Imaging spectroscopy of geological samples and outcrops: Novel insights from microns to meters
2016 GSA
Section Meetings

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

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

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

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

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

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

www.geosociety.org/sections
Featured Articles

**SCIENCE**

4 Imaging spectroscopy of geological samples and outcrops: Novel insights from microns to meters
Rebecca N. Greenberger, John F. Mustard, Bethany L. Ehlmann, Diana L. Blaney, Edward A. Cloutis, Janette H. Wilson, Robert O. Green, and Abigail A. Fraeman

Cover: Top: Hyperspectral image of an outcrop of sedimentary rocks along Mills Creek in California. Fading from near true color (left) into a spectral parameter map highlighting lithologic differences (right). Below are close-up views of portions of the outcrop with semi-transparent spectral parameters overlain. This image was acquired with the Ultra Compact Imaging Spectrometer developed by the Jet Propulsion Laboratory, California Institute of Technology. See related article, p. 4–11.

**GROUNDWORK**

36 Who will build the 21st century? Addressing critical demographic gaps in the geosciences

GSA News

11 Call for Proposals: GSA 2016 Annual Meeting & Exposition
12 GSA Honorary Fellow: Manfred R. Strecker
12 Travel Grant and Mentor Program for Early Career Scientists and Students: 35th IGC
13 GSA Honorary Fellow: Brian Windley
14 Upcoming Award, Recognition & Grant Deadlines
14 2016 Student Research Grants
16 Writing a Successful GSA Grant Proposal
17 2015 ExxonMobil Minority Student Scholarship Recipients
18 2014–2015 Congressional Science Fellow Final Report: A Legislative Win and Final Thoughts
19 GSA Education & Outreach Programs: 2016 Section Meetings
22 Penrose Conference: Layered Mafic Intrusions and Associated Economic Deposits
24 Second Announcement: GSA South-Central Section Meeting
26 Second Announcement: GSA Northeastern Section Meeting
29 Geoscience Jobs & Opportunities
38 GSA Foundation Update

Erratum: In the October 2015 issue of GSA Today, it was incorrectly noted that GSA members could renew their membership at a 15% discount through 15 Dec. 2016. The end date for the 15% discount is 15 Dec. 2015.
Imaging spectroscopy of geological samples and outcrops: Novel insights from microns to meters

Rebecca N. Greenberger, Dept. of Earth, Environmental and Planetary Sciences, Brown University, Providence, Rhode Island 02912, USA, and Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, California 91109, USA, Rebecca.N.Greenberger@jpl.nasa.gov; John F. Mustard, Dept. of Earth, Environmental and Planetary Sciences, Brown University, Providence, Rhode Island 02912, USA; Bethany L. Ehlmann, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, California 91109, USA; Bethany L. Ehlmann, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, California 91109, USA; Diana L. Blaney, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, California 91109, USA; Edward A. Cloutis, Dept. of Geography, University of Winnipeg, 515 Portage Ave., Winnipeg, Manitoba R3B 2E9, Canada; Janette H. Wilson, Headwall Photonics, Inc., 601 River Street, Fitchburg, Massachusetts 01420, USA; Robert O. Green, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, California 91109, USA; and Abigail A. Fraeman, Division of Geological & Planetary Sciences, California Institute of Technology, Pasadena, California 91125, USA

ABSTRACT

Imaging spectroscopy is a powerful, non-destructive mineralogical tool that provides insights into a variety of geological processes. This remote measurement technique has been used for decades from orbital or aerial platforms to characterize surface compositions of Earth and other solar system bodies. These instruments have now been miniaturized for use in the laboratory and field, thereby enabling petrologic analyses of samples and outcrops. Here, we review the technique and present four examples showing the exciting science potential and new insights into geological processes.

INTRODUCTION

Imaging spectroscopy is a technique whereby images are acquired in hundreds of wavelengths simultaneously, permitting spectral analysis of each discrete pixel (Goetz et al., 1985). Compositionally distinct materials reflect and absorb light differently as a function of wavelength, creating unique spectra that are used to identify and map compositional units remotely. The application of imaging spectroscopy to planetary surfaces has transformed our understanding of surface compositions throughout the solar system. The Observatoire pour la Minéralogie, l’Eau, les Glaces et l’Activité (OMEGA) and the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) have revealed the presence of clays, sulfates, carbonates, and other minerals formed through interaction with water on Mars, illuminating potentially habitable past environments (e.g., Bibring et al., 2006; Mustard et al., 2008; Murchie et al., 2009). The Moon Mineralogy Mapper (M3) provided new insights into the formation, igneous evolution, and composition of the Moon and discovered small and varying amounts of hydroxylated or water-bearing materials in its regolith (Green et al., 2011; Pieters et al., 2009, 2011). The Near Infrared Mapping Spectrometer (NIMS) on the Galileo spacecraft (Carlson et al., 1992) detected hydrated salts on Europa (McCORD et al., 1998) and mapped SO2 volcanism on Io (Douté et al., 2001). The Visible and Infrared (VIR) Mapping Spectrometer mapped lithologic units on Vesta’s surface (de Sanctis et al., 2012a, 2012b) and has arrived at the dwarf planet Ceres. The Visual and Infrared Mapping Spectrometer (VIMS) on the Cassini spacecraft mapped surface compositions on satellites of Saturn and discovered a large ethane cloud on Titan (Brown et al., 2006; Griffith et al., 2006). Closer to home, imaging spectrometers flown on aircraft, such as the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) and HyMap, and in space, such as Hyperion, have mapped mineralogies and monitored dynamic changes in ice, vegetation, and other surface processes on Earth (e.g., Vane et al., 1993; Cocks et al., 2003; Asner et al., 2004, 2007).

For geological applications, at the typical tens to hundreds of meters spatial resolutions of these imaging spectrometers (Fig. 1), regional or global lithologic units can be distinguished, and some components of the mineral assemblages can be identified. The highest-resolution airborne imaging spectrometers currently achieve spatial resolutions of meters, permitting discrimination of mineralogies at scales of boulders or larger outcrops. However, spatial resolutions of a centimeter or less are generally necessary to investigate the mineralogic and petrologic relationships within rocks—essential to understanding the geologic history—and airborne and orbital imaging spectrometers cannot achieve these resolutions. The next revolution is field- and laboratory-based imaging spectroscopy at sub-millimeter to centimeter resolutions capable of petrologic analyses (e.g., Fig. 1).

Recently, visible-shortwave infrared (VSWIR) imaging spectrometers have been miniaturized and are now commercially available for use in the field and laboratory (e.g., manufactured by Headwall Photonics, Inc., Norsk Elektro Optikk AS, and SPECIM), and prototypes have been deployed and demonstrated for use on planetary missions (Blaney et al., 2014; Ehlmann et al., 2014; Van Gorp et al., 2014; Pilorget and Bibring, 2013). Specifically, the Ultra Compact Imaging Spectrometer (UCIS) is in development by the Jet Propulsion Laboratory for a future
mission (Van Gorp et al., 2014), and the MicrOmega instrument will be on the upcoming ExoMars rover and Hayabusa-2 mission (Pilorget and Bibring, 2013). An orbital VSWIR imaging spectrometer has also been selected to fly to Europa. The shortwave infrared wavelengths are critical for mineralogical analyses because unique overtones and combination tones of vibrations within mineral structures occur in this region. The visible wavelengths alone cannot distinguish mineralogies. While not the focus of this paper, similar systems are in development to measure thermal infrared emissivity in the laboratory (e.g., Edwards and Christensen, 2013). There is a steadily growing suite of literature on the use of imaging spectroscopy of outcrops and samples, including core scanning, to answer geologically relevant questions (e.g., Kruse et al., 2012; Kurz et al., 2012; Murphy et al., 2012, 2014; Butz et al., 2015; Greenberger et al., 2015a, 2015b; Yokoyama et al., 2015). Here we highlight some exciting applications of this emerging, non-destructive technology and the science discoveries enabled.

EXAMPLE 1: CHARACTERIZING HABITABILITY AND SEARCHING FOR BIOSIGNATURES IN SERPENTINE-BEARING ROCK

The serpentinization process liberates molecular hydrogen that can sustain microbial communities and react through biotic and abiotic processes to form methane (e.g., Kelley et al., 2001, 2005; Sleep et al., 2004; Oze and Sharma, 2005; Schulte et al., 2006; Cardace and Hoehler, 2009; Etiope and Sherwood Lollar, 2013; McCollom and Seewald, 2013). The oxidation states and coordination environments of iron produce diagnostic absorption features readily detected and mapped with imaging spectroscopy but not so easily spatially resolved with traditional analysis techniques. In serpentinized bodies, the oxidation state and iron coordination chemistry are related to the volume of hydrogen produced and the availability of reduced gases capable of supporting microbial metabolisms (Marcaillo et al., 2011; Andreani et al., 2013). Though degrees of serpentinization are not readily apparent visually, work by Greenberger et al. (2015b) used imaging spectroscopy in the 0.42–1.1 µm region to map the depth of an electronic transition of tetrahedrally coordinated Fe$^{3+}$ occurring at 0.45 µm as a proxy for hydrogen production. Using new imaging data that cover an extended wavelength range (0.40–2.5 µm; Fig. 2), the 0.45 µm feature is shown with the two dominant minerals, carbonate and serpentine, which exhibit sharp vibrational absorptions mapped through calculation of the depths of these features (Clark and Roush, 1984) and other spectral parameters (data processing algorithms are described in the GSA Supplemental Data Repository). Different portions of this sample have undergone different degrees of serpentinization; those areas with tetrahedral Fe$^{3+}$ have undergone advanced serpentinization and are promising areas to search with still higher spatial resolution compositional or isotopic techniques (e.g., scanning electron microscopy, mass spectrometry) for microbial biosignatures and to understand the production of reduced gases.

EXAMPLE 2: HYDROTHERMAL ALTERATION AND DIAGENESIS OF LACUSTRINE PILLOW BASALTS

Alteration rinds illuminate conditions of water–rock interactions, and progressive changes from interior to exterior reflect increasing degrees of alteration (e.g., Haurastru et al., 2008). With sub-millimeter spatial resolutions, imaging spectroscopy measurements of alteration rinds resolve fine changes in mineralogy with alteration. Data from an Early Jurassic lacustrine pillow lava from the Hartford Basin are shown in Figure 3 (Greenberger et al., 2015a). In this work, coordinated imaging spectroscopy, electron microprobe, microscopic X-ray diffraction, microscopic thermal emission spectroscopy, and microscopic Raman spectroscopy analyses of a thick section across an alteration rind (Fig. 3C) characterized spectral, mineralogic, and chemical transformations. Unexpected key identifications with imaging spectroscopy include calcic clinopyroxenes interpreted to have undergone different degrees of serpentinization; those areas with tetrahedral Fe$^{3+}$ have undergone advanced serpentinization and are promising areas to search with still higher spatial resolution compositional or isotopic techniques (e.g., scanning electron microscopy, mass spectrometry) for microbial biosignatures and to understand the production of reduced gases.

1GSA supplemental data item 2015342, imaging spectroscopy methods and calibration, is online at www.geosociety.org/pubs/ft2015.htm. You can also request a copy from GSA Today, P.O. Box 9140, Boulder, CO 80301-9140, USA; gsatoday@geosociety.org.
Figure 2. Hyperspectral image of a serpentinite sample with red and green coatings (Nor4-14, described in Greenberger et al., 2015b) from Norbestos, Quebec, Canada. (A) Photograph of the full rock. (B) Image showing spectral parameters that map calcite (red), serpentine (green), and a feature at 0.45 μm (BD450; blue) due to tetrahedral Fe³⁺ within serpentine. The third dimension shows the reflectance as a function of wavelength for each pixel within the image, with black and purple being low and red high. (C) Plot with representative spectra of different units within the hyperspectral image. Colors correspond to colors in the spectral parameter image with locations numbered. Close-up views of the 0.45 μm feature are shown on the right. These images were acquired with Headwall Photonics Inc. High Efficiency Hyperspec® visible–near-infrared E-series (0.4–1.0 μm, 7 nm spectral resolution, 0.382 mrad instantaneous field of view) and High Efficiency Hyperspec® shortwave infrared X-series pushbroom systems (1.0–2.5 μm, 12 nm spectral resolution, 1.2 mrad instantaneous field of view) imaging spectrometers (see GSA Supplemental Data Repository [see footnote 1] for more information).

Figure 3. (A) Color composite image from a hyperspectral image acquired with the same imaging system used in Figure 2, approximating the true color of a pillow lava cross section. (B) Mineral indicator map showing calcite in red, a spectral slope indicative of the rind in green, and Fe/Mg-clay in blue. The cyan box shows the approximate location of the material on the adjacent cut face from which a thick section was prepared and imaged. (C) Mineral indicator and spectral parameter image of the thick section using the same parameters as (B). The dashed white outline shows the location of identified datolite. (D) Plot with spectral transect from the interior through the alteration rind (purple to green; location of transect shown in A). The spectrum of the innermost point (purple) reflects the oxidized, anhydrous nature of the interior matrix. Spectra of the rind (green) are consistent with an Fe/Mg-clay (chlorite and/or nontronite) and calcic clinopyroxenes. Guidelines show absorption features due to various molecular vibrations or other key spectral characteristics. A scaled, three-point moving average spectrum of datolite (black) acquired within the thick section is also shown. This figure is modified from data presented in Greenberger et al. (2015a).
structural H2O or fluid inclusions (Greenberger et al., 2015a). In addition, <2 mm-sized areas of datolite [CaBSiO4(OH)] formed from boron-rich hydrothermal fluids. While datolite is apparent elsewhere in this outcrop and has been reported throughout the Hartford Basin, the areas of datolite mineralization in this sample were unexpected because they are too small to be distinguished visually from the abundant calcite. However, they are spectrally distinct in the ~133 µm/pixel VSWIR imaging data. Imaging spectroscopy correlates and scales all of these results to the hand-sample (full cross section of the pillow lava; Figs. 3A–3B) and to portions of the outcrop characterized by similar green alteration rinds, and the same spectral features are observed at all scales. These results are consistent with a scenario in which the pillow lavas were altered initially after emplacement at high temperatures, overprinted by a progressively cooling hydrothermal system, and then altered after burial through diagenesis, specifically albitionization followed by calcite precipitation (Greenberger et al., 2015a, and references therein).

EXAMPLE 3: METEORITES, MAPPING OF PRECIOUS MATERIALS NON-DESTRUCTIVELY

Analysis of geological samples typically requires preparation of thin sections or powders for determination of crystal structure and chemical composition. Simultaneous analysis of small-scale mineralogy and texture with VSWIR microimaging spectroscopy requires no sample preparation and can be performed on a rough or cut surface. This approach is ideal for the survey of a collection of rare or precious samples to best target locations for follow-up destructive or high spatial resolution analyses. It is also ideal for in situ exploration of planetary surfaces when conducting multi-step sample preparation procedures may be prohibitively complex. Analyses of the CM2 carbonaceous chondrite Murchison from the Arizona State University meteorite collection were conducted with UCIS in micro-imaging mode (~80 µm/pixel; Fig. 4) (Ehlmann et al., 2014; Van Gorp et al., 2014; Green et al., 2015). Olivine-rich chondrules (green areas, Fig. 4B) of varying sizes are observed throughout the sample, and UCIS data permit ready identification of an atypical area, no more than a few pixels in size, with a low-calcium pyroxene-rich clast, most likely a chondrule fragment (magenta, Figs. 4D and 4F). Chondrules where olivine is affected by aqueous alteration (dark green spectrum) versus those unaffected (light green) can be discriminated (Fig. 4E), and several Fe/Mg phyllosilicate alteration phases are mapped in the matrix (blue areas in Fig. 4B; blue spectra in Fig. 4G). In addition, comparisons of the near true color image with infrared mapping in Figures 4A–4B show that visually

![Figure 4](https://www.geosociety.org/gsatoday)
similar areas are compositionally quite variable. VSWIR micro-images acquired in minutes quickly map distributions of mafic and altered phases while highlighting key compositional variations, allowing investigators to zero-in on sample locations of highest interest for more accurate but time-consuming instrumental techniques such as electron microprobe, transmission electron microscopy, or NanoSIMS analyses.

