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Understanding the environmental
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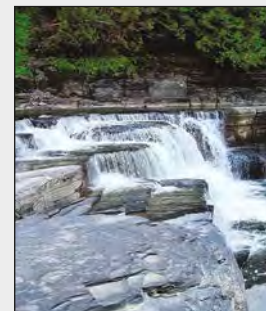
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SCIENCE

- 4 **When oil and water mix: Understanding the environmental impacts of shale development**
Daniel J. Soeder and Douglas B. Kent

Cover: The Utica Shale at Canajoharie Falls, New York, USA, 2016. Photo by Dan Soeder. See related article, p. 4–10.



GSA 2018 Annual Meeting & Exposition

- | | |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 11 President's Welcome | 30 Student Information and Activities |
| 11 GSA Presidential Address | 30 Roommates & Rides |
| 12 GSA Awards Ceremony | 31 On To the Future |
| 12 2018 GSA Medal & Award Recipients | 31 Campus Connection |
| 14 Pardee Keynote Symposia | 31 Notice of GSA Council Meetings |
| 16 Feed Your Brain: Lunchtime Enlightenment | 32 Exhibitors |
| 18 Registration | 34 K–12 GSA Experience Comes to Indy |
| 19 Events Requiring Tickets/Advance Registration | 34 GSA 2018 on Social Media |
| 19 Student Volunteers | 34 Saturday Indy Icebreaker |
| 22 Housing Dates | 35 Presentation Information |
| 22 Childcare | 38 Scientific Field Trips |
| 22 Space Requests | 40 Short Courses |
| 23 Downtown Indianapolis Hotels & Attractions | 43 GeoCareers: Career Development Events for Students and Early Career Professionals |
| 24 Discover Indianapolis—Be Surprised, Be Welcomed, Enjoy Hoosier Hospitality | 46 GeoTeachers K–12 Teacher Professional Development Workshop at Indy |
| 26 Travel & Transportation | 47 GeoCareers: Mentoring Activities at the Meeting |
| 28 Local Tours | |
| 29 Guest Program | |

GSA News

- 45 Thank You GeoCorps™ America and Geoscientists-in-the-Parks Partners
- 45 GeoCorps™ Enterprise
- 45 GeoTeachers
- 48 2019 GSA Section Meetings
- 49 GSA's Scientific Divisions
- 54 Preliminary Announcement and Call for Papers: Joint GSA Section Meeting
- 58 Preliminary Announcement and Call for Papers: Southeastern Section Meeting
- 62 Preliminary Announcement and Call for Papers: Northeastern Section Meeting
- 64 New GSA Member Benefit
- 65 Geoscience Jobs & Opportunities
- 69 GSA Foundation Update

Cover inset photo: Jammin' on the Avenue Public Art. Photo courtesy Visit Indy.

When oil and water mix:

Understanding the environmental impacts of shale development

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ABSTRACT

Development of shale gas and tight oil, or unconventional oil and gas (UOG), has dramatically increased domestic energy production in the U.S. UOG resources are typically developed through the use of hydraulic fracturing, which creates high-permeability flow paths into large volumes of tight rocks to provide a means for hydrocarbons to move to a wellbore. This process uses significant volumes of water, sand, and chemicals, raising concerns about risks to the environment and to human health. Researchers in various disciplines have been working to make UOG development more efficient, and to better understand the risks to air quality, water quality, landscapes, human health, and ecosystems. Risks to air include releases of methane, carbon dioxide, volatile organic compounds, and particulate matter. Water-resource risks include excessive withdrawals, stray gas in drinking-water aquifers, and surface spills of fluids or chemicals. Landscapes can be significantly altered by the infrastructure installed to support large drilling platforms and associated equipment. Exposure routes, fate and transport, and toxicology of chemicals used in the hydraulic fracturing process are poorly understood, as are the potential effects on terrestrial and aquatic ecosystems and human health. This is made all the more difficult by an adaptable and evolving industry that frequently changes methods

and constantly introduces new chemicals. Geoscientists responding to questions about the risks of UOG should refer to recent, rigorous scientific research.

INTRODUCTION

Large-scale scientific and engineering investigations into the natural gas potential of organic-rich shales began after the 1973–1974 OPEC oil embargo (Soeder, 2017). The Eastern Gas Shales Project (EGSP) was funded from 1977 to 1992 by the U.S. Department of Energy (DOE) with the goal of adapting engineered hydraulic fracturing treatments, also known as “fracking,”¹ to create flowpaths from natural fracture networks within the shales to vertical wellbores. The EGSP field experiments showed that fracking alone was insufficient to produce economical amounts of hydrocarbons from vertical wells (Soeder, 2017).

By the mid-1990s, technical advances in directional drilling for deep-water oil and gas, along with improvements in down-hole bit navigation (Rao, 2012), enabled Mitchell Energy to bore long, horizontal wells called “laterals” into the Barnett Shale in the Fort Worth Basin of Texas. These laterals, which contacted a much greater volume of the shale formation than vertical wells, were stimulated with a series of staged hydraulic fractures carefully spaced into discrete zones along the lateral. The combination of horizontal drilling and staged hydraulic fracturing

resulted in the production of economical quantities of natural gas from the Barnett Shale, initiating modern shale-gas and tight-oil development (Soeder, 2017). Most estimates suggest that many decades of energy supplies are available from unconventional oil and gas (UOG) resources at current usage rates (USGS, 2015).

The commercial development of shale gas and tight oil requires drilling, fracking, production, and transmission of oil/gas, management of waste streams, and well-closure (Fig. 1 #1–7) (USEPA, 2016). The scale of development has raised questions about possible risks to air, water, landscapes, ecosystems, and human health (Soeder and Kappel, 2009; Soeder et al., 2014). Large drill rigs (Data Repository Fig. S1²) are required to install the long, deep laterals. The land-clearing and pad construction activities needed to accommodate such equipment often modify landscapes and watersheds (Fig. 1 #10). Fracking involves injection of large volumes of water (~0.1 to >10 million liters) with sand to prop the fractures open and chemical additives such as friction reducers, corrosion inhibitors, anti-scale agents, and biocides (USEPA, 2016; <https://fracfocus.org/>). The water, sand, and additives are pumped into wells under pressures that exceed rock-strength to create fractures (Figs. 1 #3–4 and S2 [see footnote 2]). Many of the risks at each step of UOG development are known while others remain poorly understood (Table S1 [see

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¹ The term “frack” (with the k) is commonly used by shale gas opponents (“fracktivists”) in reference to the entire drilling, stimulation, and production process. Proponents use the spelling “frac” (minus the k) in reference only to the stimulation step. The word has no standard spelling, but for phonetics and consistency with similar words (e.g., crack) we have chosen to include the “k” but limit the use to the stimulation process.

² GSA Data Repository Item 2018251, six tables and eight figures with supporting information, is online at www.geosociety.org/datarepository/2018/.



Photograph by Dan Soeder



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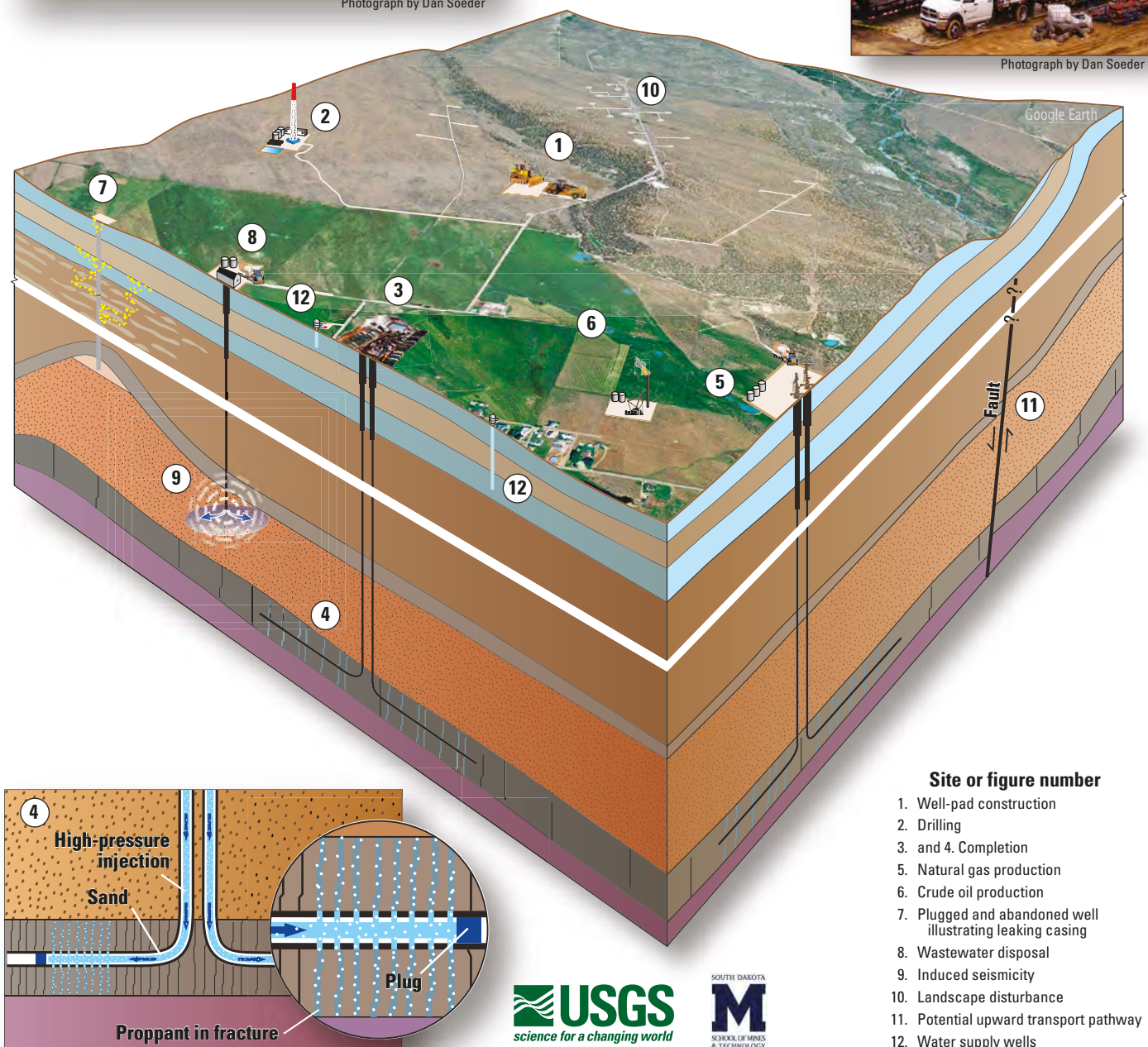


Figure 1. Schematic diagram illustrating unconventional oil and gas (UOG) development activities relevant to research on human-health and environmental impacts (not to scale): well-pad construction (1); drilling (2); completion/stimulation (3, 4); production of natural gas (5) and oil (6) with well casings designed to protect drinking-water aquifers; ultimate closure (plug and abandon), illustrating legacy well with leaking casing (7); wastewater disposal (8); induced seismicity (9); landscape disturbance (10); and potential for transport pathways from deep to shallow formations (11). Also represented are water supply wells in shallow and deep aquifers (12). Photographs by Dan Soeder.

footnote 2]), and the overall combined risk is difficult to assess (Rodak and Silliman, 2012). For example, of 1606 chemicals identified in wastewater from UOG wells, chronic toxicity values are only available for 173 (USEPA, 2016). The United States will continue to rely on the production of fossil fuel hydrocarbons for some time (Fig. S3 [see footnote 2]), and understanding of the risks must be improved.

Researchers at government agencies, universities, institutes, and industry have been investigating potential human-health and environmental impacts of UOG development. Herein we use “environmental impacts” to refer to impacts on aquatic and terrestrial organisms, communities, and ecosystems. This article aims to highlight the critical research questions in this area and to provide access to results of ongoing research.

RESEARCH QUESTIONS AND PRIORITIES

The Health Effects Institute in Boston, Massachusetts, conducted an exhaustive review of the scientific literature and solicited expert advice to identify the research needed to reduce uncertainty about potential human-health and environmental-impact risks from UOG development (HEI, 2015), identifying thirteen critical research areas (Table S1).

Assessing human-health impacts from UOG operations is complicated and challenging. A typical approach combines toxicology data with measurements of chemical exposure. Shale development sites have multiple stressors that may be detrimental to human health in nearby communities, such as chemical stress from produced-water spills, physical stress from airborne particulate matter, sensory stress from the noise and light, and emotional stress from traffic and equipment. Geoscientists play a critical role in identifying possible exposure routes of potentially hazardous materials.

The U.S. Department of the Interior (DOI), Environmental Protection Agency (EPA), and DOE developed a collaborative research framework for assessing risk from UOG development. The Department of Health and Human Services (HHS) was engaged for human-health issues, and the National Science Foundation (NSF) was engaged to coordinate federal

research with academic research (Multiagency, 2014).

Seven priority research areas were identified: (1) domestic UOG resource development trends to identify potential future impacts; (2) effects of hydraulic fracturing water consumption on local and regional water availability; (3) potential water-quality degradation from UOG development and linkage of contaminants to UOG activity; (4) potential short- and long-term air-quality impairments; (5) induced seismicity from fracking and liquid waste disposal in underground injection control (UIC) wells; (6) potential impacts of UOG development on terrestrial and aquatic ecosystems; and (7) possible effects of UOG development on human health. Lead roles in these seven areas were given to agencies based on core capabilities and mission (U.S. DOE, 2015) (Fig. S4 [see footnote 2]).

DOE research focused on engineering investigations of how drilling fluids, hydraulic fracturing chemicals, and produced liquids and gas may escape from wellbores, tanks, and other containments and enter the environment (e.g., Fig. S5 [see footnote 2]). Studies include wellbore integrity and cement technology (Kutchko et al., 2012); fate and transport of frack chemicals in groundwater (Soeder et al., 2014); and the potential for greenhouse gas (GHG) releases (Pekney et al., 2014). Field research sites have been established by DOE in West Virginia, Texas, Louisiana, and Virginia.

DOI research has primarily been performed by the U.S. Geological Survey (USGS) to assess technically recoverable UOG resources (e.g., USGS, 2015), understand the chemical composition of produced and formation waters (e.g., Orem et al., 2014; Blondes et al., 2017), and compile data related to water used for hydraulic fracturing (e.g., Gallegos et al., 2015). Water quality upstream and downstream from oil and gas wastewater injection and pipeline spill sites has been assessed (Fig. 1 #8) (e.g., Akob et al., 2016; Cozzarelli et al., 2017), along with impacts on wildlife driven by UOG-related modifications to landscapes (e.g., Preston and Kim, 2016; USGS, 2017). Induced seismicity, which results primarily from the disposal of produced water down UIC wells (Fig. 1 #9) (Rubinstein and Mahani, 2015), was investigated under the USGS earthquake hazards program.

EPA research has focused on documenting risks and identifying knowledge gaps regarding impacts of UOG development on drinking-water sources (USEPA, 2016). The EPA is also engaged in the induced seismicity issue because the agency is responsible for regulating UIC wells.

An NSF-supported study of the linkages and relationships between agriculture, energy, and water resources on the northern Great Plains investigated a concept called the food-energy-water (FEW) nexus. This area contains just 1% of the U.S. population, yet it produces 23% of the nation's crop value and 16% of U.S. energy. Scarce water resources are heavily used for both agriculture and energy, and tipping points were identified that could prevent recovery of water resources. Thus, sustainable water management practices are critical (Sieverding and Jones, 2015).

RESEARCH TO ADDRESS POTENTIAL AIR- AND WATER-QUALITY IMPACTS OF UOG DEVELOPMENT

Airborne pollutants from UOG development include methane (CH_4), carbon dioxide (CO_2), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and particulate matter (PM) released during well pad construction, drilling (Figs. S5 and S6 [see footnote 2]), hydraulic fracturing (Fig. S2), returned-fluids handling, and production (Fig. S7 [see footnote 2]). VOCs and NO_x directly degrade local and regional air quality and can form ground-level ozone and particulate matter. Variations in the composition and scale of air emissions complicate characterization of UOG sites. Automated collection and analysis of air samples obtained with mobile laboratories provide inputs for atmospheric fate and transport models (Pekney et al., 2014). Methane leakage from gas wells contributes to GHG emissions, and although it has a shorter residence time in the atmosphere compared to CO_2 , CH_4 is a much more powerful GHG. On the other hand, abundant natural gas from shale has resulted in the replacement of many old, coal-fired power plants with natural gas-fired generation, significantly decreasing CO_2 emissions from electricity production (USEIA, 2017) and improving air quality (Mac Kinnon et al., 2018).

Stray methane gas is the most common groundwater problem in areas of Marcellus Shale development in Pennsylvania, followed by dissolved salts from produced water (Brantley et al., 2014). Other contaminants linked to shale gas include metals, naturally occurring radioactive materials (NORM), and organic compounds. Contaminants enter surface water primarily through spills or leaks and infiltrate downward into shallow aquifers. No evidence supports aquifer contamination by the upwelling of fluids from production zones (e.g., Fisher and Warpinski, 2012; Hammack et al., 2014; McMahon et al., 2017).

Recent investigations have contributed to a growing consensus that stray gas in aquifers results primarily from casing failures in older production wells, rather than migration from zones where hydraulic fracturing was conducted in horizontal wells (e.g., Brantley et al., 2014; Lackey et al., 2017). The challenges of understanding stray gas migration in the subsurface were illustrated by a test at the Borden groundwater research site in Ontario, Canada. Methane was injected into the well-characterized, shallow sand aquifer, and migration was monitored spatially and temporally at high resolution (Cahill et al., 2017). The gas was transported in solution by advection and diffusion and laterally in the gas phase through interconnected layers of somewhat coarser sediments (Fig. 1 #7). It persisted in the aquifer for more than a year, longer than expected.

Baseline water-quality data are needed to assess potential water-quality degradation. Researchers from the USGS and Northeast Midwest Institute investigated decades of legacy water-quality data from the Susquehanna River Basin in Pennsylvania to determine if baseline conditions prior to shale-gas development could be determined (Betanzo et al., 2016). Most of the existing water-quality monitoring sites were found in the lower parts of the basin and established for nutrient and pesticide inputs to the Chesapeake Bay. The data sets were not useful for assessing water-quality impacts of shale-gas development in headwater streams. Impacts of UOG development on groundwater and surface-water quality can be difficult to distinguish from impacts of septic systems and legacy coal mining (Messinger and Hughes, 2000), but

elemental ratios and isotopic compositions can provide signatures of wastewater from UOG production (e.g., Akob et al., 2016; Lauer et al., 2016; McMahon et al., 2017).

Residential water-supply wells in the vicinity of new oil and gas production wells are often sampled to provide pre-drilling information about water quality. The data are collected for liability reasons (USEPA, 2016) and are not well suited for interpreting sources of contamination (Table S2 [see footnote 2]). Molofsky et al. (2016) assessed best practices for sampling, laboratory analysis methods, data management, and analysis protocols for residential water wells in areas of UOG development.

RESEARCH TO ADDRESS POTENTIAL IMPACTS OF LIQUID AND SOLID WASTES AND SPILLS

Increases in UOG activities result in more environmental violations (Kell, 2011) and spills (Lauer et al., 2016). An 11.3-million-liter spill of Bakken and Three Forks produced water into a North Dakota creek contained total dissolved solids (TDS) of 300 g per liter and high concentrations of ammonium, barium, strontium, and radium (Lauer et al., 2016; Cozzarelli et al., 2017). Geochemical alterations in the stream persisted for at least six months after the spill, and fish kills were observed 7 km downstream of the spill site. Radium and strontium isotopic signatures in downstream sediments resembled those from the spilled fluid (Cozzarelli et al., 2017). Slow release of spill-derived chemicals from sediment could provide a long-term contaminant source in aquatic ecosystems.

Organic-rich shales were deposited in anoxic marine environments and contain sulfide minerals, radionuclides, and reduced inorganic elements (Chermak and Schreiber, 2014). Hydraulic fracturing fluids often react with shale downhole, mobilizing inorganic compounds like barium (Renock et al., 2016) or creating new organic compounds that are found in the produced fluids (Kahrilas et al., 2016).

Horizontal drilling of a single shale well can generate several hundred tons of drill cuttings, which may release harmful elements like arsenic, radium, and uranium (Phan et al., 2015). The leachability of drill cuttings has been investigated in the laboratory under short-term and long-term

exposures and different environmental conditions, resulting in the identification of potentially toxic metals being mobilized from black-shale drill-cuttings (e.g., Stuckman et al., 2015). Understanding these processes will guide management of these waste materials.

SITE-BASED PROJECTS EXAMINING POTENTIAL ENVIRONMENTAL IMPACTS OF UOG DEVELOPMENT

Access to UOG sites for environmental monitoring has been challenging for non-industry researchers (Soeder, 2015), but collaboration between academic, government, and industry researchers has been improving. A multidisciplinary project begun in 2013 to examine potential environmental and human-health impacts of UOG development, primarily in the Rocky Mountain region (Table S3 [see footnote 2]), has produced more than 50 publications assessing air- and water-quality impacts; wastewater treatment and re-use; public health outcomes; and socio-political and economic factors associated with UOG development. Potential water-resource risks have been assessed near Marcellus Shale wells in Susquehanna County, Pennsylvania, since 2015 (Table S4 [see footnote 2]). Analyses of produced water and hydrocarbons from production wells are providing signatures for potential contaminants like trace metals, major ions, and hydrocarbons. Studies like these will provide insight into the natural spatial and temporal variation in water quality needed to detect impacts from UOG development.

Field research projects involving partnerships between DOE and industry are improving UOG-development technologies while reducing environmental and health impacts. The Hydraulic Fracturing Test Site (HFTS) in the Permian basin of Texas underwent environmental assessments before, during, and after development phases (Fig. 1 #1–6). Air quality was monitored for methane, NO_x, and VOCs. Groundwater quality was monitored within 4 km of production wells. Produced water was analyzed to evaluate potential impacts to wellhead and casing integrity (Table S5 [see footnote 2]). New hydraulic fracturing technologies were tested to optimize hydrocarbon extraction efficiency. Preliminary findings indicate that

groundwater quality was not degraded by the activity onsite; final results will be published in a DOE report.

The Marcellus Shale Energy and Environment Laboratory (MSEEL) is a long-term, collaborative field site located near Morgantown, West Virginia, to develop and validate new technology for improving recovery efficiency and reducing environmental impacts of shale-gas development (Table S6 [see footnote 2]). The MSEEL developed a geologic and engineering baseline using two older Marcellus wells at the site, and a vertical drill core of the Marcellus Shale was obtained from one of the new production wells. A scientific observation well supplied detailed subsurface information including 150 sidewall cores and provided monitoring access for new hydraulic fracturing technologies tested in the production laterals, which also furnish produced water and gas samples to researchers. Quality of surface water, air, and noise were monitored by geochemists, health professionals, and social scientists. Continued research at MSEEL is expected to improve extraction and management of subsurface energy resources and advance scientific understanding of the environmental and social impacts of shale development.

These two field sites have been joined more recently by the Eagle Ford Shale Laboratory in Texas, the Tuscaloosa Marine Shale Laboratory (TMSL) in Louisiana, and the Field Laboratory for Emerging Stacked Unconventional Plays (ESUP) in the Nora Gas Field in Virginia. The Geological Survey of Canada also has been performing field investigations of potential hydrocarbon migration from the Utica Shale at a depth of 2 km to shallow aquifers in the St. Lawrence lowlands (Rivard et al., 2016). Variable isotopic compositions of CH₄ indicate that biogenic and thermogenic methane likely originated from black shales underlying shallow bed-rock aquifers. Although upward migration of deep brine was discovered along a normal fault, there is no evidence of significant gas migration from the Utica Shale.

ALTERNATIVE MATERIALS AND PRACTICES

A study at the University of Arkansas, Little Rock, assessed industry adoption of hydraulic fracturing technologies that use “greener” chemicals, including low-VOC

and food-based compounds and geosynthetics to enhance containment (Thomas et al., 2018). Environmental risks of standard frack fluid chemicals and green alternatives need to be better understood, and the oil and gas industry must be convinced that green chemicals perform as well as and cost the same or less than the chemicals they replace.

These issues are also being addressed by the Environmentally Friendly Drilling (EFD) program supported by DOE at the Houston Advanced Research Center (HARC). Field trials of new technologies for site selection, drilling, completion, production, and gas compression, along with public perception studies, help industry develop oil and gas resources in a more environmentally responsible manner.

CHALLENGES AND OPPORTUNITIES

Research on the environmental impacts of UOG development was affected by dramatic decreases in oil and gas prices beginning in 2014 (Fig. S8 [see footnote 2]). Natural gas prices fell first, leading to a steady decline in the number of active drill rigs on the shale gas plays, followed a few months later by a significant drop in oil prices, leading to an even more abrupt decline in the number of active rigs drilling the Bakken Shale (USEIA, 2016). These changes resulted in logistical challenges or cancellations of planned field-monitoring projects as drillers shifted to the more lucrative parts of a play (e.g., Soeder, 2015). Fewer operating drill rigs reduced the number of potential access options for investigators.

Oil and gas production is a cyclical business. Unconventional resources feed the same markets as all other components of the energy sector. During boom times, industry is in a frenzy to gain lease positions and install wells while prices are high and competition stiff. Partnering in research on environmental and human-health impacts is low on their priority list. When prices drop, development slows down. There is less drilling and fewer opportunities for researchers, but the downward part of the cycle also provides an opportunity to discuss potential partnerships in projects investigating environmental and human-health impacts.

Industry partners are more willing to listen to researchers’ ideas and interested in data that could increase efficiency, reduce

uncertainty, facilitate fact-based regulations, and improve their social license to operate (Table S6).

Geoscientists are frequently called upon to answer questions about fracking. The issues are neither simple nor static, and keeping up with rapidly evolving technology and a highly adaptable industry is a significant challenge. For example, in 2010, the discharge of high TDS wastewater in the effluent from municipal wastewater treatment plants was identified as the greatest environmental risk from UOG development (Rozell and Reaven, 2012). Beneficial use of produced water for road de-icing and dust suppression (e.g., Skalak et al., 2014) was curtailed. A few years later, water management practices had changed to flowback recycling and disposal of residual waste down UIC wells (Rodriguez and Soeder, 2015), eliminating worries about discharge from wastewater plants. These were replaced by new concerns over the risk of spills or leaks from the improper handling of produced water (e.g., Patterson et al., 2017), and high volumes of wastewater injection causing induced seismicity (Llenos and Michael, 2013). In conclusion, the public is concerned about the uncertainties of human-health and possible environmental risks of fracking, which geoscientists can address through rigorous scientific research and responsible public engagement (Brantley et al., 2018).

