30 a.m.; and Sun., 22 Mar., 8:30 a.m. US\$10 plus trail pass. Departs from the Nordic Center.

**Landslides in the White Mountains.** P. Thompson Davis, Bentley Univ., [pdavis@bentley.edu](mailto:pdavis@bentley.edu). Sun., 22 Mar., 9 a.m. US\$70. Departs from the hotel.

**Ground Penetrating Radar: Data Collection, Processing, and Analysis.** Steve Arcone, U.S. Army ERDC-Cold Regions Research & Engineering Laboratory, [steve.a.arcone@erdc.dren.mil](mailto:steve.a.arcone@erdc.dren.mil); Seth Campbell, ERDC-Cold Regions Research & Engineering Laboratory, [seth.campbell@erdc.dren.mil](mailto:seth.campbell@erdc.dren.mil). Sun., 22 Mar., 9 a.m. US\$15. Departs from the hotel.

## SPECIAL EVENTS

**50th Anniversary Exhibition: Minerals of New England.** Daily, Sun.–Wed., 22–25 Mar., 9 a.m.–5 p.m.

**50th Anniversary Celebration.** Tues., 24 Mar., 5:30–9 p.m. Fees: professionals: US\$45; students: US\$15. *The reduced student fee is the result of generous support from Dartmouth College.*

## OPPORTUNITIES FOR STUDENTS

**Map & Career Networking Blast—“Connecting Students With Opportunity.”** Come enjoy a FREE pizza supper and networking with professionals and organizations that have employment opportunities in the geosciences.

### On To the Future (OTF)

Stop by the GSA Foundation booth at the Welcome Reception to ask an onsite representative 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 1–4 Nov. 2015 in Baltimore, Maryland, USA).

## Mentor Programs

Sponsored by the GSA Foundation. For more information, contact Jennifer Nocerino at [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).

**Roy J. Shlemon Mentoring Luncheon for Applied Science.** Mon., 23 Mar., lunchtime. Students will have the opportunity to discuss career prospects and challenges with professional geoscientists from multiple disciplines over a FREE lunch. Learn more at [www.geosociety.org/mentors/shlemon.htm](http://www.geosociety.org/mentors/shlemon.htm).

**John Mann Mentoring Luncheon for Applied Hydrogeology.** Tues., 24 Mar., lunchtime. Students interested in applied hydrogeology or hydrology as a career will have the opportunity to network with professionals in these fields over a FREE lunch. Learn more at [www.geosociety.org/mentors/mann.htm](http://www.geosociety.org/mentors/mann.htm).

## Geoscience Career Workshops

Sponsored by the GSA Foundation. For more information, contact Tahlia Bear at [tbear@geosociety.org](mailto:tbear@geosociety.org).

**Part 1: Career Planning and Informational Interviewing.** Mon., 23 Mar., 8 a.m.–9 a.m. Your job-hunting process should begin with career planning, not when you apply for jobs. This workshop will help you begin this process and will introduce you to *informational interviewing*.

**Part 2: Geoscience Career Exploration.** Mon., 23 Mar., 9 a.m.–10 a.m. What do geologists in various sectors earn? What do they do? What are the pros and cons to working in academia, government, and industry? Workshop presenters, and when possible, professionals in the field, will address these issues.

**Part 3: Cover Letters, Résumés, and CVs.** Tues., 24 Mar., 9 a.m.–10 a.m. How do you prepare a cover letter? Does your résumé need a good edit? Whether you are currently in the job market or not, learn how to prepare the best résumé possible. You will review numerous résumés helping you to learn important résumé dos and don'ts.

## Travel Grants

**Application deadline:** 17 Feb. 2015

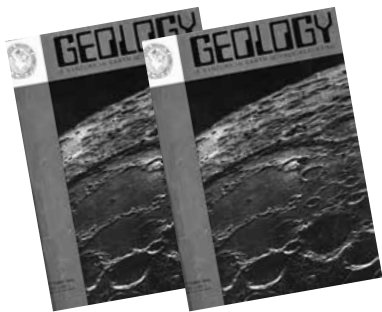
Please review the eligibility guidelines and application procedure. The application form is available at [www.geosociety.org/grants/negrant.htm](http://www.geosociety.org/grants/negrant.htm).

## Volunteer Opportunities

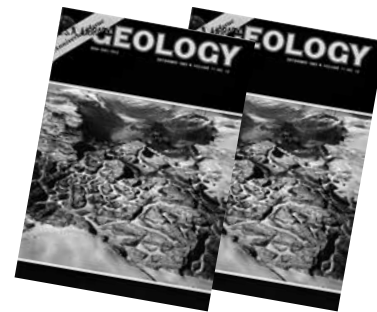
**Application deadline:** 17 Feb. 2015

The Northeastern Section offers free meeting registration to student volunteers in return for two shifts of 4–5 hours of work. Please contact the student volunteer coordinator, Lee Wilder, [geology@des.nh.gov](mailto:geology@des.nh.gov), for more information.





## Geology—Past & Future REVISITED



**Editor's note:** The following is the eighth installment of our encore presentation of articles that highlighted the 10th anniversary of the first issue of *Geology*, as published in *Geology* in Dec. 1983 [v. 11, no. 12, p. 679–691, doi: 10.1130/0091-7613(1983)11<679:GAF>2.0.CO;2]. Each section was written by a different author (author affiliation notations are as originally published in 1983). See the August 2013 *GSA Today* (v. 23, no. 8, p. 18–19) for the first installment and table of contents. In this issue: article 16: “Metamorphic petrology,” by Maria Luisa B. Crawford; and article 17: “Geologic disposal of commercial radioactive waste,” by Cyrus Klingsberg.

# Metamorphic petrology

**Maria Luisa B. Crawford**, *Department of Geology, Bryn Mawr College, Bryn Mawr, Pennsylvania 19010*

Advances in metamorphic petrology reflect an increasing sophistication in interpreting the data preserved in lower crustal and uppermost mantle rocks raised to the surface. Ten years ago the temperature and pressure stability conditions for many common minerals, primarily in aluminous and calcareous rocks, were determined on the basis of reasonable, albeit simplified, reactions among mineral phases. A fluid phase composed of pure water, or water-CO<sub>2</sub> mixtures in calcareous assemblages, was assumed. At the start of the decade, major advances appeared to lie in obtaining ever more reliable geothermometers, usable geobarometers, and a better understanding of the nature of the associated fluid and the role and consequences of diffusion. These expectations have largely been realized. Experimental, thermodynamic, and field data have provided new calibrated assemblages for assigning temperature, pressure, and fugacities of water and CO<sub>2</sub>. Mineral zoning and other kinetically controlled phenomena are also increasingly being utilized for deciphering reaction paths.

The past decade saw fundamental advances in the study and understanding of the metamorphism of mafic rocks, particularly at intermediate metamorphic grades. Similar gains remain to be made for low-temperature and low-pressure metamorphic environments. The progress in thermodynamic calculation of stability relations, one of the major achievements of the past decade, will help in this area but cannot solve the problems of metastability and of the presence of complex mineral phases. After many years of study there is no good assessment of the physical state of the fluid in rocks undergoing metamorphism and of the way that fluid is expelled from the deeper crust. As was predicted in 1973, we are beginning to grasp the true complexity of the chemistry of

this fluid phase. Much remains to be learned about its role in transporting material in the crust and as a heat-transfer agent.

Another area for continuing significant contributions from metamorphic petrologists is the interpretation of rock fabrics. Recrystallization, solution, and diffusion of materials are subjects within the domain of metamorphic petrologists and are fundamental mechanisms by which rock fabrics develop. Mineral deformation, promoting structural instability, and rock deformation, providing channelways for migrating fluids, play significant roles in metamorphic processes. The physical behavior and properties of deep-seated rocks constrain the interpretation of geophysical observations.

Ten years ago careful studies in regions where structural as well as metamorphic relations had been carefully deciphered showed that tectonic models for metamorphic terranes were possible and sorely needed. Major contributions based on thermal modeling have been made in this area; more will certainly come. This focus has encouraged a growing relationship between geochronologists and metamorphic petrologists. The advent of techniques for obtaining dates from just a few grains, and of understanding what information is preserved in metamorphic rocks for the various unstable isotope systems poses new challenges to geochronologists and to metamorphic petrologists, who must ask the right questions and learn which samples will provide the answers. The results will lead to a better grasp of the length of time involved in metamorphic events and in the cooling histories of metamorphic terranes. A hope for the decade is that determination of the bulk and isotopic compositions of individual fluid inclusions will help in understanding the retrograde path of metamorphic rocks as they return to Earth's surface.

Send brief comments to [gsatoday@geosociety.org](mailto:gsatoday@geosociety.org). Should this article spark a longer comment, please consider writing a *GSA Today* Groundwork or science article; learn more at [www.geosociety.org/gsatoday/](http://www.geosociety.org/gsatoday/).

# Geologic disposal of commercial radioactive waste

**Cyrus Klingsberg, U.S. Department of Energy, Washington, D.C. 20545**

Within the past decade several prestigious review groups have judged that (1) geologic disposal is the preferred method of isolating high-level radioactive wastes from the biosphere, (2) disposal in a mined repository can be accomplished in a safe manner, and (3) available technology is adequate to identify and characterize potential sites for a repository. A consensus that developed in the earth-science community included the proposition that safety could be predicted (not proven) only after lithologic and hydrologic properties were determined on a site-specific basis, including in situ measurements at the proposed repository depth. A second proposition holds that because no single property will determine the fate of the buried radionuclides, the waste package and the repository and its geologic environment must be analyzed as a system. The adoption of a systems approach implies that natural barriers to radionuclide migration, to the extent that they are independent, can provide significant assurance of waste isolation and can compensate for imperfect prediction. Also implied is that the waste form and other engineered components of the repository can provide significant barriers to radionuclide migration, but only to the extent that they are tailor-made to be compatible with the host rock and its environment (i.e., the multiple barrier concept).

Since the establishment of these principles, research has advanced considerably. Ten years ago, exploration was concentrated on rock salt. The Department of Energy's current exploration program employs three approaches, each of which can

identify acceptable sites: (1) to look for favorable occurrences of candidate host rocks, (2) to look for favorable environments and host rocks on large federal reservations dedicated to nuclear activities, and (3) to look for favorable geohydrologic environments that contain rocks with suitable properties. Thus, the DOE is investigating salt (bedded as well as domed), tuff, basalt, and "crystalline" (loose term for igneous and metamorphic) rocks.

What seemed to be a job mainly for geologists has turned out to involve a much wider group of interested parties, nontechnical as well as technical. As public awareness of the need for radioactive waste disposal has grown, institutional responses have been made at both the state and federal levels, leading to the passage of the Nuclear Waste Policy Act of 1982. The act requires the DOE to consult with affected states in establishing a repository site. It further provides a mechanism whereby a state can object to the selection of a site within its borders but retains for Congress the ability to override a state's objection.

During the next decade, we expect to select a site and begin excavation of the first repository at one of the nine sites now under study. Barring unexpected geologic or political complications, the currently directed congressional schedule calls for the first repository to begin operation by 1998. The repository would operate in a "retrievable mode" for about 50 years—that is, emplaced waste could be removed if some unforeseen factors should develop that would seriously reduce the safety of the repository. If no untoward events interfered, the repository would be closed, sealed, and monitored for some time.

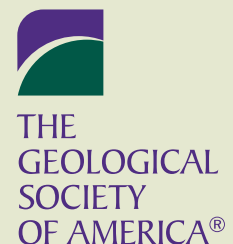
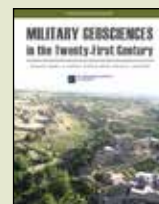
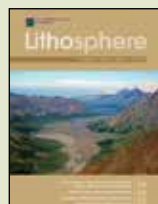
Whether the DOE program for the geologic disposal of radioactive waste will be accepted by the public remains to be seen and depends a great deal on how closely the public is involved in the many choices that must be made along the way. The technical data required to evaluate safety will be developed by earth scientists. The validity of these data, and the predictions based on them, may well be among the most important social challenges facing earth science in the next decade.