EXAMPLE 4: MAPPING OF SEDIMENTARY ROCKS EXPOSED AT MILLS CREEK

We imaged an outcrop of sedimentary rocks exposed along Mills Creek near Mono Lake, California, with UCIS in field mapping mode (Fig. 5; 0.5–2.5 µm; instantaneous field of view 1.35 mrad, 12 nm spectral resolution). Using spectral parameters, we mapped specific mineral phases present at the site, including hydrated silica (opal A), clays (Fe-, Mg-, and Al-bearing), calcite, illite/muscovite, and epidote (Fig. 5B). From these results, the stratigraphy of the outcrop lithologies can be inferred (Fig. 5C), showing variations in the depths of absorption features related to hydrated silica (red or orange) and clay mineral (green) contents of the sedimentary layers. The float rocks above the outcrop and along the creek bed at the bottom of the image have diverse compositions. Based on the higher proportions of rocks with significant calcite (cyan) and illite (magenta), we infer the likely presence of calcite- and illite-rich units higher in the stratigraphy that are not exposed at this outcrop. Much of this calcite- and illite-rich talus is located on the left portion of the outcrop near a small fan and likely is sourced from above the layered section, whereas the float rocks to the right are more similar compositionally to the exposed layered outcrop.

CONCLUSIONS

Imaging spectroscopy of samples and outcrops enables new science investigations and yields novel or unexpected mineralogic and petrologic insights into a variety of geological processes (Greenberger, 2015). This technique rapidly and non-destructively maps mineralogies with little sample preparation, showing mineral associations that might not otherwise be apparent and guiding further investigations using other, more time-consuming techniques. Other investigations have used imaging spectroscopy at similar scales to find economically viable deposits of minerals (Kruse et al., 2012), map carbonate lithologies (Baissa et al., 2011; Kurz et al., 2012), characterize alteration of basaltic samples from an impact structure (Yokoyama et al., 2015) and in a cold and arid environment (Cannon et al., 2015b), quantify the abundances of iron in a mine wall (Murphy and Monteiro, 2014), and study the Black Beauty meteorite from Mars (Cannon et al., 2015a). These types of studies also aid in preparing for imaging spectrometers on future landed planetary missions. Imaging spectrometers used herein are currently employed in laboratories such as at Brown University, the California Institute of Technology, and the University of Winnipeg.

ACKNOWLEDGMENTS

We would like to thank Headwall Photonics, Inc., especially David Bannon and Kwok Wong, for use of their hyperspectral imagers to acquire the images.
REFERENCES CITED


Manuscript received 29 May 2015; accepted 27 Aug. 2015.
TECHNICAL SESSIONS


Help ensure that your area of research and expertise is represented in next year’s technical program. Individuals and geoscience organizations are welcome to suggest topics and submit proposals for both \textit{Topical Sessions} and \textit{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 must be outlined in the proposal along with the technical support needs. Upload your proposal at \url{https://gsa.confex.com/gsa/2016AM/cfs.cgi}.

SHORT COURSES


Have something that your peers need to know? Lead a Short Course at the GSA 2016 Annual Meeting in Denver. Courses can be run to develop professional, teaching, and research skills at all levels. Proposal guidelines are available at \url{www.geosociety.org/meetings/scProposals.htm} or by contacting Jennifer Nocerino at jnocerino@geosociety.org.

CALL FOR PAPERS

\textbf{Top Five Reasons to Publish Your Science in \textit{GSA Today}:}

1. \textbf{GET NOTICED:} \textit{GSA Today}’s print edition has a large circulation, reaching more than 25,000 readers. All articles are open-access online, and page views for 2014 science articles total more than 47,000 so far (html files only; Google Analytics data, Aug. 2015).

2. \textbf{GET CITED:} Since its premier in 1991, \textit{GSA Today} has generated a tremendous proportion of citations considering that only one peer-reviewed science article is published per month. The top year for citations was 1997, with more than 1,600; articles published in 2014 are slowly building up steam, with 54 citations so far (Google Scholar data, Aug. 2015).

3. \textbf{MAKE THE COVER:} Publication of your science article in \textit{GSA Today} includes a high-impact, color front cover to draw readers to your science.

4. \textbf{MAKE AN IMPACT:} \textit{GSA Today} is ranked ninth in the world among geoscience journals according to SCImago Journal Country Rank, which measures a journal’s impact, influence, and prestige.

5. \textbf{HIT THE GROUND RUNNING:} \textit{GSA Today} currently does not have a backlog; you could see your article in print within three months of acceptance!

\url{www.geosociety.org/gsatoday}
Manfred Strecker’s research activities link studies of tectonics, climate, and landscape evolution with the goal to better understand tectonic and climatic forcing mechanisms of surface processes and their conspiring activity in sculpting the surface of our planet. In particular, he and his team have worked to better understand how the morphology of landscapes can be used to reconstruct crustal deformation processes and to bridge the temporal gap between long-term geologic manifestations of deformation and short-term observations and instrumental measurements. By joint application of morphometric analyses, neotectonic observations, paleoseismology, surface exposure dating, and thermochronological methods, they have successfully deciphered tectonic and climatic signals within sedimentologic archives and within the context of landscape evolution.

This work has been carried out in various mountain belts, including the Andes, the Himalaya, Central Asia, and the ranges bordering the Turko-Iranian Plateau. He and his team also focus on stress-field histories in the context of the structural development of linked fault systems and their impact on the evolution of sedimentary basins in the East African Rift.

Strecker did his undergraduate work at Göttingen University (Germany) and the University of North Carolina at Chapel Hill. He received his M.Sc. degree at Cornell University in 1983 and his Ph.D. from the same university in 1987. After postdoc appointments at University of Karlsruhe (Germany) and Stanford University, he joined the University of Potsdam (Germany) in 1995. Since then, he and his colleagues have been responsible for establishing a geoscience program with a strong research-based curriculum. Strecker was Visiting Professor at Vienna University, IPG Paris, and Stanford University. Since 2009 he has also been Adjunct Professor at Cornell University. He is a member of Leopoldina, the German Academy of Sciences.

Travel Grants and Mentor Program for Early Career Scientists and Students

35th International Geological Congress (IGC)

Cape Town, South Africa ✷ 27 August–4 September 2016

The Geological Society of America is accepting applications for the 35th International Geological Congress (IGC) Students and Early Career Scientists Travel Grant and Mentoring Program. This program is organized in collaboration with the GSA Foundation and the U.S. National Committee for Geological Sciences of the National Academy of Sciences. To be eligible, the applicant must be a resident or citizen of the United States and be enrolled in, or employed at, a U.S. institution. Early career scientists are defined as those within seven years of receiving their Ph.D. Each award is anticipated to be a maximum of US$3,500.

In addition to the online form and résumé, the following supplemental information will be required: A cover letter addressing your reasons for attending the meeting and a prioritized budget of expenses, proof of abstract submission, a copy of the submitted abstract, and two letters of reference.

Applications will be available in mid-to late December. The online application and supplemental material must be received electronically no later than 20 February 2016. Applicants will be notified of the results by 30 April 2016.

Questions? Please contact Jennifer Nocerino at jnocerino@geosociety.org.
Brian Windley is a leading, preeminent geoscientist whose career has revolved around understanding the manifold facets of the tectonic development of orogens through geological time, and especially application of the plate tectonic paradigm to Precambrian accretionary and collisional orogens worldwide. These include:

1. Field-based studies of (a) the accretionary Central Asian Orogenic Belt/Altaids, the Mona Complex of Anglesey/Lleyn (Wales, UK), and terranes in Yemen; and (b) the collisional Himalayan (Kohistan) and Karakoram orogens (Pakistan), the Tian Shan mountains (China), Sergipean belt (Brazil), Mozambique orogen (Madagascar), the Kumta-Coorg suture (SW India), and the Aravalli-Delhi belts in Rajasthan (India).

2. Geotectonic growth of deep continental crust in W. Greenland, S. India, and NW Scotland (Neoarchean), and the Ketilidian orogen in Greenland (Paleoproterozoic).

3. Tectonic uplift of Cenozoic mountains in West Mongolia, and climate-tectonic relationships in Central Asia.

4. Neoproterozoic ocean plate stratigraphy and accretion in Anglesey/Lleyn, and Ballantrae, Scotland.

5. Petrology of eclogitic rocks at Glenelg, Scotland; Beishan, China; Vietnam; and Kyrgyzstan, and blueschists in Anglesey and Ballantrae.

6. Chromite-layered anorthositic complexes from the roots of island arcs at Fiskenaesset (Greenland), Sittampundi (India), Chilas (Pakistan Himalayas), Limpopo (South Africa), and Chimalpahad (Eastern Ghats).

7. Tectonic development of ophiolitic complexes in Beishan, Ballantrae, Tartoq (Greenland), and Bayankhongor (Mongolia).

8. Petrology of sapphirine-bearing rocks especially at Fiskenaesset.


10. Delamination of sub-continental lithosphere in eastern China.

11. Geotectonic evolution of Precambrian cratons—West Greenland and North China Craton. These projects involved collaborative fieldwork and laboratory studies with innumerable students and staff in 23 countries.

Windley has published nine edited/co-edited books and 320 peer-reviewed papers, with >19,000 citations. Syntheses of the interdisciplinary geology of crust/mantle evolution through time integrated with the atmosphere, oceans, and metallogenesis led to The Evolving Continents in three editions.
Please go to [https://rock.geosociety.org/forms/Awardform.asp](https://rock.geosociety.org/forms/Awardform.asp) to submit a nomination form. For detailed information on nomination processes, see the October 2015 issue of *GSA Today* or go to [www.geosociety.org/awards/aboutAwards.htm](http://www.geosociety.org/awards/aboutAwards.htm). To nominate a member for GSA Fellowship, go to [www.geosociety.org/members/fellow.htm](http://www.geosociety.org/members/fellow.htm). Information can also be obtained from GSA Grants and Awards at awards@geosociety.org, +1-303-357-1060.

### 2016 GSA Medals and Awards

- Penrose Medal
- Day Medal
- Young Scientist Award (Donath Medal)
- GSA Public Service Award
- Randolph W. "Bill" and Cecile T. Bromery Award for Minorities
- GSA Distinguished Service Award
- Doris M. Curtis Outstanding Woman in Science Award
- Geologic Mapping Award in Honor of Florence Bascom
- Honorary Fellow

**Nomination deadline:** 1 Feb. 2016

### 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; **GSA members** who are not Fellows may be secondary nominators for up to two nominees. **Nomination deadline:** 1 Feb. 2016.

### 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 Mar. 2016.

### 2016 Student Research Grants

GSA is proud to offer research grants to its highly qualified student members. Students may receive a total of two GSA graduate student grants in their entire academic career, regardless of what program currently enrolled in. The **maximum award per grant is US$2,500.** Students may also qualify for specialized awards; if so, the total awarded could be more than US$2,500.

The GSA student research grant application process is online only at [www.geosociety.org/grants/gradgrants.htm](http://www.geosociety.org/grants/gradgrants.htm). No paper applications or letters will be accepted. Apply starting Dec. 2015. Submissions must be completed by Monday, 1 Feb. 2016, at 5 p.m. MST.

For further information on this program, go to [www.geosociety.org/grants/gradgrants.htm](http://www.geosociety.org/grants/gradgrants.htm), call +1-303-357-1060, or e-mail awards@geosociety.org.

### 2016 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).

- 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. **Application deadline:** 1 Feb. 2016.
- 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. **Application deadline:** 1 Feb. 2016.

### Other Awards

**Call for Nominations: AGI Awards**

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

Go to [www.agiweb.org/direct/awards.html](http://www.agiweb.org/direct/awards.html) to submit your nominations. **Nomination deadline:** 1 Feb. 2016.

**Call for Nominations: National Awards**

- **Alan T. Waterman Award:** [www.nsf.gov/od/waterman/waterman.jsp](http://www.nsf.gov/od/waterman/waterman.jsp).

**Nomination deadlines vary.**
American Museum & Natural History
Richard Gilder Graduate School
Master of Arts in Teaching

Change lives. Teach science.

Apply to a fully paid master’s degree program in Earth and space science that prepares you to teach in high-need middle and high schools in New York City and New York State.

Learn to teach from experienced education faculty and residency mentors. Study and conduct research alongside renowned Museum scientists.

Apply Today!
You’re invited to an open house, or an upcoming webinar, at the Museum. Complete details are available at amnh.org/mat

With deepest appreciation, the Museum acknowledges Kathryn W. Davis for her generous founding support of the MAT Program.
Leadership support for the MAT program is provided by The Shelby Cullom Davis Charitable Fund.
The MAT program is supported in part by the New York State Education Department, the National Science Foundation under Grant Numbers DRI-1135444 and DUE-1340806, and the U.S. Department of Education under Grant Number U335940026.

amnh.org/mat   mat@amnh.org   212-313-7464   @amnh   facebook.com/amnhmat
Writing A Successful GSA Grant Proposal

Paul H. Wetmore, Univ. of South Florida, and Amy Draut East, U.S. Geological Survey

Each year, GSA funds approximately half of the proposed graduate student research grants. 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, you can find resources at www.geosociety.org/grants/ap_tips.htm.

Like all grant proposals, GSA’s 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. Note the deadline—NO LATE SUBMISSIONS! Note eligibility, 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, and 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., the 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 problems/hypotheses from the first two sections and the tasks proposed in this section. Your planned study should test a hypothesis and 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 also must 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’ll be 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 and high resolution, and use text that is legible at a normal full-page viewing scale. A well-written caption is very helpful. Include legends, 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, and 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!
In 2015, ExxonMobil, in partnership with the GSA Foundation, helped to fund a long-standing scholarship program to encourage minority undergraduate GSA student members to continue their studies in the geosciences. The ExxonMobil Minority Student Scholarship Program provides US$1,500 to one student in each of GSA’s six regional Sections. The students also receive free registration to attend the GSA Annual Meeting and a one-year complimentary membership in GSA.

Diamond Tachera, University of Hawaii at Mānoa (Cordilleran Section)
Detaya Johnson, University of Wisconsin–Milwaukee (North-Central Section)
Stephanie Sang, Cornell University/University of Bristol (Northeastern Section)
Ida Clarke, Black Hills State University (Rocky Mountain Section)
Justin Brundin, Tarleton State University (South-Central Section)
Eric Hanna, Austin Peay State University (Southeastern Section)
My GSA-USGS Congressional Fellowship year has come to an end. Over the past year I have learned an incredible amount and feel deeply indebted to this experience. As a wrap-up, I want to discuss a piece of legislation that I worked on.