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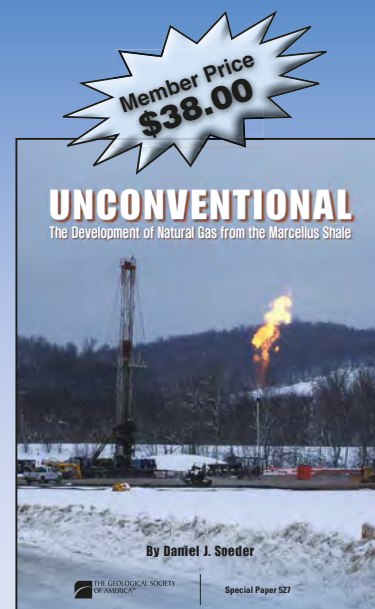
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Talk to me in Indianapolis!

Robbie Gries, GSA President
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GSA Presidential Address

Navigating “Me, too” in the Geosciences

Robbie Rice Gries

Sunday, 4 Nov., noon–1:30 p.m., Indiana Convention Center, Sagamore Ballroom 5

We have seen the “Me, too!” movement expand across all aspects of humankind. From Hollywood where it grew legs, to Congress, state legislatures, the White House, to huge corporations, small businesses, sports, television personalities, the military, the Olympics, and, yes ... to GSA.

Before Harvey Weinstein, before something hit the proverbial fan—GSA was already receiving and addressing complaints from members who experienced harassment (ranging from bullying to sexual assault) at GSA functions and in their professional lives. We launched a review of our ethics position, our obligations, and our code of conduct to ensure our Society had the ability to effectively deal with unprofessional behavior at GSA meetings, field trips, and other sanctioned events. Recognizing our lack of good definitions and effective procedures, GSA’s initiative was timely, and good strides have been made for our Society to appropriately deal with these types of inappropriate actions. We can take “proactive measures.”

I believe people in the sciences have some excellent skills to address harassment, prejudice, and gender issues. We have the scientific skills and intellect to address many societal problems, and we are good at it. We use data, published studies, field trips, and in-depth conversations with experts in our disciplines to advance our knowledge. We prime the creative pumps of our minds with these actions and techniques to find science-based solutions to nagging problems. This is second nature to the professional geoscientist.

What is not second nature to all of us is how to employ these skills, techniques, use of experts, and data-gathering abilities in our interpersonal relationships, including our interactions with colleagues, staff, students, and families. But we can. And this can make a bigger difference.

Let’s look at historic, sometimes reprehensible, behaviors demonstrated by geoscientists, changes that have already been made to counter this behavior, statistics about harassment by scientists today, and possibilities for advancing our science through advances in interpersonal skills and behaviors.

GSA Awards Ceremony

Sun., 4 Nov., noon–1:30 p.m.

Indiana Convention Center, Sagamore Ballroom 5



PRESIDENT
Robbie Rice Gries

Please join GSA President Robbie Rice Gries and GSA President-Elect Donald I. Siegel to honor and greet the 2018 GSA Medals & Awards recipients at the Presidential Address & Awards Ceremony. You will also have the privilege of hearing Gries give her Presidential Address, “Navigating ‘Me, too’ in the Geosciences.”



PRESIDENT-ELECT
Donald I. Siegel

2018 GSA Medal & Award Recipients



Kent C. Condie



Iain Stewart



Jay Quade

PENROSE MEDAL
Kent C. Condie, New Mexico Tech

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Iain Stewart, University of Plymouth

ARTHUR L. DAY MEDAL
Jay Quade, University of Arizona

YOUNG SCIENTIST AWARD (DONATH MEDAL)
Laurel Griggs Larsen, University of California Berkeley



Laurel Griggs Larsen



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Rufus Douglas Catchings

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WOMAN IN SCIENCE AWARD**
Andrea M. Balbas, California Institute of Technology

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Kristján Sæmundsson, ISOR–Iceland GeoSurvey

GSA DISTINGUISHED SERVICE AWARD
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Marilyn Suiter, National Science Foundation



Judith Totman Parrish



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Eduardo Garzanti



Bishal Upreti

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Ramon H. Treviño and **Tip A. Meckel**, editors, 2017, **Geological
CO₂ Sequestration Atlas of Miocene Strata, Offshore Texas
State Waters**: The University of Texas at Austin, Bureau of
Economic Geology, Report of Investigations no. 283, 74 p.,
<https://doi.org/10.23867/R10283D>.

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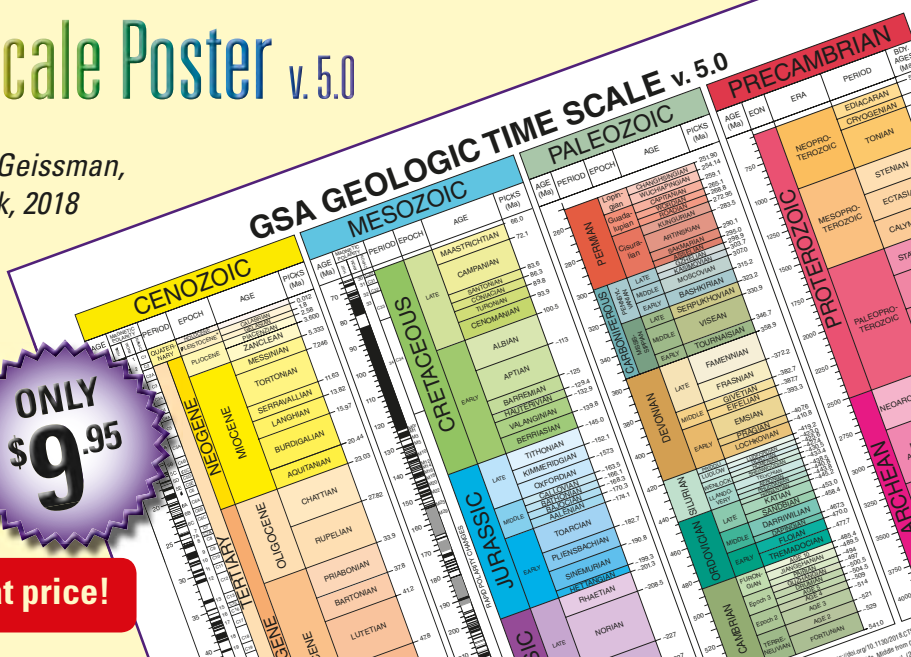
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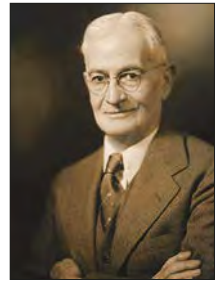
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Joseph T. Pardee

4 SUNDAY

P1. Earth As a Big Data Puzzle: Advancing Information Frontiers in Geoscience

Cosponsored by GSA Geoinformatics Division

1:30–5:30 p.m., ICC, Hall J-K

5 MONDAY

P2. Women Rising: Removing Barriers and Achieving Parity in the Geosciences

Cosponsored by GSA Geology and Society Division; GSA Geology and Public Policy Committee; Association for Women Geoscientists; Earth Science Women's Network

1:30–5:30 p.m., ICC, Sagamore Ballroom 5

6 TUESDAY

P3. Plate Tectonics Paradigm 50 Years after the Seminal Work of Morgan, Mckenzie, and Le Pichon

Cosponsored by GSA Structural Geology and Tectonics Division; GSA History and Philosophy of Geology Division; GSA Geophysics and Geodynamics Division; American Geophysical Union

8 a.m.–noon, ICC, Sagamore Ballroom 5

7 WEDNESDAY

P4. Human Evolution and Environmental History in Africa: 25 Years of Transformative Research

Cosponsored by GSA Limnogeology Division; GSA Geoarchaeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; GSA Continental Scientific Drilling Division; EarthRates

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VOLUME I

VOLUME II

SPECIAL PAPER 500:
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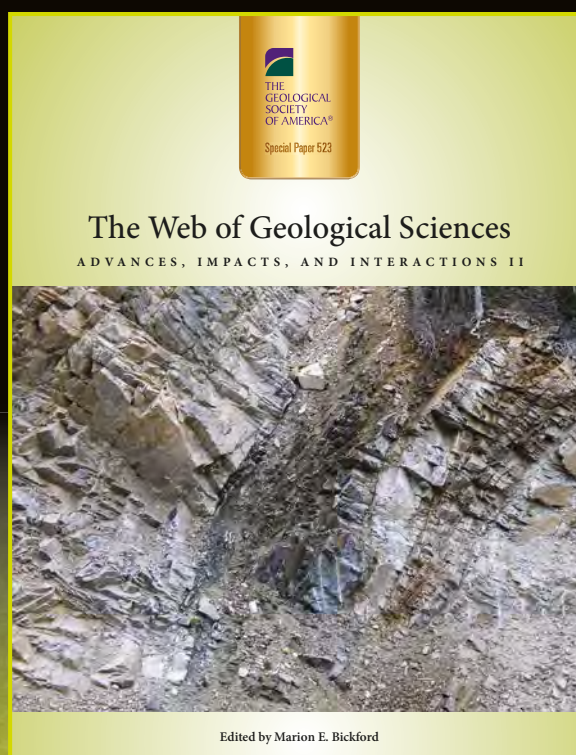
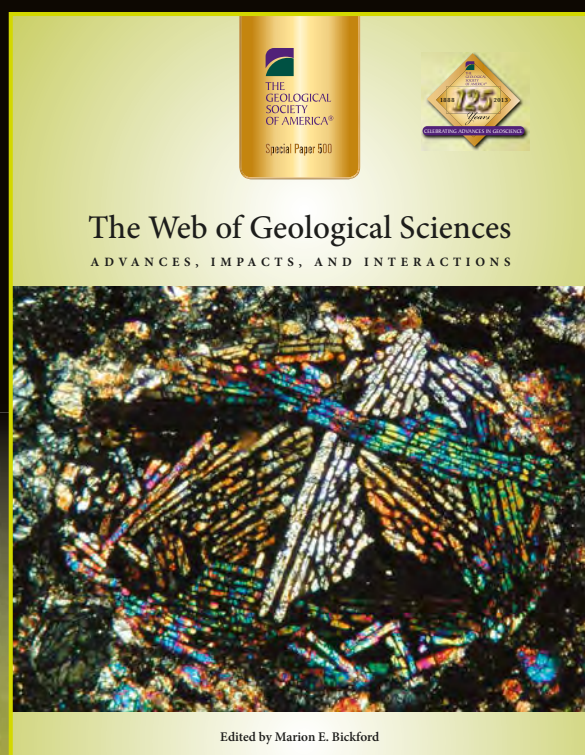
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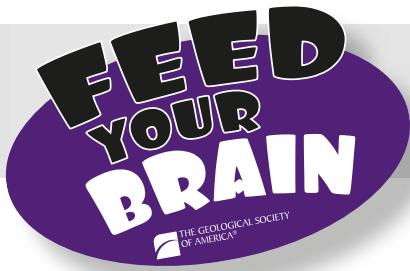


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The Resources of The Moon

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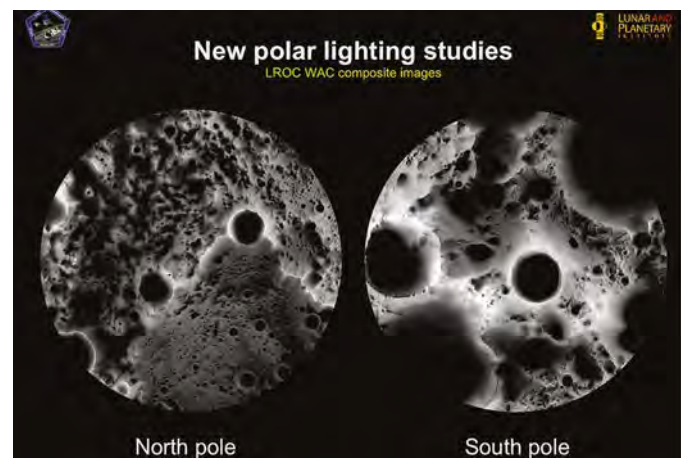
In the years since Apollo, we have discovered accessible places in near-Earth space that contain valuable material and energy resources. By learning how to access, process, and use these space resources we will advance technology, stimulate wealth, and create a spacefaring infrastructure.

The Moon holds a unique advantage in this endeavor. Areas near the poles receive near-permanent sunlight (up to 95% of the lunar year); this resource enables power generation and near-continuous surface operations in a benign temperature location. In conjunction with accessible solar power, significant quantities of water ice reside in permanently dark craters near the poles. The combined effect of these proximate resources makes permanent human presence on the Moon possible. Through the development and use of the Moon's resources, the creation of a permanent, extensible space-faring transportation system and infrastructure in space is possible.

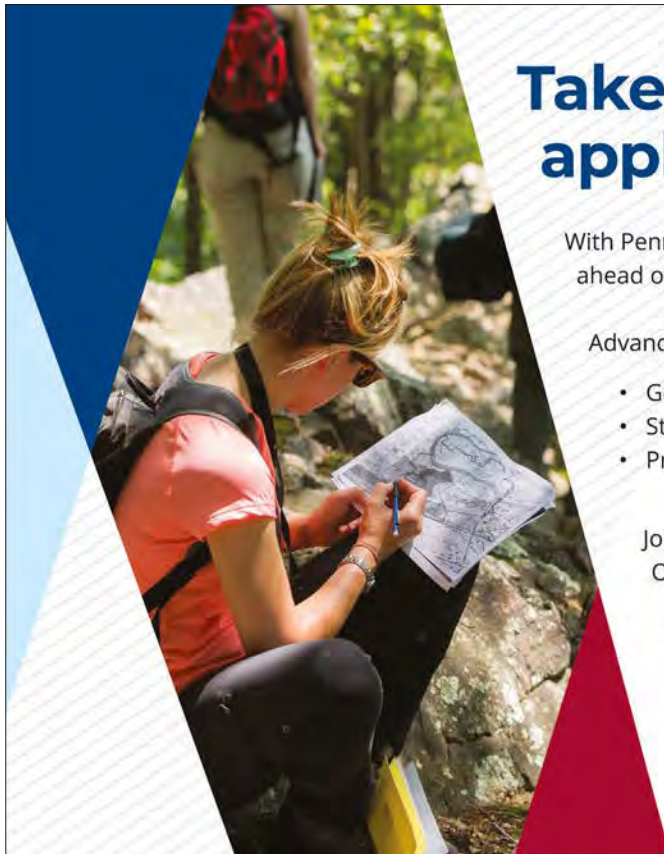
Despite this promise, many unknowns remain about the use of extraterrestrial resources. We need a variety of robotic prospecting missions in order to get advanced, high-precision data from targeted deposits. Currently, we do not know the physical and chemical state of lunar polar ice; we need to understand its

occurrence and how it varies, as well as its accessibility for mining and what equipment is needed. We must practice and understand both mining and processing, as the polar ice is mixed with a variety of other substances useful for long-term habitation of the Moon.

This view of the Moon and our reasons for returning there is relatively new; it signals a new paradigm of spaceflight. This time humanity goes to the Moon to stay—to use its resources and build a space-based, transportation infrastructure, an endeavor and future that presents major scientific, technological, economic, and national security advances.



Lunar polar lighting. Photo courtesy Paul Spudis.



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Registration

- **Early registration deadline:** 11:59 p.m. MDT, 1 October
- **Cancellation deadline:** 11:59 p.m. MDT, 8 October
- Space is available on some tours, ticketed events, field trips, and short courses. Register at community.geosociety.org/gsa2018/attendeeinfo/registration now and throughout the meeting, or

visit the onsite registration desk in the Indiana Convention Center.

You can pick up your badges at the registration desk starting at 7 a.m. on Sat., 3 Nov. Eligible attendees should inquire for their ribbons at the GSA information desk in the Indiana Convention Center during onsite registration hours.

REGISTRATION FEES

	Early Registration (June–1 Oct.)	Standard/Onsite Registration (after 1 Oct.)
Professional Member Full Meeting	US\$420	US\$499
Professional Member 1 Day	US\$255	US\$295
Professional Member >70 Full Meeting	US\$295	US\$380
Professional Member >70 1 Day	US\$195	US\$220
Professional Nonmember Full Meeting	US\$610	US\$690
Professional Nonmember 1 Day	US\$360	US\$435
Early Career Professional Member Full Meeting	US\$270	US\$340
Early Career Professional Member 1 Day	US\$165	US\$199
Student Member Full Meeting	US\$135	US\$170
Student Member 1 Day	US\$90	US\$105
Student Nonmember Full Meeting	US\$190	US\$225
Student Nonmember 1 Day	US\$125	US\$145
High School Student	US\$50	US\$50
K–12 Professional Full Meeting	US\$60	US\$70
Field Trip or Short Course Only	US\$40	US\$40
Guest or Spouse	US\$90	US\$99
Low Income Country*	50%	50%

*Participants from countries classified as “Low or Lower Middle Income Economies” by the World Bank need only pay 50% of the category fee for full meeting or one day registration. Online registration is not available for “Low or Lower Middle Income Economy” registrants. Please fill out a printable version of the registration form at community.geosociety.org/gsa2018/paperform and mail it to GSA, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301, USA.



GSA Meetings **RISE** to the top.

We support **Respectful Inclusive Scientific Events** and are committed to ensuring a safe and welcoming environment for all participants. By registering for this meeting, you agree to abide by the GSA Events Code of Conduct Policy (www.geosociety.org/conductcode) in all venues at our meetings, including ancillary events, field trips, and official and unofficial social gatherings.



GSA Section Travel Grants

GSA Sections offer travel grants to help students attending the meeting. Apply online (go to community.geosociety.org/gsa2018/funding#tg for a link) by 1 October.

Events Requiring Tickets/ Advance Registration

Sign up when you register for GSA 2018 Indy at community.geosociety.org/gsa2018/registration. If you have already registered for the meeting and want to add one of these events, contact GSA Sales & Service at gsaservice@geosociety.org. If you are not attending GSA 2018 Indy but would like to attend one of these events, contact the GSA Meetings Department at meetings@geosociety.org.

Paleontological Society (PS) Business Meeting & Awards Reception Buffet

Sun., 4 Nov., 6:30–10:30 p.m.; professionals: US\$45; students: US\$15. Indiana Convention Center, 500 Ballroom.

Night at the Indiana State Museum—A Student & Early Career Professionals Networking Event

Sun., 4 Nov., 7–9:30 p.m.; US\$15 (increases to US\$20 after 1 Oct.). Indiana State Museum.

Association for Women Geoscientists (AWG) Networking Breakfast & Awards Ceremony

Mon., 5 Nov., 6:30–8:30 a.m.; professionals: US\$29; students: US\$10.* Indiana Convention Center, Sagamore Ballroom 4.

Geoscience Information Society (GSIS) Luncheon & Awards

Mon., 5 Nov., 12–1:30 p.m.; US\$50. JW Marriott Indianapolis, Room 102.

National Association of Geoscience Teachers (NAGT), GSA Geoscience Education Division, and the Council for Undergraduate Research (CUR) Joint Awards Luncheon

Tues., 6 Nov., 11:30 a.m.–1 p.m.; US\$50. JW Marriott Indianapolis, White River Ballroom G-H.

GSA Hydrogeology Division Luncheon, Awards & Business Meeting

Tues., 6 Nov., 11:30 a.m.–2:30 p.m.; US\$50. Indiana Convention Center, Sagamore Ballroom 4.

GSA History and Philosophy of Geology Division Luncheon, Business Meeting & Awards Ceremony

Tues., 6 Nov., noon–2 p.m.; professionals: US\$48; students: US\$25.* JW Marriott Indianapolis, Room 104.

Mineralogical Society of America (MSA) Awards Luncheon

Tues., 6 Nov., 12:15–2:30 p.m.; US\$50. JW Marriott Indianapolis, White River Ballroom I-J.

MGPV–MSA–GS Joint Reception

Tues., 6 Nov., 5:45–7:30 p.m.; professionals: US\$10; students: US\$5. Indiana Convention Center, Room 204.

GSA Environmental and Engineering Geology Division Dinner & Awards Reception

Tues., 6 Nov., 6–9 p.m.; professionals: US\$50; students: US\$25. The Tap.

GSA Planetary Geology Division Annual Banquet & G.K. Gilbert Awardee Celebration

Tues., 6 Nov., 7–10 p.m.; professionals: US\$55; students: US\$30.* Rock Bottom Brewery & Restaurant.

*Limited number of student tickets available at this price. Once they are gone, only professional-priced tickets will be available.

Student Volunteers

GSA student members in good standing: Sign up to volunteer! If you work at least 10 hours during the meeting, you will get complimentary full meeting registration.

Please sign up as a volunteer first, then register for the meeting. Detailed information is online at community.geosociety.org/gsa2018/students/volunteers.

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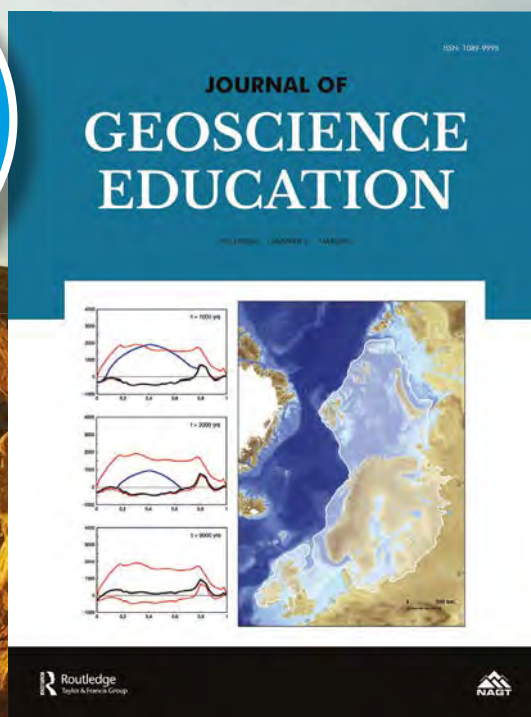
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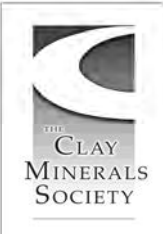
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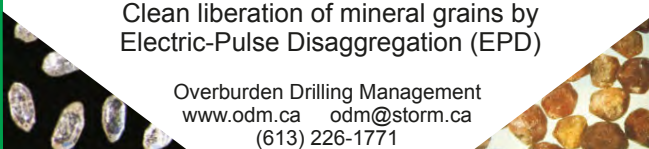
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Critical Housing Dates

1 Oct.: Last day to cancel rooms without a penalty.

10 Oct.: Room rates are guaranteed as long as there are rooms available in the GSA room block.

After 10 Oct.: Hotel room rates and/or availability cannot be guaranteed.

24 Oct.: All changes, cancellations, and name substitutions must be finalized through VisitIndy/GSA Housing Bureau.

25 Oct.: Beginning on this date, you must contact the hotel directly for all changes, cancellations, and new reservations.

Once you receive your hotel acknowledgment and have booked your travel, please review your hotel arrival/departure dates for accuracy. If you do not show up on the date of your scheduled arrival, the hotel will release your room, and you will be charged for one night's room and tax. If you have travel delays and cannot arrive on your scheduled arrival date, contact the hotel directly to make them aware of your new arrival date.



KiddieCorp will provide childcare services for GSA attendees on Sat.–Wed., 7 a.m.–6 p.m. The program is open to children six months to 12 years of age, and the cost is US\$9 per hour per child (only a one-hour minimum).

The advance registration deadline is 3 Oct. Register now at community.geosociety.org/gsa2018/attendeeinfo/needs/family. Availability is limited and handled on a first-come, first-served basis.

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Space Requests

The LAST day to submit a request for the event space and event listing page is 2 Oct. GSA will not assign any additional meeting space after this date and cannot guarantee to list your event on the website or the mobile app. Don't miss out. Go to community.geosociety.org/gsa2018/spacerequest to register your space request today.



DOWNTOWN INDIANAPOLIS HOTELS & ATTRACTIONS

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Discover Indianapolis—Be Surprised, Be Welcomed, Enjoy Hoosier Hospitality

Indianapolis museums have garnered international recognition for creativity and excellence. With numerous quality and unique institutions throughout the city, there is bound to be one that appeals to every interest and age.



The Children's Museum of Indianapolis. Photo courtesy of Lavengood Photography and Visit Indy.

For the Kids

The world's largest children's museum, the Children's Museum of Indianapolis, provides five levels of interactive exhibits and 120,000 artifacts exploring art, science, history, and culture. Over a million visitors a year come to ride the antique carousel, dig for dinosaur bones, discover National Geographic Treasures of the Earth, and stare in awe at Dale Chihuly's 43-foot Fireworks of Glass. The Sports Legend Experience, which opened in the spring of 2018, allows children of all ages to run, jump, putt, drive, and play in a 7.5-acre facility that promotes a fun and healthy lifestyle.

Conner Prairie Interactive History Park, a Smithsonian affiliate, invites guests to step back in time. Located on 200 acres, this living museum features an 1836 Prairietown, 1863 Civil War Journey, 1859 Balloon Voyage, and more. The park made Frommer's list of "Places to Take Your Kids Before They Grow Up."

Rhythm! Discovery Center entertains and informs through music. This museum allows visitors to beat on drums while learning how rhythm and percussion are part of our daily lives and our history.

The Indianapolis Zoo signature exhibits range from the International Orangutan Center to the world's largest shark touch tank and Dolphin Dome.

Sports Lovers

The Indianapolis Motor Speedway Museum captures the rich 100-year history of the world's fastest sport in the "Racing Capital of the World."

Dallara IndyCar Factory uses 23,000 square feet of interactive and hands-on exhibits to convey the intense engineering and technology behind the sport.

The NCAA Hall of Champions showcases all 24 collegiate sports and the heart and dedication it takes to be a student athlete.



The Eiteljorg Museum of American Indians and Western Art. Photo courtesy of Lavengood Photography and Visit Indy.

The Indian(a) Story

The Eiteljorg Museum of American Indians and Western Art is the only museum of its kind in the Midwest, immersing visitors in Western art and the many cultures of American Indians through exhibitions, performances, festivals, and hands-on workshops. This award-winning museum offers one of the finest collections of its kind in the world.

Uncover Indiana's secrets through hands-on exhibits exploring the state's diverse history at the **Indiana State Museum**, a world-class institution constructed from Indiana limestone, steel, and glass. Then venture down the street to the **Indiana History Center** to discover the state's past via interactive experiences and archives.

Artistic Discovery

Situated on 152 pristine acres of gardens and grounds, the **Indianapolis Museum of Art** is an impressive institution. The collection of 54,000 works spans 5,000 years of African, American, Asian, and European history, making it one of the largest encyclopedic museums in the country. Find Robert Indiana's original LOVE sculpture here, not in Philly or New York.

Those wanting a more hands-on art experience can nurture their artistic side by taking one-night pop-up classes accompanied by wine and beer at the **Indianapolis Art Center**. The Art Center is also open to guests interested in perusing works by other talented and creative local artists.

City-wide gallery tours are available on the **first Friday of every month**. This free, self-guided art event brings visitors and residents alike to galleries all around the city.