## Browse GSA's Journals & Books at [www.gsapubs.org](http://www.gsapubs.org).

*Geology – GSA Bulletin – Geosphere – Lithosphere*

Special Papers – Memoirs – Field Guides – Reviews in Engineering Geology





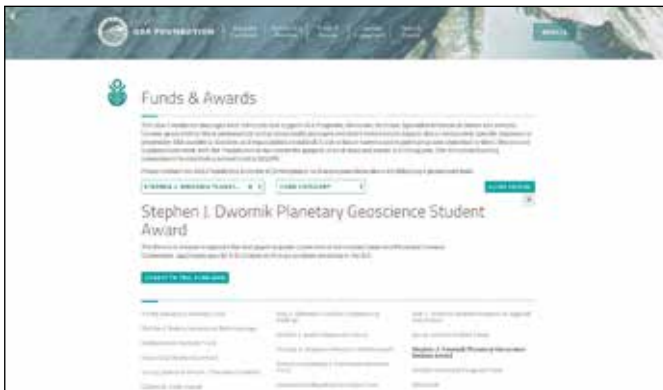
## Announcing a New Website Design

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



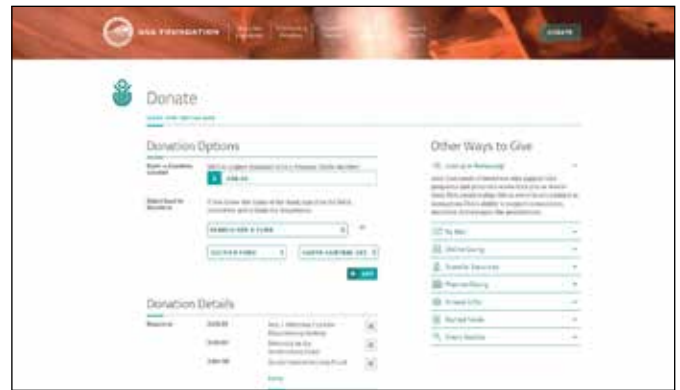
The GSA Foundation is pleased to introduce a completely updated website. The new website is designed to provide visitors with a pleasant, informative, inspiring, and efficient resource for learning about and supporting GSA programs and priorities. The

modern design incorporates suggestions from members as well as current technologies capable of addressing future needs. We invite you to visit the new site at [www.gsafweb.org](http://www.gsafweb.org) to explore several useful new features.



### Informed Choices

Decades of support from GSA members allow the GSA Foundation to offer donors an unmatched range of giving choices. Visitors now have two new search features to identify and display information about giving options. A search bar will enable visitors to search by name or term for specific funds. A second search function will provide a condensed list of giving options grouped by purpose (specialized awards, section funds, division funds, and GSA programs). Each giving option will display a short summary of its purpose and a link to additional information on the GSA website ([www.geosociety.org](http://www.geosociety.org)).



### Efficient Transactions

In response to requests, donors can now include multiple choices in one giving transaction. The search by name or purpose feature will also be available on this page. For your security, the site will utilize the latest encryption and security technology.

We are pleased to provide these improvements for GSA Foundation sponsors, donors, and visitors. The site will also feature enhanced access to information about governance, reporting, and stories about how your donations are advancing the geosciences. We welcome your suggestions and appreciate your support!



# Subaru VIP Member Benefit Ending

Due to corporate-wide shifts in sponsorship strategy, GSA's long-standing partnership with Subaru of America, Inc., will be coming to a close at the end of March 2015. GSA and the GSA Foundation are appreciative of the 14 years of support from this sponsor, which has included the Minority Student Scholarship Program, Outstanding Woman in Science Awards, the Subaru Outdoor Life Lectures, general annual meeting funding, and the VIP Partners Program (an exclusive program for GSA members in the continental USA that offers significant discounts on the purchase of a new Subaru) along with the use of two vehicles for GSA headquarters.

Some of these programs will continue, such as the Woman in Science Award, which has a supporting GSA Foundation fund. Both GSA and the GSA Foundation are looking for new opportunities to continue important programs like the Minority Student Scholarships. Proposals for a new automobile partnership are also underway.



The VIP Partners Program remains available to GSA members until 31 March 2015. Many members have taken advantage of this benefit over the years, which offers a discount on the purchase of a new Subaru. In addition, each sale of a new Subaru through the program results in a US\$100 contribution to the GSA Foundation. To give an idea of the benefit to GSA: In just the second quarter of this year, VIP sales resulted in a US\$2,700 contribution back to GSA. These returns have averaged this amount each quarter for the last two calendar years.

All GSA members who have a minimum of six consecutive months of membership qualify to purchase a Subaru using this discount. If you are interested in taking advantage of this program before the end of March, please contact GSA Sales & Service at [gsaservice@geosociety.org](mailto:gsaservice@geosociety.org) for details.

## Magnetic Susceptibility Equipment

Paleoclimatics, pollution studies, sedimentology and stratigraphy



MS3 Magnetic Susceptibility Meter



MS2B Dual Frequency Sensor



MS2K Surface Scanning Sensor



MS2D Field Probe



MS2C Core Logging Sensor



MS2E Surface Scanning Sensor for Split Cores



MS2 Susceptibility Temperature System



MS2H Downhole Sensor



US distributor  
ASC Scientific | 2075 Corte del Nogal  
Suite T | Carlsbad | CA 92011 | USA  
T: (+1) 800 272 4327  
E: [sales@ascscientific.com](mailto:sales@ascscientific.com)  
W: [www.ascscientific.com](http://www.ascscientific.com)



[www.bartington.com](http://www.bartington.com)  
**Bartington**  
Instruments

# Geoscience Jobs & Opportunities

## Positions Open

### ENVIRONMENTAL BIOGEOCHEMISTRY/ GEOBIOLOGY, DARTMOUTH COLLEGE

The Dept. of Earth Sciences at Dartmouth College invites applications for a junior rank tenure-track position in the general areas of biogeochemistry and geobiology. We especially welcome applications from candidates with research interests that include microbially-mediated biogeochemical interactions in processes of mineralization, weathering, and sequestration of contaminants; hydrocarbon formation and degradation; biogeochemical cycling in fluvial and/or cold environments, including river-channel, floodplain, and lacustrine ecosystem response to environmental change. Particular attention will be given to candidates who combine a focus on understanding fundamental processes with state-of-the-art laboratory and/or field research programs that complement and contribute to ongoing research activities in the department as well as in Dartmouth's Geisel School of Medicine and Thayer School of Engineering. The successful candidate will continue Dartmouth's strong traditions in graduate and undergraduate research and teaching. Teaching responsibilities consist of three courses spread over three of four ten-week terms.

The Dept. of Earth Sciences is home to 11 tenured and tenure-track faculty members in the School of Arts and Sciences, and enjoys strong Ph.D. and M.S. programs and outstanding undergraduate majors. To create an atmosphere supportive of research, Dartmouth College offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence, and flexible scheduling of teaching responsibilities.

Dartmouth College, a member of the Ivy League, is located in Hanover, New Hampshire (on the Vermont border). Dartmouth has a beautiful, historic campus located in a scenic area on the Connecticut River. Recreational opportunities abound all year round. To learn more about Dartmouth College and the Dept. of Earth Sciences, visit [www.dartmouth.edu/~earthsci](http://www.dartmouth.edu/~earthsci).

To submit an application, send curriculum vitae, statements of teaching and research interests and objectives, reprints or preprints of up to three of your most significant publications, and the name, address (including street address), e-mail address and fax/phone numbers of at least three references to: Environmental Biogeochemistry / Geobiology Search Committee, Dept. of Earth Sciences, Dartmouth College 6105 Fairchild Hall, Hanover, NH 03755, e-mail: [earth.sciences@dartmouth.edu](mailto:earth.sciences@dartmouth.edu)

Applications received by November 7, 2014 will receive first consideration. The appointment will be effective July 1, 2015.

Dartmouth is an equal opportunity/affirmative action employer with a strong commitment to diversity. In that spirit, we are particularly interested in receiving applications from a broad spectrum of people, including women, persons of color, persons with disabilities, veterans or any other legally protected group.

### LECTURER DEPARTMENT OF GEOLOGY COLLEGE OF WILLIAM & MARY

The Dept. of Geology at the College of William & Mary invites applications for a continuing non-tenure-eligible faculty lecturer position that will begin August 10, 2015. The department has six full-time faculty and a laboratory coordinator, and graduates ~25 undergraduate majors per year. We seek a colleague eager to interact with undergraduates in an environment in which both teaching and research are emphasized. Primary responsibilities include teaching introductory geology courses, geology labs, and one or more upper level courses. Other duties may include oversight of select department facilities (e.g., computer lab, analytical labs) and supervision of senior research projects. While the field of specialty is open, we seek an individual who can bring additional expertise to our program.

Candidate must apply online at <https://jobs.wm.edu>. Submit a curriculum vitae, a cover letter, and statements of teaching and research interests. You will be prompted to submit online the names and email addresses of three references who will be contacted by us with instructions on how to submit a letter of reference.

For full consideration, submit application materials by the review date, January 5, 2015. Applications received after the review date will be considered if needed.

Required: A Master's degree in an appropriate field is required.

Preferred: A Ph.D. or ABD is preferred at the time the candidate begins the appointment (August 10, 2015).

Information on the degree programs in the Dept. of Geology can be found at [www.wm.edu/as/geology/](http://www.wm.edu/as/geology/).

The College of William & Mary values diversity and invites applications from underrepresented groups who will enrich the research, teaching and service missions of the university. The College is an Equal Opportunity/Affirmative Action employer and conducts background checks on applicants for employment.

### RESEARCH POSITION IN SEDIMENT RADIONUCLIDE GEOCHEMISTRY

#### U.S. GEOLOGICAL SURVEY NATIONAL CENTER, RESTON, VIRGINIA

The U.S. Geological Survey, a center for geochemical research for the Nation providing unbiased research in the fields of Water, Climate, Natural Hazards, Ecosystems, Energy and Minerals, and Environmental Health (<http://water.usgs.gov/nrp/>) seeks candidates for a full-time permanent research position in sediment radionuclide geochemistry at the GS-11 or GS-12 grades. This is an interdisciplinary position and may be filled under any of several job series: Research Hydrologist/Chemist/Physical Scientist/Geologist. Grade and salary (in the range of \$60,000 to \$90,000) will be based on education and experience. Prior to starting employment with the USGS, a successful applicant will have demonstrated educational and research accomplishments, through the obtainment of a Ph.D. or equivalent doctoral degree, or through equivalent experience and knowledge, in a field related to radionuclide geochemistry. Environments of interest include surface water, ground

water and sediment, disturbed and pristine. The applicant will have demonstrated scientific vision, leadership, and productivity on exciting, societally-relevant, and collaborative inter-disciplinary research topics. The successful candidate will lead a research program which develops laboratory capabilities and guides research applications in the area of sediment fate and transport. The scientist will develop collaborations with USGS research scientists and provide assistance and direction in methods development for the Center for Sediment Dynamics and Forensics (CSDF), a center of excellence for research focused on critical sediment-related issues. A full range of observational and experimental techniques in both the laboratory and the field is applied to the research problems. Examples of techniques to be used by the CSDF include: radiometric techniques (14C, 137Cs, 7Be, 234U, 238U and other radioisotopes), Optically Stimulated Luminescence, Electron Spin Resonance, X-ray mineralogy, stable isotopes (light and heavy), basic elemental analysis, geochemical phase analyses, organic molecular markers, rare earth and trace element distributions, and carbon and nutrient analyses.

The online vacancy announcement contains additional information regarding these and other qualifications requirements. The opening date of this vacancy announcement is December 1, 2014. Applications (resumes and questionnaire responses) must be received online BEFORE midnight Eastern Time on the closing date of the announcement. It is important that candidates view the Vacancy Announcement in its entirety to be sure that all required documents are submitted. Incomplete application packages cannot be considered. For further information, please contact: Harry Jenter, 703-648-5916, [hjenter@usgs.gov](mailto:hjenter@usgs.gov), or Pierre Glynn, 703-648-5823, [pglynn@usgs.gov](mailto:pglynn@usgs.gov) in the Branch of Regional Research, or Aleccia Leyba, 303-236-9573, [aleyba@usgs.gov](mailto:aleyba@usgs.gov), Human Resources Specialist. After the opening of the vacancy on or about December 1, the vacancy announcements should be found on the Office of Personnel Management's USAJOBS website at [www.usajobs.opm.gov](http://www.usajobs.opm.gov). The Vacancy Announcement numbers are: ATL-2015-0049 (Open to all US Citizens), and ATL-2015-0050-Merit Promotion (for current or former Federal employees with competitive status or who are eligible under a special appointing authority such as VRA, Severely Physically Disabled, Returning Peace Corp Volunteers and VEOA eligibles.) U.S. citizenship is required. The USGS is an Equal Opportunity Employer.

### ASSISTANT PROFESSOR GEOPHYSICS

#### CONOCOPHILLIPS SCHOOL OF GEOLOGY AND GEOPHYSICS, MEWBOURNE COLLEGE OF EARTH & ENERGY UNIVERSITY OF OKLAHOMA

The University of Oklahoma invites applications for a tenure-track position in Geophysics at the rank of Assistant Professor. The school has a strong seismic program and is looking for a faculty member to broaden the scope of the program in non-seismic methods. We seek a dynamic colleague who will teach and supervise students at all levels, while conducting an independent, externally funded research program in his/her field of expertise.