One of my projects in Senator Gillibrand’s (D-NY) office was to assist in researching and developing legislation as it pertains to pollinator protection. Pollinators, such as honey bees, native bees, butterflies, and other insects, are essential to many of the specialty crops, such as apples and cucumbers, in New York. Globally, pollination is necessary for at least 35% of the world’s crops and upward of 90% of wild plants. This past spring, the President released the National Strategy to Promote the Health of Honey Bees and Other Pollinators, highlighting the national problem of declining bee populations and laying out a number of initiatives to reduce the impacts of stressors on pollinator health. Beekeepers throughout the U.S. have noticed an unusually high overwintering mortality among honey bee colonies, known as colony collapse disorder (CCD). Researchers investigating CCD and the overall general population decline are finding that there is no one single culprit, but a combination of stressors, including pesticides, disease, parasites, changes to habitat quality, and habitat loss.

From a legislative perspective it is difficult to craft (and get passed) one encompassing bill that would help alleviate the problem of pollinator population decline. Beekeepers have stated that one beneficial step would be to increase the natural foraging landscape so that it is free from pesticides and contains a diversity of vegetation. The Highways Bettering the Economy and the Environment (BEE) Act attempts to do this. The bill proposes integrated vegetation management practices, such as reduced mowing and increased planting of pollinator-friendly native vegetation along highway right-of-ways. The bill has the potential to create 17 million acres of natural pollinator habitat throughout the country. This type of vegetation management has already been implemented in many states and is shown to save nearly 20% in right-of-way maintenance costs. It was first introduced in the House by Representatives Denham (R-CA) and Hastings (D-FL). I worked with my office to create a Senate companion bill.

The nation’s current surface transportation legislation will expire at the end of October. This past summer the Environment and Public Works Committee (EPW) began the process of reauthorizing this legislation, which must first pass out of committee before it can be voted on by the whole Senate. To move the BEE Act forward, we worked with EPW staff to include the bill language in the original base transportation bill that was first voted on in EPW. Getting language in the bill requires approval by the committee members who are drafting the bill, and in this case was agreed upon by both parties due to the bipartisan importance of getting this legislation reauthorized. By comparison, if the pollinator legislation was introduced as an amendment or even a stand-alone bill, it would require a separate individual vote, which, given the climate of the Hill and the other legislation that necessitates votes, it probably would not have gotten a chance. By including the language in the base bill it nearly ensures that it will become law (if the bill passes).

The six-year transportation reauthorization, The DRIVE Act, with the BEE Act language, passed the Senate on 30 July 2015. Unfortunately, the committee did not accept the entire bill language, but only included portions that encourage the use of pollinator friendly vegetation, and excluded the portions that hold states accountable or require reporting, leaving little to no teeth or actionable items in the effort. I think this was a great piece of legislation that could easily have been supported by both parties, namely because it would save money—not a common occurrence. I was pretty disappointed at the end result, but have accepted this small success as a bee-sized step in the right direction for pollinator protection. This whole process was really instructive, because I was able to follow an idea through to becoming law (almost). Even with this seemingly non-divisive legislation, it truly was a nuanced process.

I am very grateful to GSA and the USGS for funding this fellowship, and I leave with determination and focus. I will remain in D.C. and have accepted a position working for the EPA. My position will be to translate and communicate chemical safety research to further the mission of the agency to protect human health and the environment. It is without a doubt that my experience over the past year helped me define the role of science in the political process and my commitment to it. I encourage anyone interested in this process to consider this fellowship, and if you have any questions, please contact me at susanna.blair@gmail.com. I want to welcome the 2015–2016 GSA-USGS Congressional Science Fellow Karen Paczkowski, who will undoubtedly do a great job over the next year.

The manuscript is submitted for publication by Susanna W. Blair, 2014–2015 GSA-USGS Congressional Science Fellow, with the understanding that the U.S. government is authorized to reproduce and distribute reprints for governmental use. The one-year fellowship is supported by GSA and the U.S. Geological Survey, Department of the Interior, under Assistance Award No. G14AP00161. The views and conclusions contained in this document are those of the author and should not be interpreted as representing the official policies, either expressed or implied, of the U.S. government.
ON TO THE FUTURE (OTF)

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

CAREER WORKSHOPS

Geoscience Career Workshop Part 1: Career Planning and Informational Interviewing

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. This section is highly recommended for freshmen, sophomores, and juniors. The earlier you start your career planning the better.

Geoscience Career Workshop Part 2: Geoscience Career Exploration

What do geologists in various sectors earn? What do they do? What are the pros and cons of working in academia, government, and industry? Workshop presenters, and professionals in the field, will address these issues.

Geoscience Career Workshop Part 3: Cover Letters, Résumés, and CVs

How do you prepare a cover letter? Does your résumé need a good edit? Whether you are currently on the job market or not, learn how to prepare the best résumé possible. You will review numerous résumés to help you learn the important dos and don’ts of the process.

MENTOR PROGRAMS

Enjoy a free lunch while meeting with geoscience mentors working in the applied sector. The popularity of these programs means that space is limited, so plan to arrive early, because lunch is first-come, first-served. For further information, contact Jennifer Nocerino at jnocerino@geosociety.org.

South-Central Section: Baton Rouge, Louisiana, USA
Roy J. Shlemon Mentor Program in Applied Geoscience
Luncheon: Monday, 21 March
John Mann Mentors in Applied Hydrogeology
Luncheon: Tuesday, 22 March

Northeastern Section: Albany, New York, USA
Roy J. Shlemon Mentor Program in Applied Geoscience
Luncheon: Monday, 21 March
John Mann Mentors in Applied Hydrogeology
Luncheon: Tuesday, 22 March

Southeastern Section, Columbia, South Carolina, USA
Roy J. Shlemon Mentor Program in Applied Geoscience
Luncheon: Thursday, 31 March

GSA Section Meetings Call for Mentors

PROFESSIONALS: Interested in sharing information about your applied geoscience career with students? Being a mentor is a rewarding experience. If you are interested in serving as a mentor at one of GSA’s Section Meetings, contact Jennifer Nocerino at jnocerino@geosociety.org.

STUDENTS: Interested in a career in the applied geosciences? Plan now to attend a Roy J. Shlemon Mentor Program in Applied Geoscience and/or a John Mann Mentors in Applied Hydrogeology Program at your 2016 Section Meeting to chat one-on-one with practicing geoscientists. These volunteers will answer your questions and share insights on how to get a job after graduation.
Renew Your 2016
GSA Membership

Journal Subscriptions • Division Memberships • Section Affiliations • GSA Foundation Support

Premier Journals
Geology, GSA Bulletin, Lithosphere, and Geosphere

Scientific Exchange
27,000 Worldwide Member Network
Publish & Present Research
GSA Meetings
18 Geoscience Divisions
6 Regional Sections

Especially for Students & Early Career Professionals
Career Development Programs
Free Online Journals
Research and Travel Grants for Students
Reduced Meeting Registrations, Membership, and Division Dues

Member-Only Discounts
Online Store, Publications, Meetings

Volunteer Opportunities
Be Involved—Make a Difference in Your Science!

Early Career Professionals: Graduated with a degree in geology or related science with highest degree within the last five years.

www.geosociety.org/members
Renew Your 2016 Membership

SAVE 15%* OFF DUES

*Discount applies to those in high income country/territory economies through 15 December 2015.
CONVENERS
Alan E. Boudreau, School of the Environment, Duke University, Durham, North Carolina, USA, boudreau@duke.edu
Eric C. Ferré, Department of Geology, Southern Illinois University, Carbondale, Illinois, USA, eferre@geo.siu.edu
Brian O’Driscoll, School of Earth, Atmospheric and Environmental Sciences, University of Manchester, Manchester, UK, brian.odriscoll@manchester.ac.uk
Edward M. Ripley, Department of Geological Sciences, Indiana University, Bloomington, Indiana, USA, ripley@indiana.edu

ORGANIZING COMMITTEE
Steve Barnes, CSIRO Mineral Resources; Mike Cheadle, University of Wyoming; James Day, Scripps Institution of Oceanography; Jeff Gee, Scripps Institution of Oceanography; Allen Glazner, University of North Carolina–Chapel Hill; Tom Kalakay, Rocky Mountain College; Mike Koski, Stillwater Mining Company; Craig Lundstrom, University of Illinois Urbana-Champaign; Wolfgang Maier, University of Manchester; Larry Meinert, U.S. Geological Survey, Mineral Resources Program; Bill Meurer, ExxonMobil; Phil Moffitt, Rocky Mountain Association of Geologists; James Scoates, University of British Columbia; Bob Stewart, North American Platinum


DESCRIPTION AND OBJECTIVES
Layered mafic intrusions play a central role in our understanding of magmatic systems. They also represent one of the fundamental modes of magma transfer from the upper mantle to the crust. These magmatic systems formed throughout geologic time from the Archean (e.g., Stillwater Complex) to the Paleogene (e.g., Skaergaard Complex) on all five continents. Because many of the best-studied layered intrusions are associated with Large Igneous Provinces, they are largely independent from tectonic processes at plate boundaries. Layered intrusions have generated significant historic interest from the igneous petrology and geochemistry communities because they lie at the heart of some of the most fundamental petrologic precepts, such as fractional crystallization and Bowen’s reaction series. These intrusions also host first-class economic deposits of platinum group elements (PGE), chrome, and nickel around the world. As an illustration of how unique and important these environments are, it is worth highlighting that the Bushveld Complex (South Africa) hosts >75% of the world’s exploited platinum. The Stillwater Complex also hosts significant economic quantities of these precious metals, at even higher grades (i.e., 18 ppm Pt + Pd) than the Bushveld, so it is an important location for understanding ore forming processes. In general, it is the combination of the industrial and scientific relevance of layered intrusions that has ensured support for research on these intrusions for the past six decades.

Despite the large volume of literature dedicated to layered intrusions, advances in various sub-disciplines are somewhat scattered, and there is a need for synthesis of the past twenty years of research as well as an urgent need to define the new scientific challenges that the broad community and graduate students...
should focus on. The Stillwater Complex is an ideal setting in which to consider these challenges, because it combines a rich tradition of petrological research with active economic interests in a relatively easily accessible location. More simply, it is one of the most important layered intrusions on Earth, in terms of historical study and quality of exposure.

The subject of layered mafic-ultramafic intrusions will bring together a range of researchers from the fields of petrology, geochemistry, mineralogy, and economic geology. These scientists use different approaches that have the potential to be better integrated to further our understanding of complex magmatic systems. This conference will provide an opportunity for researchers to address these and other recent developments in a format that allows for discussion, integration of ideas, and development of collaborations and future directions.

The meeting is an opportunity for integration of academic and industrial observations, experiments on magmatic systems, and results of petrological/geochemical modeling. The topics that will be emphasized as part of the program include:

- Petrology of layered mafic intrusions, including experimental petrology;
- Geochemistry of layered mafic intrusions; and
- Geophysics of layered mafic intrusions and prospective science forum.

Preliminary Agenda

Day 1: 8 Aug.: Petrology of layered mafic intrusions
Day 2: 9 Aug.: Visit of the Stillwater mine
Day 3: 10 Aug.: Visit of Stillwater Complex key exposures
Day 4: 11 Aug.: Geochemistry of layered mafic intrusions
Day 5: 12 Aug.: Geophysics of layered mafic intrusions and prospective science forum

This five-day conference will begin in Billings, Montana, USA, where transportation will be arranged by the organizers to Red Lodge, Montana, USA. The first day of the conference begins with two sessions focusing on recent developments on the petrology of layered mafic intrusions. On the first day of excursions (Tuesday), participants will visit the following localities: (1) sill/dike and basal series at the Hamslice; (2) ultramafic series cliff section; (3) finger structures in large boulder at the Mountain View mine entrance; (4) ultramafic-lower banded series section; (5) inch-scale doublets/octa-scale layering; and (6) mine core shed view of J-M reef section. The second day of excursions (Wednesday), participants will (1) drive up to Picket Pin, with a stop at upper unconformity; (2) hike the middle banded series section (Hess’s eggs), replacement troctolite, AN-II, Picket Pin PGE zone; and (3) continue into olivine-bearing zone V, snowball oiks in N-III, and inverted pigeonite “oiks” in GN-III. The fourth day of the conference will be dedicated to geochemical aspects of layered mafic intrusions, and the fifth day will focus on geophysical aspects of layered mafic intrusions (morning) and a discussion of future research with industry representatives. Transportation to the Billings airport will be arranged at the end of the conference.

Attendees and Estimated Costs

The registration fee will cover hotel lodging for six nights (double occupancy), breakfast, lunch, and coffee breaks for five days, handouts, and transportation for the field trips and meeting dates. Airfare is not included, and participants must make their own travel arrangements. Registration fees have not been finalized. Please check the GSA website for updates: www.geosociety.org/penrose/.

Applications and Registration


Participants will have to commit to attending the full five days of the conference. To apply, please contact the conveners at eferre@geo.siu.edu with a letter of intent that includes a brief statement of interests, the relevance of your recent work to the themes of the conference, the subject of a proposed presentation, and contact information. Interested graduate students and early career faculty are strongly encouraged to apply. Once you have been selected to participate, you will be sent registration information.
Second Announcement

SOUTH-CENTRAL SECTION

50th Annual Meeting of the South-Central Section, GSA
Baton Rouge, Louisiana, USA
21–22 March 2016
www.geosociety.org/Sections/sc/2016mtg/

Celebrating the Section’s Golden Anniversary

GSA’s South-Central Section will celebrate its Golden Anniversary by meeting at the Hilton Baton Rouge Capitol Center, located in the state capital of Louisiana, Baton Rouge. Founded in 1719, Baton Rouge is located on the banks of the Mississippi River, just upstream from the world-famous delta that is building out into the Gulf of Mexico. The region is a classic area for the study of fluvial sedimentology, coastal geology, and hydrocarbon systems and salt tectonics. Geology underlies much of the economy of the region, which is also challenged by issues such as coastal land loss, including fragile wetlands, as a result of rising sea levels and subsidence. The region is also strongly affected by hurricane systems from the Gulf of Mexico. Interest in this 50th anniversary meeting is rapidly developing! Early registration and accommodation reservations are strongly recommended.

REGISTRATION

Early registration deadline: 16 Feb.
Cancellation deadline: 22 Feb.

For further information or if you need special accommodations, please contact Peter Clift, pclift@lsu.edu. Professionals registering for the meeting are encouraged to add US$15 to their registration fee to help a student attend the 50th Anniversary Celebration.

REGISTRATION FEES (in U.S. dollars)

<table>
<thead>
<tr>
<th></th>
<th>Early Registration</th>
<th>Onsite Registration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full One Day</td>
<td>Full One Day</td>
<td></td>
</tr>
<tr>
<td>Professional Member</td>
<td>$165</td>
<td>$220</td>
</tr>
<tr>
<td>Professional Member 70+</td>
<td>$110</td>
<td>$165</td>
</tr>
<tr>
<td>Professional Non-Member</td>
<td>$180</td>
<td>$240</td>
</tr>
<tr>
<td>Student Member</td>
<td>$60</td>
<td>$110</td>
</tr>
<tr>
<td>Student Non-Member</td>
<td>$80</td>
<td>$130</td>
</tr>
<tr>
<td>K–12</td>
<td>$65</td>
<td>$110</td>
</tr>
<tr>
<td>Guest/Spouse</td>
<td>$40</td>
<td>$50</td>
</tr>
<tr>
<td>Field Trip or Short Course only</td>
<td>$40</td>
<td>$50</td>
</tr>
</tbody>
</table>

ACCOMMODATIONS

Reservation deadline: 29 Feb.
GSA has reserved blocks of specially priced rooms and townhomes at the Hilton Baton Rouge Capitol Center, 201 Lafayette Street, Baton Rouge, LA 70801, USA. Reservations can be made by calling +1-225-344-5866 or +1-800-955-6962. In order to receive the special rate, please mention that you are attending the GSA South-Central Meeting. Individual and double rooms are US$109 per room/night, plus a 13% Louisiana tax. Bookings can also be made online at https://aws.passkey.com/event/13930413/owner/32164/home (use code “GSA”). For those who would like to come early or stay after the meeting, these special rates are available 19–22 March 2016.

