


# GSA TODAY

 THE GEOLOGICAL SOCIETY  
OF AMERICA®

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## Establishing an Ethic of Sampling for Future Generations of Geoscientists

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# Field Excursions in the Front Range and Wet Mountains of Colorado for GSA Connects 2022

*Edited by Kevin H. Mahan and Lynne Carpenter*

The three field guides in this volume, associated with GSA Connects 2022 held in Denver, Colorado, USA, tackle some interesting aspects of Colorado geology and paleontology. Learn about dinosaur tracks, microbial mat, and applied photogrammetry at Dinosaur Ridge; explore the nature and extent of the Mesoproterozoic Picuris orogeny in Colorado; and learn more about Paleoproterozoic tectonics of the northern Colorado Rocky Mountains Front Range in the context of the authors' proposed tectonic models.

FLD064, 66 p., ISBN 9780813700649

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# GSA TODAY

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**Cover:** Hikers pass by a series of visible sampling holes cored into the Jurassic sandstone on the Upheaval Dome trail, Island in the Sky District, Canyonlands National Park, southeast Utah, USA. Photo by M. Chan, 2022. See related article, p. 16–18.



## GSA CONNECTS 2023

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# Register Today for Best Pricing!

## REGISTRATION

**Early Pricing Deadline:** 11:59 p.m. MDT on 13 Sept.

**Cancellation/Refund Deadline:** 11:59 p.m. MDT on 20 Sept.

Take advantage of early registration prices and ensure your spot on field trips, short courses, and events by registering now:

[community.geosociety.org/gsa2023/registration](https://community.geosociety.org/gsa2023/registration).

## TRAVEL & HOUSING

Have you made your hotel reservation yet for Connects 2023?

Please reserve your room before 20 Sept. to ensure you receive the special GSA room block rates: [community.geosociety.org/gsa2023/travel/travel-housing](https://community.geosociety.org/gsa2023/travel/travel-housing).

## ROOM SHARING/RIDE SHARING

Use the GSA Roommates & Rides community at [community.geosociety.org/gsa2023/travel/rooms-rides](https://community.geosociety.org/gsa2023/travel/rooms-rides) to post about sharing housing, airport shuttles, and/or carpool during the meeting.

## STUDENT VOLUNTEERS

GSA Student Members: Help us out by volunteering to work at least 10 hours at the meeting, and we'll help you out by covering the cost of your registration! See how the meeting works from the inside and fill vital roles that help to make the meeting a success for everyone.

The Student Volunteer Program is now open for GSA student members in good standing to sign up. Detailed information and sign-up links can be found at [community.geosociety.org/gsa2023/registration/volunteers](https://community.geosociety.org/gsa2023/registration/volunteers).

## EVENTS REQUIRING TICKETS/ADVANCE REGISTRATION

Several GSA divisions and associated societies will hold breakfasts, lunches, receptions, and awards presentations that require a ticket and/or advance registration. See the meeting website for a complete list: [community.geosociety.org/gsa2023/ticketed](https://community.geosociety.org/gsa2023/ticketed).

Ticketed events are open to everyone, and tickets can be purchased in advance when you register. If you are not attending the meeting but would like to purchase a ticket to one of these events, please contact the GSA Meetings Department at [meetings@geosociety.org](mailto:meetings@geosociety.org).

## EVENT SPACE REQUEST

The LAST day to submit a request for event space and event listing is 1 Sept.: [community.geosociety.org/gsa2023/connect/events/plan](https://community.geosociety.org/gsa2023/connect/events/plan).

## CONTINUING EDUCATION UNITS

GSA offers continuing education units (CEUs) valid toward continuing education requirements for employer, K-12 school, or professional organizations. Please check the GSA Connects 2023 website after the meeting to download your CEU certificate.

## TRAVEL GRANTS

You still have time to apply for grants. Various groups are offering grants to help defray your costs for registration, field trips, travel, etc., for GSA Connects 2023. Check the website at [community.geosociety.org/gsa2023/travel-grants](https://community.geosociety.org/gsa2023/travel-grants) for application and deadline information. Note: Eligibility criteria and deadline dates may vary by grant. The deadline to apply for the GSA Student Travel Grant is 13 Sept.

## CHILDCARE

GSA will not be providing childcare services within the Convention Center in Pittsburgh; however, we have teamed up with a local childcare service that offers individual reservations based on your needs. The cost is the responsibility of the attendee. For more information, please visit [jovie.com](https://jovie.com). To speak with the owner specifically, contact Nikki Rimer at +1-412-837-2353 or [nrimer@jovie.com](mailto:nrimer@jovie.com) or use this link to schedule a meeting: <https://calendly.com/nrimer>.



## ENCOURAGING POSITIVE MENTAL HEALTH IN THE GEOSCIENCES

Pardee Session on Tuesday, 17 Oct. from 1:30–5:30 p.m.  
Pittsburgh, Pennsylvania

Learn about coping strategies, resources, and organizational tools that can be used to facilitate accessibility, healing, and good mental health.

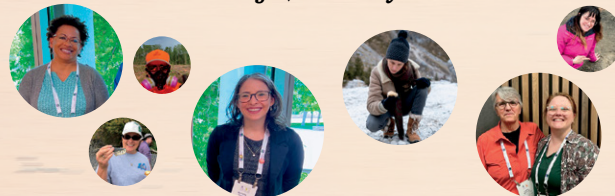


Examples will be highlighted, and suggestions will be given to help create a safe working environment for geoscientists that is conducive to good mental health.



## SPOTLIGHT ON POSITIVE AND DIVERSE FEMALE ROLE MODELS

Monday, 16 Oct. from 1:30–5:30 p.m.  
Pittsburgh, Pennsylvania



This session will be followed by the popular Women in Geology Mentor Reception from 5:30–7:00 p.m. enabling you to meet with positive, diverse role models.



Association for Women Geoscientists



## BE A MENTOR

- On To the Future Mentor
- Résumé/CV Mentor
- Drop-in Mentor
- GeoCareers Day Table Mentor
- Women in Geology Mentor
- Networking Event Mentor

Sign up to share your story and meet with students!

[community.geosociety.org/gsa2023/geocareers](https://community.geosociety.org/gsa2023/geocareers)  
&  
[www.geosociety.org/mentors](https://www.geosociety.org/mentors)



# Become a RISE Liaison



## LET'S WORK TOGETHER TO PROMOTE SAFE, PROFESSIONAL EVENTS

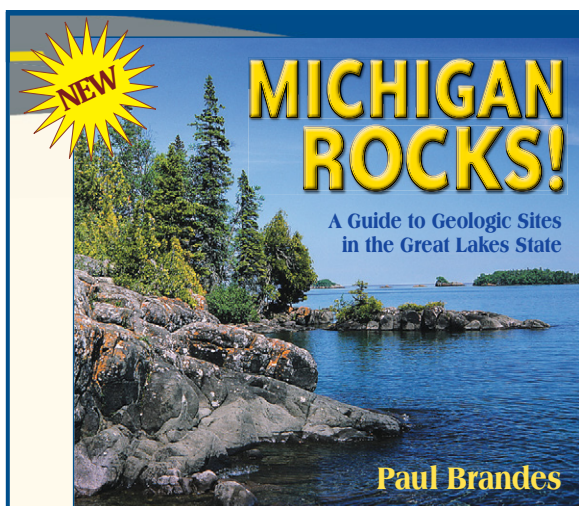
RISE stands for Respectful, Inclusive Scientific Events, and it embodies GSA's commitment to running safe, professional scientific meetings and events. Through

RISE, we aim to foster an environment where all individuals can participate fully in an atmosphere that feels safe, respectful, and professional. RISE also drives awareness of GSA's Events Code of Conduct, which ensures that all concerns are addressed as quickly, fairly, and confidentially as possible.