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Edited by John S. MacLean and James W. Sears



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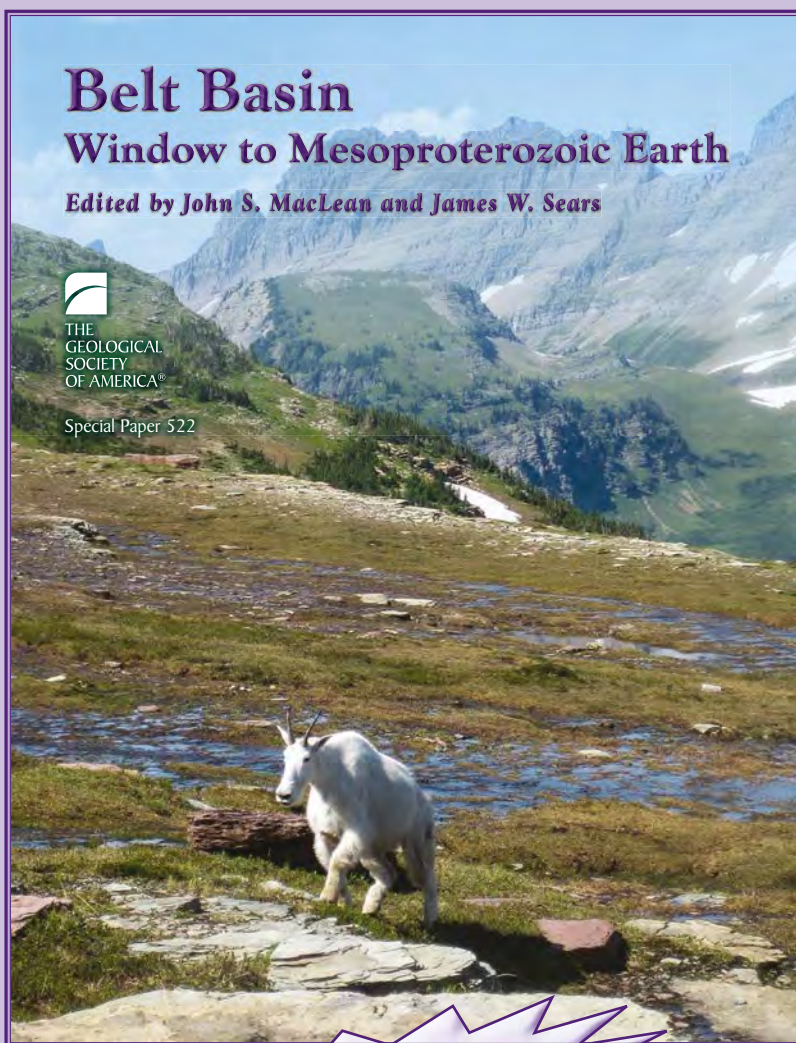
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Travel & Transportation



Indianapolis International Airport. Photo courtesy of IM Imagebank, VisitIndy.com.



Photo by Peterhuocean11 at Wikipedia public domain, via Wikimedia Commons.



By Air

Indianapolis International Airport (IND)

The LEED-certified Indianapolis International Airport is a short, low-traffic, 15-minute drive from downtown. One of the country's most environmentally friendly airports is the most passenger-friendly as well. Air travelers receive a rousing greeting to the city when they arrive at Indianapolis International Airport. The US\$1.1 billion Col. H. Weir Cook Terminal opened in 2008 as the first airport terminal designed after 9/11. It combines state-of-the-art security measures with soaring, smart design and public artwork. The Indianapolis International Airport has been consistently named the best airport in North America.



By Bus

Megabus

Megabus offers city-to-city bus tickets for as low as US\$1 for your travel around North America. The Megabus model was designed with the customer in mind, with luxury double-deckers offering free Wi-Fi, at-seat power outlets, panoramic windows, and a green alternative way to travel. Travel to Indianapolis from Atlanta, Chattanooga, Chicago, Cincinnati, Louisville, and Nashville.

Greyhound

Greyhound's iconic brand is synonymous with affordable long-distance travel in North America and a unique national network. The Indianapolis Bus Station is less than a five-minute walk from the Indiana Convention Center.



By Train

Amtrak

Amtrak offers a unique travel experience. Enjoy wide seats, plug-in power, big windows, and plenty of room to get up and stretch your legs. Amtrak has two routes stopping in Indianapolis: The Cardinal route and the Hoosier State route.



By Car

Driving

Known as the Crossroads of America, Indy is within a day's drive of more than half of the country's population. Traffic congestion is a rarity in Indianapolis, and visitors find the city's street layout straightforward and easy to navigate. Downtown features more than 70,000 parking spots.

2018  **Vote**

Tues., 6 Nov., marks the 2018 U.S. midterm elections. We encourage you to register and vote. Check for your state's rules regarding early or mail-in voting here: community.geosociety.org/gsa2018/attendeeinfo/know.

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Local Tours

The following local tours are open to all registered GSA Annual Meeting attendees and guests.

For short visits and historical tours, it is valuable to have an experienced and knowledgeable tour guide to assist you as you explore the city. Our tour groups are small and provide guests with an opportunity to ask questions and get off the beaten path!

101. Mimosas & a Masterpiece

Sun., 4 Nov., 9 a.m.–1 p.m. US\$89; min. 20 participants.

Mimosa and a Masterpiece is an innovative and inspiring art class that allows you to paint while sipping on a cocktail. A local artist will guide you stroke-by-stroke through the process of completing a featured painting. The class is fun and energetic with frequent breaks, lots of laughs, and no experience needed. Afterward, attendees will enjoy retail therapy or dining options on Mass Ave. with unique and historic shops, such as Silver in the City, Sage Clothing Boutique, Arts A Poppin, and much more!

102. Indy Sampler

Mon., 5 Nov., 9 a.m.–noon. US\$68; min. 20 participants.

Guests will enjoy an in-depth sightseeing tour of Indianapolis, including a bit of history and information on the city's main attractions, restaurants, and citizens. Throughout the tour, guests will be given an opportunity to ask questions of the well-trained guides, who love interacting with attendees.

The Indy Sampler Tour includes one stop allowing guests a stretch break and to experience one of Indy's unique attractions. The planned stop for GSA will be at the Indianapolis Motor Speedway, where guests will get a glimpse into the rich racing



Indianapolis Motor Speedway. Photo courtesy of Visit Indy.



Jammin' on the Avenue Public Art. Photo courtesy of Drew Endicott Photography, Visit Indy.

history at this famed venue—home of the annual Indy 500, the largest one-day sporting event in the world.

103. Wine and All That Jazz

Tues., 6 Nov., 1–3:30 p.m. US\$59; min. 20 participants.

Surprising to many, Indianapolis has a deep jazz heritage, along with roots and history of the Underground Railroad that went right through the heart of the city. Guests will learn more about this heritage along Indiana Avenue in the near downtown area en route to the winery. WINE... Nothing is so simply satisfying, yet so deliciously complex. For more than 25 years, the Chateau Thomas Winery has been celebrating this duality by crafting some of the most delightful wines in the country. Guests will take a cellar tour and participate in a wine tasting where they will experience the wines of Indiana's own Chateau Thomas Winery while nibbling on fruit and cheese.

104. A True Tea Experience

Wed., 7 Nov., 12:30 p.m.–4:30 p.m. US\$85; min. 20 participants.

With a thirst for more customized experiences and a drive to share the love of blending tea, HoI TEA ToI TEA has created an opportunity for you to create your very own blend. Get educated and be entertained. Take home your very own blend! You could make multiple visits and leave with a different brew each time. Never pretentious but always the proper amount of fun and blending guidance to create a tea that steeps to you! Smell the aromas, taste the flavors, feel the warmth of your cup, and chat with other tea lovers. Afterward, guests will enjoy the trendy, eclectic shops and eateries in Broad Ripple Village, just steps away.

Guest Program



Penrose Guest Hospitality Suite

Hours: Sun.–Wed., 4–7 Nov., 8 a.m.–5:30 p.m.

We warmly welcome all members of the GSA community to Indianapolis! As part of that welcome, we offer registered guests and Penrose Circle Invitees a comfortable Hospitality Suite for rest and relaxation while technical sessions are happening. As a registered guest, you are welcome to attend your companion's technical session(s), and you will also have admittance to the Exhibit Hall. Activities in the suite include complimentary refreshments, entertaining and complimentary educational seminars, and local experts ready to answer your questions about Indianapolis. Local tours and activities will also be offered for an additional fee. We hope that you take advantage of the tours to learn about the area from one of the knowledgeable tour guides.



Other Indy attractions include the children's museum. Photo courtesy of Lavengood Photography, Visit Indy.

Seminars

Fiber Art

Sun., 4 Nov., 10 a.m., Penrose Guest Hospitality Suite

Each guest will select a variety of colors from a huge assortment of wool fibers. These colorful wool fibers are pulled, by the guest, into various shapes and dimensions, positioned on a backing and ironed to fuse them into place. This creates a one-of-a-kind piece of art that can be inserted into a cardboard frame to create a card to send to a loved one or friend or taken home and framed.



Entrance Sign of Eiteljorg Museum of American Indians and Western Art, in Indianapolis, Indiana. Photo by Nick Juhasz.

Eiteljorg Museum of American Indians and Western Art

Mon., 5 Nov., 10 a.m., Penrose Guest Hospitality Suite

Guests will hear the history of how and why this fantastic museum is located in Indy as well as learn about its many collections, special exhibits, and heritage.

Smart Shopping and Nutrition

Tues., 6 Nov., 10 a.m., Penrose Guest Hospitality Suite

Grocery store and merchandise marketers use all kinds of psychological techniques to entice us to buy what they want us to buy. Learn ways to avoid some of these subtle traps, better understand product labels, and become more educated on overall nutrition.

Student Information and Activities

Please check the students information page at community.geosociety.org/gsa2018/students for the most up-to-date information on events scheduled for students.

Student Volunteers

GSA student members: Get complimentary meeting registration when you volunteer for 10 hours—plus get an insider's view of the meeting! Sign up on the meeting website, and then register for the meeting as a student volunteer.

Indy Icebreaker

Saturday, 3 Nov., 5–7 p.m. Catch up, plan your week ahead, enjoy a beer, and have fun!

Opening Reception

Sunday, 4 Nov., 5:30–7 p.m., located in the Exhibit Hall.

GSA Night at the Indiana State Museum

This is a student (graduate and undergraduate) and early career professionals networking event. Sunday, 4 Nov., 7–9:30 p.m., US\$15 (increases to US\$20 after 1 Oct.). Meet and network with other young professionals while enjoying food and drinks. Tickets will be taken at the door.

Best Student Geologic Map Competition

Please join us for poster session T179, the Best Student Geologic Mapping Competition (check the meeting program for the date and time). This session provides a venue for students to present their geologic maps that have a significant field component, with awards for the top three maps.

Roomates & Rides

Meet new people, coordinate your schedules, and plan activities while you're in Indianapolis. You can also save money by sharing rides and lodging expenses. It's free and easy! Go to community.geosociety.org/roomates to begin planning for your trip to Indy.

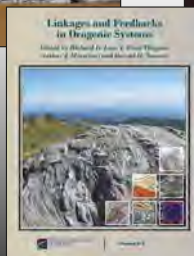
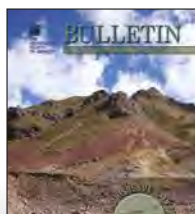


Put Your Annual Meeting Presentation to Work

Your well-received technical presentation at the GSA Annual Meeting can go far. Submit a manuscript to one of GSA's top-rated journals. Or, if you have a whole session's worth of great papers, consider submitting a book proposal.

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

For details on submitting to any of these publications, contact us at editing@geosociety.org.



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Congratulations to the 2018 On To the Future (OTF) travel awardees. GSA recently awarded over 70 travel grants to a group of students from diverse backgrounds to attend their first GSA Annual Meeting. OTF students are chosen based on their commitment to pursuing a career in the geosciences, merit, and financial need.

Help one of these students navigate their first professional meeting by signing up to serve as a mentor at <http://bit.ly/2q0iCCT>.

On To the Future Events

The following events require OTF awardee attendance:

Showcasing the Best You: A Writing Workshop to Help You Gain Internships, Fellowships, and Jobs: Sat., 3 Nov. Time TBD.

OTF Group Photo: Sun., 4 Nov., 6:15 p.m.

OTF Gatherings: Mon., Tues., and Wed., 5–7 Nov., 7:30 a.m.

Diversity and OTF Alumni Reception: Tues., 6 Nov., 5:30 p.m.

Celebrate Diversity at the Diversity and On To the Future Alumni Reception

Tues., 5:30–7 p.m., Indiana Convention Center, Room 211

Everyone is welcome at this celebration of diversity sponsored by the GSA Diversity in the Geosciences Committee. Socialize and share ideas at this informal gathering for those interested in broadening diversity in the geosciences. On To the Future attendees, OTF research grant awardees, and minority scholarship recipients will be recognized, with a special presentation by the Randolph W. “Bill” and Cecile T. Bromery Award for the Minorities recipient. Appetizers and a cash bar provided.



Campus Connection

Bringing Students and Schools Together

Indiana Convention Center, Exhibit Hall I

GSA's Campus Connection provides an excellent opportunity for students to meet face-to-face with representatives from top geoscience schools. This four-day event saves students time and travel expenses, giving the schools a chance to meet with some of the best student geoscientists in the world in a relaxed, informal setting. For a preliminary list of schools, see <https://bit.ly/2NoEyCz>.



Notice of GSA Council Meetings

2018 GSA Annual Meeting & Exposition
Indianapolis, Indiana, USA

- ▶ **Day 1:** Saturday, 3 Nov., 8 a.m.–noon
- ▶ **Day 2:** Wednesday, 7 Nov., 8 a.m.–noon

GSA Headquarters Hotel: JW Marriott*

10 S. West Street, Indianapolis, Indiana 46204, USA

All GSA members are invited to attend the open portions of these meetings.

*Meeting room to be announced. Updates will be posted on the GSA website.



Exhibitors

Exhibits in alphabetical order as of press time.

COMPANY	BOOTH NUMBER	COMPANY	BOOTH NUMBER
AASP - The Palynological Society	227	GSA History and Philosophy of Geology Scientific Division	543
American Geophysical Union (AGU)	308	GSA International	829
American Geosciences Institute (AGI)	306	GSA Karst Scientific Division	111
American Institute of Professional Geologists (AIPG)	126	GSA Membership	623
American Meteorological Society	318	GSA Opportunities	525
American Museum of Natural History	233	GSA Sedimentary Geology Scientific Division	815
ASC Scientific	418	GSA Soils & Soil Processes Scientific Division	823
Association for Women Geoscientists	553	Hitachi High-Tech Analytical Science	732
Association of American State Geologists (AASG) & Maryland Geological Survey Dept. of Natural Resources	124	IDS GeoRadar	533
Association of Earth Science Editors (AESE)	103	IKON Mining & Exploration	309
Association of Environmental & Engineering Geologists	719	Indiana Geological and Water Survey	717
Auburn University Dept. of Geology + Geography	135	Indiana State University	436
Ball State University	138	Indiana University	127
Baylor University	419	Indiana University–Purdue University Indianapolis	335
Beckman Coulter Inc.	119	International Association for Geoscience Diversity	532
Beta Analytic Inc.	619	International Centre for Diffraction Data (ICDD)	716
Bruker Corporation	609	Iowa State University	339
Brunton Outdoor Group	509	IRIS Consortium	710
Cambridge University Press	415	Isomass Scientific Inc.	300
CAMECA	535	Isotopx Inc.	632
Carl Zeiss X-ray Microscopy Inc.	214	Kansas State University	347
Center for Applied Isotope Studies, University of Georgia	110	KFUPM	136
Central Michigan University	344	Komodo Dragon	400
Colorado School of Mines Dept. Geology & Geology Engineering	144	LacCore/CSDCO	202
Consortium of Universities for the Advancement of Hydrologic Science Inc. (CUAHSI)	701	Lake Shore Cryotronics Inc.	816
Council on Undergraduate Research	105	Little River Research & Design	201
Cushman Foundation for Foraminiferal Research	222	Louisiana State University Dept. of Geology & Geophysics	346
Dino-Lite Scopes (BigC)	433	Macmillan Learning	703
DirectAMS	326	MALA Geoscience USA	218
EarthScope	708	Martin Microscope Company	443
East Carolina University	336	McGraw-Hill Professional	607
Elementar Americas Inc.	114	Meiji Techno America	818
Elsevier	810	Miami University	146
Environmental Isotope Laboratory	319	Micropaleontology Press	226
Estwing Manufacturing Company	200	Midwest GeoSciences Group	707
European Geosciences Union (EGU)	539	Millersville University	249
Florida International University	239	Mineralogical Association of Canada	104
Gems & Crystals Unlimited	506	Mineralogical Society of America	100
GeoAvatar	123	Mississippi State University	132
Geochemical Society	108	Missouri State University, Geography, Geology and Planning	236
Geocognition Research Lab	315	Missouri University of Science and Technology	134
Geological Association of Canada	106	Mountain Press Publishing Company	324
Geophysical Survey Systems Inc. (GSSI)	328	NASA HQ	515
Geoscience Information Society (GISIS)	635	National Association of Geoscience Teachers (NAGT)	314
GeoScienceWorld	633	National Association of State Boards of Geology (ASBOG®)	128
GeoSep Services	125	National Cave and Karst Research Institute (NCKRI)	208
GIA (Gemological Institute of America Inc.)	207	National Park Service	501
GSA Bookstore	321	National Science Foundation (NSF)/Geosciences Directorate/Division of Earth Sciences	709
GSA Environmental & Engineering Geology Scientific Division	821	Oklahoma State University Boone Pickens School of Geology	245
GSA Foundation	723	Oregon State University	534
GSA Geochronology Scientific Division	825	Paleontological Research Institution	224
GSA Geoinformatics Scientific Division	705	Pearson	305
		Proto Manufacturing Ltd.	120

GSA 2018 ANNUAL MEETING & EXPOSITION

COMPANY	BOOTH NUMBER	COMPANY	BOOTH NUMBER
Purdue University	217	University of Nevada–Las Vegas	432
Real World Globes	833	University of Notre Dame	242
Rice University	143	University of Oklahoma School of Geology and Geophysics	448
Rigaku Americas Corp.	811	University of Pennsylvania	122
Ruen Drilling Inc.	718	University of South Carolina	337
Rutgers University Earth & Planetary Sciences Dept.	244	University of Southern California Dept. of Earth Sciences	238
San Diego State University	338	University of Tennessee–Knoxville, EPS 306	444
SciAps Inc.	209	University of Texas at Austin Jackson School of Geosciences	333
Science is Never Settled	733	University of Texas at Dallas	434
Sensors & Software Inc.	115	University of Texas at El Paso	149
SEPM (Society for Sedimentary Geology)	407	University of Toledo	248
Sigma Gamma Epsilon	439	University of Wisconsin–Madison	343
South Dakota School of Mines and Technology	442	U.S. Science Support Program, IODP	101
Springer	518	Virginia Tech Dept. of Geosciences	232
Syracuse University	139	Waveland Press	219
Texas A&M University	332	West Virginia University	342
Texas Tech University	243	Western Michigan University	438
The Clay Minerals Society	102	Wiley	814
The FOSSIL Project	118	Wink Vibracore Drill Co. Ltd.	538
The Geological Society of London	615	Western Kentucky University, Center for Human GeoEnvironmental Studies	109
The Ohio State University, Earth Sciences	636	W.W. Norton & Company Inc.	414
The Paleobiology Database	225	Yale University Dept. of Geology & Geophysics	133
The Paleontological Society	229	Yellowstone Bighorn Research Association (YBRA)	634
Thermo Fisher Scientific	301		
<i>Treatise on Invertebrate Paleontology</i>	223		
UNAVCO Inc.	706		
University of Alabama	237		
University of Alaska Anchorage	235		
University of Arizona Geosciences Dept.	345		
University of Connecticut Center for Integrated Geosciences	147		
University of Delaware	234		
University of Florida Dept. of Geological Sciences	349		
University of Idaho, Geological Sciences	334		
University of Kansas	142		
University of Memphis	148		
University of Michigan	137		
University of Mississippi	446		
University of Missouri	145		

EXHIBITS

Exhibit Hall Hours and Opening Reception

Sunday

Exhibit Hall open: 2–7 p.m.

Exhibits Opening Reception begins at 5:30 p.m.

Monday–Tuesday

Exhibit Hall open: 10 a.m.–6:30 p.m.

Libations and Collaborations beer receptions: 4:30–6:30 p.m.

Wednesday

Exhibit Hall open: 10 a.m.–2 p.m.



4–7 November
Indianapolis, Indiana, USA

K-12 GSA Experience Comes to Indy!

How do we recruit the next generation of geoscience students to our field?

Get 'em while they're young!

Building on our success in Seattle, GSA is pleased to announce that we will be inviting K-12 teachers from the Indianapolis area to bring their classes to the GSA Annual Meeting this November for the K-12 GSA Experience. Participating students will experience the diversity of geoscientists, an improved understanding of how science actually occurs, and their connections to that process in their current studies and future college and career choices by visiting the exhibits and poster halls.

The K-12 GSA Experience will be available to classes on Monday, Tuesday and Wednesday, 5-7 Nov., between 10 a.m. and 3 p.m. (2 p.m. on the 7th). Interested teachers should complete the form at <https://goo.gl/forms/w5ODAtljtIGfp2hp2> by 30 Sept. Class pre-registration is **required**. Exhibitors with demonstrations or content specifically of interest to a K-12 audience should complete the form at <https://goo.gl/forms/W0qiYujtD1UF47yi1> (for businesses, agencies, and universities).



For more information, contact Dean Moosavi at smoosavi@geosociety.org, +1-303-357-1015.

GSA 2018 on Social Media

Annual Meeting attendees are listed in the Annual Meeting Community Directory, which is accessible only to other meeting participants at community.geosociety.org/gsa2018/directory.

Use this networking tool to search for and connect with colleagues. Keep the connections alive after the meeting through GSA Member

Community discussion forums.

New to the Member Community? If you are logging in for the first time, please navigate to community.geosociety.org, select "Log In" in the upper right-hand corner of the page, and follow the prompts to get started. We encourage you to activate your profile and upload a photo now so that others can connect with you!



Follow GSA @geosociety on **Twitter** and **Instagram** and use Annual Meeting hashtag #GSA2018.



Facebook—Join more than 280,000 GSA fans worldwide at www.facebook.com/GSA.1888.



YouTube—Learn more about GSA and careers in the geosciences at www.youtube.com/user/geosociety.



LinkedIn—Network and stay connected to your professional peers at <http://linkd.in/1HsYwni>.

Note: GSA meeting policy prohibits the use of cameras or sound-recording equipment in technical sessions.

Saturday Indy Icebreaker

► 5-7 p.m., Indiana Convention Center, 500 Ballroom

The most popular event at the Annual Meeting is the Icebreaker. Join thousands of industry professionals, students, academics, GSA Scientific Divisions, and Associated Societies to kick off the Annual Meeting in Indy with beer and great company.



Presentation Information

Your abstract acceptance e-mail will include the time and location of your presentation as well as whether you've been slated for a talk or a poster. If you are presenting a talk, please read the following information.

Oral Presentations

GSA strives to provide you with top-quality equipment in each of the technical session rooms. As you prepare your GSA oral presentation, please do so by using the 16:9 ratio in PowerPoint, or whichever presentation package you are using. To double-check this in PowerPoint, go to >Design, >Page Setup, and make sure the "slides sized for" field is set to "on-screen show (16:9)."

- **KEYNOTE PRESENTATION SOFTWARE IS NOT SUPPORTED DURING THE ANNUAL MEETING.**
- For best results, use commonly used fonts. Remember, these are rental computers, and they may not support the full selection of fonts.

To submit your presentation prior to the meeting (deadline: 11:59 p.m. EDT, 31 Oct.), please upload it to the Conference Exchange website; see <http://gsa.confex.com/gsa/extra.cgi>. You will need to know your abstract ID (see your abstract acceptance notification) and password. You can also withdraw your presentation via this site.

We strongly recommend that all speakers visit the speaker ready room to run through presentations in order to get comfortable with the equipment. We recommend this also to anyone who uploaded their presentation early. It's best to make sure images and fonts used in your presentation work well on the rented conference center equipment. Highly qualified technicians will be on hand to offer any needed assistance. The Speaker Ready Room will not have Internet service.

2018 Speaker Ready Room Hours

Indiana Convention Center, Room 201

Sat., 3 Nov., 8 a.m.–8 p.m.

Sun.–Tues., 4–6 Nov., 6:30 a.m.–6:30 p.m.

Wed., 7 Nov., 6:30 a.m.–1:30 p.m.

If you uploaded your presentation online, or if you were not able to submit your presentation online prior to the meeting, please bring your presentation on a thumb drive to the Speaker Ready Room the *day before* your presentation. Below is a schedule:

If your presentation is on:	Upload no later than:
Sunday, 4 Nov.	8 p.m., Saturday, 3 Nov.
Monday, 5 Nov.	6:30 p.m., Sunday, 4 Nov.
Tuesday, 6 Nov.	6:30 p.m., Monday, 5 Nov.
Wednesday, 7 Nov.	6:30 p.m., Tuesday, 6 Nov.



If you have a Sunday presentation and are unable to get to the speaker ready room on Saturday, please take your presentation directly to your session room at least 30 minutes before the session is scheduled to begin.

Acceptable file types: PowerPoint (.ppt, pptx, pps, or .ppsx), Microsoft Word (.doc or .docx), or PDF (.pdf). If your graphics or video clips are not embedded in your presentation, please be sure that you bring them as well. The Speaker Ready Room does not have thumb drives available, so please be sure to come prepared.

Mac users—please read: If your presentation was created on a Mac and converted to run on a PC, please test it before you come to the meeting. Avoid using a rewritable CD (CD-RW), as we've encountered compatibility problems with them. If your presentation includes embedded video, your video will most likely NOT play automatically on the PC platform. You will need to either convert your .mov files to .avi format or create a link in your slide show to an external .mov file. If you choose the latter, your animation will play in a separate QuickTime window, outside of your PowerPoint presentation. **KEYNOTE PRESENTATION SOFTWARE IS NOT SUPPORTED DURING THE ANNUAL MEETING.** **We strongly recommend that you test your Mac-produced presentation** on a Windows-based system *before* coming to the meeting. If you are unable to run your Mac presentation from a PC, we will be able to accommodate you. Please talk to the technicians in the Speaker Ready Room for more information.