CALL FOR PAPERS

Abstract deadline: 15 Dec. 2015
Submit abstracts online at www.geosociety.org/sections/sc/2016mtg/techprog.htm. Fee: US$15 for students and US$20 for all others. If you cannot submit an abstract online, please contact Heather Clark, +1-303-357-1018, hclark@geosociety.org.

TECHNICAL PROGRAM

Symposium

S1. The Bones May Be Dry but the Ideas Don’t Have to Be: Fossil Vertebrates from the Gulf Coastal Plain. Judith Schiebout, Louisiana State Univ., jschie@lsu.edu; Gary Stringer, Univ. of Louisiana at Monroe, stringer@ulm.edu.

Theme Sessions

T1. Climate Change in the Gulf Coast Region: Past, Present, and Future. Brian Schubert, Univ. of Louisiana at Lafayette, schubert@louisiana.edu; Grant Harley, Univ. of Southern Mississippi, grant.harley@usm.edu.
T2. Flow through Carbonate Aquifers and Reservoirs. Carol Wicks, Louisiana State Univ., cwicks@lsu.edu.

T3. Big Geoscientific Problems in the South-Central Region. Robert J. Stern, Univ. of Texas at Dallas, rjstern@utdallas.edu; Kevin Mickus, Missouri State Univ., kmickus@missouristate.edu; Raphael Gottardi, Univ. of Louisiana at Lafayette, rgottardi@lsu.edu.

T4. The Geochemistry of Sedimentary Systems. David Borrok, Univ. of Louisiana at Lafayette, dborrok@louisiana.edu; Achim Hermann, Louisiana State Univ., aherrmann@lsu.edu.

T5. Petroleum Geology of the Gulf of Mexico. Peter D. Clift, Louisiana State Univ., pclift@lsu.edu.

T6. Geochemistry and Water Quality of Gulf Coast Groundwaters. Karen Johannesson, Tulane Univ., kjohanne@tulane.edu; Ningfang Yang, Tulane Univ., nyang@tulane.edu.

T7. Subsidence, Accretion: Coastal Depletion? Christopher Esposito, Tulane Univ., cesposit@tulane.edu; Elizabeth L. Chamberlain, Tulane Univ., echambel@tulane.edu; Krista L. Jankowski, Tulane Univ., kjankows@tulane.edu.

T8. Hazards Related to Induced Earthquakes. Randal T. Cox, Univ. of Memphis, randycox@memphis.edu; Arleen A. Hill, Univ. of Memphis, aahill@memphis.edu; Jian Chen, Univ. of Louisiana at Lafayette, jchen@louisiana.edu.

T9. Coastal and Shelf Sediment Transport Processes and Products of the Northern Gulf of Mexico. Sam Bentley, Louisiana State Univ., sb@lsu.edu; Kehui Xu, Louisiana State Univ., kxu@lsu.edu; Jeff Obelcz, Louisiana State Univ., jobelc1@lsu.edu; Jiaze Wang, Louisiana State Univ., jwang72@lsu.edu; Crawford White, Louisiana State Univ.

T10. Fluvial Forms and Processes with Special Focus on Gulf Coast Rivers. Kory Konsoer, Louisiana State Univ., kkonsoer@lsu.edu; Jeff Nittrouer, Rice Univ., nittouer@rice.edu; Inci Güneralp, Texas A&M, iguneralp@geos.tamu.edu.

T11. Toward Sustainable Water Systems: Impacts of Climate Variability and Changing Demands. Emad Habib, Univ. of Louisiana at Lafayette, habib@louisiana.edu; Ning Zhang, McNeese State Univ., nzhang.mcnese@gmail.com; Robert Miller, C.H. Fenstermaker & Associates, robert@fenstermaker.com.

T12. Computational Geosciences and Data Visualization. Margarete Jadamec, Univ. of Houston, mjadamec@central.uh.edu; Matthew Knepley, Rice Univ., knepy@rice.edu; M. Burak Yikilmaz, Univ. of California Davis, mbyikilmaz@ucdavis.edu.


F1. Quaternary and Recent Sedimentation in the Wax Lake Delta. Sun., 20 March; departs 8:30 a.m. from the Hilton. US$220; min.: 16/max.: 28. Principal organizer: Harry Roberts, Louisiana State Univ., hrober3@lsu.edu.

F2. Miocene Vertebrates in the Pascagoula Formation: A Site Yielding Mastodon to Marine Turtle Material. Sun., 20 March; departs 9 a.m. from the Hilton and returns at 3:30 p.m., with lunch provided. US$35; min.: 5/max.: 15. Principal organizer: Judith A. Schiebout, jschie@lsu.edu.

F3. Water Flow, Sediment Flux, and Boat Traffic between the Mississippi and Atchafalaya Rivers. Sun., 20 March; departs 8 a.m. from the Hilton and returns by 4:30 p.m., with lunch provided. US$75; min.: 4/max.: 18. Principal organizer: Gary Kinsland, gkinsland@louisiana.edu.

SPECIAL EVENT
Welcoming Reception: 50th Anniversary Section Meeting. Sun., 20 March, 6:30–8:30 p.m. Visit with friends and colleagues as you enjoy the hospitality of the Hotel Capitol Center. One complimentary drink, then cash bar.

OPPORTUNITIES FOR STUDENTS
For mentor programs, career workshops, and On To the Future, see p. 19.

Volunteering
Students can earn free meeting registration by volunteering for two shifts of ~4 to 5 hours of work. If you are interested in volunteering, please contact the Student Volunteer Coordinator, Adam Turner, aturn49@lsu.edu. The volunteer application is part of the meeting registration process.

Travel Grants
Application deadline: 17 Feb. Please review the eligibility guidelines and application procedure at www.geosociety.org/Sections/sc/grants.htm.

LOCAL CONTACTS
Coordinating Chair: Peter Clift, Louisiana State University, pclift@lsu.edu
Technical Chair: David Borrok, University of Louisiana Lafayette, dborrok@louisiana.edu
Exhibits Chair: Carl Richter, University of Louisiana Lafayette, rich@louisiana.edu
Field-Trip Chair: Tara Jonell, Louisiana State University, tjonell@lsu.edu
Student Coordinator: Adam Turner, Louisiana State University, aturn49@lsu.edu
Second Announcement

NORTHEASTERN SECTION

51st Annual Meeting of the Northeastern Section, GSA
Albany, New York, USA
21–23 March 2016

www.geosociety.org/Sections/ne/2016mtg/

REGISTRATION
Early registration deadline: 16 Feb.
Cancellation deadline: 22 Feb.

REGISTRATION FEES (in U.S. dollars)

<table>
<thead>
<tr>
<th></th>
<th>Early Registration</th>
<th>One Day</th>
<th>Onsite</th>
<th>One day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Member</td>
<td>$180</td>
<td>$130</td>
<td>$225</td>
<td>$150</td>
</tr>
<tr>
<td>Professional Member 70+</td>
<td>$100</td>
<td>$80</td>
<td>$130</td>
<td>$100</td>
</tr>
<tr>
<td>Professional Non-Member</td>
<td>$200</td>
<td>$150</td>
<td>$250</td>
<td>$185</td>
</tr>
<tr>
<td>Student Member</td>
<td>$60</td>
<td>$50</td>
<td>$80</td>
<td>$70</td>
</tr>
<tr>
<td>Student Non-Member</td>
<td>$70</td>
<td>$60</td>
<td>$90</td>
<td>$80</td>
</tr>
<tr>
<td>K–12</td>
<td>$65</td>
<td>$50</td>
<td>$85</td>
<td>$60</td>
</tr>
<tr>
<td>Guest/Spouse</td>
<td>$50</td>
<td>n/a</td>
<td>$60</td>
<td>n/a</td>
</tr>
<tr>
<td>Field Trip or Short Course only</td>
<td>$40</td>
<td>n/a</td>
<td>$40</td>
<td>n/a</td>
</tr>
</tbody>
</table>

ACCOMMODATIONS
Reservation deadline: 29 Feb.
Blocks of specially priced rooms have been reserved at the Hilton Albany Hotel (40 Lodge Street, Albany, NY 12207, USA), which is three blocks from the convention center. Individual and double rooms at US$172 per room/night can be reserved by calling +1-800-445-8667 and referring to the “NEGSA conference.” Rates do not include 14% New York tax.

For students only: A block of rooms (each can accommodate up to four people) has been reserved at the 74 State Hotel (one block from the Hilton and four blocks from the convention center) at a special rate. Booking information is on the meeting website.

CALL FOR PAPERS
Abstract deadline: 8 Dec. 2015
Submit abstracts online at www.geosociety.org/sections/ne/2016mtg/techProg.htm. Fee: US$15 for students and US$20 for all others. If you cannot submit an abstract online, please contact Heather Clark, +1-303-357-1018, hclark@geosociety.org.

TECHNICAL PROGRAM

Symposia

S1. Applications of Geochemistry and Geochronology to Understanding Tectonic Processes: In Honor of Raymond A. Coish. David P. West, Jr., Middlebury College, dwest@middlebury.edu; Peter Ryan, Middlebury College, pryan@middlebury.edu; Jonathan Kim, Vermont Geological Survey, jon.kim@state.vt.us.

S2. Timing and Nature of Deformation in the Adirondack Mountains. Mike Williams, Univ. of Massachusetts, mlw@geo.umass.edu; Jeff Chiarenzelli, St. Lawrence Univ.; Tim Grover, Castleton State College.

Theme Sessions

T1. Insights from Microfossils, from Terrestrial to Marine Environments (Posters). Miriam Katz, Rensselaer Polytechnic Institute, katzm@rpi.edu; Chiara Borrelli, Univ. of Rochester, cborrelli@ur.rochester.edu; Samuel Bowser, Wadsworth Center, NYS Dept. of Health, samuel.bowser@health.ny.gov.
T2. **High-Resolution Records of Holocene Climate Change.** Eugene Domack, College of Marine Science, Univ. of South Florida, edomack@usf.edu; Amy Leventer, Geology Department, Colgate Univ., alevanter@colgate.edu.

T3. **Tropical Climate and Palaeoclimate.** Alice Doughty, Dartmouth College, alice.m.doughty@dartmouth.edu; Meredith A. Kelly, Dartmouth College; Margaret Jackson, Dartmouth College.

T4. **Glacial Landscapes as Recorders of Geomorphic Process and Climate Change.** Lee Corbett, Univ. of Vermont, ashley.corbett@uvm.edu; Jeremy Shakun, Boston College; Aaron Putnam, Univ. of Maine, aaron.putnam@umit.maine.edu.

T5. **Marine and Terrestrial Coastal Mapping: Data, Discovery, and Science.** Mark Borrell, Univ. of Massachusetts Boston, mark.borrelli@umb.edu; Bryan Oakley, Univ. of Massachusetts Boston.

T6. **Integrating Structural Geology with Hydrogeology.** Edwin Romanowicz, State Univ. of New York at Plattsburgh, romanoea@plattsburgh.edu; Jonathan Kim, Vermont Geological Survey.

T7. **Interaction between the Landscape and Aquatic Biogeochemistry.** Andrew Vermilyea, Castleton State College, andrew.vermilyea@castleton.edu; Andrew Schroth, Univ. of Vermont.

T8. **Integrating Complementary Records of Paleozoic Orogenies in the Appalachians: Bridging the Foreland and Hinterland.** Paul Karabinos, Williams College, pkarabin@williams.edu; Francis Macdonald, Harvard Univ., fmacdonald@fas.harvard.edu; Charles E. Mitchell, SUNY Buffalo, cem4graps@gmail.com; Charles A. Ver Straeten, New York State Museum, charles.verstraeten@nysed.gov.

T9. **New Perspectives on the Use of Structural Analysis to Solve Tectonic Problems: Examples from Slices through Space and Time in Northeastern North America.** Cosponsored by GSA Structural Geology and Tectonics Division. Jean Crespi, Univ. of Connecticut, jean.crespi@uconn.edu; Keith Klepeis, Univ. of Vermont, keith.klepeis@uvm.edu.

T10. **Pegmatites: Most Evolved Components of the Continental Crust.** Paul Tomascak, SUNY, Oswego, tomasca@oswego.edu; Marian Lupulescu, New York State Museum.

T11. **Interpretation of Quaternary Environments: Through Geology, Palaeontology, and Archaeology in the Glaciated Great Lakes and New England.** Andrew Kozlowski, New York State Museum/Geologic Survey, andrew.kozlowski@nysed.gov; Robert Feranec, New York State Museum, robert.feranec@nysed.gov.

T12. **A New Look at Terrane Affinity of Old Rocks in Western New England: Peri-Laurentian or Peri-Gondwana?** Craig Dietsch, Univ. of Cincinnati, dietscc@ucmail.uc.edu; Bob Wintsch, Indiana Univ., wintsch@indiana.edu.


T14. **The Grenville-Age Low Ti-Fe Oxide Deposits from New York State: Igneous or Hydrothermal?** Phil Geer, Univ. of Massachusetts; Marian Lupulescu, New York State Museum, pgeer@geo.umass.edu; Peter Valley, Weatherford Laboratories.

T15. **Stratigraphy, Sedimentology, and Paleontology of the New York Paleozoic.** James Ebert, SUNY Oneonta, james.ebert@oneonta.edu; Robert Feranec, New York State Museum; Robert.feranec@nysed.gov; D. Jeffrey Over, SUNY Geneseo, over@geneseo.edu.

---

**Call for Applications**

2016–2017 GSA-USGS Congressional Science Fellowship

Application deadline: 1 Feb. 2016

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

The GSA-USGS Congressional Science Fellowship provides a rare opportunity for a geoscientist to spend a year working for a Member of Congress or congressional committee. If you are an earth scientist with a broad geologic background, experience applying scientific knowledge to societal challenges, and a passion for helping shape the future of the geoscience profession, GSA and the USGS invite your application. The fellowship is open to GSA members who are U.S. citizens or permanent residents, with a minimum requirement of a master’s degree with at least five years of professional experience or a Ph.D. at the time of appointment.

Learn more at [www.geosociety.org/csf](http://www.geosociety.org/csf) or by contacting Kasey White, +1-202-669-0466, kwhite@geosociety.org
T16. Deciphering the Devonian: Paleobiology, Stratigraphy, and Geochemistry. Andrew M. Bush, Univ. of Connecticut, andrew.bush@uconn.edu; J. Andrew Beard, Univ. of Connecticut, james.beard@uconn.edu; Diana L. Boyer, SUNY Oswego, dboyer@oswego.edu.

T17. Geophysical Methods in the Hydrogeologist’s Toolbox. Laura Lautz, Syracuse Univ., lklautz@syr.edu; Robin Glas, Syracuse Univ., rglas@syr.edu; Zeno Levy, Syracuse Univ., zlevy@syr.edu.