The candidate should hold a Ph.D., have a demonstrated research record, and an interest in teaching undergraduates and mentoring graduate students. Potential areas of interest include gravity, magnetics, electromagnetics, and GPS applied to crustal processes. Salary, benefits, and start-up funds will be competitive and commensurate with experience. The ConocoPhillips School of Geology and Geophysics has a large, vibrant faculty with a broad range of research activities and strong ties to the petroleum industry. The student body currently includes 182 undergraduates and 110 MS and Ph.D. students. The Mewbourne College of Earth & Energy possesses extensive software and computing labs with PC and Linux platforms networked to our own dedicated cluster within the OU supercomputer center (OSCER). The College hosts numerous industrial consortia, a research institute focused on seismic monitoring, and a field campus in Colorado for field courses in geology and geophysics. The geophysics group conducts active research projects that are funded by industry as well as by U.S. and foreign government agencies and institutes. The College maintains a comprehensive pool of geophysical equipment including GPR, seismic (active and passive), magnetic, and gravity instruments as well as extensive rock physics characterization laboratories. Through collaboration with industry, we have a suite of 3D seismic and microseismic data volumes that are used for teaching, algorithm calibration, seismic geomorphological analysis, crustal imaging, and a range of open source software for lithospheric-scale research. Information about the School and College, the facilities and the entities that it houses can be found at <http://geology.ou.edu>.

Review of applications will begin December 1, 2014, and on-campus interviews will start early in 2015. The search will continue until the position is filled. The anticipated starting date is August 15, 2015. Applicants are requested to submit a complete vita/resume, statement of research and teaching interests, and a list of five references who can be contacted, including phone numbers, e-mail addresses, and mailing addresses. Questions or information requests may be addressed to Chair of the Geophysics Search Committee, at (405) 325-3253, or [ougeophysicssearchchair@ou.edu](mailto:ougeophysicssearchchair@ou.edu). Applications and nominations should be addressed to Geophysics Search Committee, University of Oklahoma, Sarkeys Energy Center, 100 E. Boyd Street, Room 710, Norman, OK 73019-1008.

The University of Oklahoma is an Affirmative Action, Equal Opportunity Employer. Women and minorities are encouraged to apply. Protected veterans and individuals with disabilities are encouraged to apply.

**DEPARTMENT OF GEOLOGY, GEOGRAPHY,  
AND ENVIRONMENTAL STUDIES  
CALVIN COLLEGE**

Applications are invited for a tenure-track geology position beginning September 2015, pending final administrative approval. Ph.D. in hand or near completion is required. The successful candidate will teach introductory geology, mineralogy, igneous and metamorphic petrology, structural geology, and participate in the department's field-oriented geology courses in southwestern Montana in May. Potential

additional course teaching could include geochemistry and/or environmental geology or other topics depending on the candidate's background and interests. Candidates are encouraged to develop a research program with undergraduates. Rank is open.

Calvin College is a Christian college in the Reformed tradition, and all faculty are expected to support the college's religious commitment and educational mission. Calvin is building a tradition of diversity, and seeks faculty who will contribute to that effort. More information can be obtained at [www.calvin.edu/admin/provost/](http://www.calvin.edu/admin/provost/).

Applicants should send a resume, transcripts, and three letters of recommendation to: Dr. Ralph Stearley, Dept. of Geology, Geography, and Environmental Studies, Calvin College, Grand Rapids, MI 49546. We will begin reviewing applications starting December 15, 2014.

**OPEN RANK (ASSISTANT, ASSOCIATE,  
OR FULL), DEPT. OF GEOLOGY AND  
GEOPHYSICS, COLLEGE OF GEOSCIENCES  
TEXAS A&M UNIVERSITY**


To significantly advance research and instructional excellence in basin tectonics and analysis, the Dept. of Geology and Geophysics invites applications for a tenure-track and/or tenured position. We seek applicants whose interest is in lithospheric controls on basin formation, structural architecture of basins and application of sequence stratigraphy to understanding basin formation mechanisms. The applicant must have a research background in tectonics/structural geology and a demonstrable record of

integrating geological and geophysical data. Candidates research interests and expertise should broaden and complement existing strengths in the Dept. of Geology and Geophysics and in particular contribute to and enhance research programs in petroleum studies and basin modeling conducted through the Berg-Hughes Center for Petroleum and Sedimentary Systems. The candidate will have the opportunity to collaborate with colleagues in a variety of related fields on the College of Geosciences that include the Center for Tectonophysics and the International Ocean Discovery Program (IODP), among others.

The academic appointment will be for nine-months, tenure track or tenured position, and is expected to be at the assistant, associate, or full professor level. Candidates with suitable qualifications may be considered for appointment as full professor, and a possible endowed chair.

Applicants should demonstrate a strong record of scholarship and the potential for developing an internationally recognized research and teaching program. The candidate will be expected to teach effectively at the undergraduate and graduate levels in his or her specialty and to supervise undergraduate, M.S. and Ph.D. research. For more information about Texas A&M University, the College of Geosciences and the Dept. of Geology and Geophysics, see <http://geoweb.tamu.edu>.

A Ph.D. is required, and the appointment may begin Sept 1, 2015 or earlier. Review of applications will begin December 1, 2014 and will continue until a suitable candidate is found. Applicants should



**NORTHWESTERN  
UNIVERSITY**

**WEINBERG  
COLLEGE OF  
ARTS & SCIENCES**

**GEOPHYSICAL FLUID DYNAMICS/CLIMATE  
DYNAMICS**

The Department of Earth and Planetary Sciences at Northwestern University invites applications for a tenure track, assistant professor position in geophysical fluid dynamics/climate dynamics, to begin as early as fall 2015.

Specifically, we seek a scientist who employs theoretical, observational, and/or numerical methods to study coupled geophysical fluid dynamical processes within the atmosphere, hydrosphere, cryosphere, and/or lithosphere. Candidates whose expertise complements that of existing faculty in solid earth geophysics, planetary science, and paleoclimate are particularly encouraged. The successful candidate is expected to teach both undergraduate and graduate courses and lead a vibrant externally funded research program. A Ph.D. is required at the time of appointment.

Deadline for applications is December 31, 2014. Applicants should visit [www.earth.northwestern.edu](http://www.earth.northwestern.edu) for submission instructions. AA/EOE.



submit a PDF including a letter of application, curriculum vita with details of published work, a statement of research and teaching interests, and contact information (including e-mail address) for at least four references to Dr. Carlos A. Dengo at [cdengo@tamu.edu](mailto:cdengo@tamu.edu); questions may be directed to the same e-mail address.

Texas A&M is a land, sea and space grant university located in a metropolitan area with a dynamic and international community of 200,000. Texas A&M is an affirmative action/equal opportunity employer committed to excellence through the recruitment and retention of a diverse faculty and student body and compliance with the Americans with Disabilities Act. We encourage applications from minorities, women, veterans and persons with disabilities. Texas A&M University also has a policy of being responsive to the needs of dual-career partners: <http://dof.tamu.edu/content/partner-placement>.

**ASSISTANT PROFESSOR, CARBONATE  
SEDIMENTOLOGY/STRATIGRAPHY  
DEPT. OF GEOLOGY AND GEOPHYSICS  
COLLEGE OF GEOSCIENCES  
TEXAS A&M UNIVERSITY**

The Dept. of Geology and Geophysics at Texas A&M University invites applications from individuals for a tenure-track faculty position as assistant professor in Carbonate Sedimentology/Stratigraphy. The position begins August 2015.

We seek candidates who will develop an externally-funded research program in the general area of Carbonate Sedimentology/Stratigraphy. This includes but is not limited to one or more of the following research topics: sequence stratigraphy, the sedimentary record of long-term climate change, depositional processes, and diagenesis. We seek applicants with strong potential to collaborate with current faculty as well as potential to interact with the Integrated Ocean Drilling Program and the Berg-Hughes Center for Sedimentary and Petroleum Systems, both housed within the College of Geosciences at Texas A&M, and the Dept. of Petroleum Engineering at Texas A&M.

Applicants for the position must have a Ph.D. at the time of appointment. Post-doctoral research and teaching experience and past experience in the petroleum industry are desirable traits for this position. A record of research in both ancient and modern carbonate systems is preferred. Successful applicants will be expected to teach effectively at the undergraduate and graduate levels in their specialty, including classes in the Petroleum Certificate curriculum; supervise undergraduate, M.S. and Ph.D. research, including students who are interested in pursuing careers in the petroleum industry. The successful candidate will be expected to initiate and maintain a vigorous, externally funded research program. Opportunities exist to participate in and build on collaborative programs with colleagues in isotope geochemistry, seismic methods, photogrammetry and GPS in the College of Geosciences.

Interested candidates should submit electronic versions of a curriculum vita, statement of research interests and teaching philosophy, the names and email addresses of at least three references, and up to four reprints by email attachments, to the Chair of the Sedimentology Search Committee ([\[geos.tamu.edu\]\(mailto:geos.tamu.edu\)\). Screening of applications will begin December 1, 2014 and continue until the position is filled. The Dept. of Geology and Geophysics \(\[geoweb.tamu.edu\]\(http://geoweb.tamu.edu\)\) is part of the College of Geosciences, which also includes the Departments of Atmospheric Sciences, Geography, and, Oceanography and Sea Grant, the Geochemical and Environmental Research Group \(GERG\), and the Integrated Ocean Drilling Program \(IODP\). Texas A&M University, a land-, sea-, and space-grant university, is located in a metropolitan area with a dynamic and international community of 172,000 people. Texas A&M University is an affirmative action/equal opportunity employer committed to excellence through the recruitment and retention of a diverse faculty and student body and compliance with the Americans with Disabilities Act. We encourage applications from minorities, women, veterans, and persons with disabilities. Texas A&M University also has a policy of being responsive to the needs of dual-career partners.](mailto:sedsearch@</a></p>
</div>
<div data-bbox=)

**FACULTY POSITION  
ENERGY GEOSCIENCES  
VIRGINIA TECH**

The Dept. of Geosciences at Virginia Polytechnic Institute & State University ("Virginia Tech") invites applicants for a tenure track position in energy geosciences. We seek a broad-thinking, multidisciplinary scientist employing a combination of field, analytical, experimental and/or theoretical approaches to understanding complex problems related to energy resources. Energy geosciences includes the origin of both conventional and unconventional hydrocarbon occurrences, natural and enhanced geothermal systems, research related to the materials and natural resources that produce energy, and the genesis of deposits that produce the materials for energy generation.

The successful candidate will be expected to establish an active externally funded research program and develop strong ties with stakeholders and constituents (private and public sectors), teach a range of undergraduate and graduate courses, advise and mentor students, maintain an exemplary record of scholarly activity, and contribute to university and professional service. A doctorate is required at the time of appointment.

How to apply: Applications should include a cover letter, curriculum vita, a statement of research and teaching interests, and the names and email addresses of four individuals from whom the search committee can request letters of reference. Interested candidates should apply online at [www.jobs.vt.edu](http://www.jobs.vt.edu) to posting number TR0140131 (see direct link below). Review of applications will commence December 15, 2014. The position will remain open until filled. Questions related to your submission may be directed to Professor Robert Bodnar ([rjb@vt.edu](mailto:rjb@vt.edu)) who serves as chair of the search committee.

Virginia Tech is an equal opportunity employer and is committed to increasing the diversity of its faculty. It welcomes applications from women, members of minority groups, protected veterans and individuals with disabilities, as well as from others who would bring additional dimensions to the university's research, teaching and outreach missions.

Apply here: <https://listings.jobs.vt.edu/postings/52633>.

**TENURE-TRACK ASSISTANT PROFESSOR  
POSITIONS IN STRUCTURAL GEOLOGY  
AND CARBONATE SEDIMENTOLOGY  
KANSAS STATE UNIVERSITY**

The Dept. of Geology at Kansas State University invites applications for two tenure-track faculty positions at the assistant professor level beginning in August 2015 in the areas of Carbonate Sedimentology and Structural Geology. A detailed advertisement for both positions is located at [www.ksu.edu/geology](http://www.ksu.edu/geology). Screening of applications begins December 15, 2014 and continues until the position is filled. Kansas State University is an EOE of individuals with disabilities and protected veterans. Kansas State University actively seeks diversity among its employees. Background check required.

**ASSISTANT PROFESSOR OF GEOLOGY  
IN IGNEOUS AND METAMORPHIC  
PETROLOGY  
CALIFORNIA STATE UNIVERSITY,  
SAN BERNARDINO**

The Dept. of Geological Sciences at California State University, San Bernardino invites applicants for a tenure-track position at the Assistant Professor level starting September 2015. A Ph.D. is strongly preferred at time of appointment; strong ABD candidates may be considered. The successful candidate will have demonstrated strength in the general area of igneous and metamorphic petrology. Courses to be taught could include mineralogy, optical mineralogy, igneous and metamorphic petrology, geochemistry, elective courses in the candidate's field of specialization, as well as a general education course in geology and an upper division capstone course in earth sciences. The appointee will be expected to advise and work closely with undergraduate students in senior research projects and with graduate students in the Earth and Environmental Sciences MS program. The appointee will provide evidence of excellence in teaching and ongoing scholarship, especially in the area of combining geologic field methods with laboratory approaches. The department strongly supports increasing diversity in both student and faculty populations; under-represented minorities, women and veterans are strongly encouraged to apply. For more information about the department, please visit <http://geology.csusb.edu>.