4-7 November
Indianapolis, Indiana, USA

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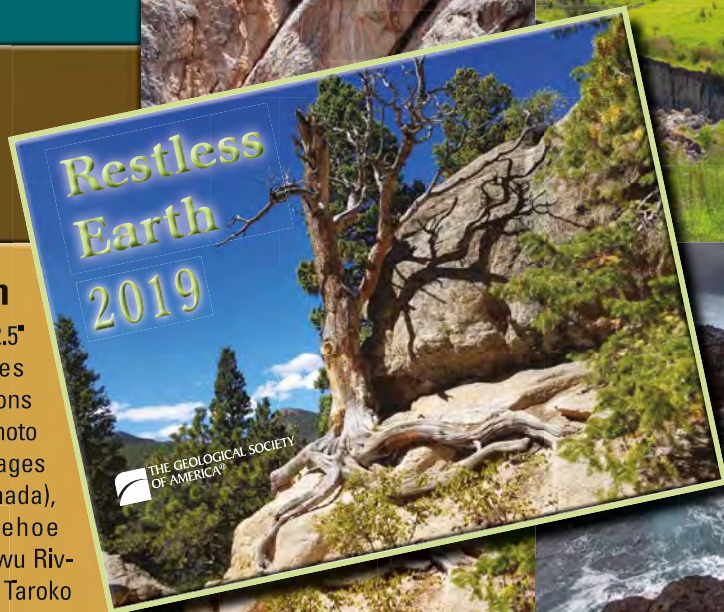
2019 CALENDAR

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rock.geosociety.org/store

Restless Earth

This 12-month, 9.5" × 12.5" calendar showcases compelling submissions to the GSA calendar photo search. Featuring images of Mount Rundle (Canada), 3-minute-old pahoehoe lava (Hawai'i), the Liwu River carving through the Taroko Gorge (Taiwan), and even a photomicrograph of dinosaur bone (Utah), this stunning calendar will delight the geologist in all of us. **CAL2019 | \$9.95**

- Dates of many noteworthy eruptions & earthquakes
- Birthdates of famous geoscientists
- Calendar of GSA events, meetings, & deadlines



ONLY
\$9.95




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Scientific Field Trips


Trip descriptions and leader bios are online at community.geosociety.org/gsa2018/fieldtrips.

401. Crossroads of Geology in New Harmony, Indiana. Thurs.–Sat., 1–3 Nov. US\$370. **Cosponsors:** *Historic New Harmony; Indiana Geological and Water Survey; Indiana State Museum; Rapp Granary–Owen Foundation; Working Men's Institute.* **Leader:** William S. Elliott, University of Southern Indiana.

 **402. Coastal Dune Environments of Southeastern Lake Michigan: Geomorphic Histories and Contemporary Processes.** Fri.–Sat., 2–3 Nov. US\$250. **Leaders:** Edward C. Hansen, Hope College; Timothy G. Fisher; Suzanne J. DeVries-Zimmerman.

403. Accessible Cave and Karst Geology of the Mammoth Cave National Park Region. Fri.–Sat., 2–3 Nov. **Cosponsors:** *The International Association for Geoscience Diversity; GSA Geoscience Education Division; GSA Karst Division; GSA Diversity in the Geosciences Committee; Mammoth Cave National Park; National Cave and Karst Research Institute.* **Leaders:** Christopher L. Atchison, University of Cincinnati; Brett H. Gilley; Rickard S. Toomey.


 **404. Geoarchaeology of the Eastern Indiana Glacial Plain.** Sat., 3 Nov. US\$182. **Cosponsors:** *GSA Archaeological Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology & Society Division; GSA Hydrogeology Division; GSA Soils & Soil Processes Interdisciplinary Interest Group; GSA History and Philosophy of Geology Division; Society for American Archaeology Geoarchaeology Interest Group; American Quaternary Association.* **Leaders:** Cynthia M. Fadem, Earlham College; Laura R. Murphy; Edward W. Herrmann.

 **405. The Kentland Impact Structure (Newton County, Indiana Stone Quarry): Structure, Stratigraphy, Age, Paleomagnetism, and Shock Metamorphism.** Sat., 3 Nov. US\$170. **Leaders:** John Weber, Grand Valley State University; Andrew D. Alder; Christian Koeberl; Michael C. Pope; R. Douglas Elmore.


406. The Pleistocene at Your Fingertips: Glacial Lake Outburst Flood Deposits and Patterned Ground in the Central Wabash Valley. Sat., 3 Nov. US\$75. **Leaders:** Darrell Schulze, Purdue University; Darryl E. Granger; Carolyn Olson; Michael Konen.


407. Kirk Bryan Field Trip: At the Edge of the Laurentide Ice Sheet: Stratigraphy and Chronology of Glacial Deposits in Central Indiana. Sat., 3 Nov. US\$85. **Cosponsor:** *GSA Quaternary Geology & Geomorphology Division.* **Leaders:** Henry Loope, Indiana University; José Luis Antinao; G. William Monaghan.

408. Geology of the Falls of the Ohio. Sat., 3 Nov. US\$199. **Leaders:** Stephen F. Greb, Kentucky Geological Survey; Alan Goldstein; William Andrews.

 **409. Karst Geology and Hydrogeology of the Spring Mill Lake and Lost River Basins in South-Central Indiana.** Sat., 3 Nov. US\$99. **Cosponsor:** *Indiana Geological and Water Survey.* **Leaders:** Lee J. Florea, Indiana Geological and Water Survey, Indiana University; Richard L. Powell; Samuel S. Frushour.

410. Pleistocene Fluvial Systems, Extent of Quaternary Glacial Maximums, and Historical Significance in Northern Kentucky. Sat., 3 Nov. US\$140. **Cosponsor:** *GSA Quaternary Geology & Geomorphology Division.* **Leaders:** Matthew A. Massey, University of Kentucky; William Andrews; Steven L. Martin; Maxwell Hammond; Antonia Bottoms.

 **411. Shorelines and Dunes along the Southern Shore of Lake Michigan: Examining Coastal Geology in the Context of Lake-Level Change.** Sat., 3 Nov. US\$138. **Leaders:** Erin P. Argyilan, Indiana University Northwest; John W. Johnston; G. William Monaghan; Kenneth Lepper; Todd A. Thompson.

 **412. The Rise of Pinnacle Reefs: Islands of Diversity in Seas of Despair.** Sat., 3 Nov. US\$99. **Cosponsor:** *Indiana Geological and Water Survey.* **Leaders:** Patrick I. McLaughlin, University of California Riverside; Carlton E. Brett; Poul Emsbo; Jonathan J. Havens.

413. Among the Dinosaurs at the Children's Museum: The Lanzendorf Collection of Dinosaur Art, Cretaceous Dinosphere, and Polly Horton Hix Paleo Prep Lab. Sat., 3 Nov. US\$75. **Cosponsors:** *GSA History and Philosophy of Geology Division; Paleontological Research Institute; Cushman Foundation; History of Earth Sciences Society.* **Leaders:** Gary Rosenberg, Milwaukee Public Museum; Renee Clary; Dallas Evans.

INDUSTRY TRACKS—Look for these icons, which identify trips in the following areas:



Economic Geology



Energy



Engineering



Hydrogeology and
Environmental Geology

414. **Caving to Buckner Cave.** Sat., 3 Nov. US\$74. **Cosponsors:** *Richard Blenz Nature Conservancy Inc.; National Speleological Society.* **Leader:** Anmar Mirza.

415. **Legacy Deposits, Mill Dams, and Long-Term Monitoring of Sediment and Nutrient Budgets on Four Mile Creek in Southwestern Ohio.** Sat., 3 Nov. US\$90. **Leaders:** Jason A. Rech, Miami University; William H. Renwick; Bartosz Grudzinski.

416. **Geology of the Salem Limestone.** Mon., 5 Nov. US\$10. **Cosponsor:** *Department of Earth Sciences, Indiana University–Purdue University Indianapolis.* **Leader:** Thomas J. Rossbach, Elizabeth City State University.

417. **Monuments, Museums, and Skyscrapers: The Stones of Downtown Indianapolis.** Wed., 7 Nov. US\$25. **Cosponsor:** *Heritage Stone Subcommittee of the International Union of Geological Sciences.* **Leaders:** Joseph T. Hannibal, Cleveland Museum of Natural History; Ann Holstein.

418. **The Maumee Megaflood and the Geomorphology, Environmental Geology, and Silurian–Holocene History of the Upper Wabash River Valley and Vicinity, North-Central Indiana.** Wed.–Fri., 7–9 Nov. US\$450. **Cosponsor:** *GSA Hydrogeology Division.* **Leaders:** Anthony H. Fleming; James O. Farlow.

419. **Middle Paleozoic Stratigraphy and Paleontology of the Greater Louisville, Kentucky, Area.** Wed.–Fri., 7–9 Nov. US\$279. **Cosponsors:** *Ohio Geological Survey; Indiana Geological and Water Survey; North American Commission on Stratigraphic Nomenclature.* **Leaders:** Carlton E. Brett, University of Cincinnati; Christopher B. Waid; Kyle Hartshorn; Katherine V. Bulinski, Patrick I. McLaughlin.

420. **Salem Limestone (Valmeyeran, Mississippian)—A High-Energy Carbonate Shoal Model.** Thurs., 8 Nov. US\$99. **Cosponsor:** *Heritage Stone Subcommittee of the International Union of Geological Sciences.* **Leaders:** Brian D. Keith, Indiana University; Todd A. Thompson.

421. **Watch What You Drink: Midwestern Alluvial-Outwash Aquifers and the CV Theis Groundwater Observatory.** Thurs., 8 Nov. US\$140. **Leaders:** Amy Townsend-Small, Univ. of Cincinnati; David Nash.

422. **Lower and Middle Pennsylvanian Coal Geology in the Illinois Basin.** Thurs., 8 Nov. US\$180. **Leaders:** Cortland Eble, University of Kentucky; Stephen F. Greb.

423. **A Day at the Museum: Behind-the-Scenes Tour of Collections, Exhibits, and Programming at Indianapolis Museums.** Thurs., 8 Nov. US\$115. **Leaders:** Polly Sturgeon, Indiana University; Peggy Fisherkeller; Eloise Batic; Becky Wolfe.

424. **The Quaternary Geology of the Southern Chicago Metropolitan Area: The Chicago Outlet, Morainic Systems, Glacial Chronology, and Kankakee Torrent.** Thurs.–Fri., 8–9 Nov. US\$190. **Leaders:** B. Brandon Curry, University of Illinois at Urbana-Champaign; Olivier Caron.

426. **Hydrogeology of The Mammoth Cave Region, Kentucky.** Thurs.–Sat., 8–10 Nov. US\$280. **Cosponsor:** *Mammoth Cave National Park.* **Leaders:** Ralph Ewers, Eastern Kentucky University.



Assorted fossils.



Granary. Photo by William Elliot.

Short Courses

Learn and explore a new topic.

Early registration deadline: 1 October

Registration after 1 October will cost an additional US\$30

Cancellation deadline: 8 October

Can I take a short course if I am not registered for the meeting? YES! You're welcome to—just add the meeting nonregistrant fee (US\$40) by 1 Oct. to your course enrollment cost. Should you then decide to attend the meeting, your payment will be applied toward meeting registration.

GSA K–12 teacher members: You are welcome to take short courses without registering for the meeting or paying the nonregistrant fee.

Continuing education units (CEUs): Most professional development courses and workshops offer CEUs. One CEU comprises 10 hours of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction.

See community.geosociety.org/gsa2018/science-careers/courses or contact Jennifer Nocerino, jnocerino@geosociety.org, for course abstracts and additional information.

The following short courses are open to everyone. Early registration is highly recommended to ensure that courses will run.

💧 501. **High Resolution Topography and 3D Imaging I: Introduction to Terrestrial Laser Scanning.** Fri., 2 Nov., 8 a.m.–5 p.m. US\$52. Limit: 24. CEU: 0.8. **Instructor:** Chris Crosby, UNAVCO. **Cosponsor:** UNAVCO.

💧 502. **Field Safety Leadership.** Fri.–Sat., 2–3 Nov., 8 a.m.–5 p.m. US\$25. Limit: 24. CEU: 1.6. **Instructors:** Kevin Bohacs, ExxonMobil Upstream Research Company (retired); Greer Barriault, ExxonMobil Upstream Research Company. **Cosponsor:** ExxonMobil Upstream Research Company.

💧 503. **Structural and Stratigraphic Concepts Applied to Basin Exploration.** Fri.–Sat., 2–3 Nov., 8 a.m.–5 p.m. US\$25. Limit: 30. CEU: 1.6. **Instructors:** Órla McLaughlin, ExxonMobil Exploration Company; Bob Stewart, ExxonMobil Exploration Company. **Cosponsors:** ExxonMobil Exploration Company; GSA Sedimentary Geology Division.

💧 504. **Sequence Stratigraphy for Graduate Students.** Fri.–Sat., 2–3 Nov., 8 a.m.–5 p.m. US\$25. Limit: 55. CEU: 1.6. **Instructors:** Bret Dixon, Anadarko; Morgan Sullivan, Chevron; Órla McLaughlin, ExxonMobil Exploration Company. **Cosponsors:** ExxonMobil Exploration Company; Anadarko; Chevron.

💧 505. **A User's Guide to Micropaleontology and Biostratigraphy: Applications in Research and Industry.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$65. Limit: 40. CEU: 0.8. **Instructors:** Thomas Demchuk, Louisiana State University/RPS Group Inc.; Ryan Weber, PaleoData Inc. **Cosponsors:** AASP - The Palynological Society; SEPM (Society for Sedimentary Geology); The Cushman Foundation; Paleontological Research Institute; Chevron Corp.

💧 506. **Ground Penetrating Radar—Principles, Practice and Processing.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$75. Limit: 24. CEU: 0.8. **Instructors:** Greg Johnston, Sensors & Software Inc.; Troy De Souza, Sensors & Software Inc. **Cosponsor:** Sensors & Software Inc.

💧 507. **Detrital Zircon Geochronology: Best Practices, Current Challenges, Future Opportunities.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$40. Limit: 40. CEU: 0.8. **Instructors:** George Gehrels, University of Arizona; Kurt Sundell, University of Arizona.

💧 508. **The Changing Face of Limnogeology—Tools and Methods for Analyzing Lacustrine Systems.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$10 students; US\$25 professionals. Limit: 40. CEU: 0.8. **Instructors:** Scott Starratt, USGS; Lisa Park Boush, University of Connecticut; Michelle Goman, Sonoma State University; David Finkelstein, Hobart and William Smith Colleges. **Cosponsors:** GSA Limnogeology Division; RCN EarthRates.

💧 509. **Geological Mapping.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$115. Limit: 40. CEU: 0.8. **Instructor:** Harvey Thorleifson, Minnesota Geological Survey. **Cosponsors:** Association of American State Geologists; GSA Geoinformatics Division.

💧 510. **High Resolution Topography and 3D Imaging II: Introduction to Structure from Motion (SfM) Photogrammetry.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$52. Limit: 24. CEU: 0.8. **Instructors:** Chris Crosby, UNAVCO; Ramon Arrowsmith, Arizona State University. **Cosponsor:** UNAVCO.

💧 511. **Earth History Visualization and Integrated Databases: TimeScale Creator Suite.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$90 students; US\$123 professionals. Limit: 30. CEU: 0.8. **Instructors:** James Ogg, Purdue University; Gabi Ogg, Geologic TimeScale Foundation. **Cosponsors:** Geologic TimeScale Foundation; SEPM (Society for Sedimentary Geology); North American Micropaleontology Section (NAMS).

💧 512. **Introduction to Drones (sUAS) in the Geosciences.** Sat., 3 Nov., 8 a.m.–5 p.m. US\$110. Limit: 24. CEU: 0.8. **Instructor:** Greg Baker, University of Kansas. **Cosponsors:** GSA Geoarchaeology Division; GSA Hydrogeology Division;

GSA Quaternary Geology and Geomorphology Division;
GeoAvatar LLC.

513. Using Sketch Comedy & Standup in Geoscience Teaching & Informal Communication. Sat., 3 Nov., 8 a.m.–5 p.m. US\$97. Limit: 20. CEU: 0.8. **Instructors:** Anthony Feig, Central Michigan University and STEmpunks Comedy Research Group; Tim Huxtable, Screen Actors Guild; and STEmpunks Comedy Research Group. **Cosponsor:** *GSA Geology and Society Division.*

514. Supporting Diversity in Two-Year College Geoscience Programs: Broadening Participation of Underrepresented Groups. Sat., 3 Nov., 8:30 a.m.–4:30 p.m. US\$45. Limit: 40. CEU: 0.7. **Instructors:** Heather Macdonald, College of William & Mary; Norlene Emerson, University of Wisconsin–Richland; Eric Baer, Highline College. **Cosponsors:** *National Association of Geoscience Teachers (NAGT); Geo2YC Division of NAGT; GSA Geoscience Education Division; SAGE 2YC.*

515. New Approaches to Date Brittle and Ductile Deformation. Sat., 3 Nov., 8 a.m.–noon. US\$35. Limit: 40. CEU: 0.4. **Instructor:** Yu Wang, China University of Geosciences (Beijing). **Cosponsor:** *China University of Geosciences (Beijing).*

\$ ♦ 516. Active Learning and Digital Geoscience Education: Update and Upgrade. Sat., 3 Nov., 8 a.m.–noon. US\$60. Limit: 25. CEU: 0.4. **Instructors:** Lev Horodyskyj, Arizona State University; Don Bratton, Smart Sparrow; Steve Semken, Arizona State University; Ariel Anbar, Arizona State University. **Cosponsor:** *Smart Sparrow.*

\$ ♦ 517. Writing Workshop for Geologists Whose Native Language is Not English. Sat., 3 Nov., 8 a.m.–noon. US\$84. Limit: 40. CEU: 0.4. **Instructor:** Patricia Bobeck, Geotechnical Translations.

518. If We Build It: Tips and Techniques in Dynamic Content. Sat., 3 Nov., 1–5 p.m. US\$25, and earn a US\$25 coupon for the GSA Bookstore. Limit: 40. CEU: 0.4. **Instructors:** Craig Jones, University of Colorado; Shan de Silva, Oregon State University. **Cosponsor:** *Geosphere.*

519. Building Mobile Apps for Geoscience. Sat., 3 Nov., 8 a.m.–noon. US\$175. Limit: 20. CEU: 0.4. **Instructors:** Shane Loeffler, University of Minnesota; John Czaplewski, University of Wisconsin–Madison. **Cosponsor:** *GSA Geoinformatics Division.*

\$ ♦ 520. Data Science for Geosciences: Latest Successful Stories and Hands-on Practice. Sat., 3 Nov., 8 a.m.–noon. US\$80. Limit: 40. CEU: 0.4. **Instructors:** Peter Fox,

Rensselaer Polytechnic Institute; Anirudh Prabhu, Rensselaer Polytechnic Institute; Fang Huang, Rensselaer Polytechnic Institute. **Cosponsor:** *GSA Geoinformatics Division.*

\$ ♦ 521. Unconscious Bias and Active Bystander Intervention Training to Promote Positive Work Climates. Sat., 3 Nov., 8 a.m.–noon. US\$10. Limit: 40. CEU: 0.4. **Instructors:** Blair Schneider, University of Kansas; Moses Milazzo, USGS. **Cosponsors:** *ADVANCEGeo Partnership; Association for Women Geoscientists; Earth Science Women's Network.*

522. Creating Meaningful Experiences in School Settings. Sat., 3 Nov., 8 a.m.–noon. US\$25. Limit: 24. CEU: 0.4. **Instructor:** Adam Blankenbicker, American Geosciences Institute. **Cosponsor:** *American Geosciences Institute.*

\$ 523. Petroleum Systems Fundamentals. Sat., 3 Nov., 1–5 p.m. US\$25. Limit: 40. CEU: 0.4. **Instructor:** Keith Mahon, Anadarko. **Cosponsor:** *Anadarko.*

\$ ♦ 524. Mobile Mapping on Android Devices in Offline Environments. Sat., 3 Nov., 1–5 p.m. US\$105. Limit: 40. CEU: 0.4. **Instructors:** Ciarán Doyle, Takor Group; Darren Smith, Takor Group. **Cosponsor:** *Takor Group.*

525. Ready to Engage: Selling Yourself at GSA 2018 and Beyond, for Students. Sat., 3 Nov., 2–4 p.m. US\$5. Limit: 50. CEU: 0.2. **Instructors:** Beth Bartel, UNAVCO; Wendy Bohon, IRIS. **Cosponsors:** *GSA Geology and Society Division; UNAVCO; IRIS.*

526. Taking Students into the Field on Their Own Time: Design and Assessment of Student Self-Guided Field Experiences Using the Free, NSF-Funded Flyover Country Mobile App. Sat., 3 Nov., 1–5 p.m. US\$138. Limit: 40. CEU: 0.4. **Instructors:** Avery Shinneman, University of Washington–Bothell; Amy Myrbo, University of Minnesota; Shane Loeffler, University of Minnesota.

\$ 527. Introduction to AMiGEO (Analytical Methods in Geosciences): Online Open-Access Modules for Teaching Laboratory Techniques. Sat., 3 Nov., 1–5 p.m. US\$25. Limit: 20. CEU: 0.4. **Instructors:** Elizabeth Johnson, James Madison University; Juhong Christie Liu, James Madison University.

Short Courses continued on p. 42

INDUSTRY TRACKS—Look for these icons, which identify sessions in the following areas:



Economic Geology



Energy



Engineering



Hydrogeology and
Environmental Geology

Short Courses continued from p. 41

528. Strengthening Students' Spatial Thinking Skills. Sat., 3 Nov., 1–5 p.m. US\$95. Limit: 40. CEU: 0.4. **Instructors:** Carol Ormand, SERC, Carleton College; Nicole LaDue, Northern Illinois University; Thomas Shipley, Temple University.
Cosponsors: NAGT; GSA Geoscience Education Division.

529. Design, Implementation, and Evaluation of Course and Curriculum-Based Undergraduate Research Experiences (CUREs) Using an Integrated Mixed Methods Approach. Sat., 3 Nov., 1–5 p.m. US\$25. Limit: 40. CEU: 0.4.
Instructors: Joseph Allen, Concord University; Elizabeth Creamer, Virginia Tech; Stephen Kuehn, Concord University.
Cosponsors: Council on Undergraduate Research; GSA Geoscience Education Division; AGU Heads and Chairs Program; Mixed Methods International Research Association.

ASSOCIATED SOCIETY SHORT COURSE

Pedagogy and Technology in the Modern Paleontology Classroom. Sat., 3 Nov., 9 a.m.–5 p.m. FREE. Phoebe Cohen, Williams College; Lisa Boush, Univ. of Connecticut; Rowan Lockwood, College of William & Mary. Pre-register by 15 Oct. at <https://bit.ly/2niKOAa>.

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The Geological Society of America®

GEOCAREERS

Career Development Events for Students
and Early Career Professionals

GEOCAREERS DAY

All GeoCareers Day events will be held on Sun., 4 Nov., in Indiana Convention Center (ICC) Sagamore Ballroom 4. All-inclusive fee: US\$25. Registration is strongly suggested and space is limited. This event is targeted toward undergraduate students, but all students and early career professionals are welcome. 8–9 a.m.: **Geoscience Career Workshop:** Before you jump into the job search process, gain an understanding of the current geoscience workforce data, including salary, employment trends, and projections. Presenters will also review the fundamentals of crafting a winning résumé and how to best utilize the USAJOBS database for applications for federal employment. 9–11 a.m.: **Company and Agency Information Session:** Agency and company booths will be set up to answer your career questions. Learn about each unique work culture and types of internships and careers available.

10–11:30 a.m.: **Career Mentor Roundtables:** Mentors from non-profits, industry, government, and academia will answer your career questions at table stations around the room.

Noon–1 p.m.: **Career Pathways Panel:** Representatives from government and industry sectors will answer questions and offer advice in preparation for a career in these fields. Lunch provided.

The following two GeoCareers Day events may be attended separately:

Geoscience Career Workshop: US\$10 fee if attending separately. Registration strongly suggested. Contact GSA Sales & Service at +1-800-443-4472.

Career Pathways Panel: Free. Lunch is included but limited to first-come, first-served. All-day participants receive priority.

NETWORKING AND PANEL EVENTS

Women in Geology Career Pathways Reception: Sunday, 4 Nov., 5:30–7 p.m., ICC, Mentoring Center, Room 206-207
This informal gathering begins with remarks from a few key women speakers who will address issues faced by women in geology. A networking session follows, providing time for sharing ideas and getting to know other women geoscientists. No registration is required.

Early Career Professionals Coffee: Monday, 5 Nov., 9–10 a.m., ICC, Mentoring Center, Room 206-207
This informal gathering will include remarks from representatives of several non-profits who have activities of interest to early career professionals. There will be time for networking and sharing ideas on how these organizations can best serve you. No registration is required.

Networking Reception: Monday, 5 Nov., 11:30 a.m.–1 p.m., ICC, Mentoring Center, Room 206-207
This reception provides students and early career professionals with an exciting opportunity to network with more than 40 geoscience professionals. The mentors will answer questions, offer advice about career plans, and comment on job opportunities within their fields.

The Paleontological Society Mentors in Paleontology Careers Luncheon: Monday, 5 Nov., noon–1 p.m., Rock Bottom Restaurant
This student luncheon features a panel of mentors representing a variety of colleges, universities, museums, and government agencies.

Women Rising Networking Social: Monday, 5 Nov., 5:30–7 p.m., ICC, Room 204
This informal social extends the discussions and connections from the Pardee Session: *Women Rising: Removing Barriers and Achieving Parity in the Geosciences*. Professionals, students, department chairs, and program managers working to be inclusive of all talents are encouraged to attend.

Hydrogeology Division Student Mentoring: Tuesday, 6 Nov., 2:30–4:30 p.m., ICC, Sagamore Ballroom 4
In a relaxed and welcoming atmosphere, this gathering will begin with remarks from hydrogeologists in a variety of career fields, including government, industry, and academia. A roundtable mentoring session follows, providing time for individuals to network, share ideas, ask questions, and discuss careers in hydrogeology.

*Career Development Events for Students and Early Career Professionals continued***EMPLOYMENT ASSISTANCE****Résumé Clinic**

Monday and Tuesday, 5–6 Nov., 9 a.m.–5 p.m., ICC, Mentoring Center, Room 206-207

Stop by the résumé clinic for a private consultation with a geoscience professional to review your résumé and discuss strategies to better market yourself to potential employers. Please bring a copy of your current résumé. This is on a first-come, first-served basis, and space is limited.

Geoscience Job Board

Stop by the Mentoring Center in the convention center to post or browse jobs, internships, or other opportunities. Also, check the online Geoscience Job Board (www.geosociety.org/jobs) for employment, fellowship, and student opportunities.

Visit community.geosociety.org/jobs for details.



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- write an attention-getting cover letter,
- choose the right journal for your work,
- and more!

Plus, hear from experts on what constitutes a good review and how you would benefit from being a reviewer.