T19. Applications of Geologic Mapping to Address Geologic Hazards, Natural Resources, and Natural History Studies. Andrew Kozlowski, New York State Museum/Geological Survey, andrew.kozlowski@nysed.gov; Brian Bird, New York State Museum/Geological Survey, brian.bird@nysed.gov.


T21. Trace Metals in the Environment. Tara Curtin, Hobart and William Smith Colleges, curtin@hws.edu; Melissa Lombard, Georgia Southern University.

T22. Organic Geochemistry in the Geosciences. Elizabeth Thomas, University of Buffalo and Univ. of Massachusetts Amherst, ekthomas@buffalo.edu; Isla Castañeda, Univ. of Massachusetts Amherst.


T24. Connecting K–12 and Higher Education: What Teachers Need, What Faculty Can Offer. Laura Guertin, Penn State Brandywine, guertin@psu.edu; Michael Passow; Missy Holzer, Chatham High School.

T25. Earth Science Student Research at the Secondary Level. Margaret Brewer-LaPorta mbrewer@pace.edu; Philip C. LaPorta, Pace University and The Center for the Investigation of Native and Ancient Quarries.

T26. Pleistocene to Anthropocene Landscape Evolution in the Northeastern U.S. Will Ouimet, University of Connecticut, willouimet@gmail.com; Noah Snyder, Boston College.

T27. New Evidence for Glacial and De-Glacial Timing and Processes in the Northeastern Region and Beyond. John Rayburn, SUNY New Paltz, rayburnj@newpaltz.edu; David De Simone.

T28. Records of Environmental Change from Lacustrine Archives. Jeff Munroe, Middlebury College, jmunroe@middlebury.edu; Don Rodbell, Union College.

T29. Landscape and Hydrologic Response and Recovery from Watershed Disturbance. Brian Yellen, UMass Amherst, brian.yellen@gmail.com; John Gartner, UMass Amherst.

T30. Processes in Biogeochemistry and Bionerolization. Dawn Cardace, University of Rhode Island, cardace@uri.edu; Zsuzsanna Balogh-Brunstad, Hartwick College.

FIELD TRIPS
All field trips take place on Sunday, 20 March. Please contact John van Hoesen, vanhoesenj@greenmt.edu, with any questions.

F1. Geology & History of the Rosendale Cement Industry. Steven Schimmmirch, SUNY Ulster County Community College, schimmms@sunyulster.edu.

F2. The Geology of Thacher Park: A Classic North American Geologic Site. Charles Ver Straeten, New York State Museum, charles.verstraeten@nysed.gov; Ed Stander, SUNY Cobleskill, standej@cobleskill.edu; Thom Engel, Northeastern Cave Conservancy, necaver@earthlink.net.

F3. Karst Hydrogeology of the Kingston–Rosendale Karst Aquifer Region within the Hudson Valley Fold-Thrust Belt. Paul A. Rubin, HydroQuest, hydroquest@yahoo.com; Curtis C. Burmeister, Univ. of the Pacific, kburmeister@pacific.edu; Alexander Bartholomew, SUNY New Paltz, barthola@newpaltz.edu.

OPPORTUNITIES FOR STUDENTS
For mentor programs, career workshops, and On To the Future, see p. 19.

Volunteering
Application deadline: 17 Feb.
Earn free meeting registration by volunteering for two shifts of ~4 to 5 hours of work. Please contact Helen Mango, helen.mango@castleton.edu, for more information. The volunteer application is part of the meeting registration process.

Travel Grants
Application deadline: 17 Feb.
Travel grants may be awarded to students presenting at the meeting. Please review the eligibility guidelines and application procedure at www.geosociety.org/grants/negrant.htm.

Travel Awards for Non-Traditional Students
Non-traditional students in the geosciences have the opportunity to receive a generous travel award to attend this meeting. Students who work full time, are financially independent, or are caring for dependents while earning an undergraduate degree are highly encouraged to apply. Check the website for details or contact Tahlia Bear at tbear@geosociety.org.

LOCAL CONTACTS
General Co-Chairs: Helen Mango, helen.mango@castleton.edu; Tim Grover, tim.grover@castleton.edu
Technical Program Co-chairs: Don Rodbell, rodbeld@union.edu; Jacqueline Smith, smithj@mail.strose.edu
Field Trip Chair: John van Hoesen, vanhoesenj@greenmt.edu
Short Course/Workshop Chair: Robert Badger, badgerrl@potsdam.edu
Positions Open

ASSISTANT PROFESSOR
PALEONTOLOGY, SUNY POTSDAM
The Geology Department at SUNY Potsdam is accepting online applications for a tenure-track Assistant Professor of Paleontology with expertise in paleoclimatology and/or paleoceanography. Teaching includes, but is not limited to, Principles of Paleontology, Historical Geology, and a high-enrollment general education course focusing on either fossil/evolution or climate change. Ideal candidate can teach a physical oceanography course. Required qualification: Ph.D. by August 15, 2016. To apply, visit: employment.potsdam.edu. Job Posting No. U-00081. Position is open until filled.

ASSISTANT PROFESSOR
OF STRUCTURAL GEOLGY
SUNY POTSDAM
The Geology Department at SUNY Potsdam is accepting on-line applications for a tenure-track Assistant Professor of Structural Geology specializing in deformation of the upper crust. Teaching includes, but is not limited to, Physical Geology, Structural Geology, and an upper-level elective. Ideal candidate can teach an applied geophysics course and utilize the College’s existing seismic network. Required qualification: Ph.D. by August 15, 2016. To apply, visit: employment.potsdam.edu. Job Posting No. U-00081. Position is open until filled.

ASSISTANT/ASSOCIATE PROFESSOR
WATERSHED ANALYSIS
MONTANA STATE UNIVERSITY
The Land Resources and Environmental Sciences Department, Montana State University, Bozeman [http://landresources.montana.edu] seeking a talented and enthusiastic individual to undertake a tenure-track, fiscal-year faculty position (63% research/27% teaching/10% service) in watershed analysis. Details of the position are available at [http://www.montana.edu/jobs/faculty]. Screening will begin January 15, 2016 until an adequate applicant pool has been established.

DEPARTMENT CHAIR, PROFESSOR
MURRAY STATE UNIVERSITY
The Jesse D. Jones College of Science, Engineering and Technology at Murray State University (MSU) is seeking applicants for the Chair of the Department of Geosciences. The department, with nine full-time tenured/tenure track faculty and approximately 50 majors, offers baccalaureate degrees in geosciences with options in earth science, environmental geology, geotechnology, and geographic information science; a master’s degree in geosciences; and a certificate in geographic information science. The department is closely affiliated with the Mid-America Remote Sensing Center (MARC), a core entity in the MSU Watershed Studies Institute.

Qualifications: Ph.D. in the geological sciences or physical geography. Qualifications for the position include documented evidence of excellence in teaching, research productivity, and service accomplishments sufficient to merit appointment at the rank of associate or full professor. Evidence of successful administrative leadership experience or the potential for successful leadership, strong written and verbal communication skills, effective interpersonal skills, and a commitment to undergraduate and graduate education are also required. Familiarity with GIS and remote sensing is required. Responsibilities: Responsibilities of this position include, but may not be limited to: budget management; strategic and long-range planning; evaluation of faculty performance; coordination of student recruitment and retention efforts; coordination of student advising; oversight of MARC; oversight of laboratory and curricular development; outreach activities; development activities; scheduling of classes; and teaching.

To apply please visit: http://www.murraystatejobs.com/postings/4943.

Women and minorities are encouraged to apply. Murray State University is an equal education and employment opportunity, M/F/D, AA employer.

FACULTY POSITION
IN EARTH AND PLANETARY MATERIALS
UNIVERSITY OF CALIFORNIA DAVIS
The Department of Earth and Planetary Sciences at the University of California Davis seeks an outstanding scholar whose study of the origin, transformation, or deformation of Earth and planetary materials addresses major processes in the solid Earth. This tenure-track faculty position is the first of multiple anticipated faculty searches directed at understanding the formation and evolution of Earth and other rocky planets, and we seek applicants whose work expands and amplifies our current research strengths. Appointment at the Assistant Professor level is anticipated. Candidates must possess a Ph.D. or equivalent in geoscience or a related field by the time of appointment. The appointee is expected to develop and maintain a vigorous externally funded research program and to be (or potential to be) an excellent teacher at the undergraduate and graduate levels. The department’s research programs and experimental, analytical and computational facilities are described at http://geology.ucdavis.edu/facilities. Candidates should submit a cover letter, CV, publication list, statements of research plans and teaching interests, and names and addresses of four references by December 20, 2015, as no new applicants will be accepted after this date. Applicants will have until January 8, 2016 to complete or revise their applications. An optional “Statement of Contributions to Diversity” is strongly encouraged. Guidance for diversity statements may be found at http://academicaffairs.ucdavis.edu/diversity/equity_inclusion. Applications should be submitted online via the job listing JPF00738 at https://recruit.ucdavis.edu/applicant/JPF00738. Inquiries may be addressed to the Search Committee Chair at epm_search@ucdavis.edu.

UC Davis is an affirmative action/equal employment opportunity employer and is dedicated to enhancing the diversity of its campus community. Women, minorities, veterans, and individuals with disabilities are encouraged to apply.

ASSOCIATE/FULL PROFESSOR
SEDIMENTARY GEOLOGY AND DIRECTOR POTENTIAL GAS AGENCY
DEPARTMENT OF GEOLOGY AND GEOLOGICAL ENGINEERING
COLLEGE OF EARTH RESOURCE SCIENCES AND ENGINEERING
COLORADO SCHOOL OF MINES
Colorado School of Mines invites applications for the anticipated position of Associate/Full Professor in the fields of Sedimentary Geology with an emphasis in applied Petroleum Geochemistry and Director, Potential Gas Agency to begin in May 2016.

The successful candidate will be expected to develop a strong and vibrant externally funded program and establish an international reputation through publication, in addition to teaching at the undergraduate and graduate levels, directing graduate research and supervising thesis projects. The successful candidate will also direct the Potential Gas Agency. As Director of the Agency the successful candidate will be expected to devote at least 33% time during the Academic Year and up to one month during the summer to the work of the Committee.

Candidates must possess a doctoral degree in geology, a record of excellence in teaching, scholarship and service, management and leadership, and national/international professional recognition. Applicants must demonstrate, or show evidence of, excellent written, oral communication and interpersonal skills. Research interests must be in areas that complement existing campus programs (unconventional petroleum research, sedimentary geology research). For the complete job announcement, full statement of qualifications and directions on how to apply, visit: http://inside.mines.edu/HR-Academic-Faculty.

Mines is an EEO/AA employer and is committed to enhancing the diversity of its campus community. Women, minorities, veterans, and individuals with disabilities are encouraged to apply.

TENURE-TRACK ASSISTANT PROFESSOR
IN TECTONICS, DEPARTMENT OF GEOLOGICAL SCIENCES AND ENGINEERING
UNIVERSITY OF NEVADA, RENO
The Department of Geological Sciences and Engineering at the University of Nevada, Reno seeks an Earth Scientist for a tenure-track faculty position at the Assistant Professor level specializing in Tectonics and Deformation. This position is expected to bring expertise in tectonic processes and deformation within the crust and/or mantle. We seek an outstanding scientist who explores Earth processes using a combination of field, laboratory, and numerical techniques and, in doing so, will establish an innovative, world-class externally-funded research program. It is expected that, depending on the candidate hired, s/he will contribute to both undergraduate and graduate curricula in regional tectonics, cordilleran evolution, our summer field camp, and required course work in structural geology as well as graduate courses in the individual’s area of expertise. The successful applicant will be expected to direct graduate student research at the M.S. and Ph.D. levels. The specific field of interest is open, but...
preference will be given to candidates who would complement and interact with our existing strengths in the structural and metamorphic evolution of the lithosphere, economic geology, geothermal systems, and natural hazards. Interested applicants must have a doctorate in geology or a related geoscience field by the time of hire. The Department is part of the Mackay School of Earth Sciences and Engineering, which also includes two state-funded Earth Science units, the Nevada Bureau of Mines and Geology and the Nevada Seismological Laboratory. More information about the Department can be found at http://www.unr.edu/geology.

Applications are due by December 31, 2015, and review will begin shortly after. All interested applicants should view the application and submit their materials at http://www.unrsearch.com/postings/19324.

Materials that will need to be uploaded include a cover letter, CV, statement of research, statement of teaching philosophy, and complete contact information for at least three letters of reference. We are expecting to fill the position by May 1, 2016, with a start date of July 1, 2016. Questions regarding the search may be addressed to the Chair of the search committee, Dr. Greg Arehart, at arehart@unr.edu. The University of Nevada, Reno is an Equal Opportunity/Affirmative Action Employer. Women and underrepresented groups are encouraged to apply.

ROGER E. DEANE
POSTDOCTORAL FELLOW
DEPARTMENT OF EARTH SCIENCES
UNIVERSITY OF TORONTO

The Department of Earth Sciences at the University of Toronto invites applications for the Roger E. Deane Postdoctoral Fellowship, a highly competitive fellowship in any field of Earth Science. The department is interested in supporting innovative research and outstanding young geoscientists to work in collaboration with one or more faculty members. Applicants are encouraged to contact potential hosts in advance to discuss areas of common interest. The Deane Postdoctoral Fellowship has an annual salary of CAD$50,000 and is awarded for a one-year period, with an anticipated extension for a second year. Anticipated start date is Sept. 2016, but earlier start dates are possible.

Application: A complete application includes: a curriculum vitae, a research proposal (2 pages maximum excluding references), and the names & addresses of at least three references. Deadline: Applications are due January 15, 2016. Submit electronic PDF applications to: Ampy Tolentino, geol_secees.utoronto.ca (subject line: Deane Postdoctoral Fellowship). Employment as Postdoctoral Fellow at the University of Toronto is covered by the terms of the CUPE 3902 Unit 5 Collective Agreement.

ASSISTANT PROFESSOR
ENVIRONMENTAL GEOCHEMISTRY/
APPLIED BIOGEOSCIENCES
WEBER STATE UNIVERSITY

The Department of Geosciences at Weber State University invites applications for a tenure-track position starting Fall 2016. We seek a person with expertise in Environmental Geochemistry, Environmental Mineralogy, and/or Applied Biogeoeciences. The successful candidate will be appointed at the Assistant Professor level and will be expected to: (1) teach upper-division courses in area(s) of expertise and lower-division courses as required, (2) establish an active and sustained research program that includes mentoring undergraduate students, (3) seek external funding in support of teaching or research, (4) establish collaborations with colleagues in the College of Science; and (5) contribute to the development of new interdisciplinary curricula including a planned environmental/sustainability science program.

Minimum Requirements include: A Ph.D. in Geology or related field (candidates who expect to complete a Ph.D. by the beginning of the Fall 2016 semester also will be considered), excellent verbal and written communication skills, evidence of teaching excellence and interest in using active-learning pedagogies, and a demonstrated commitment to conducting high-quality research, to mentoring undergraduate researchers, and to integrating research interests into the classroom.

Preferred qualifications include: Ability to forge connections along disciplinary interfaces to address environmental/sustainability opportunities and challenges, postdoctoral experience, and ability to build connections with local industries or government agencies. To learn more about the position, and to apply, please visit http://jobs.weber.edu. To apply, please complete the online application and attach a cover letter, statements of teaching philosophy and research plans, a CV, and unofficial transcripts. In addition, three letters of reference that address the candidate's qualifications for this position must be mailed to Dr. Rick Ford, Search Committee Chair, Department of Geosciences, Weber State University, 1415 Edvalson St. - Dept. 2507, Ogden, UT 84408-2507. Highest priority will be given to applications received by January 4, 2016, although screening will continue until the position is filled.