RISE Liaisons play a vital role in keeping our meetings safe and professional. By wearing RISE pins, these volunteers are visible allies, ready and willing to help GSA identify potential issues before they become problems.

Becoming a RISE Liaison is easy. It requires watching a 15-minute training video and completing a verification form. We hope you will consider volunteering for this meaningful role in time for GSA Connects 2023!

[www.geosociety.org/rise-liaison](http://www.geosociety.org/rise-liaison)



## MICHIGAN ROCKS!

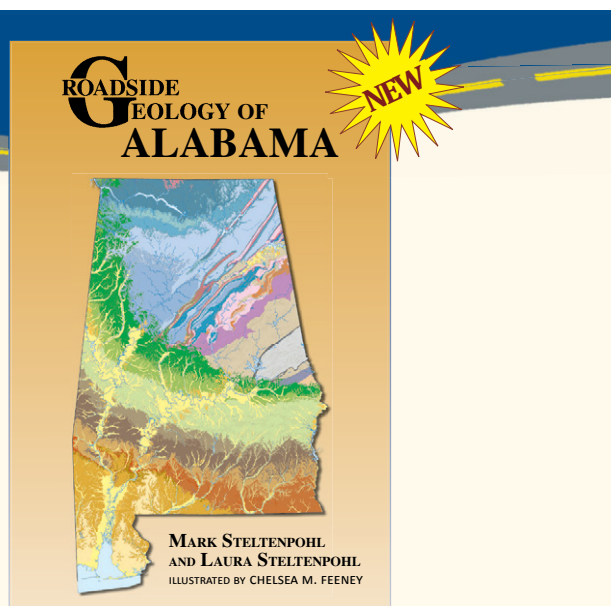
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## ROADSIDE GEOLOGY OF ALABAMA

**MARK STELTENPOHL AND LAURA STELTENPOHL  
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The authors intertwine the geology with cultural stories, legends, and history to paint an enjoyable picture of how Alabama and its rocks came to be.

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## WAYS TO ATTEND AND SAVE MONEY

- Use the Roommates & Rides community
- Be a student volunteer and receive complimentary registration
- Apply for travel grants
- Register by 13 Sept. for best pricing



**REGISTER NOW**

[community.geosociety.org/  
gsa2023/registration](https://community.geosociety.org/gsa2023/registration)



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## STUDENT AND EARLY CAREER NIGHT AT THE MUSEUM

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TICKETS: \$65**

# Short Courses

*Learn and explore a new topic. Build your skills.*

**Early registration deadline:** 13 Sept.

Early registration is highly recommended to ensure that courses will run.

**Registration after 13 Sept.** will cost an additional US\$30.

**Cancellation deadline:** 20 Sept.

**Can I take a short course if I am not registered for the meeting?** YES! You're welcome to—just add the meeting non-registrant fee (US\$55) by 13 Sept. 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 non-registrant fee.

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


See [community.geosociety.org/gsa2023/short](https://community.geosociety.org/gsa2023/short) or contact Jennifer Nocerino, [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org), for course abstracts and additional information.


## ONLINE COURSES

**501. How to Create Your Own 3D Video Game–Style Geologic Field Trip and Host it Online: Accessible, Immersive Data Visualization for Education and Research.** Fri., 6 Oct., 9:30 a.m.–5 p.m. EDT. US\$40. Limit: 40. CEU: 0.65. **Instructors:** Mattathias (Max) Needle, University of Washington; Juliet Crider, University of Washington; Jacky Mooc, University of Washington; John Akers, University of Washington. **Course Endorser:** *GSA Structural Geology and Tectonics Division.*

   **502. How the Natural Environment Gets Away with Murder: Medical Geology Fundamentals and Applications.** Fri., 6 Oct., 11 a.m.–6 p.m. EDT. US\$55 professionals; US\$25 students. Limit: 40. CEU: 0.6. **Instructors:** Laura Ruhl, Independent; Robert Finkelman, University of Texas at Dallas; Reto Gieré, University of Pennsylvania; Malcolm Siegel, Water Resources Action Project. **Course Endorsers:** *GSA Geology and Health Division; International Medical Geology Association.*





## FRIDAY COURSES

 **503. Introduction to ArcGIS Pro for Planetary Geology.** Fri., 13 Oct., 8:30 a.m.–4:30 p.m. US\$30. Limit: 40. CEU: 0.7. **Instructor:** Zoe Ponterio, Cornell University.





 **504. Understanding Carbonates for Sustainability and the Energy Transition.** Fri., 13 Oct., 8:30 a.m.–4:30 p.m. US\$112. Limit: 40. CEU: 0.7. **Instructors:** Jean Hsieh, Sedimentary Geology Consultants; Rob Forkner, BlackDiamond Exploration LLC. **Course Endorsers:** *GSA Sedimentary Geology Division; GSA Energy Geology Division; Society for Sedimentary Geology (SEPM).*

**505. Methods and Geological Applications in Geo-Thermo-Petro-Chronology I.** Fri., 13 Oct., 9 a.m.–5 p.m. US\$30. Limit: 50. CEU: 0.7. **Instructors:** George Gehrels, University of Arizona; Michelle Foley, University of Arizona; Kurt Sundell, Idaho State University; Sarah George, University of Oklahoma. Part II of this short course takes place on Saturday (517).

## FRIDAY–SATURDAY COURSE

    **506. Sequence Stratigraphy for Graduate Students.** Fri.–Sat., 13–14 Oct., 8 a.m.–5 p.m. US\$25 (those who complete the course will receive two free GSA ebooks of their choice—a US\$25 value). Limit: 40. CEU: 1.6. **Instructors:** Morgan Sullivan, Chevron Energy Technology Company; Bret Dixon, Tall City Exploration; Fabien Laugier, Chevron Energy Technology Company. **Course Endorser:** *Chevron Technology Center.*

## SATURDAY COURSES

    **507. Introduction to Field Safety Leadership.** Sat., 14 Oct., 8 a.m.–5 p.m. US\$95 professionals; US\$75 students. Limit: 40. CEU: 0.8. **Instructors:** Kevin Bohacs, KMBohacs GEOconsulting LLC; Kurt Burmeister, Century House Historical Society; Greer Barriault, ExxonMobil Upstream Research Company. **Course Endorser:** *KMBohacs GEOconsulting LLC.*

**508. On To the Future and GSA Associated Societies Expo: Finding Your Pathway to Geosciences Professions.** Sat., 14 Oct., 8 a.m.–5 p.m. By invitation only to On To the Future participants and alumni; workshop fee for invitees will be provided from NSF

## INDUSTRY TRACKS

GSA's short courses offer sessions relevant to applied geoscientists. Look for these icons, which identify sessions in the following areas:



Economic Geology



Energy







Engineering










Hydrogeology and  
Environmental Geology




grants #1801569 and #2037271. Limit: 150. CEU: 0.8. **Instructors:** Stephen Boss, University of Arkansas; Kathy Ellins, University of Texas, Austin (retired); Julia Clarke, University of Texas, Austin; Adam Papendieck, University of Texas, Austin; Elizabeth Long, Geological Society of America. **Course Endorser:** *National Science Foundation (Awards #1801569 and #2037271).*




    509. **Innovative Tools for Project Management in Academia.** Sat., 14 Oct., 8 a.m.–5 p.m. US\$124. Limit: 40. CEU: 0.8. **Instructors:** Amanda Godbold, University of Southern California; Deborah Coyle, incepta inc.