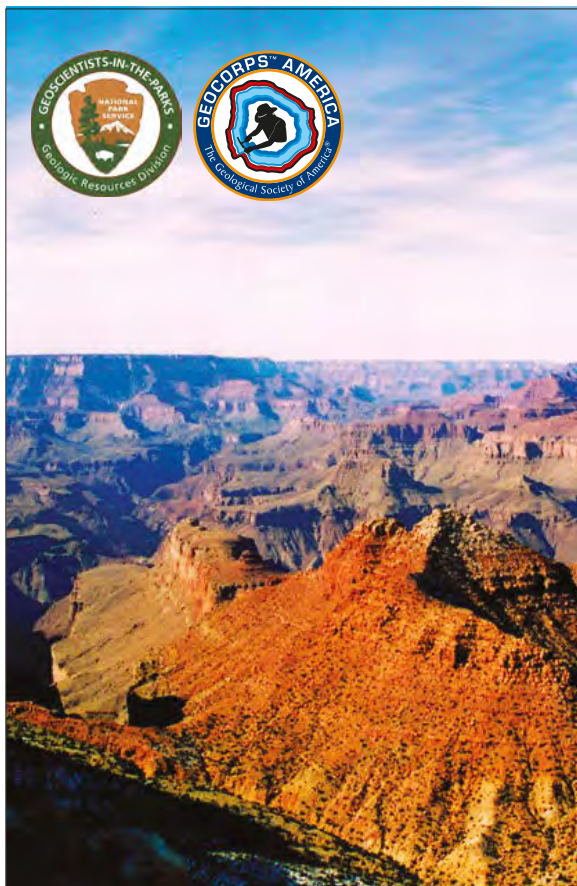
This highly successful workshop for early career geoscientists on the process of preparing and publishing papers will be held at the 2018 GSA Annual Meeting in Indianapolis, Indiana, USA. More information and a link to the application is at www.geosociety.org/wypwyp.



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GSA is seeking members to lead geoscience field trips for teachers and other educators. The goal of these trips is to give teachers authentic experiences learning about the earth in the field. If you are interested in leading or supporting a trip, please e-mail GSA's education staff at

education@geosociety.org.

GeoTeachers K-12 Teacher Professional Development Workshop at Indy



Crossbedding in Mississippian Sandstone, Turkey Run State Park, Indiana, USA. Photo by Dean Moosavi.



Groundwater discharge from Mississippian Sandstones, Turkey Run State Park, Indiana, USA. Photo by Dean Moosavi.

Indianapolis, Indiana, USA • 2–4 November

Three days of professional development geared specifically for the K–12 educator, home-school parents, and informal educators. Interact with professional geoscientists from industry, academia, and government agencies who are your workshop presenters, mentors, and field-trip leaders.

Highlights

- Day field trip to Turkey Run State Park
- Post-glacial entrenchment of streams in Mississippian sandstones
- Keynote presentation on Indiana geology
- Sunday Annual Meeting Technical Session attendance

For details and registration, go to community.geosociety.org/gsa2018/workshops, or contact Dean Moosavi, smoosavi@geosociety.org, +1-303-357-1015.



4-7 November
Indianapolis, Indiana, USA



The Geological Society of America®

GEOCAREERS

Mentoring Activities at the Meeting

GSA has a tradition of offering a variety of mentoring opportunities at the meeting, whether you are a student, early career professional, professional, or retiree. Consider being a mentor or a mentee at GSA 2018.

NEW Annual Meeting Mentorship

Be paired with a mentor/mentee for the duration of the meeting. These pairings are self-directed using an online mentoring platform. Create your profile and become a mentor or mentee right away at <https://rock.geosociety.org/mentor/>.

Short-Term Mentoring Options

Mentor groups of students and early career professionals at specific events. These require at least a one-hour commitment from mentors. Learn more and sign up for one or more of these one-on-one and/or short-term mentoring activities at bit.ly/2GIbenV.

- **Drop-In Mentorship:** Work with one student or early career professional on a first-come, first-served basis to provide academic and career pathway advice.
- **GeoCareers Table Mentor:** Attend a portion of the GeoCareers Day events that focuses on careers in industry and government. Help students and answer questions in a small-group format.
- **Networking Reception Mentor:** Address questions posed by students and early career professionals, offer advice about career plans, and comment on job opportunities within your geology employment sector.

- **Résumé Mentor:** Review student résumés and provide advice and guidance on building a winning résumé.
- **Women in Geology Mentor:** Mentor students and early career professionals as they navigate the key issues women face in the geosciences.

GSA Mentoring Center

Stop by the new mentoring center in the Indiana Convention Center, which will be open Mon.–Tues., 9 a.m.–5 p.m and Wed., 9 a.m.–3 p.m. Check the onsite mentoring center schedule to participate in the following events and activities:

- **Post or view jobs:** Bulletin boards will be available for posting jobs, internships, and opportunities for students and early career professionals.
- **Résumé Review Clinic:** If your résumé needs a good review, bring it with you and have a professional look it over.
- **Career workshops:** A variety of topics, such as successfully applying to GSA student opportunities, applying to graduate school, and exploring an array of geology careers, will be covered.
- **Drop-in mentoring:** If you have questions that you would like answered one-on-one, stop by and receive mentoring advice from a variety of geology professionals.
- **Networking events:** GSA's popular networking reception, early career coffee, and women in geology programs will all be held in this space.
- **Exhibitor presentations:** Exhibitors will answer questions on employment with their company and the day-to-day of their careers.



2019 GSA Section Meetings



Northeastern

17–19 March

Portland, Maine, USA

Meeting Chair: Steve Pollock, spollock@maine.rr.com

www.geosociety.org/ne-mtg



Joint South-Central/North-Central/ Rocky Mountain

25–27 March

Manhattan, Kansas, USA

Meeting Chairs: Matthew Kirk, matthew.f.kirk@gmail.com; Tina Niemi, niemit@umkc.edu; Shannon Mahan, smahan@usgu.gov

www.geosociety.org/sc-mtg



Southeastern

28–29 March

Charleston, South Carolina, USA

Meeting Chairs: Scott Harris, HarrisS@cofc.edu;

Katie Luciano, LucianoK@dnr.sc.gov

www.geosociety.org/se-mtg



Cordilleran

15–17 May

Portland, Oregon, USA

Meeting Chairs: Martin Streck, streckm@pdx.edu;

Jim O'Connor, oconnor@usgs.gov

www.geosociety.org/cd-mtg

Northeastern image: Portland waterfront, Portland, Maine, USA. Photo courtesy Maine Office of Tourism. Joint Meeting image: Manhattan, Kansas, USA. Photo courtesy K-State Photo Services. Southeastern image: Beach boardwalk, Charleston, South Carolina, USA. Photo courtesy Meetcharleston.com. Cordilleran image: Chaticleer Point, Portland, Oregon, USA. Photo by Martin Streck.

GSA's Scientific Divisions

At its May 2018 meeting, GSA Council approved recommendations that GSA Divisions be called GSA Scientific Divisions and that Interdisciplinary Interest Groups (IIGs) be formally terminated as a governance structure and existing IIGs be transitioned into GSA Scientific Divisions. Including the newest Geochronology Division, GSA now has a total of 21 Scientific Divisions.

Scientific Divisions serve a critical function within the Society:

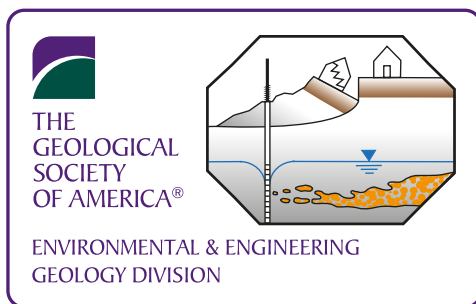
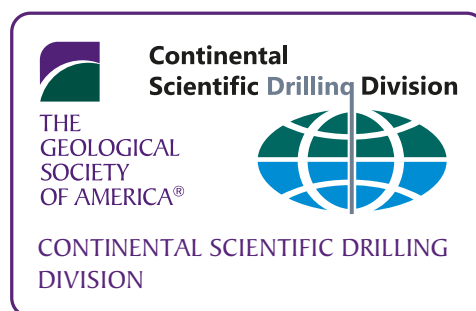
- Connecting members to colleagues worldwide and providing information related to specific interest areas;
- Providing opportunities for leadership and service, specialty meetings, awards, student support, and development of the GSA Annual Meeting technical program.

Division membership costs between US\$3 and US\$12 annually. Join one or more Scientific Divisions when you renew your 2019 membership at www.geosociety.org/members or by calling +1-888-443-4472.

The **Continental Scientific Drilling Scientific Division** (est. 2017; ~1,352 members) focuses on continental scientific drilling and coring research tools used in many GSA Divisions and fields. This Division promotes collaborative research across communities, presents on scientific drilling projects to the wider scientific community, and provides opportunities for students and early career scientists to participate in continental scientific drilling projects. Learn more at <https://bit.ly/2tSExy5>.

The **Energy Geology Scientific Division** (est. 1954; ~639 members [formerly the Coal Geology Division]) encourages energy research and the interchange of scientific information about energy resources and related issues within the wide range of their geologic significance and acts as an organized group in promoting these objectives. The Division sponsors a major award for outstanding contributions to the field of coal geology, the Gilbert H. Cady Award, and also recognizes the volunteered contributions of its members through its Distinguished Service Award. For students, the Division offers the Antoinette Lierman Medlin Scholarship, the Antoinette Lierman Medlin Laboratory and Field Awards, and a Best Student Paper Award. Learn more at www.uky.edu/KGS/coal/GSA/.

The **Environmental & Engineering Geology Scientific Division** (est. 1947; ~1,652 members) seeks to advance the ability of geologists to identify, characterize, and mitigate adverse geological and environmental conditions and hazards affecting human safety and the built environment. To do so, the Division promotes research, education, and dissemination of information relevant to members. Each year, the Division honors an outstanding recent publication with the E.B. Burwell, Jr., Award and, along with the Association of Environmental and Engineering Geologists, commissions the Richard H. Jahns Distinguished Lecturer. Other Division awards include the Meritorious Service Award, the Distinguished Practice Award, and, for students, the Roy J. Shlemon Scholarship Awards. Learn more at community.geosociety.org/eegdivision.





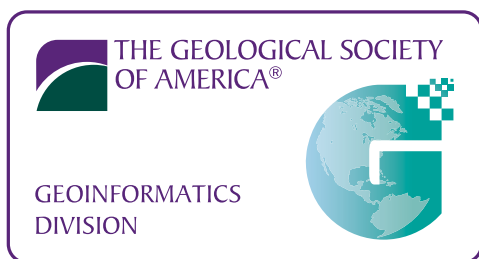
The **Geoarchaeology Scientific Division** (est. 1977; ~461 members [formerly the Archaeological Geology Division]) provides a forum for the presentation and discussion of papers on archaeological geology in order to stimulate and promote research and teaching within this field. Division awards include the Rip Rapp Archaeological Geology Award, the Richard Hay Student Paper/Poster Award, and the Claude C. Albritton, Jr., Award memorial fund. Learn more at rock.geosociety.org/arch.



The **Geobiology & Geomicrobiology Scientific Division** (est. 2001; ~546 members) promotes interdisciplinary research focusing on the interplay between the biosphere, lithosphere, hydrosphere, and atmosphere. More specifically, geobiologists and geomicrobiologists examine the effects of biological activities on geological processes and the influences of geological settings on biological processes—both at the macro- and micro-biological scales and in the past through the present. Members are invited to the yearly lunch banquet where winners of the annual Outstanding Contributions to Geobiology & Geomicrobiology Awards are celebrated. Learn more at www.geosociety.org/gsa/division/gbgm/home.aspx.



The **Geochronology Scientific Division** (est. 2018; ~129 members) aims to represent geochronologists of all types, as well as the many geoscientists who use geochronological data. The geochronology community is rapidly evolving, growing in breadth of methodologies and application. The Division focuses on the timing and rates of geological events and processes. These events include mass extinctions, stage boundaries, volcanic eruptions, earthquakes, major floods, and impact events. Processes include tectonic, geomorphic, igneous, metamorphic, sedimentological, biogeochemical, and paleoclimatic processes. From geological to human time scales, geochronology underpins our ability to constrain the rates of processes that present key challenges to societal security and sustainability, including coastal processes, climate change, critical zone management, earthquake and volcanic hazards, and natural resources. Learn more at <https://bit.ly/2ILJv54>.



The **Geoinformatics Scientific Division** (est. 2006; ~214 members) advances “Data to Knowledge,” providing GSA members with an opportunity to participate in the emerging field of cyber-infrastructure. The Division actively promotes and sponsors short courses, symposia, and books that emphasize information technology–supported discovery and integration of geoscience data leading to a more comprehensive understanding of Earth and the planets as complex systems. Each year, the Division presents the Outstanding Contributions in Geoinformatics Award. Learn more at community.geosociety.org/geoinformaticsdivision.



The **Geology and Health Scientific Division** (est. 2005; ~224 members) focuses on the intersection of natural or anthropogenic geological conditions with health, disease, pathology, and death in modern and fossil humans, animals, and plants. This Division fosters communication and collaboration among scientists and health practitioners with an emphasis on the interdisciplinary relationship of geology to medicine, biology, chemistry, and other sciences. Division awards include the Meritorious Service

Award, the Distinguished Service Award, and, to students, the Best Publication Award. Learn more at rock.geosociety.org/GeoHealth.

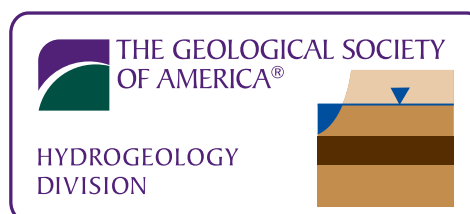
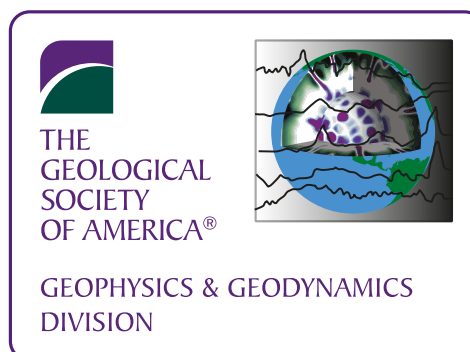
The **Geology and Society Scientific Division** (est. 2003; ~362 members) advances the concept of “geology working for society” by providing GSA members with opportunities to bring together multiple fields of geoscience to address important societal issues. This Division actively hosts interdisciplinary symposia at national and regional meetings, provides forums to help its members effectively communicate with decision makers and the public, encourages student achievement in helping to inform public policy by sponsoring a Best Student Presentation Award at the national meeting, and honors professional achievement in enhancing public policy by presenting a Distinguished Lecture at the annual meeting. The Division also works closely with the Geology and Public Policy Committee to develop and distribute GSA position statements. Learn more at community.geosociety.org/gsocdivision.

The **Geophysics and Geodynamics Scientific Division** (est. 1971; ~571 members) facilitates the presentation and discussion of the ideas of scientists interested in geophysics, fosters communication among geophysicists and other earth scientists, and promotes research and publication. This Division sponsors the George P. Woollard Award and lecture for outstanding contributions to geology through the application of the principles and techniques of geophysics. For students, the Division offers the Allan V. Cox Student Research Award and the GSA Geophysics and Geodynamics Division Student Research Award. Learn more at www.geosociety.org/gsa/division/geophysics/home.aspx.

The **Geoscience Education Scientific Division** (est. 1991; ~831 members) fosters the active participation of GSA members in all aspects of earth-science education. The Division complements and expands on the contributions of GSA’s Education, Communications, and Outreach group, the National Earth Science Teachers Association (NESTA), the National Association of Geoscience Teachers (NAGT), the National Science Teachers Association (NSTA), and other similar organizations. It sponsors the Biggs Earth Science Teaching Award and a Distinguished Service Award. Learn more at community.geosociety.org/gedivision.

The **History and Philosophy of Geology Scientific Division** (est. 1976; ~349 members) works to encourage the study and communication of the philosophy and history of geology. The Division sponsors technical sessions at GSA meetings and honors geologists for their research, writing, and historical work through the Mary C. Rabbitt History of Geology Award, the Gerald M. and Sue T. Friedman Distinguished Service Award, and the History & Philosophy of Geology Student Award. Learn more at community.geosociety.org/histphildiv.

The **Hydrogeology Scientific Division** (est. 1959; ~1,353 members) focuses on the geologic aspects of hydrogeology, the role of geology in the hydrologic cycle, and the importance of hydrogeology to society and science. The Division has a well-established mentor program (John Mann Mentors in Applied Hydrogeology)



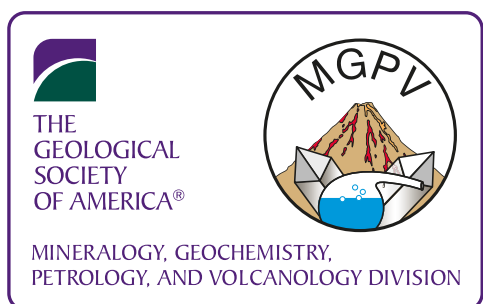


for students looking at careers in this field. The Birdsall-Dreiss Distinguished Lecturer honorees are named by this Division, along with the O.E. Meinzer Award, the George Burke Maxey Distinguished Service Award, the Kohout Early Career Award, and the Hydrogeology Division Student Research Grant Awards. Learn more at community.geosociety.org/hydrodivision.

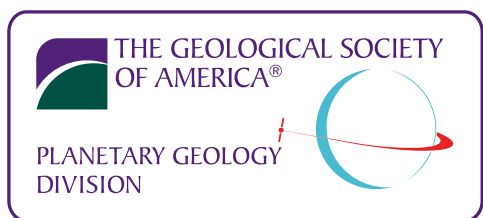
Karst Scientific Division (est. 2014; ~306 members): The study of karst terranes necessarily involves a wide variety of subjects and specialties, spanning almost every Division in GSA and scientific disciplines outside of GSA's purview. These include geology, biology, microbiology, soils, environmental geology, engineering, geology, geochemistry, geophysics, structural geomorphology, archaeology, urban planning, climatology, paleoclimatology, meteorology, hydrology, speleology, and even planetary studies. Comprehensive karst studies also can require the assistance of cave explorers and mappers, cave divers, mathematicians, modelers, and computer programmers. In all cases, practitioners in each discipline bring with them their own experiences, perspectives, insights, tools, and scales of reference. Learn more at community.geosociety.org/karstdivision.



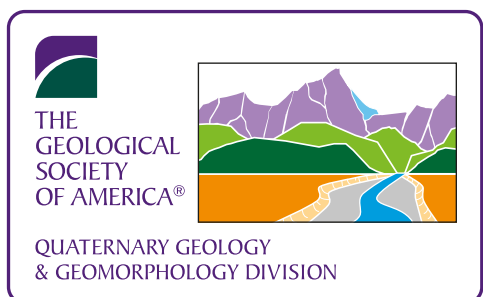
The **Limnogeology Scientific Division** (est. 2002; ~269 members) encourages research on both ancient and modern lakes around the world, the collaboration of scientists from all disciplines on lake research, and the fostering of student research and careers in lake studies. The Division sponsors the Israel C. Russell Award and the Kerry Kelts Student Research Award. Learn more at rock.geosociety.org/limno.



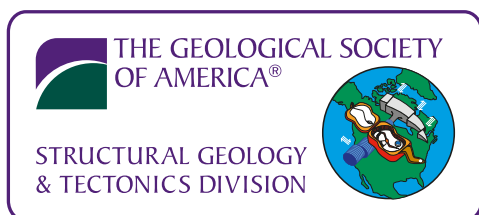
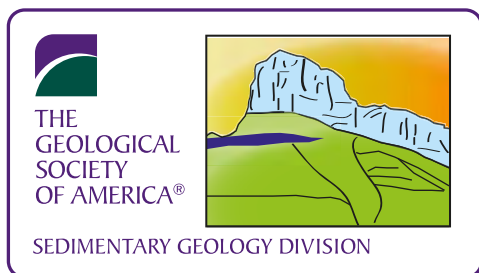
The **Mineralogy, Geochemistry, Petrology, and Volcanology Scientific Division** (est. 2009; ~1,891 members) promotes awareness, teaching, and research in these fields and stimulates discussion about the knowledge, ideas, research results, and problems regarding these fundamental areas of the earth sciences. Annually, the Division sponsors a Distinguished Geologic Career Award and two student research grant awards. Learn more at community.geosociety.org/mgpvdivision.



The **Planetary Geology Scientific Division** (est. 1981; ~735 members) fosters interactions among planetary scientists, facilitates the presentation and discussion of their research and ideas, stimulates communication with other earth scientists, and promotes planetary geology to a broad audience. Awards sponsored by the Division include the G.K. Gilbert Award, the Ronald Greeley Award for Distinguished Service, and, for students, the Eugene M. Shoemaker Impact Cratering Award, the Stephen E. Dworkin Awards for best student presentations at the annual Lunar and Planetary Science Conference, student travel grants, and (jointly with the Meteoritical Society) the Pellas-Ryder Award for the best student-authored paper in planetary science. Learn more at rock.geosociety.org/pgd.



The **Quaternary Geology and Geomorphology Scientific Division** (est. 1955; ~1,445 members) facilitates communication among scientists in these fields and the presentation of their research and ideas to the wider scientific community. Several awards are given by this Division, including the Distinguished Career Award, the Kirk Bryan Award, the Gladys W. Cole



Memorial Award, the Farouk El-Baz Award for Desert Research, and the J. Hoover Mackin, Arthur D. Howard, and Marie Morisawa student research awards. Learn more at community.geosociety.org/qggdivision.

The **Sedimentary Geology Scientific Division** (est. 1985; ~1,369 members) works to ensure the presentation of sedimentary-related topics and sessions at GSA meetings and actively nurtures the work of students by offering the Sedimentary Geology Division Student Research Grant Award and Student Poster Awards and by providing financial aid for students to attend Division-sponsored short courses and field trips. It also offers the Laurence L. Sloss Award for outstanding accomplishments in sedimentary geology and contributions to GSA and cosponsors the Stephen E. Laubach Research in Structural Diagenesis Award (alternating with the Structural Geology and Tectonics Scientific Division). Learn more at community.geosociety.org/sedimentarygeologydiv.

The **Soils and Soil Processes Scientific Division** (est. 2017; ~207 members) works on issues with particular solutions that include land stewardship, water quality and quantity, carbon cycling, and paleoclimate reconstruction. The evolving soils community is expanding beyond traditional links with agriculture and pedogenic processes and (re-)connecting with geosciences. The Division heightens the visibility of shallow Earth's processes and invites collaboration between the soils and geosciences communities. It also offers numerous advantages and opportunities for the professional preparation of broadly trained current and future students focusing on biosphere processes. Learn more at <https://bit.ly/2tMjldT>.

The **Structural Geology and Tectonics Scientific Division** (est. 1980; ~1,698 members) focuses on the geometry and mechanisms of natural and experimental deformation at all scales and works to promote the research of scientists in these fields and to facilitate communication and discussion at all levels of the earth sciences. The Division offers a Career Contribution Award for advancement of the science of structural geology and tectonics, an Outstanding Publication Award, and a Division Student Research Grant Award. It also cosponsors the Stephen E. Laubach Research in Structural Diagenesis Award (alternating with the Sedimentary Geology Scientific Division). Learn more at rock.geosociety.org/sgt.

JOINT GSA SECTION

53rd South-Central
53rd North-Central
71st Rocky Mountain
Manhattan, Kansas, USA
25–27 March 2019

www.geosociety.org/sc-mtg



Manhattan, Kansas, USA. Photo courtesy K-State Photo Services.

Source to Sink across the Midcontinent: Geosciences from the Rockies to the Gulf

LOCATION

Thriving as a lively college environment in the Flint Hills, Manhattan, Kansas, USA, is home to delectable dining destinations, a vibrant nightlife, and exciting outdoor adventures. Take a short walk from the conference venue to explore downtown shops and restaurants or learn about the local history and ecology at the Flint Hills Discovery Center. Borrow a bike from the local bike share program and cruise along the Kansas River on the Linear Park Trail. Whether you want to explore some of the last remnants of native tallgrass prairie, poke around in the Permian bedrock, or soar through the trees on a zipline, Manhattan is a great starting point for a wide-range of adventures. We have assembled an exciting and diverse program for this first-of-its-kind triple regional meeting and look forward to seeing you in Manhattan in 2019.

CALL FOR PAPERS

Abstract deadline: 4 December

Submit online: www.geosociety.org/sc-mtg

Abstract submission fee: US\$18 for students and US\$30 for all others.

Descriptions are online. For additional information, please contact the local Technical Program Chair, Joel Spencer, joelspen@ksu.edu.

THEME SESSIONS

- T1. **Conventional and Unconventional Reservoir Rocks: Advances in Experiments, Modeling, and Simulations.** Principal organizer: Behzad Ghanbarian, Kansas State University, ghanbarian@ksu.edu. Co-organizers: Chi Zhang, University of Kansas, chizhang@ku.edu; Reza Barati, University of Kansas, rezab@ku.edu; Manika Prasad, Colorado School of Mines, mpasad@mines.edu.
- T2. **Niobrara: Outcrop to Foreland Basin.** Principal organizer: Wayne K. Camp, Anadarko Petroleum Corporation, wayne.camp@anadarko.com. Co-organizer: Marc Buursink, U.S. Geological Survey.
- T3. **Injection-Induced Seismicity in the U.S. Midcontinent: Where Are We after a Decade?** Principal organizer: Tandsi Bidgoli, University of Missouri Columbia, bidgolit@missouri.edu. Co-organizer: Jacob Walter, Oklahoma Geological Survey, jwalter@ou.edu.
- T4. **Crustal Structure of the Midcontinent using Geophysical and Geodynamic Data.** Principal organizer: Kevin Mickus, Missouri State, kevinmickus@missouristate.edu.
- T5. **Mantle Dynamics and Lithospheric Deformation.** Principal organizer: Claudia Adam, Kansas State University, cadam@ksu.edu.
- T6. **Tectonic Processes and Characteristics of Laramide Foreland Deformation.** Principal organizer: Jacob Thacker, University of New Mexico, jacoboliverthacker@gmail.com. Co-organizer: Shari Kelley, New Mexico Bureau of Geology, shari.kelley@nmt.edu.
- T7. **Evolution of the Southern Rio Grande Rift.** Principal organizer: Jason Ricketts, University of Texas at El Paso, jricketts@utep.edu. Co-organizer: Jesse Kelsch, University of Texas at El Paso, jesse.veena@gmail.com.
- T8. **Cenozoic Magmatic and Tectonic Processes of Colorado–New Mexico: Understanding Voluminous Volcanism during the Transition from Laramide Contraction to Rio Grande Rift Extension.** Principal organizer: Gary Michelfelder, Missouri State University, garymichelfelder@missouristate.edu. Co-organizers: Jacob Thacker, University of New Mexico, jacoboliverthacker@gmail.com; Conor O'Dowd, Missouri State University, odowd1@live.missouristate.edu; Brooke Benz, Missouri State University, benz5@live.missouristate.edu.
- T9. **Magmatism in the Mid-Continent and Beyond.** Principal organizer: Matthew Brueseke, Kansas State University, brueseke@ksu.edu. Co-organizer: Pamela Kempton, Kansas State University, pkempton@ksu.edu.
- T10. **Rhyolite/Granite Magmatism.** Principal organizer: Don Parker, Baylor University, don_parker@baylor.edu. Co-organizers: Matthew Brueseke, Kansas State University, brueseke@ksu.edu; Richard Hanson, Texas Christian University, r.hanson@tcu.edu.