A criminal background check is required as a condition of employment. EOE/Minorities/Females/Vets/Disability.

VISITING ASSISTANT OR ASSOCIATE PROFESSOR IN PETROLOGY AND MINERALOGY, DEPARTMENT OF GEOLOGY AND GEOPHYSICS
TEXAS A&M UNIVERSITY

The Department of Geology and Geophysics at Texas A&M University invites applications for a full-time, non-tenure track position at the rank of Visiting Assistant or Associate Professor to teach courses in Petrology, Mineralogy, and Mineral Resources. The position is a nine-month appointment beginning January 1, 2016, contingent upon availability for up to three years. Responsibilities consist of teaching at least four courses per academic year in some combination of Mineralogy, Petrology, and/or Mineral Resources.

The department will support the successful candidate's pursuit of independent research and development of a professional academic portfolio, with the opportunity to collaborate with students and colleagues in the College of Geosciences, including the Berg-Hughes Center for Sedimentary and Petroleum Systems, the Center for Tectonophysics and the Deep Crust and Mantle Group.

For more information about TAMU, the College of Geosciences and the Department of Geology and Geophysics, see http://geoweb.tamu.edu/

A Ph.D. with specialization in mineralogy or petrology at the time of appointment is required, but ABD candidates also will be considered. 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 Mineralogy/Petrology Search Committee (petrosearch@geos.tamu.edu). Screening of applications will begin November 1, 2015, and continue until a suitable candidate is appointed. The Department of Geology and Geophysics is part of the College of Geosciences, which also includes the Departments of Atmospheric Sciences, Geography, and Oceanography, 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 American 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.

TENURE-TRACK ASSISTANT PROFESSOR
PHYSICAL GEOGRAPHY
DEPARTMENT OF EARTH SCIENCE
UTAH VALLEY UNIVERSITY
OREM, UTAH

The Department of Earth Science at Utah Valley University (UVU) invites applications for a full-time, tenure-track position in Physical Geography, to begin August 2016. The successful candidate will have a Ph.D. in physical geography or a closely related field, as well as a demonstrated commitment to excellence in undergraduate teaching. Expertise in GIS and remote sensing is highly valued by our program. Responsibilities will include teaching introductory and upper division courses in the candidate’s area of expertise, as well as engaging in some combination of research, supervision of undergraduate research, activity in professional organizations, continuing education, and service.

UVU is a fast-growing comprehensive state institution with an enrollment of over 30,000 students. UVU values student-centered instruction and provides strong support for undergraduate research. The Department of Earth Science consists of 13 faculty and 2 full time staff members, excellent facilities, and B.S. programs in Geography, Environmental Science & Management, and Earth Science Education. The department’s Geography program has expanded with the addition of a new minor, a geography education endorsement, a GIS certificate program, and plans to develop a B.S. in Geography.

UVU is located at the foot of the Wasatch Mountains 40 minutes south of downtown Salt Lake City. The area offers outstanding outdoor recreation opportunities and a vibrant cultural scene including highly acclaimed ballet, symphony and outdoor concert series. For more information, please visit www.uvu.edu/earthscience, contact
Michael Bunds, the Department Chair (michael.bunds@uvu.edu), or Weihong Wang, the Search Committee Chair (weihong.wang@uvu.edu). To apply, please visit https://www.uvu.jobs/postings/17466. Applications will be evaluated beginning 12/31/2015. Utah Valley University is an Affirmative Action / Equal Opportunity/ Equal Access Employer.

LECTURER, DEPARTMENT OF GEOLOGY AND ENVIRONMENTAL SCIENCE UNIVERSITY OF PITTSBURGH

The Department of Geology and Environmental Science at the University of Pittsburgh is seeking qualified applicants for a faculty position at the rank of Lecturer, pending budgetary approval. This position is outside of the tenure stream and is contracted for 3 years, with renewals and promotion expected. The successful candidate will teach a variety of undergraduate courses for a new B.S. major in Environmental Science, ideally including a scientific writing class. The duties associated with this position would include advising Environmental Science and Geology majors, preparation of course materials, and academic program assessment. Additional duties may include, at the option of the successful candidate, developing proposals for undergraduate research, curriculum development, outreach, or attracting underrepresented minorities. The candidate must possess a Ph.D. in Geoscience, Environmental Science, or other related disciplines. Teaching experience is essential. Excellent communication and writing skills are required. The appointment begins in the fall term of 2016.

Applicants should submit a cover letter explaining their qualifications along with their CV, teaching and advising statements, and arrange for 3 letters to be uploaded to: https://facultysearch.as.pitt.edu/apply/index/MTM0. For each reference, you will have the opportunity to input a personal email address or an email address generated through Interfolio’s Online Application Delivery. In both cases, an email notification will be sent to the designated address with instructions about uploading the letters to our system. To ensure full consideration, applications must be received by January 15, 2016. The University of Pittsburgh is an Affirmative Action, Equal Opportunity Employer. Women, members of minority groups under-represented in academia, veterans, and disabled are especially encouraged to apply.

FULL TIME, ASSISTANT RESEARCHER (COLLECTION MANAGER) KU BIODIVERSITY INSTITUTE

The KU Biodiversity Institute seeks a full time Assistant Researcher (Collection Manager) to oversee its world-class collections of invertebrate fossils. Required qualifications include master’s degree in museum studies, geology, systematics, or paleontology, knowledge of invertebrate fossil taxonomy and identification, knowledge of care and management of natural history collections, and familiarity with biodiversity informatics. For additional information and complete application instructions please visit https://employment.ku.edu/staff/45668R. KU is an EEO/AAD. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex (including pregnancy), age, national origin, disability, genetic information or protected Veteran status. Review begins 1 Feb. 2016.

TWO TENURE-TRACK ASSISTANT PROFESSOR POSITIONS IN BASIN-MODELING/SOLID EARTH GEOPHYSICS AND SEDIMENTOLOGY KANSAS STATE UNIVERSITY

The Department of Geology at Kansas State University invites applications for two tenure-track faculty positions at the assistant professor level beginning in August 2016 in the areas of (1) sedimentology and/or stratigraphy, (2) basin-scale modeling or solid earth geophysics. A detailed advertisement for both positions is located at www.ksu.edu/geology. Screening of applications begins December 21, 2015, and continues until the position is filled. Full consideration will be given to applications received by December 1, 2015. 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.

TENURE TRACK POSITION IN HYDROLOGY, SURFACE PROCESSES INDIANA UNIVERSITY

The Department of Geological Sciences at Indiana University invites applications for a tenure-track faculty position in hydrology or surface processes at the rank of Assistant Professor. Applicants’ areas of research expertise may include, but are not limited to: fluid processes within the critical zone, surface and groundwater flow, catchment-scale hydrology, landscape evolution, physical surface processes on earth and other planets, tectonic geomorphology, computational modeling in any of these fields and the study of their connections to global climate. We seek individuals whose research complements one or more of our strengths in sedimentation and stratigraphy, near-surface processes and environmental geosciences, geophysics and tectonics, geochemistry, and atmospheric sciences. Our departmental research and teaching resources include a premier Geologic Field Station and the instrumented Willow Creek Watershed in Montana, extensive analytical instrumentation, GIS and remote sensing facilities, coupled with exceptional campus infrastructure for high performance computing, and engagement with the Integrated Program for the Environment. Successful candidates, who must hold a PhD degree by the time of appointment, are expected to develop a strong, collaborative, externally funded program, to supervise research by graduate and undergraduate students, and to teach both undergraduate and graduate courses in their fields of expertise.

Please submit a cover letter, a curriculum vitae, statements of teaching and research interests, the names and email addresses of three individuals willing to provide reference letters, and electronic copies of up to five relevant publications. General inquiries should be addressed to search.geo15@indiana.edu and specific questions should be referred to the Chair of the Search Committee, Professor Simon Brassell (simon@indiana.edu) or sent to Geology, 1001 E. Tenth Street, Bloomington, IN 47405. Applications should be completed online via http://indiana.peopleadmin.com/postings/1924. Review of applications will begin November 1, 2015, and continue until the position is filled.

Indiana University is an equal employment and affirmative action employer and a provider of ADA services. All qualified applicants will receive consideration for employment without regard to age, ethnicity, color, race, religion, sex, sexual orientation or identity, national origin, disability status or protected veteran status.

MARSHALL-HEAPE CHAIR IN GEOLOGY TULANE UNIVERSITY

The Department of Earth and Environmental Sciences at Tulane University invites applications for the newly established Marshall-Heape Chair in Geology. 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 Earth scientist 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 10, 2016, 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/31900. 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). Further information about the department and university can be obtained at http://tulane.edu/esse/eeinst. Tulane University is an EEO/ADA/AA employer.

TENURE-TRACK FACULTY POSITION ENERGY GEOSCIENCES, DEPARTMENT OF GEOLOGICAL SCIENCES THE UNIVERSITY OF ALABAMA

The Department of Geological Sciences at The University of Alabama invites applications for a tenure-track faculty position in energy geoscience, beginning August 2016, to be filled at the assistant professor level. Candidates are invited to apply who have specialties within any field of geoscience pertaining to energy exploration. Scientists with industry experience are encouraged to apply. Candidates must have a strong record of research and must have received a Ph.D. in geology, geophysics, or a related field at the time of appointment. The successful candidate will establish a vigorous, externally funded research program, develop relationships with the energy industry, work closely with the Center for Sedimentary Basin Studies, and attract and advise high-quality graduate students. Teaching responsibilities will include undergraduate and graduate courses in her/his specialty and introductory geology. The department has a broad range of geophysical, geochemical, and computational facilities, in addition to University shared facilities, including the Dauphin Island Sea Lab. Departmental software includes industry standards such as ProMAX, Petrel, TechLog, PetroMod, Move, Petra, GeoSoft, ArcGIS, and Matlab. Details regarding existing research programs, equipment and
Questions should be directed to Dr. Fred Andrus (fandrus@ua.edu). Applicants should go to http://facultyjobs.ua.edu to electronically apply for this position. When submitting an application, candidates must provide a cover letter, CV, research and teaching statements, a list with the contact information for at least three referees. Applications will be reviewed beginning December 7, 2015, and will continue until the position is filled. The University of Alabama is an Equal Opportunity/Affirmative Action Employer and actively seeks diversity in its employees.

VISITING INSTRUCTOR
VISITING ASSISTANT PROFESSOR
HYDROGEOLOGY, MIAMI UNIVERSITY

The Department of Geology and Environmental Earth Science at Miami University invites applications for a temporary, full-time faculty position on the Oxford campus, beginning August 2016. This is a nine-month (two academic semesters) appointment that may be renewed for up to four years pending funding availability and satisfactory performance. The primary responsibility of this position is teaching, including foundation courses in physical and environmental geology, and intermediate and upper level courses such as Water & Society and Hydrogeology. An M.S. in geology or a related field is required for appointment as Instructor; a Ph.D. is preferred and is required for appointment as a Visiting Assistant Professor. Submit cover letter, vita, statement of teaching philosophy and experience, unofficial copy of transcripts, and three letters to reference to https://miamioh.hiretouch.com/job-details?jobID=1862. Inquiries can be directed to Cathy Edwards at edwardca@miamioh.edu. Review of applications will begin on January 15, 2016, and continue until position is filled. Miami University, an EO/AA employer encourages applications from minorities, women, protected veterans and individuals with disabilities. Miami does not permit, and takes action to prevent, harassment, discrimination, and retaliation. Requests for reasonable accommodations for disabilities should be directed to Ms. Mary Jane Leveline at (513) 529-2027. Annual Security and Fire Safety Report may be found at: http://www.MiamiOH.edu/campus-safety/annual-report/index.html. Criminal background check required. All campuses are smoke- and tobacco-free.

THREE ASSISTANT PROFESSOR POSITIONS
DEPARTMENT OF GEOLOGY & GEOGRAPHY
WEST VIRGINIA UNIVERSITY

The Department of Geology and Geography at West Virginia University seeks to fill three geology faculty positions. Applicants should have a PhD or equivalent degree in geology, earth science or related field by the start date. Review of applications for all positions will begin January 15, 2016 and continue until each position is filled; start date for all positions is August 15, 2016.

PALEOBIOLOGY: We seek to hire a full-time (9-month), tenure-track Assistant Professor specializing in Paleobiology, which could include expertise in Invertebrate or Vertebrate Paleontology, Micro-paleontology, Paleocology, Paleobotany/Palynology, ichnology, or related fields. The successful candidate will be expected to develop a vigorous externally-funded research program, teach core undergraduate classes in paleontology, graduate courses in the area of his/her expertise, and mentor graduate and undergraduate students. Candidates should demonstrate potential to establish a strong externally-funded research program, publish in peer-reviewed journals, and excel in teaching at the undergraduate and graduate levels. To apply, please visit jobs.wvu.edu and navigate to the position title listed above. Upload (1) a single PDF file containing a curriculum vitae, statement of research interests, statement of teaching philosophy, and names, titles, and full contact information for 3 references; and (2) PDF files of up to 3 publications. In addition, arrange for 3 letters of reference to be sent to Paleobiology@mail.wvu.edu. For additional information, please see pages.geo.wvu.edu/Paleobiology or contact the search chair, Amy Weislogel, at Paleobiology@mail.wvu.edu or (304) 293-6721.

Quantitative Structural Geology or Geomechanics: We seek to hire a full-time (9-month), tenure-track Assistant Professor specializing in quantitative structural geology with interests in the study of fractured reservoirs and geomechanics. The successful candidate will be expected to develop a vigorous externally-funded research program, teach undergraduate classes in structural geology or geomechanics, teach graduate courses in the area of his/her expertise, and mentor graduate and undergraduate students. Candidates should demonstrate potential to establish a strong externally-funded research program, publish in peer-reviewed journals, and excel in teaching at the undergraduate and graduate levels. To apply, please visit jobs.wvu.edu and navigate to the position title listed above. Upload (1) a single PDF file containing a curriculum vitae, statement of research interests, statement of teaching philosophy, and names, titles, and full contact information for 3 references; and (2) PDF files of up to 3 publications. In addition, arrange for 3 letters of reference to be sent to Geomechanics@mail.wvu.edu. For additional information, please see pages.geo.wvu.edu/Geomechanics or contact the search chair, Dengliang Gao, at Geomechanics@mail.wvu.edu or (304) 293-3310.

Teaching Assistant Professor of Geology: We seek to hire a full-time (9-month), non-tenure track Teaching Assistant Professor. The successful candidate will teach a variety of undergraduate courses, including both large introductory and smaller upper-division classes, in the classroom and online, and the field component of the B.S. capstone course, Geology Field Camp (the last with an additional summer stipend). Specialty area is open. Teaching Assistant Professors at WVU are eligible for promotion; however, promotion to senior ranks is not a requirement for institutional commitment and career stability. This position is a nine-month renewable appointment (no maximum number of terms) and includes full benefits. The position carries an 80% teaching (4 courses per semester) and 20% service assignment. The successful candidate will join a faculty that takes great pride in having members recognized at the university, state, and national levels for excellence in teaching. The Department occupies the recently renovated Brooks Hall with state-of-the-art teaching technologies and facilities. To apply for this position, interested candidates should visit jobs.wvu.edu and navigate to the position title listed above. Upload a single PDF file containing a curriculum vitae, statement of teaching interests and philosophy, teaching evaluations as available, and full contact information for 3 references. In addition, please arrange for three letters of reference to be sent directly to GeologyTAP@mail.wvu.edu. For additional information, please see pages.geo.wvu.edu/GeologyTAP or contact the search chair, Thomas Kammer, at GeologyTAP@mail.wvu.edu or (304) 293-9663.