Applications must be submitted electronically using <http://agency.governmentjobs.com/csusb/default.cfm?transfer=1> and must include a cover letter, a curriculum vitae, recent transcripts (official transcripts will be required pending an offer), statements of research/professional accomplishments and goals, and teaching philosophy and strategies, together with the names and complete contact information of at least three references. Review of the applications will begin January 12, 2015, and will continue until position is filled. Inquiries about this position may be directed to Dr. Alan L. Smith (e-mail: [alsmith@csusb.edu](mailto:alsmith@csusb.edu)).

California State University, San Bernardino is an Affirmative Action/Equal Opportunity Employer. We consider qualified applicants for employment without regard to race, color, reli-

gion, national origin, age, gender, gender identity/ expression, sexual orientation, genetic information, medical condition, marital status, veteran status, or disability.

**ASSOCIATE PROFESSOR OR  
PROFESSOR-LEVEL SENIOR GEOSCIENTIST  
CALIFORNIA STATE UNIV., BAKERSFIELD**

The Dept. of Geological Sciences at California State University, Bakersfield seeks to hire a tenure-track faculty member at the Associate Professor or Professor level beginning in the Fall of 2015. Though the particular expertise is open, applicants who specialize in Geophysics, Quaternary Geology, Petroleum Geology, Petrophysics, or Hydrogeology will receive preference. The successful candidate will be expected to chair the department starting in the Fall of 2017 for at least one three-year term. Review of applications will begin after December 31, 2014 and continue until the position is filled. The full announcement, more information about the department and the university, and application information can be found at [www.csusb.edu/geology/\\_files/TT14.pdf](http://www.csusb.edu/geology/_files/TT14.pdf).

**FACULTY POSITION  
IN SOLID EARTH SCIENCE  
UNIVERSITY OF MINNESOTA DULUTH**

The Dept. of Earth and Environmental Sciences at the University of Minnesota Duluth invites applications for a tenure-track appointment to begin August of 2015. We seek a broadly-based earth scientist who will complement our existing teaching and research strengths in crustal geology, resources, surficial processes, sedimentology, paleoclimatology, hydrogeology, planetary geology, and geophysics. Fields of



## Marshall-Heape Chair, Solid-Earth Geophysics

The Department of Earth and Environmental Sciences at Tulane University invites applications for the newly established Marshall-Heape Chair in Geology, in the Department of Earth and Environmental Sciences at Tulane University. We seek a scholar with an outstanding international reputation who will be appointed at the Full Professor level with tenure. We particularly seek a broad-based geoscientist with a research focus in Solid-Earth Geophysics, who complements current faculty expertise and offers potential for collaborative research. The Marshall-Heape Chair is expected to lead a widely recognized, externally funded research program that will attract PhD-level graduate students and postdoctoral scholars of the highest caliber. Teaching duties are both at the graduate and undergraduate levels. For full consideration, applications should be received by January 15, 2015, but the position will remain open until filled. Applications should include a curriculum vitae, research and teaching statements that articulate how the mission of the department would be enhanced, and the names and contact information of at least three references. Applications must be submitted electronically via the following link: [apply.interfolio.com/27240](http://apply.interfolio.com/27240). Any inquiries may be directed to Dr. Torbjörn Törnqvist, Department of Earth and Environmental Sciences, Tulane University, 6823 St. Charles Ave., New Orleans, LA 70118-5698 ([tor@tulane.edu](mailto:tor@tulane.edu)). Further information about the department and university can be obtained at <http://tulane.edu/sse/eens>. Tulane University is an EEO/ADA/AA employer.

### Now Accepting Applications:

## GSA Education & Outreach Programs

Application deadline for both programs: 3 Feb. 2015



### GeoCorps™ America—Summer 2015

GSA is now accepting applications for paid geoscience opportunities on public lands managed by the National Park Service, the U.S. Forest Service, and the Bureau of Land Management. All levels of geoscientists—students, educators, professionals, retirees, and others—are encouraged to apply. Learn more at [www.geosociety.org/geocorps](http://www.geosociety.org/geocorps) and [www.facebook.com/GeoCorps](http://www.facebook.com/GeoCorps).

### Mosaics in Science—Summer 2015

GSA is now accepting applications for paid STEM (science, technology, engineering, and math) opportunities in National Parks throughout the United States. The goal of the Mosaics program is to increase the level of diversity among those who seek STEM careers within the National Park Service. Learn more at [www.geosociety.org/mosaics](http://www.geosociety.org/mosaics).



The National Park Service  
The Geological Society of America®

expertise may include, but are not limited to, mineral science, petrology, economic geology, fluid-rock interactions, geodynamics, tectonics, and early Earth history. This is a tenure-track faculty position with responsibility for teaching, research and service to the University. Appointment at the Assistant Professor level is preferred, but applicants with appropriate qualifications may be considered at the Associate Professor level.

Essential qualifications for the position are: (1) completion of a Ph.D. in earth science by July 1, 2015, from a regionally-accredited university or equivalent program; (2) expertise in mineral science, which may include mineralogy, petrologic applications of mineralogy, geochemistry, economic geology, or mineral physics; (3) potential for acquiring external research funding; (4) an established or emerging research publication record; (5) experience in teaching, which may include teaching assistantships; and (6) excellent written communication skills. Essential qualifications for an appointment as Associate Professor also include teaching, scholarship, and leadership commensurate with department expectations for promotion to Associate Professor. Preferred qualifications for all candidates include an interest in interdisciplinary research, collaboration with individuals of diverse backgrounds, and in attracting undergraduate and graduate students who traditionally are underrepresented in the geosciences; and demonstrated excellent oral communication and interpersonal skills. Currently, our faculty teach three courses per year. The successful candidate will teach a core geology majors' course in Mineralogy, including optical mineralogy, plus other introductory- to graduate-level courses each year. The candidate will also be expected to develop an externally funded research program that involves both undergraduate and graduate students, and to provide service to the profession, campus, and greater community.

For a complete position description, information about our program, and how to apply online, visit the following website: <http://employment.umn.edu/applicants/Central?quickFind=125390>. Formal review of applications will begin on January 5, 2015 and applications must be received by February 1, 2015, to be considered. The University of Minnesota is an equal-opportunity educator and employer, and we encourage individuals from underrepresented groups to apply. For further information regarding this position, please contact Prof. John Goodge, Chair of the Earth Science Faculty Search Committee.

**ASSISTANT, ASSOCIATE, OR  
FULL PROFESSOR, STRUCTURAL  
GEOLOGY/TECTONICS  
SCHOOL OF THE ENVIRONMENT  
WASHINGTON STATE UNIVERSITY  
Position #119909**

Washington State University (WSU) is currently seeking to fill a tenure-track/tenured Assistant, Associate or Full Professor position in the area of Structural Geology/Tectonics. This position is a permanent, 9-month faculty position located on the Pullman Campus. This position is part of a multi-year series of new hires intended to contrib-

ute to the growth and development of the School of the Environment, an interdisciplinary academic unit at WSU that focuses on Earth, Water, and the Environment. Duties include developing and teaching undergraduate and graduate courses and mentoring MS and Ph.D. graduate students. The successful candidate will develop an internationally recognized research program in structural geology/tectonics. Specific areas of emphasis within this broad field are open, but we are particularly interested in candidates who will develop an externally funded research program that includes a strong field-based component.

Required: Assistant Professor: Earned doctorate in a discipline related to structural geology and tectonics, at time of employment; record of research accomplishments as demonstrated by peer-reviewed publications and/or extramural grantsmanship; demonstrated ability and/or potential to successfully teach and mentor students at the graduate and undergraduate levels. Associate Professor: in addition, 6 years of experience as an Assistant Professor or equivalent. Professor: in addition, 6 years of experience as an Associate Professor or equivalent, and national/international reputation in their field.

Preferred: Demonstrated ability to: develop collaborations; teach field camp and other field-based courses; lead field trips at the undergraduate and graduate level; and develop a strong field-based research component.

For questions about the position contact Jeff Vervoort at (509) 335-5597; [vervoort@wsu.edu](mailto:vervoort@wsu.edu).

To apply visit: <https://www.wsujobs.com>. Application materials must include a letter describing how your experience and training meet qualifications for the position, a research plan, a statement of teaching philosophy, current vitae, and names and contact information for three professional references. Screening begins January 6, 2015. EEO/AA/ADA.

**FIXED-TERM INSTRUCTOR  
GEOLOGICAL SCIENCES AND  
INTEGRATIVE STUDIES  
MICHIGAN STATE UNIVERSITY  
EAST LANSING, MICHIGAN**

The Dept. of Geological Sciences & the Center for Integrative Studies in General Science, are jointly seeking a fixed-term faculty instructor to teach undergraduate general education science courses (emphasis on the Integrative Physical Sciences).

- Appointment begins 8/16/15 and will be a renewable, one year (9 months) position with expectation of continuation based on satisfactory performance. Opportunities exist to teach summer semester classes for additional pay.
- Responsibilities include teaching integrative science courses (e.g., History of Life; Climate Change) and Earth Science courses.
- Teaching loads will typically be two to three sections per semester.
- Opportunities exist to teach upper-level courses in Geological Sciences, to participate in building online courses, and collaborate with researchers engaged in cutting-edge research in disciplinary-based science education.
- Minimum qualifications include: Ph.D. in Earth

Sciences, related fields, or in science education with an earth science emphasis; and evidence of training or experience in teaching undergraduate science courses. Salary will be commensurate with experience.

Please submit a CV, a statement of teaching philosophy and experience, application, and three letters of recommendation to [jobs.msu.edu](mailto:jobs.msu.edu) (posting number 0193). Application review begins Dec. 15th, 2014, and will continue until the position is filled.

For questions contact: David T. Long, Chair of the Search Committee ([long@msu.edu](mailto:long@msu.edu))

Gabe Ording, Director of the Center for Integrative Studies ([ordingga@msu.edu](mailto:ordingga@msu.edu))

**TENURED OR TENURE-TRACK  
PROFESSOR, IGNEOUS AND/OR  
METAMORPHIC PETROLOGY  
DEPT. OF GEOLOGICAL SCIENCES  
THE UNIVERSITY OF TEXAS AT AUSTIN**

The Dept. of Geological Sciences at The University of Texas at Austin seeks to hire a faculty member in the field of igneous and/or metamorphic petrology. We seek an outstanding scientist who will establish an innovative, world-class, externally funded research program in the petrological evolution of the Earth's crust and/or mantle. The field of interest is open, but preference will be given to candidates who would complement and interact with our existing strengths in structural and metamorphic evolution of the lithosphere, magmatic processes, and/or mantle dynamics. We seek a candidate who will take advantage of the existing geochemical analytical capabilities of the Jackson School, and in particular the electron microprobe, scanning electron microscopes, laser ablation single and multi-collector ICP-MS, TIMS, stable isotope laboratories, and High Resolution Computed X-Ray Tomography facility, as well as interact with and possibly utilize the existing experimental petrology and high-pressure mineral physics laboratories. The search is open rank, with a preference for those at the Assistant Professor level. A Ph.D. is required by the expected start date (August 22, 2015).

The Dept. of Geological Sciences is part of The Jackson School of Geosciences (JSG), which also includes two research units, the Institute for Geophysics ([www.ig.utexas.edu/](http://www.ig.utexas.edu/)) and the Bureau of Economic Geology ([www.beg.utexas.edu/](http://www.beg.utexas.edu/)). The JSG is home to more than 190 research scientists and faculty members, and one of the largest combined graduate and undergraduate enrollments of any major Earth science program in the country. At JSG, petrology is a part of the Solid Earth and Tectonic Processes research theme and the Petrology and Mineral Physics discipline.

Review of applications will begin December 31, 2014, and continue until the position is filled. All interested applicants should submit cover letter, CV, research statement, teaching statement, and complete contact information for three letters of reference via e-mail to [dgs@jsg.utexas.edu](mailto:dgs@jsg.utexas.edu). Questions regarding the search may be addressed to the head of the search committee, Dr. James Gardner, at [gardner@jsg.utexas.edu](mailto:gardner@jsg.utexas.edu).

Background check conducted on applicant selected.



The University of Texas at Austin is an Affirmative Action/Equal Opportunity Employer.

**ASSISTANT PROFESSOR  
IN WATER SCIENCE,  
DEPT. OF GEOLOGICAL SCIENCES  
JACKSON SCHOOL OF GEOSCIENCES  
THE UNIVERSITY OF TEXAS AT AUSTIN**

The Dept. of Geological Sciences in the Jackson School of Geosciences at The University of Texas at Austin seeks to hire a tenure-track Assistant Professor in Water Science. We seek candidates at the forefront of their science who will contribute to leadership in research and teaching. Candidates interested in chemical, physical, and biological processes, or water resource sustainability, are encouraged to apply.