    510. **Talking Science: A Communicating Science Workshop.** Sat., 14 Oct., 8 a.m.–5 p.m. US\$15. Limit: 40. CEU: 0.8. **Instructor:** Steven Jaret, Kingsborough Community College. **Course Endorsers:** *GSA Planetary Geology Division; National Science Foundation Integrated Earth Science project EAR-1814051.*





   511. **Resistivity Surveying: Getting the Best and Making the Most from Electrical Resistivity Tomography and Induced Polarization Data.** Sat., 14 Oct., 8 a.m.–5 p.m. US\$120. Limit: 40. CEU: 0.8. **Instructors:** Morgan Sander-Olhoeft, Guideline Geo Americas Inc.; Makayla Shoup, Guideline Geo Americas Inc. **Course Endorser:** *Guideline Geo.*

512. **Quantitative Analysis, Visualization, and Modeling of Detrital Geochronology Data.** Sat., 14 Oct., 8 a.m.–5 p.m. US\$100 professionals; US\$25 students. Limit: 40. CEU: 0.8. **Instructors:** Joel Saylor, University of British Columbia; Kurt Sundell, Idaho State University; Jack Fekete, University of Arkansas.

 513. **Using the StraboSpot and StraboMicro Data Systems for Geology.** Sat., 14 Oct., 8 a.m.–5 p.m. US\$20 (those who complete the course will receive two free GSA ebooks of their choice—a US\$20 value). Limit: 40. CEU: 0.8. **Instructors:** Doug Walker, University of Kansas; Julie Newman, Texas A&M University. **Course Endorser:** *GSA Structural Geology and Tectonics Division.*

   514. **Ground-Penetrating Radar—Principles, Practice, and Processing.** Sat., 14 Oct., 8:30 a.m.–4:30 p.m. US\$75. Limit: 40. CEU: 0.7. **Instructor:** Greg Johnston, Sensors & Software Inc. **Course Endorser:** *Sensors & Software Inc.*

   515. **How to Build a Digital Crust.** Sat., 14 Oct., 9 a.m.–4:30 p.m. US\$100; scholarships available: see <https://digitalcrust.org> or inquire at [daven.quinn@wisc.edu](mailto:daven.quinn@wisc.edu) for more info. Limit: 40. CEU: 0.65. **Instructors:** Daven Quinn, University of Wisconsin–Madison; Snir Attia, New Mexico Institute of Mining and Technology; William Gearty, American Museum of Natural History; Benjamin Linzmeier, University of South Alabama; Lucia Profeta, Columbia University; Akshay Mehra, University of Washington. **Course Endorsers:** *GSA Geoinformatics and Data Science Division; GSA Structural Geology and Tectonics Division; GSA Geochronology Division.*



    516. **Introduction to OpenTopography for Research and Education.** Sat., 14 Oct., 9 a.m.–5 p.m. US\$35. Limit: 40. CEU: 0.7. **Instructors:** Christopher Crosby, EarthScope Consortium; Ramon Arrowsmith, Arizona State University. **Course Endorser:** *OpenTopography.*

517. **Methods and Geological Applications in Geo-Thermo-Petro-Chronology II.** Sat., 14 Oct., 9 a.m.–5 p.m. US\$30. Limit: 50. CEU: 0.7. **Instructors:** Mauricio Ibanez-Mejia, University of Arizona; Peter Reiners, University of Arizona; Kendra Murray, Idaho State University; Allen Schaen, University of Arizona. Part I of this short course takes place on Friday (505).

518. **Virtual Reality in Geoscience Education.** Sat., 14 Oct., 9:30 a.m.–5 p.m. US\$118. Limit: 30. CEU: 0.65. **Instructors:** Kelly Best Lazar, Clemson University; Stephen Moysey, East Carolina University.

## HALF-DAY SATURDAY COURSES

519. **How to Have Productive Conversations with People about Science.** Sat., 14 Oct., 8 a.m.–noon. US\$50 professionals; US\$35 students. Limit: 40. CEU: 0.4. **Instructors:** Denise Hills, Advanced Resources International Inc.; Beth Bartel, Michigan Technological University; Eliana Perlmutter, Independent; Jansen Smith, Geozentrum Nordbayern. **Course Endorsers:** *GSA Geology and Society Division; GSA Geology and Public Policy Committee; GSA Energy Geology Division; GSA Geoscience Education Division; GSA Geology and Health Division.*

  520. **Deep-time.org: The One-Stop Online Research Platform for Geoscientists.** Sat., 14 Oct., 8 a.m.–noon. US\$50 professionals; US\$30 students. Limit: 40. CEU: 0.4. **Instructors:** Linshu Hu, Zhejiang University; Xinbing Wang, Shanghai Jiao Tong University; Junxuan Fan, Nanjing University; James Ogg, Chengdu University of Technology. **Course Endorser:** *International Union of Geological Sciences (IUGS)'s Deep-Time Digital Earth.*





521. **Open & FAIR Mineral Data: Best Practices for Sharing and Reusing Observations from the Field and Lab.** Sat., 14 Oct., 8 a.m.–12 p.m. (noon). US\$50. Limit: 40. CEU: 0.4. **Instructors:** Kerstin Lehnert, Columbia University; Lucia Profeta, Columbia University.

522. **Building Better Broader Impacts (and Evaluation) for NSF Grant Proposals.** Sat., 14 Oct., 1–5 p.m. US\$140. Limit: 40. CEU: 0.4. **Instructors:** Amy Myrbo, Amiable Consulting; Shirley Jackson, York College/CUNY; Cheryl Manning, Northern Illinois University.




523. **Voices of Integrating Culture in the Earth Sciences (VOICES).** Sat., 14 Oct., 1–5 p.m. US\$109. Limit: 40. CEU: 0.4. **Instructors:** Lisa White, University of California, Museum of Paleontology; Wendy Todd, University of Minnesota Duluth.

# Scientific Field Trips

Descriptions and leader bios are online at [community.geosociety.org/gsa2023/field](https://community.geosociety.org/gsa2023/field).  
ECP—early-career professional.