WVU is an EEO/Affirmative Action Employer and welcomes applications from all qualified individuals, including minorities, females, individuals with disabilities, and veterans. For additional information about the department visit www.geo.wvu.edu.

LECTURER FACULTY POSITION
GEOSCIENCE, MIAMI UNIVERSITY

The Department of Geology and Environmental Earth Science at Miami University invites applications for a full-time Lecturer faculty position on the Oxford campus, beginning August 2016. The Lecturer will teach undergraduate courses, including foundation courses in physical and environmental geology, as well as intermediate level courses; advise undergraduate students; provide professional service to the department and university. Required: M.S. in geoscience by date of appointment and documented teaching experience. Desired: Ph.D. in geoscience with interest in contributing to supervision of undergraduate student research and field-based experiences. Submit cover letter, vita, statement of teaching philosophy and experience, unofficial copy of transcripts, and names of three (3) referees to https://miamioh.hiretouch.com/job-details?jobID=1874. Letters of reference will be requested upon receipt of application. Inquiries can be directed to Cathy Edwards at edwardca@miamioh.edu. Review of applications will begin on January 15, 2016 and continue until position is filled. Miami University, an EO/AA employer encourages applications from minorities, women, protected veterans and individuals with disabilities. Miami does not permit, and takes action to prevent, harassment, discrimination and retaliation. Requests for reasonable accommodations for disabilities should be directed to Ms. Mary Jane Leveline at (513) 529-2027. Annual Security and Fire Safety Report may be found at: http://www.MiamiOH.edu/campus-safety/annual-report/index.html. Criminal background check required. All campuses are smoke- and tobacco-free.

TENURE-TRACK ASSISTANT PROFESSOR
HYDROGEOLOGY, CALIFORNIA STATE UNIVERSITY, NORTHridge

The Department of Geological Sciences at California State University, Northridge invites applications for a full-time tenure-track faculty position at the level of Assistant Professor in hydrogeology. We offer B.S. and M.S. degrees in Geology and in Geophysics. The successful candidate must have a Ph.D. at the time of appointment. Experience in post-doctoral research
and/or University-level lecture instruction is desirable. We seek an innovative hydrogeologist with technical expertise in one or more of the following fields: subsurface 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. We particularly seek candidates who both complement our current research program and integrate across sedimentology, stratigraphy and geophysics. The successful candidate is expected to develop a vigorous research program, which includes seeking extramural funding, publishing peer-reviewed papers, and involving undergraduate and M.S. students. Furthermore, the successful candidate is expected to demonstrate teaching excellence and provide effective instruction to students of diverse backgrounds in a multicultural setting. Potential classes to be taught by the new hire include: a new undergraduate core course in Earth Systems, general education courses in water resources and environmental geology and elective offerings at the upper-division and/or graduate level in the candidate’s research specialty.

Applicants should submit a cover letter, CV, the names and full contact information for three references, statement of teaching philosophy, and statement of research interests. Electronic submissions are strongly encouraged and should be sent to: hydrogeo.search@csun.edu. Materials can also be sent to: Hydro Search Committee, Department of Geological Sciences, California State University Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8266. Review of applications will begin 1 January 2016. Priority will be given to applications received by this date, but the position remains open until filled. For additional information, see http://www.csun.edu/geology. The University is an EEO/AA employer.

ASSISTANT PROFESSOR OF GEOLOGY AND GEOPHYSICS
Missouri University of Science and Technology

The Department of Geosciences and Geological and Petroleum Engineering invites applications for a full-time tenure-track faculty position in Geology and Geophysics at the Assistant Professor level in petroleum geology with expertise in carbonate reservoirs and basin analysis to begin in August, 2016. Review of applications will begin in November and continue until the search is completed. The successful candidate will be expected to develop an externally-funded research program integrated with excellence in teaching at both the graduate and undergraduate levels with a commitment to interdisciplinary work. Teaching responsibilities will include courses as part of degree requirements as well as in the candidate’s area of expertise. The Department currently has 20 full-time faculty, and 371 undergraduate and 309 graduate degree-seeking students with established B.S., M.S., and Ph.D. programs in Geology & Geophysics, Petroleum Engineering, and Geological Engineering. Closely associated departments include Environmental Engineering and Mining Engineering. Local area establishments with active research include the U.S. Geological Survey (Mid-continent Geospatial Mapping Center), Missouri Department of Natural Resources, Fort Leonard Wood, the Missouri S&T Rock Mechanics and Explosives Research Center, Materials Research Center, and Energy Research and Development Center. Interested applicants should submit a cover letter, a current curriculum vitae, a statement of research and teaching interests and experience, and complete contact information for four references electronically to the Missouri University of Science and Technology’s Human Resource Office at hr@mst.edu.

The final candidate is required to provide copies of official transcript(s) for any college degree(s) listed in application materials submitted, prior to the start of employment. In the final candidate may be required to verify other credentials listed in application materials. Failure to do so may result in the withdrawal of the job offer. All job offers are contingent upon successful completion of a criminal background check. The University of Missouri is an equal access, equal opportunity, affirmative action employer that is committed to achieving a diverse faculty and staff. Equal Opportunity is and shall be provided for all employees and applicants for employment on the basis of their demonstrated ability and competence without unlawful discrimination on the basis of their race, color, national origin, ancestry, religion, sex, sexual orientation, gender identity, genetic information, disability, or protected veteran status.

GEOCHEMISTRY LAB MANAGER
Miami University

The Department of Geology and Environmental Earth Science at Miami University invites applications for a Geochemistry Lab Manager. The Lab Manager will be expected to manage new trace metal geochemistry and ICP-OES labs, and to share responsibility for ICP-MS, HPLC and powder XRD labs. Duties will include training and supervision of lab users, laboratory maintenance, data quality assurance, assistance in teaching laboratory-based courses, oversight of radiation and environmental health and safety compliance, and laboratory financial management. Laboratory technique development and adaptation for analysis of diverse geologic and environmental materials expected, with opportunities to pursue research and external funding. Required: M.S. or Ph.D. in geology or related field, at least 4 years of experience in major and trace element analysis of geologic materials by plasma techniques at the time of the appointment, and proven experience in successful training and supervision of geochemistry lab users. Desired: experience in powder XRD and HPLC analysis; expertise in laboratory technique development, computer programming and electrical and mechanical abilities. Submit cover letter, vita and unofficial copy of transcripts to: https://miamioh.hiretouch.com/job-details?jobID=1868. Arrange to have three (3) letters of recommendation sent to GeochemistrySearch@miamioh.edu. Screening of applications will begin January 15, 2016, and continue until the position is filled. Miami University, an EO/AA employer encourages applications from minorities, women, protected veterans and individuals with disabilities. Miami does not permit, and takes action to prevent, harassment, discrimination and retaliation. Requests for reasonable accommodations for disabilities should be directed to Ms. Mary Jane Leveline at (513) 529-2027. Annual Security and Fire Safety Report may be found at: http://www.miamiOH.edu/campus-safety/annual-report/index.html. Criminal background check required.

DEPARTMENT CHAIR
TENURE-TRACK ASSISTANT PROFESSOR AND INSTRUCTOR, DEPARTMENT OF GEOGRAPHY AND GEOLOGY, THE UNIVERSITY OF SOUTHERN MISSISSIPPI

The University of Southern Mississippi invites applications for a faculty position as department chair. The successful candidate is expected to develop and continue until the search is completed. The Department of Geology and Environmental Earth Science at Miami University invites applicants for a Geochemistry Lab Manager. The Lab Manager will be expected to manage new trace metal geochemistry and ICP-OES labs, and to share responsibility for ICP-MS, HPLC and powder XRD labs. Duties will include training and supervision of lab users, laboratory maintenance, data quality assurance, assistance in teaching laboratory-based courses, oversight of radiation and environmental health and safety compliance, and laboratory financial management. Laboratory technique development and adaptation for analysis of diverse geologic and environmental materials expected, with opportunities to pursue research and external funding. Required: M.S. or Ph.D. in geology or related field, at least 4 years of experience in major and trace element analysis of geologic materials by plasma techniques at the time of the appointment, and proven experience in successful training and supervision of geochemistry lab users. Desired: experience in powder XRD and HPLC analysis; expertise in laboratory technique development, computer programming and electrical and mechanical abilities. Submit cover letter, vita and unofficial copy of transcripts to: https://miamioh.hiretouch.com/job-details?jobID=1868. Arrange to have three (3) letters of recommendation sent to GeochemistrySearch@miamioh.edu. Screening of applications will begin January 15, 2016, and continue until the position is filled. Miami University, an EO/AA employer encourages applications from minorities, women, protected veterans and individuals with disabilities. Miami does not permit, and takes action to prevent, harassment, discrimination and retaliation. Requests for reasonable accommodations for disabilities should be directed to Ms. Mary Jane Leveline at (513) 529-2027. Annual Security and Fire Safety Report may be found at: http://www.miamiOH.edu/campus-safety/annual-report/index.html. Criminal background check required.

Department Chair: (Posting 0003695): Applicants are required to have a Ph.D. in geology or a closely related field from an accredited university with a minimum of 18 hours of graduate coursework in geology or a closely related field. Further, candidates should have professional credentials sufficient to be considered eligible for appointment as a full professor. Expectations for this position include (1) providing leadership and direction in shared governance in areas of goal-setting and assessment, faculty recruitment, hiring, mentoring and tenure/promotion evaluation; (2) providing leadership and guidance to advance the research capabilities and scholarly activities of the department; (3) promoting and participating in an active research agenda within the department; (4) ensuring that academic programs in the department maintain high standards; (5) excellence in instruction of general education, advanced undergraduate, and graduate-level courses in geology; (6) directing the administration of the department; and (7) service to the college, university and greater academic community.

Assistant Professor: (Posting 0003736): Applicants are required to have a Ph.D. in geology or a closely related field from an accredited university with a minimum of 18 hours of graduate coursework in geology or a closely related field. Expectations for this position include (1) developing a consistent
and productive externally funded research program that includes graduate and undergraduate students; (2) excellence in instruction of general education, advanced undergraduate and graduate-level courses; and (3) service to the department, college, university and greater academic community.

**Instructor (Posting 0003737):** Applicants are required to have a master’s degree or Ph.D. in geology or a closely related field from an accredited university with a minimum of 18 hours of graduate coursework in geology or a closely related field. Expectations for this position include (1) excellence in instruction of general education and advanced undergraduate courses in geology; (2) advisement services to undergraduate geology students; (3) service to the department, college and university; and (4) public outreach and advocacy for geology in the community.

Applications must be submitted online at https://jobs.usm.edu. Required application materials can also be found at this website. Applications must be completed by December 15, 2015, to ensure full consideration for the chairperson position, and December 15, 2015, for the assistant professor and instructor positions. More information about the department can be found at www.usm.edu/geography-geology.

Founded in 1910, The University of Southern Mississippi is a comprehensive doctoral and research-driven university with a proud history and an eye on the future. A dual-campus university, Southern Miss serves students on campuses in Hattiesburg and Long Beach, in addition to five teaching and research sites in Mississippi and through Online at Southern Miss. Since 2006, Southern Miss students have collected seven Goldwater Scholarships, three Truman Scholarships and 14 National Science Foundation Graduate Research Fellowships. Our Center for Undergraduate Research affords our students meaningful research opportunities, and as a proven leader in innovation, we conduct transformative research that translates into real-world solutions. As one of a select number of institutions in the nation accredited in art, dance, music and theatre, we are a haven for creativity and artistic expression. In the classroom or lab, on the playing field, or in the performance hall, we strive to have a positive impact not only on our students, but also the world around us. Further information is found at www.usm.edu.

As an Affirmative Action/Equal Employment Opportunity employer/Americans with Disabilities Act institution, The University of Southern Mississippi encourages minorities, women, veterans and persons with disabilities to apply.

**ASSISTANT PROFESSOR (ECOLOGIC GEOLOGY/MINERALOGY) SOUTHERN ILLINOIS UNIVERSITY CARBONDALE**

The Department of Geology at Southern Illinois University Carbondale invites applications for a tenue-track position in economic geology/mineralogy at the assistant professor level, starting August 16, 2016, contingent upon available funding. More information, including qualifications and how to apply is available at http://affact.siu.edu/faculty.php (Search COS-351). Application deadline: January 4, 2016, or until filled. SIU Carbondale is an Affirmative Action/Equal Opportunity employer of individuals with disabilities and protected veterans that strives to enhance its ability to develop a diverse faculty and staff and to increase its potential to serve a diverse student population. All applications are welcomed and encouraged and will receive consideration.

**W.B. HAMILTON PROFESSOR OF EARTH SCIENCES SOUTHERN METHODIST UNIVERSITY**

Position No. 06029. The Roy M. Huffington Department of Earth Sciences at SMU announces a search to fill a named tenure-track or tenured professorship (the rank is open) honoring WB Hamilton. We solicit nominations and applications from earth scientists who maintain vigorous and sustainable research programs and who have a commitment to full participation in the educational mission of the department to provide professional training in a liberal arts environment. As the fourth holder of the chair established in 1921, the successful candidate will extend existing departmental strengths in earth science. The department’s focus is on pure research to understand Earth history and geologic processes with applied research on problems in the national interest such as climate and environmental change, earthquake seismology including induced seismicity, natural hazards, nuclear test ban monitoring and resources including geothermal energy. The expected start date is August 1, 2016.

Applications can be submitted electronically to sswcob@smu.edu or in writing: Professor John Walther, Search Committee Chair, Department of Earth Sciences, Southern Methodist University, P.O. Box 6395, Dallas TX 75275.

Applicants should include curriculum vitae, statements of research and teaching interests, and contact information for three references. To insure full consideration applications must be received by December 5, 2015, but the committee will continue to accept applications until the position is filled. The committee will notify applicants of its employment decisions after the position is filled.

Southern Methodist University will not discriminate in any program or activity on the basis of race, color, religion, national origin, sex, age, disability, genetic information, veteran status, sexual orientation, or gender identity and expression. The Executive Director for Access and Equity/Title IX Coordinator is designated to handle inquiries regarding nondiscrimination policies and may be reached at the Perkins Administration Building, Room 204, 6425 Boaz Lane, Dallas, TX 75205, 214-768-3601, accessequity@smu.edu.

Hiring is contingent upon the satisfactory completion of a background check.

**JUNIOR LEVEL FACULTY POSITION SEDIMENTARY BASIN ANALYSIS DEPARTMENT OF MARINE, EARTH, AND ATMOSPHERIC SCIENCES NORTH CAROLINA STATE UNIVERSITY**

The Department of Marine, Earth, and Atmospheric Sciences (MEAS) at North Carolina State University (NC State) intends to fill a junior (Assistant / Associate Professor) tenure-track faculty position in sedimentary basin analysis. Possible research areas include, but are not limited to, the relationship of basin evolution to mantle processes, linkages of stratigraphy to landscape evolution as a function of tectonics, climate, and sea-level change, the prediction of sub-surface porosity and permeability to model the movement of water and hydrocarbons, and the use of stratigraphy in paleo-environmental and paleobiological studies. The starting date for this position is 15 August 2016. Candidates that combine surface and/or subsurface observations with numerical simulations, analogue models, or laboratory experiments to investigate the geologic history of sedimentary basins are preferred, and applicants should have a strong interest in interdisciplinary collaborations across and beyond the geosciences.