We are interested in a wide range of disciplines related to water including but not limited to: (1) physical hydrology, (2) low-temperature geochemistry, (3) remote sensing and geophysics, and (4) alpine and glacial hydrology.

As part of the Jackson School of Geosciences ([www.jsg.utexas.edu](http://www.jsg.utexas.edu)), the department ([www.geo.utexas.edu](http://www.geo.utexas.edu)) has over 50 faculty and a community of research staff with a broad range of specialization and access to outstanding research facilities and equipment.

Applicants should submit a letter of application, curriculum vitae, statements of research and teaching interests, and contact information for at least three references. Submit a compiled electronic copy to [[water.search@jsg.utexas.edu](mailto:water.search@jsg.utexas.edu)] or send to: Water Science Search Committee, Dept. of Geological Sciences, University of Texas at Austin, Austin TX 78712. Review of applications will begin December 15, 2014 and continue until the position is filled.

Background check conducted on applicant selected.

The University of Texas at Austin is an Affirmative Action/Equal Opportunity Employer.

**GEOLOGY AND GEOLOGICAL  
ENGINEERING, SOUTH DAKOTA  
SCHOOL OF MINES AND TECHNOLOGY**

The Dept. of Geology and Geological Engineering at the South Dakota School of Mines & Technology invites applications for a nine-month tenure track position in Geology and Geological Engineering with an expertise in geophysics. The position will be filled at the Assistant, Associate, or Full Professor level. An earned doctorate in geophysics or a closely related discipline is required by the anticipated August 2015 starting date. The successful candidate will develop and teach undergraduate and graduate courses in geophysics and related fields, develop and maintain a strong externally funded research program that complements department strengths, and advise undergraduate and graduate students. For questions about this position, contact Larry Stetler, Search Chair, at [Larry.Stetler@sdsmt.edu](mailto:Larry.Stetler@sdsmt.edu).

Individuals interested in this position must apply online at [www.sdsmt.edu/employment](http://www.sdsmt.edu/employment). Human Resources can provide accommodation to the online application process and may be reached at (605) 394-1203. Review of applications will begin January 12, 2015, and will continue until the position is filled. Employment is contingent upon completion of a satisfactory background investigation. SDSM&T is an EEO/AA/ADA employer & provider



**Colorado School of Mines  
Assistant Professor – Geological  
Engineering/Underground  
Construction & Tunneling**

Colorado School of Mines (Mines) invites applications for a tenure-track Assistant Professor position in the field of geological engineering with emphasis on site investigations, rock mass characterization, and subsurface analysis especially as it relates to Underground Construction and Tunneling (UC&T). Mines is home to a world class geological engineering program. In addition to the geological engineering faculty members in the department of Geology and Geological Engineering, a number of faculty members in Civil Engineering and Mining Engineering teach and pursue research in areas related to geological engineering.

With this search and complimentary faculty searches in Mining Engineering and in Civil and Environmental Engineering, Mines aims to further build upon its world class multidisciplinary education and research infrastructure in UC&T. Teaching responsibilities will include geological engineering and UC&T degree program courses.

For more information, the complete job announcement and directions on how to apply, please visit: <http://inside.mines.edu/HR-Academic-Faculty>

**ASSISTANT, ASSOCIATE, OR PROFESSOR  
GEOLOGY & GEOLOGICAL ENGINEERING  
SOUTH DAKOTA SCHOOL OF  
MINES AND TECHNOLOGY**

The Dept. of Geology and Geological Engineering at the South Dakota School of Mines & Technology invites applications for a nine-month tenure track position in Geological Engineering with an expertise in groundwater. The position will be filled at the Assistant, Associate, or Full Professor level. An earned doctorate in geological engineering or a closely related engineering discipline is required by the anticipated August 2015 start date. Preference will be given to candidates that are, or are eligible to become, licensed professional engineers. The successful candidate will develop and teach undergraduate and graduate courses in groundwater and related fields, develop and maintain a strong externally funded research program that complements department strengths, and advise undergraduate and graduate students. The department offers B.S., M.S., and Ph.D. degrees in Geology and Geological Engineering, and an M.S. degree in Paleontology. Nine-month salary range is commensurate with background and experience. For questions about this position, contact J. Foster Sawyer, Search Chair, at [Foster.Sawyer@sdsmt.edu](mailto:Foster.Sawyer@sdsmt.edu).

Individuals interested in this position must apply online at [www.sdsmt.edu/employment](http://www.sdsmt.edu/employment). Human Resources can provide accommodation to the online application process and may be reached at (605) 394-1203. Review of applications will begin January

14, 2015, and will continue until the position is filled. Employment is contingent upon completion of a satisfactory background investigation.

SDSM&T is an EEO/AA/ADA employer and provider.

**ASSISTANT PROFESSOR OF GEOLOGY  
TENURE TRACK POSITION  
STRUCTURAL GEOLOGY/TECTONICS  
AND/OR ECONOMIC GEOLOGY  
UNIVERSITY OF MISSISSIPPI**

The Dept. of Geology and Geological Engineering at the University of Mississippi invites applications and nominations for a tenure-track faculty position at the rank of assistant professor. Requirements are a Ph.D. in Geology, or related field, at time of appointment with a demonstrated strength in structural geology/tectonics and/or economic geology and the ability to teach courses in structural geology and petrography. In addition, the successful candidate will be expected to teach summer field-based courses for additional compensation and develop additional undergraduate and graduate courses in their area of expertise. We encourage applicants with field-based research interests, strong skills in geologic mapping, and the ability to apply quantitative analysis in their research. The successful candidate will integrate into a cohesive Geology and Geological Engineering Dept. and have responsibility for teaching undergraduate and graduate students in both disciplines and be expected to contribute broadly to our Geology and Geological Engineering

programs. Additional requirements are strong teaching and communication skills and evidence of scholarly achievement. The anticipated starting date for the successful candidate will be in August 2015.

The University of Mississippi offers B.S., M.S., and Ph.D. degrees in both geology and geological engineering and M.S. and Ph.D. degrees in hydrology. We are located in the historic town of Oxford, in the wooded hills of north Mississippi. Oxford has a small college-town atmosphere with excellent public schools, affordable housing, performing arts, fine restaurants, and bookstores. The urban attractions of Memphis, Tennessee are 70 miles to the north.

Review of applications will begin January 5, 2015 and continue until the position is filled. Apply online only at <http://jobs.olemiss.edu>. Applications cannot be accepted in any other format. If you need assistance with the online application process, please contact The University of Mississippi Employment Office at 662-915-5690. For additional information, contact Dr. Robert M. Holt at [rmholt@olemiss.edu](mailto:rmholt@olemiss.edu). The University of Mississippi is an EEO/AA /Title VI/Title IX/Section 504, ADA/ADEA employer.

**ASSISTANT PROFESSOR  
GROUNDWATER HYDROLOGY/  
HYDROGEOLOGY**

**UNIVERSITY OF CALIFORNIA, RIVERSIDE**

The College of Natural and Agricultural Sciences at the University of California, Riverside invites applications for a tenure track position in groundwater hydrology or hydrogeology at the rank of Assistant Professor. The position has 25% Instruction and Research and 75% Organized Research in the Agricultural Experiment Station (<http://cnas.ucr.edu/about/anr/>), and will be located in the Dept. of Environmental Sciences or Dept. of Earth Sciences depending upon the candidate's background and research interests. The successful candidate will develop a nationally recognized program in groundwater hydrology or hydrogeology. The incumbent is expected to have expertise in subsurface hydrology and measurement and modeling of groundwater flow, reactive transport modeling, or remote and/or geophysical sensing of groundwater. Research areas may include, but are not limited to, local and regional-scale groundwater dynamics and groundwater quality; the impact of climate change on groundwater recharge, storage and use; water injection and/or withdrawal and induced seismicity; or groundwater transport of contaminants. The successful candidate is expected to be fully engaged in the teaching mission of the department and university, including formal classroom instruction in undergraduate and graduate programs in Environmental Sciences or Geological Sciences and mentoring of M.S. and Ph.D. students. Teaching responsibilities will include undergraduate courses in groundwater hydrology or hydrogeology and graduate courses in the candidate's area of specialty. A Ph.D. in groundwater hydrology, hydrogeology, or related field and a proven ability to conduct innovative hydrologic research are required. Evaluation of applications will begin on December 1, 2014, but the position will remain open until filled. Applications must include a vita, statements of research and teaching interests, and list of at least 3 professional references. All application materials, including letters of recommen-

dation, must be submitted through AP Recruit at: <https://aprecruit.ucr.edu/apply/JPF00xxx>. For more information about the position, please contact Dr. Michael Anderson, Dept. of Environmental Sciences, University of California, Riverside; [michael.anderson@ucr.edu](mailto:michael.anderson@ucr.edu). For questions on application procedures and requirements, please contact Judy Bliss, Academic Personnel Coordinator, at [judy.bliss@ucr.edu](mailto:judy.bliss@ucr.edu). Additional information about the Departments of Environmental Sciences and Earth Sciences can be found at: <http://envisci.ucr.edu/> and <http://earth-science.ucr.edu/>. The University of California is an Equal Opportunity/Affirmative Action/Disability/Veterans Employer.

**MINERALOGY/PETROLOGY  
WESTERN WASHINGTON UNIVERSITY**

Western Washington University invites applications for a tenure-track Assistant Professor starting September 2015, with research and teaching specialties in mineralogy or petrology. Western Washington University is a nationally recognized, public, masters-granting institution located in the Pacific Northwest at the base of the North Cascade Mountains. We seek a colleague whose research interests could include metamorphism and the dynamics of orogenic systems, low-temperature alteration processes, generation of ore deposits, or planetary geology. Required qualifications for the position include (1) a Ph.D. in an appropriate Earth Science field at the time of appointment, (2) the ability to develop a high-quality undergraduate teaching program including courses in Mineralogy and Optical Petrography, and contribute to field courses such as Field Camp or Field Petrology, (3) the ability to establish an externally-supported research program, (4) the ability to involve students in research, (5) the ability to contribute to the graduate (MS) degree program, (6) ability to work with a diverse student body and (7) a demonstrated capacity to pursue important problems in the Earth sciences using field-based and quantitative techniques. Preferred qualifications include postdoctoral experience, college-level teaching experience in the courses listed above, ability to teach Introductory Geology, and potential to develop local field research projects. The ideal candidate will engage in collaboration within the Geology Dept. and the Advanced Materials Science and Engineering Center (AMSEC) and will enhance without duplicating existing departmental strengths in igneous petrology/volcanology, field geology, geomorphology, geophysics, tectonics, geoscience education, and planetary geology, as well as emerging directions in engineering geology and ore-forming systems. For more information see <http://geology.wvu.edu/dept/> and [www.wvu.edu/amsec/](http://www.wvu.edu/amsec/).

Interested candidates must apply online. To see a full position description and log in to WWU's Electronic Application System for Employment (EASE), please go to <https://jobs.wvu.edu/JobPosting.aspx?jPID=6211>. Applications must include a cover letter outlining teaching and research experience and accomplishments with specific reference made to the required and preferred qualifications described above. The application should also include a C.V., graduate school transcripts, as well as goals and plans for teaching and research at WWU. The names and contact information for letters of refer-

ence from four persons familiar with the candidate's research and teaching must be provided; one of these references must be from outside the applicant's current institution. Review of all application materials will begin on January 5, 2015; position is open until filled. Questions regarding this position should be directed to the search committee chair, Liz Schermer ([Liz.Schermer@wwu.edu](mailto:Liz.Schermer@wwu.edu)) or the Geology Dept. chair, Bernie Housen ([Bernard.Housen@wwu.edu](mailto:Bernard.Housen@wwu.edu)). WWU is an EO/AA employer and encourages applications from women, minorities, persons with disabilities, and veterans.