    **401. Underground Treasures: Exploring the Stunning Caves of Tennessee and Kentucky.** Thurs.–Sat., 12–14 Oct. US\$957. Cosponsor: *Edmunds Central School District*. Leader: Spencer Cody, Edmunds Central School District, [Spencer.Cody@k12.sd.us](mailto:Spencer.Cody@k12.sd.us).

Join us on an exciting three-day adventure in discovering some of America's most remarkable underground geological wonders as we experience the caves of Tennessee and Kentucky. Day one will begin in Atlanta, where we will load our 15-passenger van. Our first stop will take us deep into Lookout Mountain above Chattanooga, Tennessee, to see the tallest and deepest underground waterfall in the United States, Ruby Falls. We will continue into the foothills of the Smoky Mountains to explore the Craighead Caverns cave system and see The Lost Sea, America's largest underground lake. Our final stop will take us to Tuckaleechee Caverns below Smoky Mountains National Park with its remarkable stadium-size "Big Room" of formations. We'll spend the night in Knoxville. Day two will take us up into Kentucky to Bowling Green's Lost River Cave through chert and limestone formations traversing the underground river via boat. Additionally, Lost River Cave has a remarkable blue hole formation that sinks into a deeper underground river. Next, we will head up to Cave City to tour Crystal Onyx Cave. We will then head into Mammoth National Park to explore the remarkable formations of Great Onyx Cave on a lantern tour with lodging in Cave City. On day three, we will conclude our caving adventure in grand fashion with the Grand Historic Tour of Mammoth Cave to learn about the cave's amazing geological features and interesting history. After the tour, we will head up to Pittsburgh to drop off field trip attendees at the convention center.

   **402. Examining Late Paleozoic Paleosol Records across Outcrop to Nanoscales for Climatic and Environmental Signals.** Fri.–Sat., 13–14 Oct. US\$503. Cosponsor: *Sedimentary Geology Division*. Leader: Amy Weislogel, West Virginia University, [amy.weislogel@mail.wvu.edu](mailto:amy.weislogel@mail.wvu.edu).

This is a hybrid field trip/workshop aimed at advancing the application of automated mineralogy to paleosol characterization. During day one, we will visit approximately four to five Upper Pennsylvanian–lowermost Permian outcrops in southwestern Pennsylvania (mainly Dunkard Group) that display a range of paleosols records (Vertisols, Oxisols, Spodosols, and Histosols) of late Paleozoic ice age environmental change. During day two,

participants will be provided with a compositional assessment of the paleosols we visited, including bulk-rock mineralogy/geochemistry and automated mineralogy, to discuss data analysis and interpretation. If time permits en route back to Pittsburgh, we will visit additional outcrops to continue this discussion. During day one, for each outcrop, we will examine macroscale features augmented with smaller-scale observations from optical microscopy. We will discuss sampling strategy/protocols for spatially nested observations from outcrop to nanoscale. During day two, we will evaluate traditional bulk-rock geochemistry versus automated mineralogy and consider potential future avenues of research that can leverage a "big data" approach to environmental reconstruction from paleosols using automated mineralogy, including assessment of environmental indices. This trip will appeal to sedimentologists interested in the application of cutting-edge automated mineralogy to paleosol characterization, as well as to sedimentary geologists more broadly interested in late Paleozoic ice age climate dynamics, terrestrial/critical zone deposits, and terrestrial paleobiology. Additionally, some paleosols in the region, particularly those associated with coal horizons, have been shown to host high concentrations of critical elements that are potential feedstock for batteries in the transition to green-energy or low-to-no-carbon energy systems.

 **403. Hydrology and Geology of the Fernow Experimental Forest.** Fri.–Sat., 13–14 Oct. US\$755. Leaders: Jill Riddell, West Virginia University, [jlridell@mix.wvu.edu](mailto:jlridell@mix.wvu.edu); Benjamin Rau; Christopher Russoniello.

The Fernow Experimental Forest (FEF), in Parsons, West Virginia, was set aside in 1934 as a research forest within the Monongahela National Forest. In 1950, small head watersheds in the western portion of FEF were delineated and subjected to different silvicultural treatments. Temperature, discharge, and water chemistry have been monitored in these watersheds for approximately 60 years. The bedrock geology dips to the east with layered sandstone and limestones exposed in the west and east, respectively, of NNE-flowing Elk Lick Run. Small-gauged head watersheds discharge into Elk Lick Run, which discharges into the Cheat River. New research in the FEF seeks to monitor stream temperature in the small head watersheds throughout the FEF and in Elk Lick Run to evaluate the effects of watershed morphology and bedrock geology on stream temperature. This field trip will consist of stops at established watersheds in the FEF to

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demonstrate the effectiveness of robust long-term data collection; road cuts and outcrops of the bedrock geology to observe the underlying units in the FEF; the confluence of the Cheat River to observe the scale of the hydrology of the region; and the Timber and Watershed Laboratory in Parsons, West Virginia, to showcase the historical and modern significance of research forests to the scientific community. We invite all persons with an interest in hydrology, geomorphology, geochemistry, or sedimentary geology to join us to explore and discuss the complex relationships between surface hydrology and bedrock geology. This trip is accessible to persons able to ride in a car.

  **404. Geologic Setting and Organic Architecture of Fallingwater, Frank Lloyd Wright's Masterpiece.** Fri., 13 Oct. US\$127 professionals and early career professionals; US\$20 students. Cosponsor: *Earth Science Excursions, LLC*. Leaders: Fred Zelt, fbzelt@aol.com; Jim Shaulis; Grant Wach.

We will tour the interior and grounds of Fallingwater, a cantilevered residence that was built atop Pennsylvanian Pottsville Sandstone and a waterfall on Bear Run in the scenic Laurel Highlands east of Pittsburgh. Fallingwater is a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site, has received many architectural honors, and is regarded by many as Frank Lloyd Wright's architectural masterpiece. The house and grounds represent exemplary blending of the natural environment with a structure that fulfilled the requirements of the original owners. In addition to being built on a sandstone outcrop, local sandstone was built into the exterior and interior of Fallingwater. For example, the living room was designed so that natural sandstone crops out from the floor in a focal point near the fireplace. This field trip is an opportunity to explore one of the most famous structures in the world in October when deciduous trees on the grounds and in the Laurel Highlands should be showing autumn colors.

We encourage student member participation with a reduced registration fee for this trip. Anyone is welcome regardless of ability. The trip offers students an opportunity to meet with their peers, expand their network, and interact with a group of professionals with diverse viewpoints. They will have an opportunity to learn in the field with an expert who will highlight local geology. We'll end the day with the option of dinner together and further discussion.



 **405. Central Pennsylvania Springs and Karst in Honor of William B. White.** Sat., 14 Oct. US\$168. Cosponsors: *Laura Toran; Ellen Herman*. Leader: Laura Toran, Temple University, ltoran@temple.edu.

Attendees will visit classic Pennsylvania karst features where some of the foundational karst work in the United States was conducted by Will White and his colleagues and students. We will examine some of the springs described by Shuster and White in their 1971 publication and compare the results of that study, which relied on biweekly sampling, to more recent high-frequency sampling. Data loggers and stormwater sampling used to characterize springs more recently will be demonstrated. We will also visit caves, sinkholes, and a large and well-known road cut through the karst-forming Ordovician carbonates of the folded Valley and Ridge physiographic province.