- T11. **Microanalyses, Macro Implications: Using Microscale Analyses to Decipher System-to-Regional Scale Processes.** Principal organizer: Tenley Banik, Illinois State University, tjbanik@ilstu.edu. Co-organizer: Benjamin Hallett, University of Wisconsin–Oshkosh, hallettb@uwosh.edu.
- T12. **Mineral and Energy Extraction: Impacts on Society and Health.** Principal organizer: Jackie D. Horn, University of Texas at Dallas, jdh130330@utdallas.edu. Co-organizers: Susan Stover, Kansas Geological Survey, susanstover@ku.edu; Leah Thompson, University of Texas at Dallas, leah.thompson@utdallas.edu; Saugata Datta, Kansas State University, sdatta@ksu.edu; Sinjini Sinha, University of Alberta, sinjinisinha.geo@gmail.com; Robert Finkelman, University of Texas at Dallas, bofb@utdallas.edu.
- T13. **Women and Geology: Leading the Charge for Inclusion.** Principal organizer: Beth Johnson, University of Wisconsin–Fox Valley, beth.a.johnson@uwc.edu. Co-organizer: Susan Stover, Kansas Geological Survey, susanstover@ku.edu.
- T14. **Geoscience Outreach and Engagement.** Principal organizer: Lisa Anderson, University of Purdue Extension, ande1028@purdue.edu. Co-organizer: Peter Voice, Western Michigan University, peter.voice@wmich.edu.
- T15. **Innovative Approaches to Broadening Student Geoscience Experiences across the Midcontinent.** Principal organizer: Liane Stevens, Stephen F. Austin State University, stevenslm@sfasu.edu. Co-organizer: Michael DeAngelis, University of Arkansas–Little Rock, mtdeangelis@ualr.edu.
- T16. **Microbiomes in the Geosphere.** Principal organizer: Matthew Kirk, Kansas State University, mfkirk@ksu.edu. Co-organizers: Marcos Sarto, Kansas State University, sarto@ksu.edu; Christina Richardson, Kansas State University, crichardson@ksu.edu.
- T17. **Natural and Artificial Tracers in Catchment Hydrologic and Biogeochemical Research.** Principal organizer: Lucy Rose, University of Minnesota–Twin Cities, larose@umn.edu. Co-organizer: Ethan Pawlowski, University of Minnesota–Twin Cities, pawlo026@umn.edu.
- T18. **Unconventional Aquifers and Aquifer Management.** Principal organizer: Andrea Croskrey, Texas Water Development Board, andrea.croskrey@twdb.texas.gov.
- T19. **Aquifer Storage and Recovery: Water Quantity and Quality Impacts.** Principal organizer: Mandy Stone, U.S. Geological Survey, mstone@usgs.gov.
- T20. **Advances in the Measurement and Modeling of Integrated Surface and Subsurface Hydrologic Systems.** Principal organizer: Andrea Brookfield, University of Kansas, abrookfield@ku.edu. Co-organizers: Behzad Ghanbarian, Kansas State University, ghanbarian@ksu.edu; Vahid Rahmani, Kansas State University, vrahmani@ksu.edu; Rick Devlin, University of Kansas, jfdevlin@ku.edu.
- T21. **Continuous Water Quality Monitoring.** Principal organizer: Brian Kelly, U.S. Geological Survey, bkelly@usgs.gov.
- T22. **Surface Water Quantity and Flood Risks.** Principal organizer: Craig Painter, U.S. Geological Survey, cpainter@usgs.gov.
- T23. **The Low Down on the High Plains: Geologic and Hydrogeologic Studies of the High Plains Aquifer.** Principal organizer: Jon J. Smith, Kansas Geological Survey, jjsmith@kgs.ku.edu. Co-organizer: Randy L. Stotler, University of Kansas, rstotler@ku.edu.
- T24. **Karst Processes and Speleology.** Principal organizer: Kaitlyn Gauvey, Fort Hays State University, klgauvey@mail.fhsu.edu. Co-organizer: Jonathan Sumrall, Fort Hays State University, jbsumrall@fhsu.edu.
- T25. **Climate and Land-Use Influences on Erosion and Sediment Flux and Impacts on Sustainable Water Management in Reservoirs.** Principal organizer: Vihad Rahmani, Kansas State University, vrahmani@ksu.edu. Co-organizers: Aleksey Sheshukov, Kansas State University, ashesh@ksu.edu; Abigail Langston, Kansas State University, alangston@ksu.edu; Arnaud Temme, Kansas State University, arnaudtemme@ksu.edu.
- T26. **Midcontinent Paleoclimatology.** Principal organizer: Karin Goldberg, Kansas State University, kgoldberg@ksu.edu. Co-organizer: Keith Miller, Kansas State University, keithbmiller@gmail.com.
- T27. **Terrestrial Hydroclimate Variability through the Holocene: Causes and Impacts Based on Proxies and Models.** Principal organizer: Aubrey Hillman, University of Louisiana Lafayette, aubrey.hillman@louisiana.edu. Co-organizer: Byron Steinman, University of Minnesota–Duluth, bsteinma@d.umn.edu.
- T28. **Exciting New Interdisciplinary Themes in Quaternary Geochronology.** Principal organizer: Shannon Mahan, U.S. Geological Survey, smahan@usgs.gov. Co-organizers: Sebastien Huot, Illinois State Geological Survey, shuot@illinois.edu; Tammy Rittenour, Utah State University, tammy.rittenour@usu.edu; Joel Spencer, Kansas State University, joelspen@ksu.edu.
- T29. **Quaternary Landscape Evolution in the Midcontinent: Improved Insights from Geochronology.** Principal organizer: Paul Hanson, University of Nebraska–Lincoln, phanson2@unl.edu. Co-organizer: Joel Spencer, Kansas State University, joelspen@ksu.edu.
- T30. **The Chronology of Big Pleistocene Events and Tracking Them from Source to Sink.** Principal organizer: Brandon B. Curry, Illinois State Geological Survey, bcurry@illinois.edu. Co-organizer: Sebastien Huot, Illinois State Geological Survey, shuot@illinois.edu.
- T31. **Past and Present Landform Deposition and Stabilization in Glacial and Periglacial Environments.** Principal organizer: Elizabeth Ceperly, University of Wisconsin–Madison, ceperley@wisc.edu. Co-organizers: Lucas Zoet, University of Wisconsin–Madison, lzoet@wisc.edu; J.E. Rawling III, Wisconsin Geological and Natural History Survey, elmo.rawling@wgnhs.uwex.edu.
- T32. **Geology of the Greater Kansas City Area (Posters).** Principal organizer: Richard Gentile, University of Missouri–Kansas City, gentiler@umkc.edu.
- T33. **Undergraduate Student Research (Posters).** Principal organizer: Robert Shuster, University of Nebraska–Omaha, rshuster@unomaha.edu.

FIELD TRIPS

Trip descriptions are online. For additional information, please contact the Field Trip co-chairs, Susan Stover, susanstover@ku.edu, and Rex Buchanan, rex@kgs.ku.edu.

- FT1. **Looking beneath the Plains: Geology of the Ogallala Formation and the Central High Plains of Kansas.** Sat.–Sun, 23–24 March (overnight in Scott City, Kansas). Principal organizer: Jon Smith, Kansas Geological Survey, jjsmith@kgs.ku.edu. Co-organizer: Tony Layzell, Kansas Geological Survey, alayzell@kgs.ku.edu.
- FT2. **The Kansas Cretaceous—The Birth of Modern Paleontology in the U.S.** Sat.–Sun, 23–24 March (overnight in Oakley, Kansas). Principal organizer: Michael J. Everhart, Sternberg Museum of Natural History, mike@oceansofkansas.com. Co-organizer: Bruce Schumacher, U.S. Forest Service, baschumacher@fs.fed.us.
- FT3. **Late-Quaternary Landscape Evolution and Geoarchaeology in the Flint Hills of Northeastern Kansas: A Tale of Two Sites.** Sun., 24 March (3/4 day, begins mid-morning). Principal organizer: Rolfe Mandel, Kansas Geological Survey, mandel@kgs.ku.edu.
- FT4. **Sedimentology of the Indian Cave Sandstone at Echo Cliff, Kansas: A Pennsylvanian Incised Valley Fill Preserving Putative Tidal Bore Deposits.** Sun., 24 March, or Thurs., 27 March (full day). Principal organizer: Christopher R. Fielding, University of Nebraska–Lincoln, cfielding2@unl.edu. Co-organizer: R. Matthew Joeckel, University of Nebraska–Lincoln, rjoeckel3@unl.edu.
- FT5. **The Science and the Industry of the Permian Hutchinson Salt.** Sun., 24 March (full day). Principal organizer: Marcia Schulmeister, Emporia State University, mschulme@emporia.edu. Co-organizers: Kathleen Counter Bennison, West Virginia University, kcbenison@mail.wvu.edu; Anna Sołda Andeskie, West Virginia University, asandeskie@mail.wvu.edu.
- FT6. **Trails West, Kansas City Vicinity, Missouri and Kansas.** Sun., 24 March (full day). Principal organizer: James S. Aber, Emporia State University, jaber@g.emporia.edu. Co-organizer: Susan W. Aber, Emporia State University, abersusie@gmail.com.
- FT7. **Windows into the Cretaceous Mantle of the North American Mid-Continent—Kimberlites of Riley County.** Sun., 24 March (afternoon). Principal organizer: Pamela Kempton, Kansas State University, pkempton@ksu.edu. Co-organizers: Matt Brueseke, Kansas State University, brueseke@ksu.edu; Kayleigh Rogers, Kansas State University, kayleighr@ksu.edu.
- FT8. **Environmental Legacy of Mining in Southeast Kansas.** Wed.–Thurs., 27–28 March (overnight). Principal organizer: Bob Jurgens, Kansas Department of Health and Environment, bob.jurgens@ks.gov. Co-organizer: Jackie Horn, University of Texas at Dallas, jdh130330@utdallas.edu.
- FT9. **Kansas River Alluvial Aquifer: Water Use and Real-Time Water-Level Monitoring.** Wed., 27 March (afternoon). Principal organizer: Don Whittemore, Kansas Geological Survey, donwhitt@kgs.ku.edu.
- FT10. **The Importance of Geology in Critical Zone Processes at the Konza Prairie Long-Term Ecological Research**

Site, Northeastern Kansas. Wed., 27 March (afternoon). Principal organizer: Gwen Macpherson, University of Kansas, glmac@ku.edu. Co-organizer: Pamela Sullivan, University of Kansas, plsullivan@ku.edu.

- FT11. **Geology of the Flint Hills, Kansas: Sea-Level and Climate Changes in the Permian.** Thurs., 28 March (full day). Principal organizer: Karin Goldberg, Kansas State University, kgoldberg@ksu.edu. Co-organizer: Keith Miller, Kansas State University (retired), keithbmill@gmail.com.

SHORT COURSES

Descriptions are online.

- SC1. **Making Geoscience Animations and Videos and Assessing them in the Classroom.** Sun., 24 March. Principal organizer: Robert J. Stern, University of Texas at Dallas, rjstern@utdallas.edu. Co-organizers: Ning Wang, University of Texas at Dallas, ning.wang@utdallas.edu; Jeffrey Ryan, University of South Florida, ryan@usf.edu; Lochlan Vaughn, University of Texas at Dallas, lochlan.v Vaughn@utdallas.edu; Siloa Willis, University of Texas at Dallas, siloa.willis@utdallas.edu.
- SC2. **GSA On To the Future Professional Skills Short Course for Students.** Sun., 24 March. Principal organizers: Stephen K. Boss, University of Arkansas, sboss@uark.edu; Tahlia Bear, Geological Society of America, tbear@geosociety.org. Co-organizers: Aisha Morris, UNAVCO, morris@unavco.org; Katherine Ellins, University of Texas at Austin, kellins@jsg.utexas.edu.

OPPORTUNITIES FOR STUDENTS AND EARLY CAREER PROFESSIONALS

Mentor Programs

Learn more at www.geosociety.org/mentors.

Roy J. Shlemon Mentor Program in Applied Geoscience.

Students and early career professionals will have the opportunity to discuss career prospects and challenges with applied geoscientists from various sectors over a FREE lunch.

John Mann Mentors in Applied Hydrogeology Program.

Students and early career professionals interested in applied hydrogeology or hydrology as a career will have the opportunity to network with professionals in these fields over a FREE lunch.

Geoscience Career Workshops

Part 1: Career Planning and Informational Interviewing.

Your job hunting process should begin with career planning, not when you apply to 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.

Part 2: Geoscience Career Exploration. What do geologists in various sectors earn? What do they do? What are the pros and cons to working in academia, government, and industry? Workshop presenters and professionals in the field will address these issues.

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 in the market for a job or not, learn how to prepare the best résumé possible. You will review numerous résumés helping you to learn important résumé dos and don'ts.

ACCOMMODATIONS

Hotel registration deadline: 4 March 2019

A block of rooms has been reserved at the Hilton Garden Inn, and the meeting rate is US\$109 per night plus tax for single or double occupancy. Reservations at the Hilton Garden Inn should be made by calling +1-785-532-9116. Please be sure to mention that you are attending the Geological Society of America conference; the group code is GSA.

REGISTRATION

Early registration deadline: 19 February 2019

Cancellation deadline: 25 February 2019

Registration opens in early December. For further information or if you need special accommodations, please contact the local organizing chair, Matthew Kirk, mfkirk@ksu.edu.

ORGANIZING COMMITTEE

Organizing Chairs: Matthew Kirk, mfkirk@ksu.edu; Tina Niemi, niemit@umkc.edu; Shannon Mahan, smahan@usgs.gov

Technical Program Chairs: Joel Spencer, joelspen@ksu.edu; Alison Graettinger, graettingera@umkc.edu; Shari Kelley, shari.kelley@nmt.edu

Field Trip Chairs: Susan Stover, susanstover@ku.edu; Rex Buchanan, rex@kgs.ku.edu

Sponsorship Chairs: Saugata Datta, sdatta@ksu.edu; JJ Lee, leej@umkc.edu

Student Volunteer Chair: Aida Farough, afarough@ksu.edu

Exhibits Chair: Matthew Brueseke, brueseke@ksu.edu

Graphics Chair: Alexandria Richard, allierichard@ksu.edu



As alumni of Oregon State University,
you've made an impact

OUT THERE

Re-discover where your journey began
Visit us at GSA 2018, booth #534

We invite Oregon State University alumni and friends to join us:

- Monday, November 5, 5:30-7:30 p.m.
- Rock Bottom Restaurant & Brewery
10 West Washington St., Indianapolis
- Guests will enjoy complimentary appetizers and beverages.
RSVP appreciated: ceoas.oregonstate.edu/alumni/events/

Contact info: desirae.wrathall@osualum.com



Preliminary Announcement and Call for Papers

SOUTHEASTERN SECTION

68th Annual Meeting of the Southeastern Section, GSA

**Charleston, South Carolina, USA
28–29 March 2019**

www.geosociety.org/se-mtg



Beach boardwalk, Charleston, South Carolina, USA. Photo courtesy Meetcharleston.com.

Southeastern Hospitality in the Geosciences: From Ancient Systems to Modern Resiliency

LOCATION

With a prime coastal setting, historical architecture, renowned cuisine, deep history, and friendly locals, Charleston, South Carolina, USA, repeatedly earns top honors as one of the premier destination cities in the U.S. and the world. Centered in the classic mesotidal, mixed-energy barrier coastline of the South Atlantic Bight, this area presents unparalleled opportunities for exploring topics ranging from Quaternary coastal geomorphology and coastal response to sea level changes, to paleoenvironmental research, earthquake hazards, and a long history of accumulation from the denudation of the Appalachians. In the center of downtown, the conference is within convenient reach of the Piedmont and Blue Ridge geologic provinces farther inland. The Technical Program, Field Trips, and Short Courses developed for the 68th meeting of GSA's Southeastern Section cover a diverse

range of topics, including offshore research, marine vertebrate paleontology, K–12 earth-science education, geologic hazards past and present, new technologies for mapping, hydrologic processes and applications in the coastal plain, limnology, terrane accretion, and the origin of ultramafic bodies in suture zones. Please bring a guest with you to the conference, as we are developing a rich program for them, including culinary tours, trips to the plantations and National Parks, as well as visits to the beaches and tours of downtown. The spring is one of the most lovely times of year in Charleston, and we look forward to seeing you here when the azaleas are in bloom!

CALL FOR PAPERS

Abstracts deadline: 4 December

Submit online at www.geosociety.org/se-mtg

Abstract submission fee: US\$18 for students and US\$30 for all others.

If you cannot submit an abstract online, please contact Heather Clark, +1-303-357-1018, hclark@geosociety.org.

TECHNICAL PROGRAM

Theme Sessions

Descriptions and sponsorships are online.

- T1. **Behavior of Animals, Dead or Alive: Neoichnology Informing Ichnology.** Patricia Kelley, University of North Carolina–Wilmington, kelleyp@uncw.edu; Anthony J. Martin, Emory University, geoam@emory.edu.
- T2. **Climate Change and Geologic Hazards in the Caribbean: Past, Present, and Future.** Blair Tormey, Western Carolina University, btormey@wcu.edu; Kelly Best Lazar, Clemson University, klazar@clemson.edu; Katie McDowell Peek, Western Carolina University, kmcdowell@wcu.edu.
- T3. **Gondwana vs. Laurentia: Terrane Accretion and Crustal Growth in the Southeastern United States.** Paul A. Mueller, University of Florida, pamueller@ufl.edu; James Tull, Florida State University, jtull@fsu.edu; Jim Knapp, University of South Carolina, knapp@geol.sc.edu.
- T4. **Marine Vertebrate Paleontology of the Atlantic and Gulf Coastal Plains.** Robert W. Boessenecker, College of Charleston, boesseneckerrw@cofc.edu; Rachel A. Racicot, Claremont College, rachel.racicot@gmail.com; Sarah J. Boessenecker, College of Charleston, michaliess@cofc.edu; Matthew L. Gibson, Charleston Museum, mgibson@charlestonmuseum.org; N. Adam Smith, Clemson University, smith23@clemson.edu.
- T5. **A Window into Regional Deformation and Sedimentation through Geo-, Thermo-, and Petrochronology.** David L. Barbeau, Jr., University of South Carolina, dbarbeau@geol.sc.edu; Alex Pullen, Clemson University, apullen@clemson.edu; Andrew L. Leier, University of South Carolina, aleier@geol.sc.edu.
- T6. **Limnogeology: Sedimentary Records from Modern and Ancient Lakes.** Michael McGlue, University of Kentucky, michael.mcglue@uky.edu; Eva Lyon, University of Kentucky, eva.lyon@uky.edu.
- T7. **Past and Future Coastal Evolution in Response to Sea-Level Changes and Storm Impacts.** Michael Fenster,

- Randolph-Macon College, mfenster@rmc.edu; Duncan FitzGerald, Boston University, dunc@bu.edu.
- T8. **Innovations in Earth Science Education.** Cynthia Hall, College of Charleston, hallcr@cofc.edu; Rodney Moore, Charleston County School District, rodney_moore@charleston.k12.sc.us; Gina Boyd, Berkeley County School District, boydd@bcscschools.net.
- T9. **Offshore Research on the Mid- and South-Atlantic Continental Shelf.** Katie Luciano, South Carolina Geological Survey, lucianok@dnr.sc.gov; William Lassetter, DMME-DGMR, william.lassetter@dmme.virginia.gov; D. Reide Corbett, East Carolina University, corbettdd@ecu.edu; Clark Alexander, Skidaway Institute of Oceanography, clark.alexander@skio.uga.edu; David Mallinson, East Carolina University, mallinsond@ecu.edu; Scott Howard, South Carolina Geological Survey, howards@dnr.sc.gov; Scott Harris, College of Charleston, harriss@cofc.edu.
- T10. **Sedimentary Systems of the Post-Alleghanian Eastern U.S. Atlantic Margin: Implications for Geologic Evolution, Resource Potential, and Carbon Sequestration.** Andrew Parent, Virginia Tech, amparent@vt.edu; Cody Mason, University of West Georgia, cmason80@vt.edu.
- T11. **UAV/Drone Technology and Spatial Metrics for the Coastal Zone.** Narcisa Pricope, University of North Carolina–Wilmington, pricopen@uncw.edu; Joanne Halls, University of North Carolina–Wilmington, hallsj@uncw.edu.
- T12. **Natural Hazards Prediction.** Antonios E. Marsellos, Hofstra University, antonios.marsellos@hofstra.edu; Katerina Tsakiri, Rider University, ktsakiri@rider.edu; Bret Bennington, Hofstra University, j.b.bennington@hofstra.edu; Jase Bernhardt, Hofstra University, jase.e.bernhardt@hofstra.edu; Menas Kafatos, Chapman University, kafatos@chapman.edu.
- T13. **Reconstructing Paleo-Environmental Changes.** Theodore Them, College of Charleston, themtr@cofc.edu; Benjamin Gill, Virginia Tech, bgill@vt.edu; Jeremy Owens, Florida State University, jdowens@fsu.edu; Seth Young, Florida State University, sayoung2@fsu.edu.
- T14. **Origin and Significance of Ultramafic Bodies in Suture Zones from the Appalachians and Beyond.** Céline Martin, University of North Carolina–Charlotte, cmart175@uncc.edu; Christopher M. Bailey, College of William & Mary, cmbail@wm.edu.
- T15. **Geologic Studies of the U.S. Atlantic Coastal Plain.** William R. Doar III, South Carolina Geological Survey, doarw@dnr.sc.gov; Christopher S. Swezey, U.S. Geological Survey, cswezey@usgs.gov.
- T16. **Undergraduate Research (Posters).** Lee Phillips, University of North Carolina–Greensboro, plphilli@uncg.edu; Jeff Ryan, University of South Florida, ryan@mail.usf.edu.
- T17. **Recent Advances and New Approaches in the Study of Faults and Shear Zones in Orogenic Systems.** Jackie Langille, University of North Carolina–Asheville, jlangill@unca.edu; Timothy Diedesch, Georgia Southern University, tdiedesch@georgiasouthern.edu.
- T18. **Hydrological Processes and Problems across the Southeastern United States.** JP Gannon, Western Carolina University, jpgannon@wcu.edu; Mark Lord, Western Carolina University, mlord@wcu.edu; David Kinner, Western Carolina University, dkinner@wcu.edu.
- T19. **Recent Advances in Saltmarsh Evolution, (Eco) Geomorphology, and Sustainability.** Carol Wilson, Louisiana State University, carolw@lsu.edu; Zoe Hughes, Boston University, zoeh@bu.edu; Alejandra C. Ortiz, North Carolina State University, aortiz4@ncsu.edu.
- T20. **The Science, Environmental Impacts, and Policy of Beach Nourishment.** Robert S. Young, Western Carolina University, ryoung@email.wcu.edu; Andrew Coburn, Western Carolina University, acoburn@email.wcu.edu.
- T21. **Mesozoic to Cenozoic Tectonics and Magmatism of the Southeastern United States.** Erin Beutel, College of Charleston, beutele@cofc.edu; John Chadwick, College of Charleston, chadwickj@cofc.edu.
- T22. **Applications of Hydrology and Biogeochemistry to Stormwater Management.** James J. Connors, James J. Connors & Associates LLC, jjc@jamesjconnors.com; Barbara A. Beckingham, College of Charleston, beckinghamba@cofc.edu; Vijay M. Vulava, College of Charleston, vulavav@cofc.edu; Timothy J. Callahan, College of Charleston, callahant@cofc.edu; M. Richard DeVoe, South Carolina Sea Grant Consortium, devoerm@scseagrant.org.
- T23. **Technology and Mapping in the 21st Century.** Norman S. Levine, College of Charleston, levinen@cofc.edu; K. Adem Ali, College of Charleston, alika@cofc.edu; M. Scott Harris, College of Charleston, harriss@cofc.edu; Leslie R. Sautter, College of Charleston, sautterl@cofc.edu.
- T24. **Geoarchaeology.** Ervan Garrison, University of Georgia, egarriso@uga.edu; Jessica Cook Hale, University of Georgia, jcook@uga.edu.

FIELD TRIPS

Trip registration opens in December. Descriptions are online. For additional information, please contact the Field Trip Co-Chairs: John Chadwick, chadwickj@cofc.edu, and Steve Jaume, jaumes@cofc.edu.

Rerouting Water: Understanding and Managing Urban Hydrology in Historic Charleston. Guinn Wallover, Clemson University Cooperative Extension Service, cggarre@clemson.edu; Timothy Callahan, College of Charleston, callahant@cofc.edu; Amy Scaroni, Clemson University Cooperative Extension Service, ascaron@clemson.edu; Kim Morganello, Clemson University Cooperative Extension Service, kcounts@clemson.edu.

A Walking Tour of Earthquake Damage in Historic Charleston. Steven C. Jaume, College of Charleston, jaumes@cofc.edu; Norman Levine, College of Charleston, levinen@cofc.edu.

Paleontology of the “Ashley Phosphate Beds” of Charleston. Robert W. Boessenecker, College of Charleston, boesseneckerrw@cofc.edu; Rachel A. Racicot, Claremont College, rachel.racicot@gmail.com; Sarah J. Boessenecker, College of Charleston, michaliess@cofc.edu; Matthew L. Gibson, Charleston Museum, mgibson@charlestonmuseum.org; N. Adam Smith, Clemson University, smith23@clemson.edu.

Fossil Collection, Collaboration, and Citizen Science Using the myFOSSIL Mobile App. Richard Bex, The FOSSIL Project, University of Florida, rbex@ufl.edu; Victor Perez, Florida Museum of Natural History, victorjperez@ufl.edu; Bruce MacFadden, Florida Museum of Natural History, bmacfadd@flmnh.ufl.edu; Sadie Mills, Florida Museum of Natural History, smills@floridamuseum.ufl.edu; Robert Boessenecker, College of Charleston, boesseneckerrw@cofc.edu; Kent Crippen, University of Florida, kcrippen@coe.ufl.edu.

Neiochnology of Edisto Island: Eat, Prey, Love, Burrow. Anthony J. Martin, Emory University, geoam@emory.edu; Patricia Kelley, University of North Carolina–Wilmington, kelleyp@uncw.edu.

The Dynamics of the South Carolina Coast—Barrier Islands, Wetlands, Rivers, and the Delta. Till J.J. Hanebuth, Coastal Carolina University, thanebuth@coastal.edu. Zoe Hughes, Boston University, zoeh@bu.edu; Joshua H. Long, Coastal Carolina University, jhlong@coastal.edu; Duncan M. Fitzgerald, Boston University, dunc@bu.edu.

SHORT COURSES

Descriptions are online.

Field Geophysics Using ABEM WalkTEM, ABEM Terrameter, and Mala Ground-Penetrating Radar. Amber Onufer, Guideline Geo (ABEM and Mala), aon@malags.com; Per Westholm, Guideline Geo, per.westholm@guidelinegeo.com.