**TENURE-TRACK FACULTY  
POSITION IN STABLE ISOTOPE  
GEOCHEMISTRY/PALEOCLIMATOLOGY  
DEPT. OF EARTH AND ENVIRONMENTAL  
SCIENCES, UNIVERSITY OF KENTUCKY**

The Dept. of Earth and Environmental Sciences (EES) at the University of Kentucky invites applications for this tenure track faculty position with an anticipated start date of August 2015. Exceptional candidates at all ranks will be considered. We seek candidates with expertise in light, stable isotope geochemistry, in particular as applied to research questions in the field of paleoclimatology. The department maintains a fully equipped, state of the art stable isotope geochemistry facility (three IRMS and full set of peripherals) for analysis of HCNO in virtually any substance. In addition to maintaining a productive, externally funded research program, the new faculty member will teach and mentor at the introductory, major, and graduate levels. Potential collaborative research opportunities exist with faculty in EES; staff of the Kentucky Geological Survey and the Center for Applied Energy Research; and faculty in the College of Arts and Sciences, the College of Agriculture, Food and Environment, and the College of Engineering. The successful individual will have a demonstrated publication record, and will have developed, or show the potential for developing, a nationally recognized research program; relevant experience beyond the Ph.D. is essential. Applications will be accepted electronically through Interfolio at <http://apply.interfolio.com/27039>. We will begin review of applications on January 15, 2015; however, applications will be accepted until the position is filled. The University of Kentucky is an Affirmative Action/Equal Opportunity university that values diversity and is located in an increasingly diverse geographical region. Women, persons with disabilities, and members of other under represented groups are encouraged to apply. The University also supports family friendly policies. Additional details of the Dept. of Earth and Environmental Sciences (faculty, research clusters, and facilities) and the University of Kentucky may be viewed at our web pages: [www.as.uky.edu/ees](http://www.as.uky.edu/ees) and [www.uky.edu](http://www.uky.edu).

**TWO TENURE-TRACK POSITIONS  
AT TEXAS TECH UNIVERSITY**

The Department of Geosciences at Texas Tech University seeks applicants for two assistant professor, tenure-track positions. A Ph.D. in an Earth Science (or closely related) discipline at time of appointment is required.

Position 1 focuses on sedimentary systems with an emphasis on one or more of clay mineralogy,



diagenesis, mudstones, carbonate petrology and reservoir characterization. A letter of application, including names of three referees, short statements of research and teaching philosophies, and vita can be uploaded online at [www.texastech.edu/careers/requisition #2209BR](http://www.texastech.edu/careers/requisition#2209BR). Questions should be sent to Dr. Paul Sylvester, Search Committee Chair: [paul.sylvester@ttu.edu](mailto:paul.sylvester@ttu.edu).

Position 2 focuses on seismology, emphasizing the imaging of crustal features (from shallow sedimentary and structural studies to investigation of crustal scale tectonic features). A letter of application, including names of three referees, short statements of research and teaching philosophies, and vita can be uploaded online at [www.texastech.edu/careers/requisition #2211BR](http://www.texastech.edu/careers/requisition#2211BR). Questions should be sent to Dr. Harold Gurrola, Search Committee Chair: [harold.gurrola@ttu.edu](mailto:harold.gurrola@ttu.edu).

Candidates with strong records of scholarship and who have the proven capacity or clear potential to bring externally sponsored research to Texas Tech University are encouraged to apply. Teaching duties include graduate and undergraduate courses in the candidate's specialty. The department ([www.geosciences.ttu.edu](http://www.geosciences.ttu.edu)) has active research specialties in Geology, Geophysics, Geochemistry, Geography, and Atmospheric Science. Texas Tech is located in Lubbock on the edge of the Permian Basin. The region appreciates the social and economic importance of geology and geophysics knowledge due to the importance of petroleum and groundwater to the Texas economy. Service duties include program-building, as well as commitment to extra-curricular activities. Service to the department, college, and university is expected.

As an Equal Employment Opportunity/Affirmative Action employer, Texas Tech University is dedicated to the goal of building a culturally diverse faculty committed to teaching and working in a multicultural environment. We actively encourage applications from all those who can contribute, through their research, teaching, and/or service, to the diversity and excellence of the academic community at Texas Tech University. The university welcomes applications from minorities, women, veterans, persons with disabilities, and dual-career couples. Evaluation of candidates will begin January 30, 2015.

**ASSOCIATE SEDIMENTOLOGIST  
OR SEDIMENTOLOGIST  
(DEPENDENT ON QUALIFICATIONS)  
ILLINOIS STATE GEOLOGICAL SURVEY  
PRAIRIE RESEARCH INSTITUTE  
UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN**

The Illinois State Geological Survey (ISGS) is part of the Prairie Research Institute (PRI) at the University of Illinois at Urbana-Champaign which is centrally located between Chicago, St. Louis, and Indianapolis. PRI houses five large scientific surveys covering a wide range of expertise including biology, water resources, climate, geology, sustainable technology and archaeology. The ISGS is a premier state geological survey, with over 200 scientists and technical support staff, serving the needs of the public, government, and industry with earth science information



## Faculty Position in Petroleum Geosciences

The Department of Geosciences at The Pennsylvania State University is pleased to announce a new tenure-track position in the broad area of Petroleum Geosciences. We seek applicants whose research interests address fundamental geoscience questions in areas relevant to petroleum geosystems including, but not limited to exploration geophysics, multi-channel seismic imaging, petrophysics, borehole geophysics, reservoir geomechanics, basin analysis, geodynamics, structural geology, sedimentary geology and stratigraphy, geochemistry, or geofluids. This position is part of a group hiring initiative within the newly formed Institute of Natural Gas Research (INGaR). The Geoscience hire will likely contribute to the Discovery and Exploration component of INGaR and complement existing Department of Geosciences strengths.

We expect to fill this position at a junior-to-mid-career level, although, in exceptional cases, a senior hire may be possible. Applicants must have a doctorate in geosciences or a related discipline. The successful candidate will be expected to teach courses at both the undergraduate and graduate levels, to develop an internationally recognized, externally funded research program, to supervise and support graduate students (M.S. and Ph.D.) in their research, and to contribute to the operation of the department, college, university, and profession. Demonstrated experience with or a significant interest in working with industry is expected. The successful candidate will be aligned with the interests of the Institute but have their academic tenure home in the Department of Geosciences.

The Department of Geosciences is home to approximately 35 faculty, 100 graduate students (in M.S. and Ph.D. programs), and an undergraduate program offering degrees in Geosciences, Earth Sciences, Geobiology, and Earth Science and Policy. The oil and gas industry provides fellowships and career opportunities for many students in the Department. The individual hired in this position is expected to play a significant role in this industry collaboration including participation in the Petroleum Geosystems Initiative MS training program. Further information on the Department can be found at: <http://www.geosc.psu.edu/>.

Evaluation of applicants will begin on January 15, 2015. Applicants should submit a cover letter, a statement of professional interests (research and teaching), a curriculum vita, and the names and addresses of three references. Nominations and applications will be considered until the position is filled. Questions about this position may be directed to Kevin Furlong, chair of the search committee, at [kp1@psu.edu](mailto:kp1@psu.edu).

Apply to job 54242 at <http://apptrkr.com/540868>

**CAMPUS SECURITY CRIME STATISTICS:** For more about safety at Penn State, and to review the Annual Security Report which contains information about crime statistics and other safety and security matters, please go to <http://www.police.psu.edu/clery/>, which will also provide you with detail on how to request a hard copy of the Annual Security Report.

Penn State is an equal opportunity, affirmative action employer, and is committed to providing employment opportunities to minorities, women, veterans, disabled individuals, and other protected groups.



and research relevant to natural resources, environmental quality, economic vitality, and public safety. The University is a land-grant institution that provides access to world-class laboratory and academic facilities, Big Ten athletic events, and internationally acclaimed cultural opportunities.

We are seeking an individual to fill one position to plan, coordinate, and conduct basic and applied research related to bedrock geology and industrial minerals. Characterize sedimentary rocks with a focus on the lithostratigraphy and sequence stratigraphy utilizing sedimentology, biostratigraphy, chemostratigraphy, and bedrock geologic mapping.

Serve as principal investigator, lead research and projects, and perform tasks in that capacity, including management and production of projects, grants, contract reports and other deliverables. Master's degree in sedimentology-stratigraphy or related discipline. Ph.D. is highly preferred. A minimum of 5 years related industry and/or research experience post master's degree. Research experience in sedimentology-stratigraphy (both carbonates and siliciclastics) including lithostratigraphy, sequence stratigraphy, chemostratigraphy, and other related field as applied to stratigraphic correlation and basin analysis. The successful in-

dividual's qualifications will determine the level to which he/she is appointed.

Applications must be received by January 9, 2015. To apply, please visit <https://jobs.illinois.edu/academic-job-board> to complete an online profile and to upload a (1) cover letter, (2) résumé/CV, (3) the names and contact information (including e-mail addresses) of three professional references. All requested information must be submitted for your application to be considered. Incomplete information will not be reviewed.

For further information please contact Lori Walston-Vonderharr, Human Resources, Illinois State Geological Survey, at [lwalston@illinois.edu](mailto:lwalston@illinois.edu) or 217-244-2401.

The University of Illinois is an EEO Employer/Vet/Disabled <http://inclusiveillinois.illinois.edu/>.

## Scholarship Opportunities

### JONATHAN O. DAVIS SCHOLARSHIP UNIVERSITY OF NEVADA, RENO

The Jonathan O. Davis Scholarship supports graduate students working on the Quaternary geology of the Great Basin. The national scholarship is \$5,000 and the University of Nevada, Reno, stipend is \$1,500. The national scholarship is open to graduate students enrolled in an M.S. or Ph.D. program at any university in the United States. The Nevada stipend is open to graduate students enrolled in an M.S. or Ph.D. program at the University of Nevada, Reno. Details on application requirements can be found at: [www.dri.edu/GradPrograms/Opportunities/JonathanDavis](http://www.dri.edu/GradPrograms/Opportunities/JonathanDavis). Applications must be post-marked by February 17, 2015. Proposal reviews will not be returned. Applications should be addressed to: Executive Director Division of Earth and Ecosystem Sciences Desert Research Institute 2215 Raggio Parkway Reno, Nevada 89512, USA.

## Fellowship Opportunities

### TURNER POSTDOCTORAL FELLOWSHIP UNIVERSITY OF MICHIGAN

This highly competitive fellowship is open to candidates who have obtained a Ph.D. in any field within Earth and environmental sciences.

The department seeks qualified applicants who are interested in collaborating with one or more faculty members. Applicants are encouraged to contact prospective faculty host(s) prior to the application deadline to discuss areas of common interest and to develop innovative research proposals.

Turner Postdoctoral Fellows receive an annual salary of \$55,000, discretionary research funds of \$5,000 per year, and a generous benefits package. The fellowship is awarded for a one-year period, with an anticipated extension for a second year.

Application: Applicants must have a Ph.D. To apply please go to: [www.earth.lsa.umich.edu/turner2015/newapplicant](http://www.earth.lsa.umich.edu/turner2015/newapplicant). Complete the online application, including the names and addresses of at least three references, and upload (as a single PDF) the required application documents, which should include a curriculum vitae and a research proposal



THE UNIVERSITY OF TEXAS  
AT DALLAS  
The Department of Geosciences

## OPEN RANK FACULTY POSITIONS

The Department of Geosciences at The University of Texas at Dallas is searching to fill three open, tenure-track or tenured faculty positions in the fields of basin analysis, geophysics, and neotectonics. We are searching broadly. These positions aim at the Assistant Professor level, but highly qualified candidates will be considered for Associate Professor or Professor level appointments. The institution entertains the possibility of a team consisting of one senior scientist and two junior scientists to fill the positions. The positions are to be filled during the 2014-2015 academic year.

For the basin analysis position(s), the successful candidate should have principal interests in fundamental processes of sedimentary basin architecture and evolution, and in the application of basin analysis to energy and environmental issues.

The geophysics position(s) is/are broadly defined to include expertise in any facet of geophysics applied to the study of Earth's interior. Candidates for the neotectonics position(s) is/are expected to have research interests in geomorphology, structural geology, near surface geophysics, and/or geochronology as applied to solving neotectonic problems.

We seek individuals with the potential to develop vibrant, sustained, externally funded research programs that complement existing departmental strengths and who will contribute effectively to the Department's educational programs at the BS, BA, MS and Ph.D. levels. We especially encourage geoscientists interested in field studies and helping to strengthen the Ellison Miles Center for Geological Field Studies. We also very much want to increase the diversity of the Department and especially encourage women and minorities to apply.

These positions are part of a departmental expansion and all of them will play a pivotal role in the University's strategic emphasis on energy and the environment. We are seeking individuals who will complement and expand departmental concentrations in structural geology, active and ancient tectonics, geophysics, geospatial science, and computational geoscience. Successful candidates may build upon our traditional collaboration with the petroleum and minerals industry in areas that encompass carbon dioxide sequestration and the exploration and development of petroleum and mineral resources. The Department of Geosciences has strong and expanding undergraduate and graduate programs. UTD is a relatively young and rapidly growing institution. It attracts very talented students (mean freshman SAT > 1200) with great diversity and is situated in a metropolitan area that is undergoing rapid growth.

Applications will be reviewed beginning October 15, 2014, but will be considered until the positions are filled. Indication of gender and ethnicity for affirmative action statistical purposes is requested as part of the application.