**406. Drake Well: Understanding the Birthplace of the Oil Age and its Historical Human and Environmental Impacts.**

Sat., 14 Oct. US\$144. Cosponsors: *History of Earth Sciences Society; GSA History and Philosophy of Geology Division*. Leaders: Renee Clary, Mississippi State University, rclary@geosci.msstate.edu; Stephen Boss; William R. Brice; Christy Hyman.

Edwin Drake's first commercially drilled oil well in the United States ushered in an "Oil Age" that impacted the trajectory of geology and humankind. Renowned historian of petroleum geology Dr. William "Bill" Brice leads the field excursion to the Drake Well Museum and Park in Titusville, Pennsylvania, for a daylong exploration of the immediate impact of oil production in Pennsylvania and the long-term legacy of the Oil Age for humanity. The state park includes multiple exhibits detailing the geology and technology of the Drake Well—including some of the historic indigenous oil-seep sites, a full-scale replica of Drake's original drilling shack and derrick, plus several other original outdoor equipment exhibits. We will examine local stratigraphy and learn why there would have been no Drake Well discovery if Drake sited his well ~100 m in any direction from where it is. Other excursion stops include William Andrew "Uncle Billy" Smith's gravesite (the 1859 driller of the Drake Well), the Edwin Drake grave and memorial, and Pithole, the remnants of an oil boom town that grew into a major population center and the third largest Pennsylvania post office in a few quick years. Dr. Christy Hyman (Mississippi State University) interweaves petroleum's legacy—both positive and negative—to address the landscape, human impacts, and environmental justice issues of the petroleum industry.


  **407. Overview of Environmental and Engineering Geology and Geohazards with a Virtual Field Trip to Landslides near Pittsburgh.** Sat., 14 Oct. US\$205. Cosponsors: *Pittsburgh Geological Society; GSA Environmental and Engineering Geology Division*. Leader: James Hamel, jvhamel3918@gmail.com.

In an effort to expose GSA's On To the Future students and young professionals to career possibilities in the applied geosciences, the Association of Environmental and Engineering Geologists (AEG) is hosting this applied geosciences career discussion and virtual field trip (VFT) to the Interstate Route 79 and Toms Run Nature Reserve Landslide Areas, 9 miles (14 km) northwest of Pittsburgh. This career presentation and VFT are endorsed by the Pittsburgh Geological Society (PGS) and the GSA Environmental and Engineering Geology Division. AEG members will present a brief overview of applied geoscience careers in environmental and engineering geology, geohazards, and landsliding in southwestern Pennsylvania. The field trip leader will lead participants through the VFT, with questions and discussion at the end of each trip segment. This Google Earth-based VFT was prepared in lieu of an in-person field trip planned as part of the 75th anniversary celebration of the PGS in March 2020, which was canceled due to COVID-19. The in-person field trip was run in April 2022, and its guidebook is available on the PGS website: [https://pittsburghgeologicalsociety.org/uploads/pubs/Interstate\\_Route\\_79\\_and\\_Toms\\_Run\\_Nature\\_Reserve\\_Landslide\\_Areas\\_North\\_of\\_the\\_Ohio\\_River\\_and\\_Northwest\\_of\\_Pittsburgh\\_March\\_2022.pdf](https://pittsburghgeologicalsociety.org/uploads/pubs/Interstate_Route_79_and_Toms_Run_Nature_Reserve_Landslide_Areas_North_of_the_Ohio_River_and_Northwest_of_Pittsburgh_March_2022.pdf). Participants will be provided electronic access to the PGS VFT and guidebook along with 1–2 page handouts on environmental and engineering geology, geohazards, and landsliding in southwestern Pennsylvania. There


will be no formal GSA guidebook. Participants should bring a laptop computer and provide a Gmail address (for access to the PGS VFT) to the trip leader a minimum of two weeks prior to the event.

**408. Paleoenvironmental and Tectonic Implications of an Upper Devonian Glaciogenic Succession from East-Central West Virginia, USA.** Sat., 14 Oct. US\$201. Leaders: Frank Ettensohn, University of Kentucky, fettens@uky.edu; D. Clay Seckinger; David P. Moecher; Cortland F. Eble.

The trip examines a single, long exposure along U.S. Highway 48 near Bismarck in east-central West Virginia that includes upper parts of the Hampshire Formation and overlying parts of the lower Price Formation, all of which are Late Devonian in age. Lower parts of the Price Formation (Rockwell Member) contain a controversial unit with diamictites of likely glaciogenic origin. The mere presence of the diamictites, as well as the age and source of contained clasts and matrix, based on detrital zircon provenance, suggests important implications relative to coeval tectonism and unroofing of the orogen. Moreover, unusual sedimentary facies and soft-sediment deformation in parts of the Rockwell Member may be related to synsedimentary activity on the nearby West Virginia Dome. The sedimentary succession in this exposure is unique and provides opportunities to discuss interpretations related to age, sedimentary facies, eustasy, glaciation, local structural activity, and regional tectonism.

 **409. The Cultural Geology of Youngstown: Geological Setting, Building and Decorative Stones, Iron and Steel Heritage, and More.** Sat., 14 Oct. US\$203. Leaders: Joseph Hannibal, jhannibal@uakron.edu; Brigitte Petras; Colleen McLean.

This trip will provide an overview of the geological setting of Youngstown, Ohio, along the Mahoning River and the major building and decorative stones used in Youngstown, notably the marble cladding of the Butler Museum of American Art (which has seen some deformation), the Kasota stone (Oneota Dolostone) used for St. Columba Cathedral (which is full of fossil burrows), and stones used in beautiful Oak Hill Cemetery. It will also include visits to the Museum of Industry and Labor, which features exhibits related to the iron and steel industry of the region, and the Clarence R. Smith Mineralogy Museum. The trip will include discussion of the relationship of Youngstown with Pittsburgh and the canal system that once linked the two steel cities.


 **410. The Warren Hamilton Field Trip: Special Geologic Features of Ohiopyle State Park, Pennsylvania.** Sat., 14 Oct. US\$160. Cosponsor: *Earth Science Excursions LLC*. Leaders: Fred Zelt, fbzelt@aol.com; Jim Shaulis; Frank Pazzaglia.

With waterfalls and the deepest gorge in Pennsylvania, Ohiopyle State Park provides opportunities to observe a variety of habitats,

three-dimensional exposures of the Pennsylvanian sandstone most responsible for shaping Laurel Highlands landscapes, and evidence for the relationship between Pleistocene–Holocene climate cycles, landscape evolution, and knickpoint migration rate in a periglacial highland setting. Ohiopyle is one of the most popular public lands in the region, and the relationships among geology, ancient climates, and the landscape can be observed on an excursion to some of the most scenic natural features of the park: Baughman Rock Overlook, Cucumber Falls, Ohiopyle Falls, Meadow Run Waterslide, and Youghiogheny River Entrance Rapid. We will visit outcrops of fluvial/deltaic sandstones within the Pennsylvania Pottsville Formation and discuss evidence for penecontemporaneous deformation of this part of the Allegheny Plateau during the Alleghenian orogeny. Mapping of Pleistocene river terraces and cosmogenic age dating conducted here in the last few years by Lehigh University geologists have greatly increased current understanding of the evolution of this special landscape. Our hike will include a visit to a 10-m-long *Lepidodendron* fossil. We will walk for as much as 5 km on a sidewalk and hiking paths that have hills, steps, roots, holes, rocks, and uneven ground.