Earthquakes, Sea-Level Rise, and Fossils, Oh My ... Earth Science Issues from the Lowcountry to Engage Your K–12 Students. Cynthia Hall, College of Charleston, hallcr@cofc.edu; Erin Beutel, College of Charleston, beutele@cofc.edu; Sarah Michalies, College of Charleston, michaliess@cofc.edu; Cass Runyon, College of Charleston, runyonc@cofc.edu.

REGISTRATION

Early registration deadline: 19 February 2019

Cancellation deadline: 25 February 2019

Registration opens in December. For further information or if you need special accommodations, please contact one of the general co-chairs, M. Scott Harris, harriss@cofc.edu, or Katie Luciano, lucianok@dnr.sc.gov.

ACCOMODATIONS

Hotel registration deadline: 26 February 2019, 5 p.m., EDT

A block of rooms has been reserved at the Francis Marion Hotel, 387 King Street, Charleston, South Carolina 29403, USA, in the center of Historic Charleston. The meeting rate is US\$219 per night plus tax. Reservations can be made by calling +1-843-722-0600. Please be sure to identify yourself with the group code SEGSA19 and that you are attending the GSA Southeastern Section Meeting.

OPPORTUNITIES FOR STUDENTS AND EARLY CAREER PROFESSIONALS

Mentor Programs

Interested in a career in the applied geosciences? Plan now to attend a **Roy J. Shlemon Mentor Program in Applied Geoscience**, or a **John Mann Mentors in Applied Hydrogeology Program**. Students and early career professionals will have the opportunity to discuss career prospects and challenges with applied geoscientists and applied hydrogeology or hydrology scientists, respectively, over a free lunch. Learn more about these programs at <http://www.geosociety.org/mentors>.

Geoscience Career Workshops

Interested in career advice? Plan to attend a workshop for students and early career professionals to learn more about the ins and outs of the profession.

Part 1: Career Planning and Informational Interviewing.

Your job hunting process should begin with career planning, not when you apply to 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.

Part 2: Geoscience Career Exploration. What do geologists in various sectors earn? What do they do? What are the pros and cons to working in academia, government, and industry? Workshop presenters and professionals in the field will address these issues.

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 in the market for a job or not, learn how to prepare the best résumé possible. You will review numerous résumés helping you to learn important résumé dos and don'ts.

LOCAL COMMITTEE

General Co-Chairs: M. Scott Harris, harriss@cofc.edu; Katie Luciano, lucianok@dnr.sc.gov

Technical Program Co-Chairs: Erin Beutel, beutele@cofc.edu; Chris Hein, hein@vims.edu

Field Trip Co-Chairs: John Chadwick, chadwickj@cofc.edu; Steve Jaume, jaumes@cofc.edu

Sponsorships Chair: Amber Onufer, amber.onufer@guidelinegeo.com

Exhibits Chair: Blair Tormey, btormey@wcu.edu

Treasurer: Adem Ali, alika@cofc.edu

Student Volunteer Chair: Cyndi Hall, hallcr@cofc.edu

GSA's Northeastern Section announces an Iceland field trip in conjunction with its 2019 meeting:

ICELAND

The Formation and Evolution of a Young, Dynamic, Volcanic Island

3–14 July 2019

Principal organizer: Brennan Jordan, University of South Dakota, brennan.jordan@usd.edu

Co-organizers: Tenley Banik, Illinois State University, tjbanik@ilstu.edu; Tamara Carley, Lafayette College, carleyt@lafayette.edu

The trip will be a 10-day circuit of Iceland visiting geologic sites along the Ring Road with excursions off of this route to experience the geologic and scenic diversity of the island. There will be an emphasis on magmatic and tectonic processes, also including sites of geomorphological interest.

<https://tinyurl.com/GSAIceland>



Preliminary Announcement and Call for Papers

NORTHEASTERN SECTION

54th Annual Meeting of the Northeastern Section, GSA

17–19 March 2019

Portland, Maine, USA

www.geosociety.org/ne-mtg



Portland waterfront, Portland, Maine, USA. Photo courtesy Maine Office of Tourism.

LOCATION

The 54th Annual Meeting of GSA's Northeastern Section will take place in Portland, Maine, USA, at the Holiday Inn By The Bay, in downtown Portland. Portland is a welcoming city. Cultural sites and varied dining opportunities are within a short walk of the conference center. Portland is easily accessed by car via Interstate 95 and Interstate 295, by train via Amtrak's Downeaster, by air via Portland's Jetport (PWM), and by bus. We have developed a technical program that covers a diverse set of geologic topics and processes, including applied geology; education; northeastern tectonics; Quaternary geology and climate; coastal, groundwater, and river processes; geological hazards; and magmatism, metamorphism, and structural geology.

CALL FOR PAPERS

Abstract deadline: 11 December

Submit online at www.geosociety.org/ne-mtg

Abstract submission fee: US\$18 for students and US\$30 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. **Geology, Structure, Geochronology, and Tectonics in Southern New England: An Eclectic Session in Honor of Robert P. Wintsch.** *Cosponsored by NETectonics.* Greg Walsh, U.S. Geological Survey, gwalsh@usgs.gov; John Aleinikoff, U.S. Geological Survey, jaleinikoff@usgs.gov; Ryan McAleer, U.S. Geological Survey, rmcaleer@usgs.gov.
- S2. **Late Wisconsinan Deglaciation of Northern New England and Adjacent Canada: A Session to Honor the Career and Contributions of Woodrow (Woody) B. Thompson.** Brian K. Fowler, New Hampshire Geologic Resources Advisory Committee, b2fmr@metrocast.net; P. Thompson Davis, Bentley University, pdavis@bentley.edu; Harold W. Borns, University of Maine, harold.borns@maine.edu.

Theme Sessions

- T1. **The Formation and Evolution of Iceland: Magmatic, Tectonic, and Geomorphological Processes.** Brennan Jordan, University of South Dakota, brennan.jordan@usd.edu; Tamara Carley, Lafayette College, carleyt@lafayette.edu; Tenley Banik, Illinois State University, tjbanik@ilstu.edu.
- T2. **Beyond Sustainability: The Anthropocene as a Paradigm for Thinking about Earth across Disciplines.** Gary Gomby, Central Connecticut State University, garygomby@ccsu.edu; W. John Kress, Smithsonian Institution, kressj@si.edu.
- T3. **Intertwining Earth Science Issues with the Nature of Science.** Patricia M. Millette, Mt. Blue High School, patti.millette@maine.edu; Daniel Frost, Thornton Academy, dan.frost@thorntonacademy.org.
- T4. **Best Practices in Geoscience Education.** Tarin Weiss, Westfield State University, tweiss@westfield.ma.edu; Lori Weeden, University of Massachusetts–Lowell, lori_weeden@uml.edu.
- T5. **New Perspectives on Mineral Resources of the Northeast.** John F. Slack, U.S. Geological Survey (emeritus) and Memorial University of Newfoundland, jfslack7@gmail.com; Martin G. Yates, University of Maine, yates@maine.edu.
- T6. **Groundwater and Surface Water Hydrology in the Northeastern United States.** Ryan P. Gordon, Maine Geological Survey, ryan.gordon@maine.edu.
- T7. **Private Wells—Current Challenges and Opportunities.** Sille Larsen, Vermont Dept. of Health, sille.larsen@vermont.gov; Liz Royer, Vermont Rural Water Association, lroyer@vtruralwater.org; Paul Susca, New Hampshire Department of Environmental Services, paul.susca@des.nh.gov; Patti Casey, Vermont Agency of Agriculture, patti.casey@vermont.gov; Joe Ayotte, U.S. Geological Survey, jayotte@usgs.gov.
- T8. **Soils: Processes at the Bio-Geo Interface.** Zsuzsanna Balogh-Brunstad, Hartwick College, balogh_brunz@hartwick.edu; Dawn Cardace, University of Rhode Island, cardace@uri.edu; Amanda Olsen, University of Maine, amanda.a.olsen@maine.edu.

- T9. **Building from the Top Down? An Interdisciplinary Approach to Connections between Paleopedology and Ichology.** Jesse Thornburg, Temple University, jesse.thornburg@temple.edu; Christopher Sparacio, University of Connecticut, christopher.sparacio@uconn.edu.
- T10. **Regional Advances in Seafloor Mapping and Benthic Habitat Classification.** Matthew Nixon, Maine Coastal Zone Management Program, matthew.e.nixon@maine.gov; Dan Sampson, Massachusetts Office of Coastal Zone Management, daniel.sampson@state.ma.us.
- T11. **Current Research in Coastal and Marine Processes.** Mark Borrelli, University of Massachusetts–Boston, mark.borrelli@umb.edu; Bryan A. Oakley, Eastern Connecticut State University, oakleyb@easternct.edu.
- T12. **Floods: Past, Present, and Future.** Brian Yellen, University of Massachusetts–Amherst, yellen@geo.umass.edu; Jon Woodruff, University of Massachusetts–Amherst, woodruff@geo.umass.edu; Michael Toomey, U.S. Geological Survey, mtoomey@usgs.gov; Tim Cook, Worcester State University, tcook3@worcester.edu.
- T13. **River Corridor Processes and Related Decision Making.** Sean Smith, University of Maine, sean.m.smith@maine.edu; Anne Lightbody, University of New Hampshire, anne.lightbody@unh.edu; Melissa E. Landon, University of Maine, melissa.landon@maine.edu.
- T14. **Lake Sediments as Archives of Environmental Change.** Kevin M. Spigel, Unity College, kspigel@unity.edu.
- T15. **Reconstructing Past Climate from the Geologic Record of Ice Sheets and Mountain Glaciers.** Aaron Putnam, University of Maine, aaron.putnam@maine.edu; Brenda Hall, University of Maine, brendah@maine.edu; Thomas Lowell, University of Cincinnati, lowelltv@ucmail.uc.edu.
- T16. **Insights on the Ongoing Dynamics of Northeastern North America from Geology and Geophysics.** William Menke, Columbia University, menke@ldeo.columbia.edu; Paul Karabinos, William College, pkarabin@williams.edu; Vadim Levin, Rutgers University, vlevin@eps.rutgers.edu; Michael Williams, University of Massachusetts–Amherst, mlw@geo.umass.edu.
- T17. **Integrative and Innovative Appalachian Tectonics: Linking Novel Field and Laboratory Studies.** Adam Ianno, Juniata College, iannoa@juniata.edu; Allison Severson, Colorado School of Mines, aseverson@myemail.mines.edu.
- T18. **Peri-Gondwanan Terranes and Their Origins: What Do We Really Know? Cosponsored by NETectonics.** Yvette D. Kuiper, Colorado School of Mines, ykuiper@mines.edu; Margaret D. Thompson, Wellesley College, mthompso@wellesley.edu; R. Damian Nance, Ohio University, nance@ohio.edu.
- T19. **Detrital Mineral Constraints on Appalachian-Caledonide Tectonics.** Doug Reusch, University of Maine at Farmington, reusch@maine.edu; Dave West, Middlebury College, dwest@middlebury.edu; Justin Strauss, Dartmouth College, justin.v.strauss@dartmouth.edu; Dwight Bradley, U.S. Geological Survey, dbradley@usgs.gov.
- T20. **Geology of the Grenville Orogeny and Adirondack Mountains.** Michelle Markley, Mount Holyoke College, mmarkley@mtholyoke.edu; Michael Williams, University of Massachusetts, mlw@geo.umass.edu.
- T21. **Deciphering Tectonic Processes Using Metamorphic Petrology.** Wentao Cao, SUNY Fredonia, cao@fredonia.edu; Jesse Walters, University of Maine, jesse.walters@maine.edu.
- T22. **Relating Rheology and Deformation in Earth's Lithosphere and Cryosphere.** Scott Johnson, University of Maine, johnsons@maine.edu; Chris Gerbi, University of Maine, christopher.gerbi@maine.edu; Walter A. Sullivan, Colby College, wasulliv@colby.edu.
- T23. **Simulation, Visualization, and Statistical Tools for Environmental Data Analysis.** Andrew Reeve, University of Maine, asreeve@maine.edu.
- T25. **Geoarchaeology: Investigations and Techniques.** Alice R. Kelley, University of Maine, akelley@maine.edu.
- T25. **The Roles of Geochronology and Geochemistry of Granitoid Plutons in Deciphering Orogenic Events.** David Gibson, University of Maine at Farmington, dgibson@maine.edu; and Sandra Barr, Acadia University, sandra.barr@acadiau.ca.
- T26. **Laser Ablation (LA) ICP-MS.** Alicia Cruz-Uribe, University of Maine, alicia.cruzuribe@maine.edu.

FIELD TRIPS

Trip registration opens in December. Descriptions are online; for additional information, please contact the field trip chair, Myles Felch, mfelch@mainemineralmuseum.org.

Iceland: The Formation and Evolution of a Young, Dynamic, Volcanic Island. Trip leaders: Brennan Jordan, University of South Dakota, brennan.jordan@usd.edu; Tenley Banik, Illinois State University, tibanik@ilstu.edu; Tamara Carley, Lafayette College, carleyt@lafayette.edu. Planned for July 2019 (see p. 61).

Maine Mineral and Gem Museum, Bethel Maine. Leader and coordinator: Myles Felch, Maine Mineral Museum, mfelch@mainemineralmuseum.org, www.maine.mineralmuseum.org.

Landslides in the Presumpscot Formation Leader: Lindsay Spigel, Maine Geological Survey, lindsay.spigel@maine.gov.

Self-Guided Trips to Locations of Geological Interest in the Greater Portland Maine Area. Coordinator: Stephen Pollock, stephen.pollock@maine.edu.

WORKSHOPS

Intertwining Earth Science Issues with the Nature of Science. Patricia Millette, Mt. Blue High School, patti.millette@maine.edu; Daniel Frost, Thornton Academy, dan.frost@thorntonacademy.org.

Innovations in LA-ICP-MS in the Earth Sciences. Alicia Cruz-Uribe, University of Maine, alicia.cruzuribe@maine.edu; Hanna Brooks, University of Maine, hanna.brooks@maine.edu.

GSA STUDENT MENTOR PROGRAMS AND CAREER WORKSHOPS

The GSA GeoCareers Program will run two student programs in Portland. These are (1) the Roy J. Shlemon Mentor Program in Applied Geoscience and John Mann Mentors in Applied Hydrogeology Program luncheons; and (2) three 50-minute career

workshops to assist students and early career professionals with job hunting and résumé writing skills.

Mentor Programs

Plan to attend a Roy J. Shlemon Mentor Program in Applied Geoscience and/or a John Mann Mentors in Applied Hydrogeology Program luncheon at the 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.

Geoscience Career Workshops

Part 1: Career Planning and Informational Interviewing.

Your job-hunting process should begin with career planning, not when you apply to 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.

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.

Part 3: Cover Letters, Résumés, and CV's. How do you prepare a cover letter? Does your résumé need a good edit? Whether you are currently in the market for a job or not, learn how to prepare the best résumé possible. You will review numerous résumés to help you to learn important résumé dos and don'ts.

REGISTRATION

Early registration deadline: 11 Feb. 2019

Cancellation deadline: 19 Feb. 2019

Registration opens in December. For further information or if you need special accommodations, please contact the general chair, Stephen Pollock, stephen.pollock@maine.edu.

ACCOMMODATIONS

Hotel registration deadline: 22 Feb. 2019

A block of rooms has been reserved at the Holiday Inn By The Bay. The meeting rate is US\$150 per night plus tax. Reservations should be made by calling the Holiday Inn at +1-800-315-2621 (toll free) or +1-207-775-2311 (local). Please be sure to mention that you are attending the GSA meeting.

The Holiday Inn By The Bay is ADA compliant. Persons needing services related to ADA should contact Stephen Pollock, stephen.pollock@maine.edu, or Sally Page at the Holiday Inn By the Bay at +1-800-315-2621 (toll free) or +1-207-775-2311 (local).

LOCAL COMMITTEE

General Chair: Stephen Pollock, stephen.pollock@maine.edu

Technical Program Co-Chairs: Robert G. Marvinney, robert.g.marvinney@maine.gov; and Amber H. Whittaker, amber.h.whittaker@maine.gov

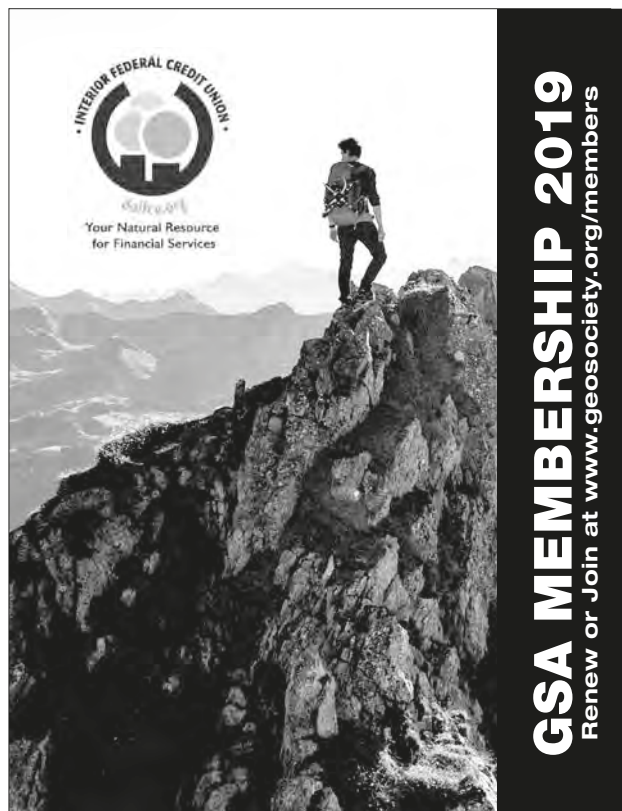
Field Trip Chair: Myles Felch, mfelch@mainemineralmuseum.org

Exhibits: Irwin Novak, novak@maine.edu

Sponsorships: Clifford Lippitt, cliff.lippitt@swcole.com

Student Volunteers: David Gibson, dgibson@maine.edu

Short Courses and Workshops: Martin Yates, yates@maine.edu



New GSA Member Benefit

Interior Federal Credit Union (IFCU) serves their members 24/7 through online and mobile banking, call-center employees, 5,500 shared-branches, and 55,000 ATMs nationwide. With some of the best rates in the country, you can become a member with just a US\$25 deposit into a savings account. As an ongoing incentive for GSA members, IFCU will fund the first US\$25 deposit into a savings account to establish membership.

Their young adult account (www.interiorfcu.org/accounts/young-adult-accounts/) also has a number of benefits ideal for GSA student members:

- 3% annual percentage rate (APR) on a checking account, with no fees for ATM transactions and a free “oops” coupon;
- 0% APR for six months on a credit card;
- Accumulator certificate with only US\$50 to open;
- US\$50 gas card with first car loan;
- First-time home buyer's program; and
- Private student loans and student loan consolidation.

Find out more about Your Natural Resource for Financial Services at www.interiorfcu.org.

Geoscience Jobs & Opportunities

Ads (or cancellations) must reach the GSA advertising office no later than the first of the month, one month prior to the issue in which they are to be published. Contact advertising@geosociety.org, +1.800.472.1988 ext. 1053, or +1.303.357.1053. All correspondence must include complete contact information, including e-mail and mailing addresses.

Online: www.geosociety.org/jobs.

Rates are in U.S. dollars.

Classification	Per Line for 1st month	Per line each add'l month (same ad)
Positions Open	\$9.30	\$9.25
Fellowship Opportunities	\$9.30	\$9.25
Opportunities for Students		
First 25 lines	\$0.00	\$5.00
Additional lines	\$5.00	\$5.00

Positions Open

GIS/REMOTE SENSING SPECIALIST & GEOSPATIAL CENTER DIRECTOR, DEPT. OF EARTH AND SPACE SCIENCES, LAMAR UNIVERSITY, BEAUMONT, TEXAS

Posting Number: 201121583. Position Number: 499699

The GIS/Remote Sensing Specialist and Center Director will support the Lamar Geospatial Center (LGC) by developing and teaching remote sensing classes and workshops, as well as GIS and GPS classes including those supporting GIS Certification, a Minor in GIS when required; and, eventual development of a Masters in Geospatial Science. This person will lead the day-to-day operations of the LGC and projects associated with it, including database management, submission of reports, and the writing of grant proposals pertaining to the LGC. Note that funded research and presentations/publications are also expected duties of the successful candidate. A track record of funded projects is desirable.

Essential Job Functions:

1. Develops and teaches workshops related to remote sensing and geospatial technology.
2. Develops and teaches academic remote sensing and GIS classes offered for credit toward GIS Certification, a GIS Minor, and Masters in Geospatial Sciences through Lamar University.
3. Manages people responsible for the collection of data, data entry, data conversion and data organization of LGC geospatial products.
4. Performs data verification and QA/QC for LGC geospatial projects.
5. Generates reports, maps and other technical documents in support of LGC geospatial projects.
6. Writes research proposals, makes presentations, and publishes research results.
7. Promotes the Lamar Geospatial Center to the community.

Minimum Qualifications:

1. Knowledge of multiple operating systems and remote sensing/geospatial software applications, particularly the ESRI suite of ArcGIS software products and common extensions on a Windows operating system.
2. Ability to provide technical support to clients for remote sensing, GIS and GPS related hardware and software issues.

3. Highly skilled in collecting, processing, editing and manipulating geospatial data.
4. Excellent oral and written communication skills.
5. Ability to effectively lead a team of geospatial specialists.

Education: A Geoscience or Planetary Science related Ph.D. degree specializing in Remote Sensing, or GIS/Geospatial Science is required.

Work Experience: Applicant must have at least 3 years of increasingly responsible Remote Sensing and GIS project management experience. Field experience with GPS units, and post-processing knowledge, is important. Thorough knowledge of Remote Sensing, GIS and GPS computer applications is expected.

Application Process: Please access Human Resources' job application page at <https://jobs.lamar.edu> and click on Faculty Positions. Find this position in the list and click on it. This will take you to the posting details and the Apply for this Job tab. Please include (1) Letter of Interest, (2) Curriculum Vitae, (3) Statement of Teaching Philosophy. Also requested are the names and contact information for at least three references and letters from them if available, as well as unofficial transcripts and other miscellaneous information you would like to include. Alternatively, you can send this information to Lamar University, Human Resources, 4400 MLK Pkwy, P.O. Box 10009, Beaumont, Texas 77710. However, the online application process is preferred.

Salary: Commensurate

Lamar University is an Equal Opportunity/Affirmative Action Employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability or protected veteran status.

Lamar University is proud to provide employment preference to veteran applicants in accordance with Texas 805 Government Code, Section 657.003.

This position is security-sensitive and thereby subject to the provisions of the Texas Education Code §51.215, which authorizes the employer to obtain criminal history record information.

ASSISTANT PROFESSOR OF GEOSCIENCES, SEDIMENTOLOGY/STRATIGRAPHY, DENISON UNIVERSITY

Denison University invites applications for a tenure-track assistant professor position in the Dept. of Geosciences, to begin in August 2019. We seek a broadly-trained scientist engaged in the study of sedimentology and/or stratigraphy that complements our department's current strengths in paleontology, petrology/volcanology, process geomorphology, and structural geology. Successful candidates should demonstrate potential to be an outstanding teacher, active scholar, and contributor to the continued growth of the Dept. and University. Candidates must have a Ph.D. at the time of appointment.

We seek a colleague who is committed to teaching excellence in the liberal arts tradition. Ideal candidates will have broad interests beyond their individual specialties and will provide a balance of classroom, field and laboratory experiences for our students. Candidates must have the desire

and ability to teach courses across all levels of the curriculum. The typical teaching load is three lab courses per year. In addition, successful candidates are expected to maintain a vibrant and productive research program that actively incorporates undergraduate students.

Denison University is an academically rigorous liberal arts college with an increasingly diverse campus community. It offers a competitive salary and a comprehensive benefits package. Denison is located in the village of Granville, 30 minutes from Columbus, Ohio, the state capital, which hosts a wide range of cultural and artistic opportunities. Granville also offers an excellent public school system and easy access to outdoor activities.

All application materials will be handled electronically at <https://employment.denison.edu>. Applications must include: (1) a letter of application addressing the position requirements listed above; (2) a current curriculum vitae; (3) academic transcripts of undergraduate and graduate courses (unofficial acceptable); (4) a statement of teaching philosophy and experience; and (5) a statement of your research program in a liberal arts context. In addition, please list the contact information for three persons who know your teaching and scholarship well who will then be requested to upload reference letters. Completed application materials submitted by October 22, 2018, will receive full consideration. Evaluation will continue until the position is filled. **For those attending, we will meet with selected candidates at the 2018 GSA Annual Meeting in Indianapolis and the 2018 AGU Fall Meeting in Washington DC.** Please contact Dr. Erik Klemetti, chair, with any questions at klemettie@denison.edu.

To achieve our mission as a liberal arts college, we continually strive to foster a diverse campus community, which recognizes the value of all persons regardless of religion, race, ethnicity, gender, color, gender identity and or expression, sexual orientation, family configuration, disability, socioeconomic status, religion, national origin, age, or military status. For additional information and resources about diversity at Denison, please see our Diversity Guide at <http://denison.edu/forms/diversity-guide>. Denison University is an Affirmative Action, Equal Opportunity Employer.

FACULTY POSITION IN GEOPHYSICS AND GEOCHEMISTRY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY (MIT)

The Dept. of Earth, Atmospheric, and Planetary Sciences at the Massachusetts Institute of Technology (MIT), Cambridge, MA 02139, invites qualified candidates to apply for a tenure-track faculty position. The search is in the broad area of geophysics and geochemistry encompassing the Earth and other planetary bodies in the solar system. We seek candidates who use theory, observation, and/or experimentation and particularly encourage applicants whose work crosses traditional disciplinary boundaries. Candidates should have the potential for innovation and leadership in research and a commitment to teaching at the undergraduate and graduate levels.

Applicants must hold a Ph.D. in geoscience or related field by the start of employment. Our intent

is to hire at the assistant professor level, but more senior appointments may also be considered. A complete application must include a cover letter, curriculum vitae, one- to two-page descriptions each of research and teaching plans, and three letters of recommendation. We request that in their cover letter, applicants explicitly commit to our department's code of conduct: <https://eapsweb.mit.edu/about/code-conduct>

Applications are being accepted at Academic Jobs Online: <https://academicjobsonline.org/ajo/jobs/11380>

To receive full consideration, complete applications must be received by November 1, 2018.

Search Contact: Ms. Karen Foshier, HR Administrator, EAPS, 54-924, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307, email: kfosher@mit.edu

MIT is an equal employment opportunity employer. All qualified applicants will receive consideration for employment and will not be discriminated against on the basis of race, color, sex, sexual orientation, gender identity, religion, disability, age, genetic information, veteran status, ancestry, or national or ethnic origin.