Questions about the positions should be directed to the Department Head, Professor John W. Geissman, [geissman@utdallas.edu](mailto:geissman@utdallas.edu). Applicants should submit a complete resume, a statement of research interest and the names and contact information of five professional references via online applications available at:

<http://go.utdallas.edu/pnr141001>

<http://go.utdallas.edu/pns141001>

<http://go.utdallas.edu/pnt141001>

*The University of Texas at Dallas is an Equal Opportunity/Affirmative Action Employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability, pregnancy, age, veteran status, genetic information or sexual orientation.*

(5 pages maximum excluding references).

Deadline: Applications and reference letters for the 2015 competition are due January 15, 2015.

Inquiries should be sent to Michigan-Earth-Search@umich.edu. Women and minorities are encouraged to apply. The University of Michigan is an equal opportunity/affirmative action employer.

## Opportunities for Students

**Ph.D. Fellowship in Paleobiology/Paleontology at the University of Pennsylvania.** A Ph.D. fellowship in Paleobiology is available in the Dept. of Earth and Environmental Science at the University of Pennsylvania, starting in Fall 2015. Prof. Lauren Sallan seeks a graduate student to address major paleobiological questions, such as how global change has affected life over time, how life evolves at high levels (macroevolution), and the origins of living biodiversity. Specific topics include, but are not limited to: the drivers and ecological consequences of mass extinction the role of predation and competition in setting marine biodiversity, the characteristics of adaptive radiations and "living fossils," the effects of long-term environmental events on biodiversity trends, and major transitions in early vertebrate evolution. The student can also develop a novel project that address similar questions using quantitative, phylogenetic and descriptive methods. While research in the lab has focused on fishes, any suitable group of fossil animals may be used. Applicants are encouraged to contact Prof. Sallan (lsallan@sas.upenn.edu) for details. Applications for entry in Fall 2015 are due December 15, 2014, and must be submitted online at <https://www.applyweb.com/upenn/>.

**Ph.D. Position, Stable Isotope Geochemistry, Indiana University-Purdue University Indianapolis.** The Stable Isotope Biogeochemistry laboratory in the Dept. of Earth Sciences at Indiana University-

Purdue University Indianapolis is currently accepting applications for a Ph.D. research assistantship that will begin in the fall of 2015. The graduate research will be part of an NSF funded project to study isotope geochemistry associated with biological sulfur cycling in anoxic lakes. The study sites include Mahoney Lake, British Columbia and Green Lake, New York. We are seeking candidates with field experience and backgrounds in chemistry, geology, and stable isotopes. Information about the laboratory and current research projects is available at <http://earthsciences.iupui.edu/~wgilhool/>. Those interested in the position should email a CV and personal statement to Dr. William Gilhool (wgilhool@iupui.edu). Complete graduate applications are due January 15th (<http://earthsciences.iupui.edu/graduate/admissions-requirements>).

**Graduate Student Opportunities, Case Western Reserve University.** Students with backgrounds in geology, physics, chemistry, biology, engineering and related fields are encouraged to apply for our Ph.D. and MS programs in Earth, environmental, and planetary sciences. Areas of active research in the department include planetary geology and geophysics, igneous geochemistry, mineral physics, sediment transport, aqueous geochemistry and carbon sequestration. For more information, see <http://geology.case.edu> or write to [eeeps-gradinfo@case.edu](mailto:eeeps-gradinfo@case.edu). Financial assistance is available. Application deadline: 1/15/2015.

**Graduate Student Opportunities, Ohio University.** The Dept. of Geological Sciences at Ohio University invites applications to its graduate program for the Fall of 2015. The department offers an MS degree in Geological Sciences and areas of emphasis within three research clusters: paleobiology and sedimentary geology, solid earth and planetary dynamics, and environmental and surficial processes. Prospective

students are encouraged to contact faculty directly to discuss potential research topics. Qualified students are eligible to receive teaching or research assistantships that carry a full tuition scholarship and a competitive stipend. For additional program and application information, visit the department website at [www.ohio.edu/cas/geology](http://www.ohio.edu/cas/geology) or contact the graduate chair, Dr. Alycia Stigall (stigall@ohio.edu). Review of applications begins 1 February.

**Assistantships, Dept. of Geosciences, Univ. of Akron.** The Dept. of Geosciences, Univ. of Akron, Ohio, has assistantships available starting in the spring and fall 2015 for students who have the drive and curiosity to succeed in graduate school. Examples of the on-going research include studies in geobiology, structural and environmental geology, studies of the climate record contained in lake sediments, oceans, and caves, and in global biogeochemical cycles. Interested students may contact Dr. John Peck at [jpeck@uakron.edu](mailto:jpeck@uakron.edu) for more information and apply online at [www.uakron.edu/gradsch/apply-online/](http://www.uakron.edu/gradsch/apply-online/).

**M.S. Positions. The Geological Sciences Dept. at Central Washington University** seeks motivated students for two NSF-funded projects; prior research experience is beneficial. Student research positions (MS) are available starting Fall 2015.

1. Geodynamic modelling will focus on characterizing the extensional evolution of the West Antarctic Rift System. The student must be willing and able to participate in Antarctic fieldwork; computer programming skills are beneficial. Contact: Dr. Audrey Huerta ([huerta@geology.cwu.edu](mailto:huerta@geology.cwu.edu)).
2. Geochronology and thermobarometry will focus on documenting the spatial and time evolution of P-T conditions in the North Qaidam ultrahigh-pressure terrane, western China. A strong petrology background is required. Contact: Dr. Chris Mattinson ([mattinson@geology.cwu.edu](mailto:mattinson@geology.cwu.edu)).

## Call for Applications

2015–2016 GSA-USGS

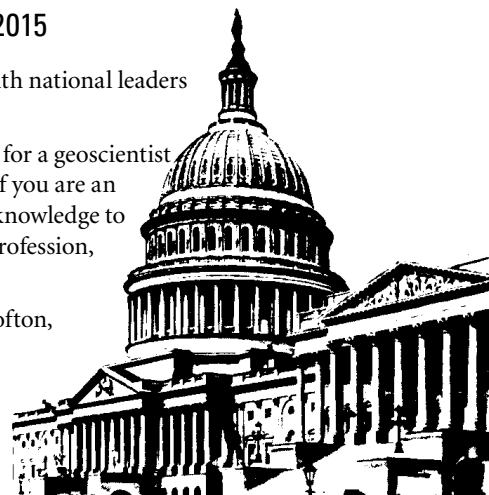
# Congressional Science Fellowship

Application deadline: 1 Feb. 2015

Bring your science and technology expertise to Capitol Hill to work directly with national leaders at the interface between geoscience and public policy.

The GSA-USGS Congressional Science Fellowship provides a rare opportunity for a geoscientist to spend a year working for a Member of Congress or congressional committee. If you are an earth scientist with a broad geologic background, experience applying scientific knowledge to societal challenges, and a passion for helping shape the future of the geoscience profession, GSA and the USGS invite your application.

Learn more at [www.geosociety.org/csf/scifello.htm](http://www.geosociety.org/csf/scifello.htm) or by contacting Susan Lofton, +1-303-357-1040, [slofton@geosociety.org](mailto:slofton@geosociety.org)



# How scientometry is killing science

**A.M. Celâl Şengör**, *İTÜ Maden Fakültesi, Jeoloji Bölümü ve Avrasya Yerbilimleri Enstitüsü, Ayazağa 34469 İstanbul, Turkey; sengor@itu.edu.tr*

*“Publish or perish” is making science perish.*

When I was a student, one of my professors once said that the quality of a field geologist is assessed through gossip. When I asked him what he meant by it, he responded by pointing out that unlike in laboratory work or purely theoretical endeavors, a field geologist's work was difficult to impossible to replicate and therefore to check. One therefore relied on the opinion of those people who were closely associated with that work through similar interest or actual collaboration or simply close acquaintanceship with the author, since publication in a reputable journal does not always guarantee high-quality work. When one needed evaluation of a certain geologist's work, one asked those people's opinion who were familiar with it.

This is still done, but it is now increasingly shadowed by scientometric data. Scientometry was defined by its creators (as *Naukometriya* in Russian) Nalimov and Mul'chenko (1969, p. 191; 1989) as “the application of those quantitative methods which are dealing with the analysis of science viewed as an information process,” although the idea of keeping an index of citations originated in 1873 with *Shepard's Citations*, in the United States common law, which enabled previous court decisions to be looked up with ease. During evaluation of geologists (not only academic), letters of recommendation are increasingly supported by the number of papers published in peer-reviewed journals, the number of citations, and such evaluation factors as *h* or *g*. A result of this reliance on scientometric data has been the proliferation of “scientific” journals, the main reason for the existence of which is to publish papers that will be scanned by the scientometric organizations. Among such journals even clandestine ones have come into existence, allowing authors to cite each other's work just to boost their scientometric standing. When detected, scientometric survey organizations throw them out of their lists, but until then they continue their sinister activity and influence the scientometric data.

This state of affairs is particularly pernicious in societies with no scientific tradition. Here is an example from my own experience in my own country, Turkey. Turkey had no science whatever prior to the founding of the Republic of Turkey in 1923. After the Republic was founded, one of the chief aims of its founder, Mustafa Kemal Atatürk (1881–1938), was to introduce science into his country. To that end, he made use of the opportunity provided

by Hitler's expulsion of Jewish and politically undesirable scientists from Germany by hiring as many of such Nazi victims as possible. The experiment largely failed, however, because it turned out that the natives were more interested in obtaining university positions with a view to enhancing their social status than in discovering the secrets of nature. The result was that after the Germans left (almost all of them left in exasperation as soon as the war was over; some returned home, others went to the United States) the university positions began to be filled with politically manipulative but scientifically incompetent people. Therefore, after a forced start, Turkish science largely returned to its pre-Republican levels. Medicine looked as if it were an exception: It was not. Many competent physicians were indeed trained in Turkish universities, but they saw their job as providing service to the community while filling their own pockets by opening private practices parallel with their positions as university teachers. Vanishingly few of them have done any scientific research.

In the early nineties a group of Turkish scientists, upon the urging of the then cabinet member Professor Erdal İnönü (1926–2007), a physics professor and Caltech Ph.D. (who, after a promising start as a Princeton post-doc, himself abandoned science for administrative positions and eventually politics) decided that founding an academy of sciences might help to improve things. Accordingly, İnönü's government appointed ten founding members. Their job was to elect another ten immediately, thus bringing the number to 20 with the purpose of constituting a council to enable the Academy to begin functioning. I was one of the ten appointed. During the discussions it became obvious that our most urgent matter was to establish criteria by which the next ten members (and also the future ones) might be elected. Since we were all from different disciplines and since there was no existing Turkish science community as such, we only knew the more prominent people in our own fields. It was therefore decided to rely on scientometric data. The result turned out to be so appalling that it led one member to exclaim, “Why the hell don't we once consider what the candidate will be remembered for after he or she croaks!” Despite such protests, the process went nowhere and the Academy got stuck with the scientometric data, because an alternative, which might have existed in a scientifically mature society, simply was not available in Turkey. As a disastrous consequence, many a worthless “scientist” was elected; many an excellent one was excluded. The Islamist government of Mr. Recep Tayyip Erdoğan used this as an excuse to destroy the Academy entirely in 2012 by having members appointed directly by state organizations that his party controlled (cf. Schiermeier, 2012).

Turkish universities also rely on scientometric data more than anything else and end up having to appoint incompetent people



to university positions, because if they do not, the unsuccessful candidate goes to court and argues that his or her scientometric data are better than those of so and so. The court almost invariably reverses the decision of the university, giving the position to the scientometrically better-looking, but in reality inferior, candidate.

This is deadly. It automatically disadvantages stratigraphers, structural geologists, tectonicists, or geologists with regional interests. People working in laboratories and with modeling almost always look better scientometrically than their colleagues working in the more field-orientated areas of geology. But, the success of laboratory work is ultimately and critically dependent on field data. Geology is commonly regarded as unique among the sciences because of its historical component. This is untrue. Cosmology also has an historical component (at least since Edwin Hubble [1889–1953]), and every theoretical science making cosmological statements has to take the historical evolution of the universe into account. No theoretical cosmological model can be taken seriously if it flatly contradicts the data on the evolution of the universe. Similarly, no theory of biological evolution can expect a hearing if it contradicts paleontological observations.

Ignoring field relationships, for example, has been detrimental to the studies of the Altaiids over the last two decades (see Şengör, 2014; Şengör et al., 2014). This is an orogenic system occupying some nine million square kilometers in central and northwestern Asia. After the publication of the synthesis by Şengör et al. (1993) in *Nature*, there was a surge of publications reporting geochemical data from the Altaiids, which was, in itself, most welcome. Almost every one of these papers contains some statement about the tectonic evolution of either the small area in which the authors (such papers are invariably multi-authored) worked or, worse, about the entire system. However, because an adequate knowledge of the field relationships is commonly lacking in a vast number of these papers, such statements are usually baseless, contradictory, and often plainly wrong. Once, I encountered a doctoral student in the field collecting rocks with a view to doing zircon dating. When I asked him which units he was working on, I was shocked to discover that he neither knew nor cared.