Baughman Rock Overlook at Ohiopyle State Park, Pennsylvania.

 **411. A Land of Ice and Water: An Accessible Introduction to Glacial and Watershed Processes in Western Pennsylvania.** Thurs., 19 Oct. No cost. Cosponsor: *The International Association for Geoscience Diversity (IAGD)*. Leaders: Jennifer Piatek, Central Connecticut State University, piatekjel@ccsu.edu; Anita Marshall; Yesenia Arroyo.

We will explore the geology of western Pennsylvania and the impacts of water on the region's geomorphology in this day trip, which will leverage accessible field trip stops to provide all attendees with an opportunity to interact with the local geology, hydrology, and history. The first part of the trip will explore local and regional geological history visible from Frick Park, located within the Pittsburgh city limits, via landscapes, overlooks, and outcrops along paved trails and park roads. After this introduction

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to the local geology, we will visit two passive treatment systems, one at the Pittsburgh Botanic Garden and one at Wingfield Pines, which were installed to treat net-acidic and net-alkaline coal mine drainage, respectively. Participants will have an opportunity to learn about passive treatment system design, engage in water sampling, and discuss their analysis with local experts to examine the effectiveness of these treatment systems.


This trip is sponsored by the International Association for Geoscience Diversity (theIAGD.org) and is offered at no cost to participants.

**Accessibility:** All field trip locations will include wheelchair-accessible options: stops in Frick Park will utilize park trails and paths, and will require minimal walking. Restroom facilities will be available at the lunch stop and at the Botanic Gardens. Water-sampling stops are within 250 yards of parking areas and can be accessed on low-slope wide paths that will accommodate mobility devices. Driving time between sites will be approximately 30 minutes.


Accommodations such as ASL interpreters will be provided upon request. Everyone is welcome, but in order to ensure that priority is given to geoscience colleagues with disabilities, an application form is required. Learn more and apply at <https://theiagd.org/2023-accessible-field-trip-land-of-ice-and-water-western-pa/>.

 **412. A Short Tour of the Fluviokarst of Southeastern West Virginia.** Wed.–Fri., 18–20 Oct. US\$450. Cosponsor: *West Virginia Geological Survey*. Leaders: John Tudek, [hewhocaves@gmail.com](mailto:hewhocaves@gmail.com); J. Wayne Perkins.




Join us for two and a half days of exploring the exceptional karst of southeastern West Virginia. During this time, we will examine numerous features that make West Virginia southern karst one of the world-class areas for karst exploration. After the close of the conference on the first day, we will travel from Pittsburgh to Lewisburg, West Virginia, passing through and stopping at our newest national park, New River Gorge National Park, and enjoying the view from the overlook at the visitor center. On day two, we will examine some of the many features of the karst in and around the Davis Spring Basin of the Mississippian Period, which is, at ~75 square miles (194 km<sup>2</sup>), the largest karst basin in West Virginia. We will visit a few of the passages in the over 100 miles (161 km) of explored caves in the basin and see multiple inlets to the system as well as the primary outlet—Davis Spring. On day three, we will travel back to Pittsburgh through scenic West Virginia, passing through Germany Valley, home to over 60 miles (97 km) of integrated, possibly hypogenic cave development in Cambrian–Ordovician rocks before stopping at Seneca Rocks to see some of West Virginia’s most spectacular scenery, where vertical beds of the Tuscarora sandstone rise above the limestone valley below. Following this, we will arrive in Pittsburgh in the early evening.

 **413. A Record of the Pleistocene: Periglacial Landforms, Deposits, and Fauna in the Appalachian Highlands of Maryland, West Virginia, and Pennsylvania.** Thurs.–Fri., 19–20 Oct. US\$570. Primary leader: Rebecca Kavage Adams, Maryland Geological Survey, [rebecca.adams@maryland.gov](mailto:rebecca.adams@maryland.gov); coleaders: David K. Brezinski, Maryland Geological Survey, [david.brezinski@maryland.gov](mailto:david.brezinski@maryland.gov); Mitzy Schaney, University of Pittsburgh at Johnstown, [m.schaney@pitt.edu](mailto:m.schaney@pitt.edu); Steve Kite, West Virginia University, [jkite@wvu.edu](mailto:jkite@wvu.edu).

Pleistocene features will be examined at sites in the Appalachian Plateau region of Maryland, West Virginia, and Pennsylvania. The first day will begin at the Carnegie Museum of Natural History in Pittsburgh, observing Pleistocene fossils collected regionally. While in Pittsburgh, we will view terraces created by glacial Lake Monongahela, and then we will proceed to Morgantown, West Virginia, for a look at fine-grained sediments also deposited by glacial Lake Monongahela. The final stop for the day will be in the Laurel Highlands at Mount Davis in southern Pennsylvania, known for polygonal patterned ground formed in periglacial conditions. The second day will include three stops in the Upper Youghiogheny Basin of West Virginia and Maryland. The first of these will be The Nature Conservancy’s Cranesville Swamp. This relict Pleistocene peat bog houses northern flora rare in this region; its pollen record offers a glimpse into climatic changes over the Pleistocene. The second stop will be at the nearby Snaggy Mountain rock maze, the result of frost-heaving in massive Homewood sandstone of the Pottsville Formation. We will view another remnant Pleistocene bog, The Glades, on the way to our fourth and final stop at the Cumberland Bone Cave near Cumberland, Maryland. At this site, a diverse record of Pleistocene fauna was discovered in the early 1900s that is still being studied today.




 **414. Coal to Clean Water: Passive and Active Acid Mine Drainage Treatment Systems in the Pittsburgh Area.** Thurs., 19 Oct. US\$113. Leaders: Benjamin Hedin, [ben.hedin@hedinenv.com](mailto:ben.hedin@hedinenv.com); Rosemary Capo; Robert Hedin.

The Pittsburgh coal seam has been mined in western Pennsylvania for over 200 years. One consequence of coal mining is the generation of acid mine drainage (AMD), which is responsible for orange and white streams in the Pittsburgh area. The field trip will visit an outcropping of the Pittsburgh coal seam and three Pittsburgh coal acid mine drainage (AMD) treatment systems. The trip will highlight different AMD chemistry, due to hydrology, and different treatment technologies. The treatment systems include a passive system treating alkaline AMD with settling ponds and wetlands, a passive system treating acid AMD with limestone, and an active system treating alkaline AMD with hydrogen peroxide.



   **415. George Washington’s Word Broken: Kinzua Dam and the Seneca Nation.** Thurs.–Fri., 19–20 Oct. US\$600. Leader: Patrick Burkhardt, Slippery Rock University, [patrick.burkhardt@sru.edu](mailto:patrick.burkhardt@sru.edu).