Applications must hold a Ph.D. degree in the geosciences or a related field. Postdoctoral experience is preferred, but not required. The successful candidate must demonstrate strong potential for outstanding accomplishments in research, research supervision, and teaching. The successful applicant will be expected to teach an undergraduate-level course in stratigraphy, as well as other undergraduate and graduate classes commensurate with the candidate’s interest and expertise. An interest in participating in the Department’s capstone undergraduate geology field course also is desirable. MEAS places a high value on excellent instruction and the use of innovative teaching methods.

Affiliated with the College of Sciences at NC State, MEAS is one of the largest interdisciplinary geoscience departments in the nation. Opportunities exist for disciplinary and interdisciplinary interactions with more than 30 marine, earth, and atmospheric scientists. Additional information about the department and its facilities can be found on the web page: http://www.meas.ncsu.edu.

Review of applications will begin on 15 November 2015; the position will remain open until filled. Applications, including cover letters, curriculum vitae, teaching and research statements, and contact information for three references must be submitted online at https://jobs.ncsu.edu/. Please search for position number 00001300.

Founded in 1887, NC State is a land-grant institution distinguished by its exceptional quality of research, teaching, extension, and public service. Located in Raleigh, North Carolina, NC State is the largest university in North Carolina, with more than 34,000 students and 8,000 faculty and staff. National rankings consistently rate Raleigh and its surrounding region among the five best places in the country to live and work, with a highly educated workforce, moderate weather, reasonable cost of living, and a welcoming environment. A collaborative, supportive environment for business and innovation and research collaborations with area universities and the Research Triangle Park are compelling reasons for relocation to the area. NC State is an equal opportunity and affirmative action employer. All qualified applicants will receive consideration for employment without regard to race, color, national origin, religion, sex, sexual orientation, age, veteran status, or disability. Applications from women, minorities, and persons with disabilities are encouraged.
Opportunities for Students

The Jonathan O. Davis Scholarship supports graduate students working on the Quaternary geology of the Great Basin. The national scholarship is US$7,500 and the University of Nevada, Reno stipend is US$7,500. 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: http://www.dri.edu/GradPrograms/Opportunities/JonathanDavis. Applications must be post-marked by February 17, 2016. Proposals will not be returned. Applications should be addressed to: Executive Director Division of Earth and Ecosystem Sciences, Attn: Davis Scholarship, Desert Research Institute, 2215 Raggio Parkway, Reno, Nevada 89512.

Lindahl Ph.D. Scholarships, Department of Geological Sciences, The University of Alabama. The University of Alabama, Department of Geological Sciences seeks highly qualified Ph.D. students with specializations in topics that complement faculty research interests. Exceptional students will receive Research or Teaching Assistantships and a Lindahl Scholarship totaling US$22,000 for a nine month appointment. The University of Alabama covers the cost of non-resident tuition and fee waivers. Funding is renewable for at least 4 years if expectations are met. Other fellowships are available from the Graduate School on a competitive basis. Further details are at http://www.geo.ua.edu/. Applicants should contact Dr. Delores Robinson (dmr@ua.edu) to express interest. Review of applications for Fall 2016 admission will begin January 15, 2016.

DIRECTOR
Kansas Geological Survey • The University of Kansas, Lawrence
Full-time position serving as the Director of the Kansas Geological Survey (KGS) and State Geologist. Must develop and articulate a vision of KGS programs, understand the concept of serving Kansas through high-quality research in the applied geosciences, and embrace a collegial leadership style. Requires doctorate in the geosciences with 10 years professional experience, 3 years administrative experience, national recognition in geoscience research, excellent communication skills, knowledge of natural resources and the environmental aspects of their use, and demonstrated ability to deal with natural-resource policy issues.

The KGS is a research and service division of the University of Kansas (KU). Created in 1889, the Survey studies the geology of Kansas, develops new techniques for exploring and analyzing geologic data, and produces and disseminates maps, reports, and scientific papers. Among the premier earth-science research and service institutions in the U.S., the KGS has an annual state budget of $5.8 million, a fiscal year 2014 grant and contract budget of $2 million, and employs more than 115 researchers, support staff, and students engaged in a variety of disciplines. Staff collaborate extensively with faculty and students in academic departments at KU.

Full announcement and application info. at www.kgs.ku.edu/General/jobs.html. Review will begin January 25, 2016, position open until filled. For further information contact Jim Butler (jbutler@kgs.ku.edu) or Greg Ludvigson (g hudvigson@kgs.ku.edu). KU is an EO/AAE, http://policy.ku.edu/IOA/nondiscrimination.
Who will build the 21st century? Addressing critical demographic gaps in the geosciences

Bradley D. Cramer, Dept. of Earth and Environmental Sciences, University of Iowa, Iowa City, Iowa 52242, USA, bradley-cramer@uiowa.edu; Katherine J. Lewandowski, Dept. of Geology/Geography, Eastern Illinois University, Charleston, Illinois 61920, USA, kjlewandowski@eiu.edu; Arthur Goldstein, Bartlett College of Science & Mathematics, Bridgewater State University, Bridgewater, Massachusetts 02325, USA, arthur.goldstein@bridgew.edu; Pranoti Asher, American Geophysical Union, Washington, D.C. 20009, USA, pasher@agu.org; Jeffrey Ryan, School of Geosciences, University of South Florida, Tampa, Florida 33620, USA, ryan@usf.edu; David I. Schofield, British Geological Survey, Greenmeadow Springs, Tongwynlais, Cardiff CF15 7NE, UK, dis@bgs.ac.uk; Rex Buchanan, Kansas Geological Survey, University of Kansas, Lawrence, Kansas 66047, USA, rexB@kgs.ku.edu; Richard Denne, Marathon Oil, Houston, Texas 77055, USA, radenne@marathonoil.com; William I. Ausich, School of Earth Sciences, The Ohio State University, Columbus, Ohio 43210, USA, ausich.1@osu.edu; Thijs R.A. Vandenbroucke, EVO-Eco-Paleo, UMR 8198 du CNRS, Université Lille 1, Villeneuve d’Ascq 59655, France, and Dept. of Geology and Soil Sciences, Ghent University, Ghent 9000, Belgium, Thijs.Vandenbroucke@UGent.be; Sherman Lundy, BMC Aggregates L.C., Elk Run Heights, Iowa, 50707, USA, sherml@bmcaggregates.com; Tyler Priest, Dept. of History and Dept. of Geographical and Sustainability Sciences, University of Iowa, Iowa City, Iowa 52242, USA, tyler-priest@uiowa.edu; and Ryan J. Clark, Iowa Geological Survey, University of Iowa, Iowa City, Iowa 52242, USA, ryan-j-clark@uiowa.edu

INTRODUCTION

The geoscience workforce in the United States may be facing a critical shortage of trained personnel (Gonzalez and Keane, 2011; NRC, 2013; Mosher et al., 2014; Wilson, 2014a). The National Bureau of Labor Statistics projects a 16% increase in geoscience jobs by 2022. If, as projected, more than half of the present geoscience workforce retires by that time (Wilson, 2014a, 2014b), up to 185,000 new geoscientists will be needed. Graduation rates in U.S. geoscience programs (Wilson, 2014a) are slowly increasing but still lack the capacity to produce such numbers by 2022 (Fig. 1A). The result is a projected shortfall of 135,000 trained geoscientists within the next decade (Wilson, 2014a, 2014b). To meet these growing challenges to our ability to research, assess, and utilize our natural resources in an environmentally responsible manner, we must increase the number of geoscience students.

RECENT PROGRESS

The National Research Council (NRC) and National Science Foundation (NSF) addressed the impending shortage of geoscientists (NRC, 2013; Mosher et al., 2014) in the context of federal funding and undergraduate education (Fig. 1A). The NRC identified a three-tiered framework, Awareness, Engagement, and Professional Preparation, as steps in the process of training the next generation of geoscientists and suggested a “System Approach” to coordination of existing federal funding (NRC, 2013). The NRC called for better connections among Federal agencies, academic institutions, and professional societies to clarify educational and training pathways, as well as the need to collect more and better data on which programs are successful and why, with a focus on critical incident analysis as a means of understanding what brings students into the geosciences.

The recent NSF-supported Summit on the Future of Undergraduate Geoscience Education (Mosher et al., 2014) focused on Curriculum and Competencies, Pedagogy/Technology, and Underrepresented Groups. Participants agreed that the next generation of geoscience students needs to approach the field as the applied sum of all sciences (Mosher et al., 2014) and effectively communicate across disciplines as well as with the public. The K–12 Next Generation Science Standards can help develop these skills, but most school districts lack teachers with geoscience training, and most students will never take a K–12 geoscience course (Wilson, 2014a, 2014c; LaDue and Brown Manning, 2015). Of particular concern is how poorly the geosciences have recruited and retained students from underrepresented groups (Fig. 1B; Wilson, 2014a). Workforce data demonstrate that students exposed to K–12 geoscience are more likely to pursue geoscience degrees (Wilson, 2014a). Therefore, expanded opportunities and support for underrepresented students at all levels, as well as expanded opportunities for K–12 teacher training in the geosciences (LaDue and Brown Manning, 2015), are critical to rebuilding the geoscience workforce.

INCREASING CAPACITY

Nearly half of all students receiving a geoscience degree decide to become a geoscientist at some point after their first year of undergraduate education (Wilson, 2014c). Considered in light of the growing numbers of students who enter higher education at two-year colleges, the transition between two-year and four-year institutions is critical to expanding the geoscience student pipeline. Entry-level courses need to highlight the geosciences as a potential career path. These upstream improvements in awareness must include efforts to engage underrepresented students by recruiting them into introductory courses and providing mentorship and research opportunities in pursuit of geoscience degrees.

Undergraduate geoscience student enrollments are increasing (Wilson, 2014a); however, undergraduate and graduate professional training opportunities are relatively stagnant or even
contracting. Student numbers in field camps are up nationwide, yet the number of universities offering field camps has declined by 60% since 1995 (Petcovic et al., 2014). Many universities offer anecdotal evidence that the number of applicants to geoscience graduate programs is increasing, yet the number of funded graduate student positions available has not kept pace. The M.S. degree is the “working” degree in the geosciences, but decades ago a trend began to remove M.S. programs to focus exclusively on Ph.D. programs, applying further pressure on the number of funded graduate student positions available. Increases in the number of students entering the upstream end of the geoscientist pipeline must be matched by growth in opportunities for advanced and graduate training downstream in the form of graduate funding, mentorship, and field and research opportunities.

Participation in the process of science (LaDue and Brown Manning, 2015) is critical to training the next generation of geoscientists, and more than half of all geoscience undergraduate majors participate in some form of faculty-directed research (Wilson, 2014a). As with industry, the lack of student numbers in field camps is up nationwide, yet the number of universities offering field camps has declined by 60% since 1995 (Petcovic et al., 2014). Many universities offer anecdotal evidence that the number of applicants to geoscience graduate programs is increasing, yet the number of funded graduate student positions available has not kept pace. The M.S. degree is the “working” degree in the geosciences, but decades ago a trend began to remove M.S. programs to focus exclusively on Ph.D. programs, applying further pressure on the number of funded graduate student positions available. Increases in the number of students entering the upstream end of the geoscientist pipeline must be matched by growth in opportunities for advanced and graduate training downstream in the form of graduate funding, mentorship, and field and research opportunities.

Participation in the process of science (LaDue and Brown Manning, 2015) is critical to training the next generation of geoscientists, and more than half of all geoscience undergraduate students participate in some form of faculty-directed research (Wilson, 2014a). However, the average age of geoscience faculty in the U.S. is 60 years (Wilson, 2014a). As with industry, the lack of younger personnel is threatening the ability to train future students in key disciplines of the geosciences. This problem is exemplified by the looming extinction of paleontology in both academia and industry (Saucier, 2015). We must maintain our ability to train the future geoscience workforce by rebuilding the aging academic workforce.

**SELF-IDENTIFICATION & COMPETENCIES**

Student specialization, and increased social self-identification with that specialty, often comes increasingly early in academic careers. Students self-identifying as specialists, instead of geoscientists, leads to an increasingly narrow focus of study. Instead of embracing the interrelated facets of geology, early-career students are frequently advised to specialize at the expense of expanding their potential interests in disciplines they may not encounter early on. Furthermore, such specialization limits their core competencies and their ability to cross-train others in the future. Increased student specialization must be matched by mentorship that advocates for multidisciplinary research activities.

Colleges and universities can help bridge the gap between geoscience education and training objectives and end-user competencies by reengaging their alumni. Competency objectives should be driven by the eventual employers of geoscience students (both public and private), not exclusively by geoscience departments. Academia is just one of the professions in which geologists find employment, and it is critical that we expose students to other voices and perspectives early and often during their education if we are to rebuild the geoscience workforce.

**ACKNOWLEDGMENTS**

We thank G. Dickens (editor), J. Geissman, B. Thomas, and an anonymous reviewer for comments that significantly strengthened this manuscript. This work is the outcome of a 2014 International Geoscience Programme (IGCP) Project 591 Public Policy Symposium at the University of Iowa. Travel funding was provided by a Stanley Major Projects Award, International Programs, University of Iowa.

**REFERENCES CITED**


*Manuscript received 1 Feb. 2015; accepted 9 June 2015.*
Celebrating 35 Years of the GSA Foundation, 1980–2015

Margaret R. Eggers

As Chair of the GSA Foundation Board of Trustees, I am pleased to mark 35 years of the GSA Foundation and its service to GSA members. Each year, we have reason to celebrate the impressive community of individuals and organizations who support GSA and its programs through the Foundation. Your continued generosity allows GSA to provide first-rate opportunities for young geoscientists and to facilitate excellence in scientific research. The Foundation provides support to GSA programs that offer mentoring to young students, promote diversity in our science, and help expand the reach of GSA in public policy and education.

Looking forward, the Foundation will work to increase financial resources for key GSA programs and priorities. Every gift and sponsorship expands GSA’s advancement of the geosciences and supports both new and career geoscientists. We would like to say “thank you” again to our loyal and new supporters. For many individuals, December is an excellent time to renew your annual contribution to GSA or join this generous community by making the GSA Foundation one of your charitable priorities. We look forward to working with you in 2016 and beyond to strengthen our Society and its unique and vital role in advancing the geosciences.

GSA Foundation Snapshot: Fiscal Year 2015

- **Total Giving**: US$18,222,879
- **Foundation Assets**: US$1,895,169
- **Transferred to GSA**: US$1,060,052

Your Support Will Strengthen Key GSA Priorities
- Communicating Our Science
- Future Geoscientists
- Policy Programs
- Geoscience Education

GeoCorps participants at Devil’s Tower, Wyoming, USA.

2014 On To the Future Participants.
Countdown to Open Access

Soon anyone anywhere in the world will be able to access GSA’s journals free of charge.

As announced in May 2015, GSA’s journals are going open access. Beginning in January 2017, all Geology content will become freely available. Geosphere and Lithosphere will follow in 2018 and GSA Bulletin in 2019.

As part of this transition, GSA members will receive online access to the four journals as part of their membership in January 2017.

The journals will maintain the same level of quality and scientific review that has driven them to become leaders in their field, but now, in fulfillment of GSA’s mission, their content will have worldwide dissemination with no access barriers, extending the reach and increasing the impact of this quality research.

www.gsapubs.org

GSA Publications Highlights