But every student knows that by working in a laboratory simply measuring samples, and therefore obtaining “quantitative” data fast, he or she has a much better chance of publishing ten papers while a field worker can only generate one. Therefore, the former will be in a much stronger position when it comes to finding a job. But without the one with the field data, the ten published by the other will be condemned to remain meaningless.

What is most regrettable is that the funding agencies, by relying on scientometric criteria, exacerbate this deplorable situation. One hears ever more frequently the importance of being “quantitative” in geology. One of my mentors once retorted to such a statement

by saying “no other branch of geology is as quantitative as field geology: The field geologist reports dips and strikes in numbers—in thousands!”

One of the reviewers of this note asked that the following sentence should be considered for addition to the text. I entirely agree with what is said in that sentence and add it here with pleasure: “Properly made geologic maps are the most quantitative data in geoscience: While we may debate the nature of a contact, the contact and dip-strike measurements, if properly located, should be there 100–200 years hence and are therefore both quantitative and reproducible, something that cannot be said of experiments in some of the other sciences.” History fully bears out this statement.

Is there a remedy? The sheer numbers now involved in science make it very difficult to build opinions on the basis of “gossip.” The solution lies in making sure that the office making a decision on a scientist (which is different from decisions about creating faculty and/or researcher positions in institutions) consists *only* of a person or persons competent in the field in which the office is expected to produce an opinion. Anybody relying on scientometric criteria alone to make a decision about a scientist is simply not competent to do so.

Do not let us ever forget: More does not automatically mean better.

## ACKNOWLEDGMENTS

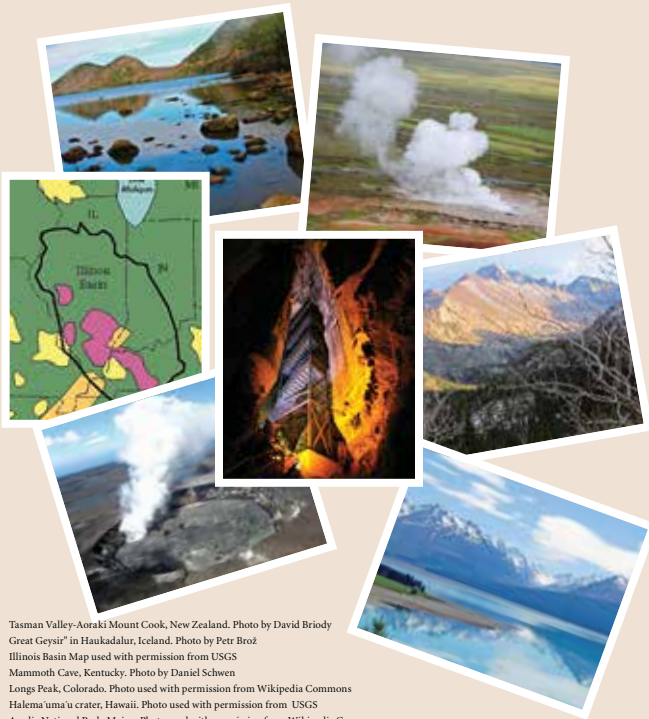
I thank Kevin Burke and Damian Nance plus two other anonymous reviewers for their constructive comments on this note.

## REFERENCES CITED

- Nalimov, V.V., and Mul'chenko, Z.M., 1969, *Naukometriya, Nauchenie Razvitiya kak Informatzionnogo Protzessa*: Nauka, Moscow, 192 p.
- Nalimov, V.V., and Mul'chenko, Z.M., 1989, Study of science development as an information Process: *Scientometrics*, v. 15, p. 33–43.
- Schiermeier, Q., 2012, More Turkish scientists resign from state Academy: *Nature News* blog, 11 June 2012, <http://blogs.nature.com/news/2012/06/more-turkish-scientists-resign-from-state-academy.html> (last accessed 30 Sept. 2014).
- Şengör, A.M.C., 2014, Outcrops, isotopic ages, terranes and the undesirable fate of tectonic Interpretations: *Geodinamica Acta* (Aral İ. Okay special issue), v. 26, p. 159–174, doi: 10.1080/09853111.2013.858953.
- Şengör, A.M.C., Natal'in, B.A., and Burtman, V.S., 1993, Evolution of the Altaiid tectonic collage and Palaeozoic crustal growth in Eurasia: *Nature*, v. 364, p. 299–307, doi: 10.1038/364299a0.
- Şengör, A.M.C., Natal'in, B.A., Sunal, G., and Van der Voo, R., 2014, A new look at the Altaiids: A superorogenic complex in northern and central Asia as a factory of continental crust. Part 1: Geological data compilation (exclusive of palaeomagnetic observations): *Austrian Journal of Earth Sciences*, v. 107, p. 169–232.

*Manuscript received 4 Aug. 2014; accepted 29 Sept. 2014. \**

# 2015 GeoVentures and Field Camps



Tasman Valley-Aoraki Mount Cook, New Zealand. Photo by David Briody  
 Great Geysir\* in Haukadalur, Iceland. Photo by Petr Broz  
 Illinois Basin Map used with permission from USGS  
 Mammoth Cave, Kentucky. Photo by Daniel Schwen  
 Longs Peak, Colorado. Photo used with permission from Wikipedia Commons  
 Halema'uma'u crater, Hawaii. Photo used with permission from USGS  
 Acadia National Park, Maine. Photo used with permission from Wikipedia Commons

## GeoVentures

- 2–15 July: Explore New Zealand—Life on a Plate Boundary!
- 20–31 July: Explore Dynamic Iceland!
- 5–12 August: Explore Hawaiian Volcanoes for K–12 Teachers

## Field Camps

- 14–18 June: Illinois Basin Field Camp
- 20–25 June: Rocky Mountain Field Camp
- 12–18 July: Mammoth Cave Field Camp
- 26 July–1 August: Acadia Field Camp

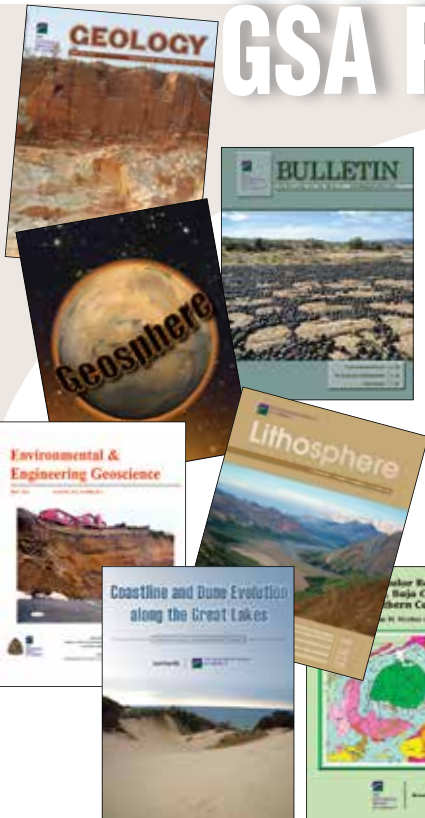
These trips are fantastic for K–12 teachers, students, informal educators, and pre-service teachers!

For more information on GeoVentures contact  
**Gary Lewis** at [glewis@geosociety.org](mailto:glewis@geosociety.org).

For more information on Field Camps contact  
**David Buehler** at [dbuehler@geosociety.org](mailto:dbuehler@geosociety.org).

**“Because the best geologists are the ones that have seen the most rocks!”**

# GSA Publications Highlights



## Put Your Annual Meeting Presentation to Work

From session room to worldwide exposure via the desktops, laptops, tablets, pads, and smart phones of your colleagues (oh, and via paper copies, too), your well-received technical presentation at the GSA Annual Meeting can go far.

Submit a manuscript to one of GSA’s top-rated journals. Or, if you have a whole session’s worth of great papers, consider submitting a book proposal.

With six journals and four book series, GSA has a range of publication outlets to meet your needs for speed of publication, article size, targeted collections, and distribution. Author information can be found at

[www.geosociety.org/pubs/contrib.htm](http://www.geosociety.org/pubs/contrib.htm).

For details on submitting to any of these publications, contact us at [editing@geosociety.org](mailto:editing@geosociety.org).



THE  
 GEOLOGICAL  
 SOCIETY  
 OF AMERICA®

To subscribe, contact [gsaservice@geosociety.org](mailto:gsaservice@geosociety.org), or call +1-888-443-4472, or +1-303-357-1000, option 3.

# *Take Control of the 2015 Annual Meeting!*

**1-4 NOVEMBER**

**GSA 2015**

**Baltimore, Maryland, USA**



## **Technical Session Proposals**

**Deadline: 1 Feb. 2015**

Ensure that your area of research and expertise is represented in next year's technical program. Any individual or geosciences organization is welcome to suggest topics and submit proposals for both Topical Sessions and Pardee Keynote Symposia. Pardee Symposia are high-profile sessions on significant scientific developments, with invited speakers only. Topical Sessions are a combination of invited and volunteered papers. Unique formats are allowed, but they must be outlined in the proposal, along with the technical support needs. Sessions that promote spirited discussion are encouraged.

<https://gsa.confex.com/gsa/2015AM/sessionproposals.epl>

## **Short Course Proposals**

**Deadline: 2 Feb. 2015**

Share the wealth (of knowledge)—lead a Short Course. Courses can be run to develop professional, teaching, and research skills at all levels. Proposal guidelines are available online or by contacting Jennifer Nocerino at [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).

<http://www.geosociety.org/meetings/scProposals.htm>

***Propose Technical Sessions, Plan a Field Trip, and/or Offer a Short Course***



**THE  
GEOLOGICAL  
SOCIETY  
OF AMERICA®**



SPECIAL PAPER 505  
**MEMBER PRICE**  
**\$70**  
**MEMBER PRICE**  
SPECIAL PAPER 505

## Volcanism, Impacts, and Mass Extinctions: Causes and Effects

*Edited by Gerta Keller and Andrew C. Kerr*

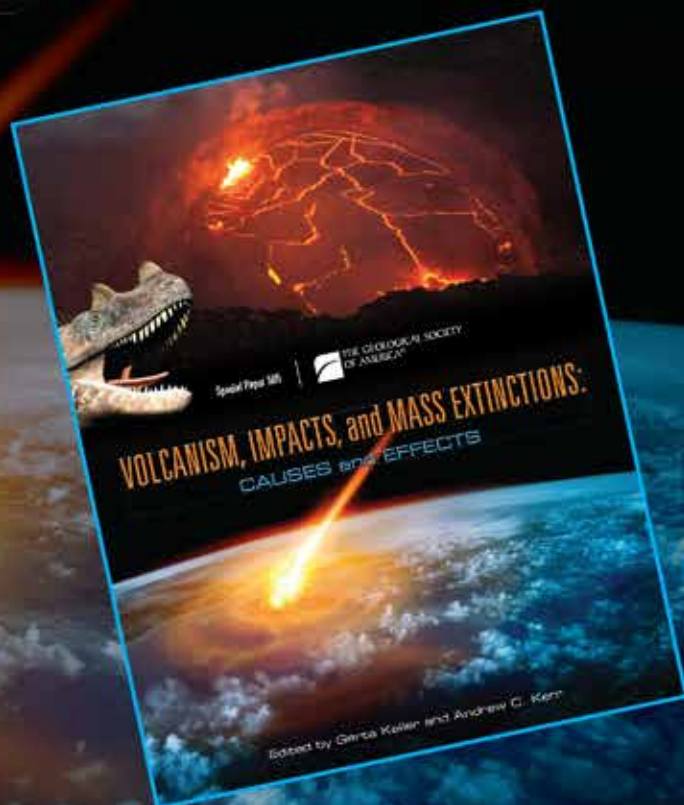
This volume comprises papers stemming from the international, multi-disciplinary conference that took place in March 2013 at London's Natural History Museum (NHM). This conference brought together researchers across geological, geophysical, and biological disciplines to assess the state of research into the causes of mass extinction events and, in particular, to evaluate the respective roles of volcanism, bolide impacts, and associated climate and environmental changes. Key results of this seminal conference are presented in papers spanning a wide range of disciplines. Contributors conclude that large igneous province volcanism along with associated climate and environmental changes played significant roles in four of the five major mass extinctions in Earth history. There is overwhelming agreement that a single large asteroid or comet impact (Chicxulub) could not have been the sole cause of the end-Cretaceous mass extinction, but rather was a contributing factor along with volcanism.

SPE505, 455 p., ISBN 9780813725055  
list price \$99.00 | **member price \$70.00**



THE  
GEOLOGICAL  
SOCIETY  
OF AMERICA®

toll-free 1.888.443.4472  
+1.303.357.1000, option 3  
gsaservice@geosociety.org



**BUY ONLINE** ▶ <http://rock.geosociety.org/store/>