The Treaty of Canandaigua was signed on 11 Nov. 1794, between the United States and the Grand Council of the Six Nations. The 50 signatories included Thomas Pickering, agent for George Washington, and Chief Corn Planter (Seneca, Gaiänt’wakê), as well as others of the Cayuga, Mohawk, Oneida, Onondaga, and Tuscarora Tribes of the Iroquois Confederacy. This agreement secured Indigenous Nation lands, including the Allegheny River Watershed, in addition to promises of perpetual peace and friendship. Kinzua Dam (U.S. Army Corps of Engineers), completed in 1965, displaced 600 Seneca members, condemning 10,000 acres that constituted one third of their land, including valuable farmland and fisheries. The Seneca Nation still holds an annual event to Remember the Removal, after the Treaty of Canandaigua was broken by the Kennedy administration. You will see the story of Kinzua Dam, as it is well told in the impressive new Seneca Iroquois Museum. The Long House accommodations for the overnight are also on that property. Watch this trailer to enhance



your understanding: <https://www.lakeofbetrayal.com/>. The Treaty of Canandaigua, one of the first treaties between the United States and Indigenous Nations, was broken again by the eviction and the emplacement of the dam. This trip will depart Pittsburgh, follow the Allegheny River to Kinzua Dam, and then traverse Allegany State Park, New York. Indigenous people will welcome us at the Seneca Iroquois Museum in Salamanca, the location where tribal members were presented 3 acres (0.012 km<sup>2</sup>) apiece in exchange for the condemnation of their lands. An evening will be spent in a local hotel, providing time for meeting all parties, sharing meals, and engaging in cultural exchange likely to include social dancing, storytelling, and viewing collections. The field trip will review the regional geology of the Allegheny Plateau, including the Salamanca Re-entrant of the Laurentide ice sheet. Participants need to expect rustic accommodations, including a plank bunk, so they must bring a sleeping bag, blanket, and pillow.

   **416. Fracking in the Oldest Commercial Oil Field: From Legacy Extraction to Environmental Impacts.** Thurs., 19 Oct. US\$160. Cosponsor: *Pennsylvania State University*. Leaders: Susan L. Brantley, Pennsylvania State University, [sxb7@psu.edu](mailto:sxb7@psu.edu); Tao Wen.

The oldest commercial oil well was in Pennsylvania, leading the state to be the biggest producer of oil in the country. The resulting boom and subsequent development of oil and gas (as well as coal) left hundreds of thousands of operating, abandoned, and orphaned oil and gas wells and coal mines in the state. Most recently, shale-gas companies drill vertical boreholes that are then bent into horizontal orientations to extract gas from source rock (Marcellus Shale and other formations). High-pressure, high-volume hydraulic fracturing ("fracking") is used to release the gas. Development since 2004 has resulted in more than 10,000 shale-gas wells in the state, returning Pennsylvania to the status of a top gas-producing state. Pennsylvania is also one of the top two states for underground gas storage facilities. Shale gas has kept energy costs low, returning money to landowners and the state, and is now replacing some Russian imports in Europe. This has led to acceptance of shale-gas development by some members of the public but pushback on the part of others who note environmental issues and human health impacts thought to be associated with the industry. This trip will emphasize the interplay between extraction and the environment by visiting a subset of these locations (depending upon timing and permissions): a shale-gas well pad; a brine treatment facility; legacy oil and gas wells; and associations between coal mining and gas drilling.

  **417. Postglacial Tectonism and Bluff Erosion of Northern Erie County, Pennsylvania.** Thurs., 19 Oct. US\$229. Cosponsors: *GSA Planetary Geology Division; GSA Structural Geology and Tectonics Division; GSA Quaternary Geology and Geomorphology Division*. Leaders: Nicholas Lang, National Aeronautics and Space Administration, [nicholas.p.lang@nasa.gov](mailto:nicholas.p.lang@nasa.gov); Christopher Dolanc.

This one-day field trip will explore geologic processes that have shaped northern Erie County, Pennsylvania, since glacial retreat in this region. Emphasis will be placed on (1) evidence for postglacial faulting as exposed in strath terraces along local streams, and (2) rates, styles, and causes of bluff erosion along the Lake Erie shoreline.

  **418. Special Geologic Features of the Erie Lakeshore in Northwestern Pennsylvania.** Thurs., 19 Oct. US\$160. Cosponsor: *Earth Science Excursions LLC*. Leaders: Fred Zelt, Earth Science Excursions LLC, [fbzelt@aol.com](mailto:fbzelt@aol.com); Gary Fleeger.

This trip will examine bluffs and beaches on the shoreline of Lake Erie. We will examine till in lakeshore bluffs and view shoreline sands of Pleistocene Lake Warren, a predecessor of Lake Erie, perched atop till. Shoreline erosion and mass wasting have left till-derived pebbles, cobbles, and boulders on beaches. These clasts have a variety of provenances, including outcrops of Devonian limestone, older Paleozoic carbonates, cross-bedded and burrowed quartz sandstones, and a wide variety of metamorphic and igneous rocks. The crystalline rocks include white marble likely derived from outcrops near Ottawa, augen gneiss, garnet gneiss, gray granite, pink granite, and more. We will see beautifully faceted and striated cobbles and small boulders. Although they are in till from the most recent glaciation, many of these clasts probably were carried by a succession of glaciations, and some may have been eroded from very distant outcrops in Canada. We will also examine Upper Devonian bedrock, which underlies till along the lakeshore. The Upper Devonian strata consist of interbedded shales, siltstones, and fine-grained sandstones that were deposited in offshore environments in the Acadian foreland basin. Tempestite sandstones display abundant sole marks, cross-bedding, and, in places, trace fossils. The tops of some sandstone beds include abundant feeding, locomotion, and resting traces, including traces from *Rusophycus*. It is likely that we will visit a lakeshore exposure that requires walking 3 miles (5 km) in a park through savannah and woodland habitats, with uneven ground and a 60-ft-tall (18-m-tall) hill near the lakeshore.

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# Thank you

**Thank you to all of our mentors for volunteering their time to connect and provide insight to students and early career professionals at our GSA Section meetings. Our organization is grateful to have members who are dedicated to giving back to their geoscience community.**

## Southeastern-Northeastern

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Lisa White

# Establishing an Ethic of Sampling for Future Generations of Geoscientists

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## ASSESSING THE ETHICS OF SAMPLING

The growing concerns about the ethics of geologic sampling are relevant to teaching, research, and our geoheritage (Chan and Mogk, 2022). This paper examines our current culture and attitudes on ethics from sample collection to archiving, based on a community survey across multiple professional societies and geoscience disciplines, as well as a Geological Society of America (GSA) Connects 2022 Noontime Lecture Town Hall. Many helpful comments and suggestions from the geoscience community have helped move this process forward toward a consensus on the need for developing standards for ethical geologic sampling. The topic of sampling is complex and exposes values in conflict, with individual examples intimately tied to a particular question being asked; thus, one size does not fit all. Professional societies can provide a valuable service by having clearly stated guidelines for professional practice (e.g., as a requisite for publication), and by developing resources about sampling that can be easily accessed and imported into curricula for training future generations of geoscientists.