TENURE-STREAM ASSISTANT PROFESSOR IN SEDIMENTARY GEOLOGY, UNIVERSITY OF NEVADA LAS VEGAS

The Dept. of Geoscience at the University of Nevada Las Vegas invites applications for a full-time, tenure-track faculty position in sedimentary geology at the Assistant Professor level. Preferred research areas include, but are not limited to, sedimentary basin evolution with applications to tectonics or Earth-life-environment interactions across critical transitions in Earth history. We are particularly interested in individuals who integrate field investigations with innovative geochemical, geochronological, or other analytical techniques to pursue interdisciplinary research. The successful candidate is expected to establish a vigorous, externally-funded research program; teach effectively at both undergraduate and graduate levels, including undergraduate field courses; and perform service duties at all levels. Opportunities for collaboration exist with departmental research groups in tectonics/structural geology, paleoclimatology, paleontology/stratigraphy, petrology/volcanology, planetary geology, and hydrogeology/surface processes. The successful applicant could begin as early as January 2019.

The UNLV Geoscience Dept. (<https://geoscience.unlv.edu/>) has 21 faculty, 200 undergraduate students, and more than 50 MS/PhD students. The department hosts laboratory facilities including stable isotope, argon geochronology, fluid inclusion, XRF/XRD, ICP-MS, soils, and electron microprobe/SEM labs. This position requires a Ph.D. from a regionally accredited college or university. Salary competitive with those at similarly situated institutions. Position is contingent upon funding.

Application materials must include a cover letter, curriculum vitae, proposed research plans (five page limit), statement of teaching philosophy and interests, and contact information for five referees. Although this position will remain

open until filled, review of candidates' materials will begin on October 1, 2018 and best consideration will be gained for materials submitted prior to that date. Materials should be addressed to Dr. Michael Wells, Search Committee Chair, and submitted at <https://hrsearch.unlv.edu>. For assistance with the application on-line portal, please contact UNLV Employment Services at (702) 895-2894 or hrsearch@unlv.edu.

MULTIPLE FACULTY POSITIONS IN SOLID EARTH GEOSCIENCES AND PLANETARY SCIENCES GEORGIA TECH

The School of Earth and Atmospheric Sciences (EAS, www.eas.gatech.edu) at Georgia Tech invites applications for two tenure-track faculty positions in solid earth geosciences and one tenure-track faculty position in planetary and space sciences. Applicants will be considered at all ranks. For the solid earth geosciences positions, we are looking for broad-minded geoscientists with interests that complement our current geophysical strengths in geodesy, geomorphology, glaciology, seismology, computational methods, planetary and space sciences. For the planetary and space science position, we invite candidates who will build a competitive research program that complements or extends the strengths of our ongoing planetary and space research, and who bridge connections within geophysics and ongoing and future missions through observational, theoretical, or modeling approaches. We seek individuals who are interested in working in a dynamic and interdisciplinary university that includes a diverse group of planetary and space, earth, ocean, and atmospheric sciences, and many top-ranked engineering programs. Candidates are expected to demonstrate an exceptional commitment to teaching and mentoring of students.

Georgia Institute of Technology, located in the diverse, and thriving metropolis of Atlanta, is consistently a top ranked educational and research institution. Georgia Tech prides itself on its engineering resources, collaborations, its quantitative and rigorous undergraduate student body, and its commitment to diversity, equity, and inclusion. Applicants should send an application letter, curriculum vitae, a statement of research interests, a description of their teaching interests and their advising/mentoring philosophy, and the names and contact information for at least three references. Application materials should be submitted as PDF files via [Academicjobsonline.org](https://academicjobsonline.org). Requests for information should be directed to earthplanet_search@eas.gatech.edu. Applications will be considered beginning October 1, 2018 but the search will continue until the positions are filled. An earned doctorate is required by the start of the appointment. Georgia Tech is an equal education/employment opportunity institution dedicated to building a diverse community. We strongly encourage applications from women, minorities, individuals with disabilities, and veterans. Georgia Tech has policies to promote a healthy work-life balance and is aware that attracting faculty may require meeting the needs of two careers.

FELLOWSHIP OPPORTUNITY NATIONAL AIR AND SPACE MUSEUM'S CENTER FOR EARTH AND PLANETARY STUDIES

Applications are invited for a postdoctoral fellowship positions at the National Air and Space Museum's Center for Earth and Planetary Studies. The fellowship supports independent research projects in planetary science.

The Center for Earth and Planetary Studies (CEPS) is the scientific research unit at the National Air and Space Museum. Most of the research in CEPS focuses on planetary geologic and geophysical processes that have shaped the surfaces of rocky and icy bodies in the solar system including the Earth and Moon. CEPS scientists are actively involved in many of NASA's and ESA's current and planned planetary robotic missions. Research is supported by an extensive collection of archival photographs of the Moon, and images and maps the planets and their satellites.

Research areas of interest include planetary landscape evolution, planetary volcanism and cryovolcanism, tectonics of rocky and icy bodies, radar remote sensing and radar sounder studies, and analysis of terrestrial analog landforms. Competitive proposals should demonstrate knowledge and expertise in areas such as quantitative remote sensing analysis, tectonics and tectonophysics, volcanic processes, and quantitative terrestrial and planetary geomorphology.

Please apply by October 1, 2018 through the Smithsonian SOLAA site, SOLAA.si.edu, and select the Earth and Planetary Sciences Fellowship program under the National Air and Space Museum.

ASSISTANT PROFESSOR TENURE-TRACK MULTIPLE DISCIPLINES, AMHERST COLLEGE

The Amherst College Dept. of Geology invites applications for a tenure-track appointment at the rank of Assistant Professor with expertise in one of the following broadly defined fields:

- Climate Science and Paleoclimate; or
- Mineralogy, Petrology, and High-Temperature Geochemistry; or
- Structural Geology, Tectonics, and Geophysics.

We seek a colleague who is committed to excellence in earth science education in a liberal arts context with a record that demonstrates the promise of high-quality research and who is excited about involving undergraduate students in research projects. Today, Amherst College comprises a profoundly diversified student body; nearly one-quarter of Amherst's students are Pell Grant recipients and 45 percent of our students identify as domestic students of color. The College is committed to cultivating a challenging and inclusive educational environment, therefore we seek candidates who can teach, mentor, and inspire students of different sexual orientations, genders, races, ethnicities, nationalities, and religious and socioeconomic backgrounds. Amherst College is an equal opportunity employer and encourages persons of all genders, persons of color, and persons with disabilities to apply. The college is committed to enriching its educational experience and its culture through the diversity of its

faculty, administration, and staff. We encourage applications from those who will offer rigorous, integrated classroom, field, and laboratory experiences for our students. Geology faculty teach three courses with labs per year, supervise students in independent research leading to honors theses, serve as academic advisor to geology majors and underclass students in general, support the activities of the Geology Dept., and participate in the life of the College through service. The appointee to this position will regularly teach courses at the introductory level that engage a broad range of students and more advanced courses within their area of expertise for students majoring in Geology. Opportunities for teaching interdisciplinary courses are also available. The ability to direct writing, quantitative analysis, and research at all undergraduate levels is necessary. The successful candidate will be expected to sustain a dynamic and productive research program that is grounded in original observations and analysis of Earth materials and is conducive to substantive undergraduate participation. Start-up funds and other forms of institutional support are available. This appointment will begin July 1, 2019. Candidates must have completed the Ph.D. at the time of appointment; post-doctoral experience is beneficial. Applications should be submitted electronically via Interfolio <https://apply.interfolio.com/51958>. We request a cover letter, curriculum vita, contact information for three references who have agreed to provide letters of recommendation, and a statement in which you describe your current research agenda, what you would like to teach to undergraduate students and how you envision doing so, and the background, experience, or interests that position you to support Amherst's commitment to diversity and inclusion. Review of applications will begin on September 14, 2018, and continue until the position is filled. Applications completed by September 14, 2018, will be assured of full consideration. For more information about Amherst College and the Geology Dept. please visit our websites: www.amherst.edu and <https://www.amherst.edu/academiclife/departments/geology>. Questions should be addressed to Professor Anna Martini, Search Committee Chair: ammartini@amherst.edu.

MUSEUM SCIENTIST IN EARTH SCIENCES, UNIVERSITY OF CALIFORNIA-RIVERSIDE
REQ. ID #201806111005

UC Riverside Earth Sciences Dept. seeks a Museum Scientist to conserve, oversee, and utilize departmental research, reference, and teaching collections; and manage the museum outreach program. The position is 85% time with flexible Monday through Friday hours. Candidates seeking external research or outreach funding that may supplement salary while pursuing departmental goals are particularly encouraged to apply. The department, which has recently rapidly grown in faculty, is within the College of Natural and Agricultural Sciences, and has strong specimen-based research in fault petrology, geochemistry, and paleontology. Such research complements departmental research foci in Organic and Paleoenvironmental Evolution, and Earthquake Processes

(see <http://earthscience.ucr.edu/>). We are looking for individuals with a strong background in specimen-based earth-life history research, familiarity with a broad range of geological materials, and an active interest in Museum Science including digitization and databasing. The new hire will engage with UCR's Center for Integrative Biological Collections, a rapidly evolving college-wide initiative. A Ph.D. is preferred, along with experience of and/or qualifications in collections management. The University of California is an Affirmative Action/Equal Opportunity employer. Please visit <http://jobs.ucr.edu/> for more information and to apply for this career position. Applications received by September 15th will receive priority attention.

HYDROGEOLOGISTS
GEOHYDROLOGY SECTION, KANSAS
GEOLOGICAL SURVEY
UNIVERSITY OF KANSAS, LAWRENCE

Two full-time positions to lead KGS hydrogeochemical and groundwater hydrology investigations. Faculty-equivalent, sabbatical-eligible positions at the rank of Assistant or entry-level Associate Scientist. Requires Ph.D. with an emphasis on 1) aqueous geochemistry related to groundwater resources or 2) groundwater hydrology of sedimentary aquifer systems, and scientific leadership potential. Emphasis on state-of-the-science field studies and complementary theoretical research. Complete announcement/application info at www.kgs.ku.edu/General/jobs.html. Review of applications will begin Oct. 15, 2018.

Apply online at <http://employment.ku.edu/academic/12288br> for the Hydrogeochemist and at <http://employment.ku.edu/academic/12289br> for the Groundwater Hydrologist. For further information contact Geoff Bohling (geoff@kgs.ku.edu) or Don Whittemore (donwhitt@kgs.ku.edu). For further information about other aspects of the position, contact Annette Delaney, HR, at adelaney@kgs.ku.edu or 785-864-2152. KU is an EO/AAE, <http://policy.ku.edu/IOA/nondiscrimination>.

TWO FACULTY POSITIONS IN
PETROLOGY/VOLCANOLOGY
AND MINERAL RESOURCES

UNIVERSITY OF ALASKA ANCHORAGE

The Dept. of Geological Sciences at the University of Alaska Anchorage (www.uaa.alaska.edu/geology/) seeks to hire two tenure-track faculty members (open rank), with a start date of August 2019. We aim to expand and complement existing areas of research expertise in the Department which include geochemistry, structural geology, sedimentology, stratigraphy, petroleum geology, geophysics, hydrogeology, and planetary geology. The successful candidates are expected to teach undergraduate and graduate courses to a diverse student body in the B.S. and M.S. programs in geological sciences.

(1) Igneous/Metamorphic Petrology and/or Volcanology: teaching expectations for this position include igneous & metamorphic petrology, volcanology, geological field methods or field camp, advanced petrology, and other courses in support of the Department's teaching needs.

(2) Mineral Resources and/or Economic Geology: we encourage applications from individuals with expertise in one or more of the following areas: economic geology; mining geology; mineral resources in magmatic, hydrothermal, and/or placer deposits; structure and emplacement of ore deposits; or mineral exploration. Teaching expectations for this position include mineralogy, ore deposits, geological field methods or field camp, advanced mineral resources, and other courses in support of the Department's teaching needs.

We seek applicants with a commitment to teaching, research, and partnership building with resource industries and research organizations in Alaska and elsewhere. Successful candidates must develop externally funded research that actively involves graduate and undergraduate students. Both positions require a Ph.D. in geological sciences or a related field at the time of initial appointment, university teaching experience or potential, and demonstration of research experience and future potential. Relevant industry or post-doctoral experience will be considered favorably.

Please submit a cover letter, curriculum vitae, a statement of teaching and research interests that includes how you will involve students in research opportunities, contact information for at least three references, and unofficial academic transcripts to careers.alaska.edu for: (1) posting 509521 (petrology or volcanology); or (2) posting 509519 (mineral resources). Review of applications will begin September 24, 2018.

For more information regarding these positions, please contact the department director, Dr. Simon Kattenhorn: skattenhorn@alaska.edu.

UAA is an AA/EO Employer and Educational Institution. Applicant must be eligible for employment under the immigration Reform and Control Act of 1986 and subsequent amendments. Your application for employment with UAA is subject to public disclosure under the Alaska Public Records Act.

TENURE-TRACK, ASSISTANT
OR ASSOCIATE PROFESSOR,
CLIMATOLOGY MIDDLE TENNESSEE
STATE UNIVERSITY

The Middle Tennessee State University (MTSU) Dept. of Geosciences invites applications for a tenure-track Assistant or Associate Professor in climatology beginning August 1, 2019. Teaching responsibilities include undergraduate and graduate courses in climatology, climate change, Earth science, physical geography, and related disciplines. Applicants with abilities to teach courses in meteorology and develop discipline-related courses for the Department's new Environmental Science major will receive special consideration. The successful candidate will be expected to undertake collaborative and multi-disciplinary research within the department and university, and to be actively involved in university and professional service. Candidates must have completed a PhD in geosciences or related field at time of appointment.

MTSU Geosciences offers BS degrees in Geoscience with concentrations in Geology, Physical

Geography, Environmental Science, and a MS concentration in Geosciences. The Department is comprised of 12 faculty and research staff, approximately 100 undergraduate majors, and 20 graduate students. In 2017, the Department moved into new teaching and research facilities, including specialized laboratories in GIS, remote sensing, hydrology and geochemistry. The Department emphasizes excellence in teaching, while also supporting the development of new and innovative research programs at both the undergraduate and graduate levels.

Required documents for application include a cover letter, curriculum vita, statement of teaching philosophy, and statement of research experience and interest. Three letters of recommendation and official university transcripts (not issued to student) of all degrees received will be required of all applicants selected for an interview. Please contact Dr. Henrique Momm (henrique.momm@mtsu.edu, 615-904-8372) with questions.

To apply for this position, go to <http://mtsujobs.mtsu.edu> and follow the instructions on how to complete an application, attach documents, and submit online. Review of applications begins September 3 and continues until position is filled. Rank and salary are commensurate with education and experience. Proof of U.S. citizenship or eligibility for U.S. employment will be required prior to employment (Immigration Control Act of 1986). Clery Act crime statistics for MTSU available at http://police.mtsu.edu/crime_statistics.htm or by contacting MTSU Public Safety at 615-898-2424. EO/AA employer.

LECTURER IN APPLIED GEOCHEMISTRY AUBURN UNIVERSITY

The Dept. of Geosciences at Auburn University invites applications for a 9-month nontenure track faculty position in Applied Geochemistry beginning January 1, 2019. The position is a one-year appointment subject to annual review and is renewable based on performance, need for services and available funding.

Applicants must have a Ph.D. in Geology/Geochemistry with demonstrable teaching experience. The successful candidate will teach two undergraduate courses (Introduction to Geochemistry and Environmental Geology) and one graduate course (Aqueous and Environmental Geochemistry or Mineral Resources and Environment) per year. Required qualifications include excellent written and interpersonal communication skills. Quantitative, analytical, and/or fieldbased geochemical tools that could be incorporated into both undergraduate and graduate courses will be an asset. The candidate selected for the position must meet eligibility requirements to work in the United States at the time the appointment begins and be able to continue working legally for the proposed term of employment.

Applicants should submit a curriculum vitae, a letter of application (1-2 pages) describing teaching philosophy and experience, and the names and contact information for three professional references. To apply please go to <http://aufacultypositions.peopleadmin.com/postings/2994>,

complete the online form and upload the required application documents.

Applicants are encouraged to visit the AU website to learn more about Auburn University and the Dept. of Geosciences (www.auburn.edu/cosam/departments/geosciences/index.htm). Review of applications will begin October 1, 2018, and will continue until a candidate accepts appointment.

Auburn University is an EEO/VET/Disability Employer

TECTONOPHYSICIST, TENURE-TRACK DEPT. OF GEOLOGICAL SCIENCES CALIFORNIA STATE UNIVERSITY FULLERTON (CSUF)

The Dept. of Geological Sciences at CSUF invites applications for a tenure-track, Assistant Professorship in the broad field of tectonophysics beginning August 2019. We are seeking an Earth scientist who integrates field and geophysical techniques to investigate tectonic questions, demonstrates a strong commitment to teaching excellence and shows evidence of an existing or developing active, externally funded, student-centered, research program. A Ph.D. in Geological Sciences or related field is required at the time of appointment. We seek scholars who will teach introductory geophysics (bi-annually) and regularly participate in the teaching geologic field techniques, summer field camp, upper-division or graduate courses their area of specialization as well as general education courses. Preference will be given to candidates who can occasionally teach structural geology.

The successful candidate will contribute to the diverse CSUF campus. To apply, please go to: <https://apps.fullerton.edu/facultyrecruitment> to view all job listings and select 10499BR to begin the application process. To ensure full consideration, submit all application materials by November 16, 2018.

Planning to Meet with Candidates during the GSA Annual Meeting?

Draw attention to your ad! Ask about additional placement on the Job Board in the Employers' Special Section for GSA 2018 Indianapolis.

Find those qualified geoscientists to fill vacancies. Use print issues of GSA Today and GSA's Geoscience Job Board (geosociety.org/jobs). Bundle and save for best pricing options.

That unique candidate is waiting to be found.



WIESS AND PAN POST-DOCTORAL RESEARCH FELLOWSHIPS Department of Earth, Environmental and Planetary Sciences

The Department of Earth, Environmental and Planetary Sciences at Rice University is inviting applications for the Wiess and the Pan Postdoctoral Research Fellowships. We are seeking candidates with independent research interests that intersect with one or more faculty within our department. Both domestic and international applicants are welcome, but applicants must have a Ph.D. awarded within three years of the time of appointment.

The research fellowships will be supported for two years, pending satisfactory progress during the first year, and covers an annual stipend of \$60,000 with a benefits package and an additional annual discretionary research allowance of \$3,500.

Applicants are requested to develop a proposal of research to be undertaken during the fellowship period. The principal selection criteria are scientific excellence, a clearly expressed research plan to address questions at the forefront of their field of study, and research synergies with at least one faculty. The proposed research should, however, encompass independent research ideas and explore new directions beyond the applicant's Ph.D. Preference will be given to applicants whose proposals demonstrate independence and originality, and also the potential for collaboration with one or more faculty in the Department of Earth, Environmental and Planetary Sciences.

The application for both fellowships is due on 1 November, 2018. Applicants are required to submit one application only at <http://jobs.rice.edu/postings/15058>. The application should include the following documents:

- (1) A cover letter.
- (2) A research proposal of no more than 3 pages (not counting references) of single-spaced text and figures.
- (3) A current CV, including a list of publications.

As part of the online application, the applicant will also have to provide the names and contact information of three or more people who will be asked to submit reference letters by the same deadline.

The highest ranked applicants will be invited to visit Rice in early 2019. Following acceptance, the appointment may begin anytime before 1 January, 2020. For further information or questions contact the chair of the search committee at esci-postdoc@rice.edu.

Rice University is located in Houston, Texas, and is a private, coeducational, nonsectarian university that aspires to path-breaking research, unsurpassed teaching, and contributions to the betterment of our world. Rice fulfills this mission by cultivating a diverse community of learning and discovery that produces leaders across the spectrum of human endeavor.

Rice University is an Equal Opportunity Employer with commitment to diversity at all levels, and considers for employment qualified applicants without regard to race, color, religion, age, sex, sexual orientation, gender identity, national or ethnic origin, genetic information, disability or protected veteran status.

<https://earthscience.rice.edu/open-positions/>



Tektonikos: Student Donors Giving Back to GSA

The GSA Foundation (GSAF) is privileged to work with a broad range of partners to generate resources toward a single mission: providing funds in support of the goals and programs of GSA. Over the past months, we have highlighted many of the volunteers and staff who dedicate their time, experience, and resources to support students—the future of our science. However, one of the Foundation's most dynamic and enthusiastic groups of contributors to GSA is student members themselves. In recognition of the generous financial support of this group, the GSAF is proud to announce the formation of our student giving circle: Tektonikos: Building the Future.

Tektonikos recognizes the impressive commitment to philanthropic support that GSA's student members demonstrate and provides a way to encourage and recognize student desire to begin giving back to GSA. Students are an important part of our community; in 2017 alone, students accounted for nearly 32% of GSA's membership. Philanthropically, GSAF received 1,122 gifts—nearly 16% of the total number of donations received in 2017—from our student members. The name Tektonikos, voted upon by hundreds of students at each Section Meeting in 2018, comes from the Greek root meaning “to build up,” which reflects this student commitment to the future of GSA.

Joining Tektonikos is simple: Students become members when they give US\$50 in a year, which some choose to fulfill through recurring monthly gifts of just US\$5—roughly the cost of a cup of coffee. GSAF also provides special perks to Tektonikos members. In addition to a specially designed bandana available only to student donors, we will be revealing other benefits as the year progresses. Keep an eye on our News and Events page (<https://gsafweb.org/news-events>) for more information. We also encourage current student donors to visit our booth at the Annual Meeting for a special thank you.

Are you a student member committed to investing in the future of the geosciences? If you are interested in being part of the Tektonikos student giving circle, you can make a one-time or recurring gift at <https://gsafweb.org/donate>. If you would like to learn ways you can share the message with your friends and colleagues, please contact Clifton Cullen at +1-303-357-1007 or ccullen@geosociety.org.



Cliff Cullen, assistant director of individual giving, hands student donor Gavin Davidson of SUNY Cortland a bandana.



GSA student members voting at the GSAF booth during a Section Meeting.



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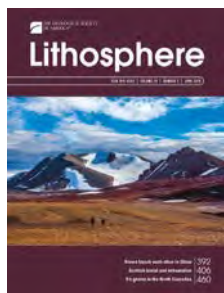
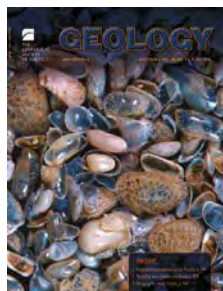


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GSA Publications Milestones



Geology continues its reign as the Journal Citation Reports' #1 ranked geology journal for the twelfth year in a row. According to Clarivate Analytics (formerly Thomson Reuters), it had a 2019 impact factor of 5.073 and a five-year impact factor of 5.451.

The Geological Society of America Bulletin's impact factor was 4.039, with a five-year impact factor of 4.45. GSA Bulletin ranks 19 among multidisciplinary geoscience journals.

Both the impact factor and five-year impact factor soared for *Geosphere*, reaching 2.811 and 2.741 respectively.

The impact factor for *Lithosphere* was 2.766, with a five-year impact factor of 3.195.

While Clarivate Analytics does not produce impact factors for book series, it indexes GSA's Special Papers, Memoirs, and Reviews in Engineering Geology in its Book Citation Index, which is part of the Web of Science.

Explore GSA's journals and books at www.gsapubs.org

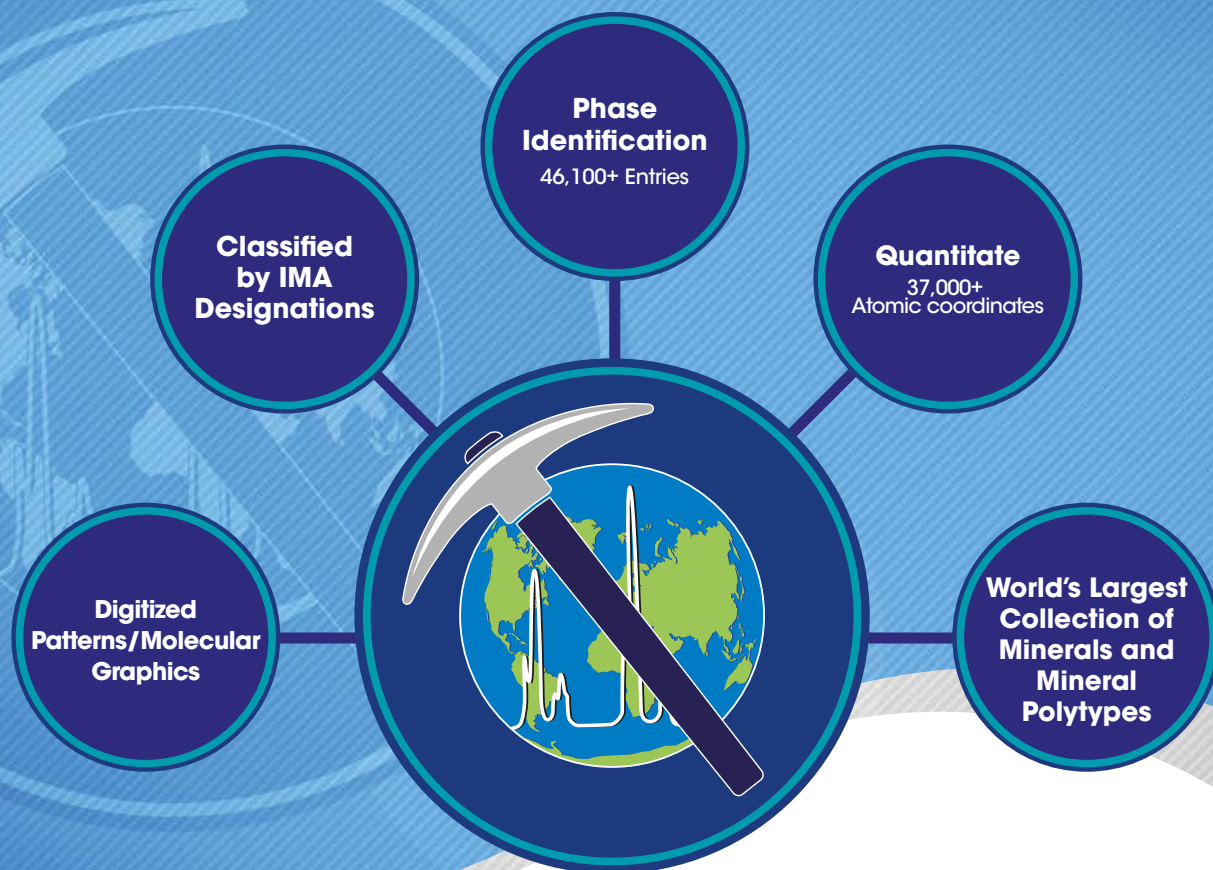


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TAKING ON 21ST CENTURY CHALLENGES CREATING 21ST CENTURY LEADERS

From the Earth’s core to outer space, research at The University of Texas at Austin’s Jackson School of Geosciences is advancing the understanding of our world and beyond for the benefit of humankind.