## SURVEY RESULTS

A survey made up of 46 questions was beta tested and refined prior to its release to multiple listservs of co-sponsor societies in August 2022, administered by GSA staff. We collected results ( $n = 810$ ) over a three-week open period for responses. All anonymous survey data (see Supplemental Material<sup>1</sup>) were aggregated so that no individuals could be identified. Nearly all questions had a full spectrum of choices, many

with optional comment boxes. The results are briefly summarized in the six categories (A–F) below and served as a springboard for discussion at the GSA Connects 2022 Noontime Lecture Town Hall in Denver, Colorado, USA.

### A. Participant Data

We received data in nearly all sectors of different demographic types, including from all represented subdisciplines across 47 countries (with U.S. emphasis). The majority of respondents were White males, reflecting the common demographic in geological sciences. In the broad range from students to professionals, 61% held Ph.D. degrees. About 65% of respondents were GSA members, 56% were American Geophysical Union (AGU) members, and 92% were affiliated with other societies, reflecting multiple society memberships.

### B. Sampling Practices

Sampling is a critical practice in the geosciences with a variety of purposes: 68% for research, 34% for industrial use, 23% for teaching, and 27% for outreach or other. Roughly half of the survey participants said that in hindsight, they might have sampled differently. Respondents noted the need for sample inventories and documentation, and the responsibility to develop comprehensive metadata, including how and where samples are collected, stored, and shared to optimize their utility by other researchers.

### C. Permissions and Permits

The vast majority of respondents seek appropriate permissions and permits for their sampling and mostly navigate without

problems. Some respondents commented on the value of inviting interaction with landowners, and others noted inconsistent rules between different federal agencies. Particularly in international work, respondents stressed the need for communication and collaboration with resident international colleagues and stakeholders, thereby also addressing the criticism of “helicopter or parachute science,” in which researchers from wealthier countries drop in and conduct research in emerging countries with little or no interaction with local scientists or community members (e.g., Stefanoudis et al., 2021). Respondents suggested that a website, or a panel of experienced expert mentors, should provide guidance and best practices for early-career workers who could use advice on getting started in certain international areas.


### D. Sampling Sampling Process

Most respondents (82%) always or mostly try to minimize their impact on the natural environment when sampling, but at least half (51%) felt that they might have over-sampled at times. About 74% of respondents have seen obvious sampling (on four or more occasions) by previous geoscientists. “Poor judgement” in sampling can have a negative impact on our discipline and the public perception of geoscientists (e.g., Sahagún, 2021). Survey participants indicated that >60% of samples were used for research, but ~16% of collected samples were never analyzed.

### Sample Fate

What is the ultimate fate of collected samples after the sampler’s retirement or

<sup>1</sup>Supplemental Material. Bar graphs showing responses to the GSA Survey on Ethics of Sampling and group discussion questions from GSA Connects 2022 Noontime Lecture Town Hall for the Culture and Ethics of Geologic Sampling. Please visit <https://doi.org/10.1130/GSAT.S.23528430> to access the supplemental material, and contact [editing@geosociety.org](mailto:editing@geosociety.org) with any questions.

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CITATION: Chan, M.A., and Mogk, D.W., 2023, Establishing an Ethic of Sampling for Future Generations of Geoscientists: *GSA Today*, v. 33, p. 16–18, <https://doi.org/10.1130/GSATG559GW.1> © 2023 The Authors. Gold Open Access: This paper is published under the terms of the CC-BY-NC license. Printed in the USA.



end of career? Although 27% think the majority of samples will go to a designated archive or other research or teaching collections (18%), 44% of the respondents either do not know where their samples will go or believe the majority will be discarded. This response stresses the need for examining other alternatives for repurposing or sharing samples, and/or finding appropriate archives, particularly where the samples have the proper locality and scientific documentation. In rare cases, with department closures, reorganization, or refocusing, there may be a loss of curation staff, and samples may be given low priority and/or simply tossed without time to investigate repurposing. Ethics of sample retention and curation are also important, particularly in a changing world where some original collection sites are no longer accessible for physical, social, or political reasons.

## **E. Training, Impact**

Given how important sampling is to our discipline, it is surprising that 63% of respondents have never had any formal training as students on sampling ethics. There is a strong consensus that students want and could use more training in values and ethics in their curriculum. Some students noted that they hear more about “leave no trace” through the outdoor recreation industry. Given how important outdoor interactions are to geologists, ethics training should be a high priority. Many indicated they would welcome resources and materials to help integrate ethics into the curriculum. 91% of respondents feel that sampling in very sensitive sites with strong geoheritage value or cultural and/or spiritual significance might warrant careful review of sampling plans and procedures.

## **F. Actions for the Future**

Although requiring proof of sampling permits can be difficult and sometimes unrealistic, nearly 75% of respondents felt that publications should possibly require a sampling ethics statement. And, going forward, 79% of respondents indicated interest in development and access to teaching or resource materials on the ethics of sampling. Certain geoscience society journals are already implementing codes of publishing ethics and/or mandatory standards that include statements on sampling ethics. As an example on the ethics of fossil sampling, the Society of Vertebrate Paleontology has already developed an ethics code that specifically addresses sampling practices

(SVP, 2023), and that applies to all of their membership and those who publish in their journals or participate in their events. Similarly, the Geological Society of London (GSL, 2023) requires a statement regarding ethical sampling practices in their publications. Expansion of the GSA Code of Ethics & Professional Conduct (GSA, 2023a) to explicitly address ethical sampling practices is a positive action GSA can take to collaborate and provide resources to fill this clear need. GSA has begun to address the issue of sampling ethics and related open access to samples and data in their Ethical Guidelines for Publication (section 3.7, GSA, 2023b) and GSA Data Policy for Publications (paragraph 4, GSA, 2021), but these policies and position statements need to be revisited and strengthened.

## **TARGETED SUGGESTIONS**

Small groups at the GSA Connects 2022 Noontime Lecture Town Hall had spirited discussions targeting five topics (highlights below) that could affect how professional societies can respond.

### **1. On Resources**

Formal training on permitting and the ethics of sampling is highly desirable. Publications, webpages, or online resources with best practices would be useful across all sectors and subdisciplines. Also, checklists and resources for navigating permits and building relationships with land managers (government, tribal, and private) could be useful for many. A central webpage with a good search engine would be immediately relevant.

### **2. On Advice**

It is common to look to our professional societies for advice and professional guidance. Societies can help with information repositories and flow charts for developing field and sampling plans, a possible form or checklist for educational versus research activities, and an advisory board of experienced researchers that can recommend best practices at specific localities. Students may see or find themselves in situations that cause angst about sampling ethics. An advisory board or confidential mentoring could provide valuable advice on how to navigate such difficult situations.

### **3. On Formal Statements**

Position statements are mostly outward looking, but societies could look at internal

commitments to ethics and possibly bolster their existing codes of ethics. Even informal statements can have an impact. One example of a simple action to take would be reading a few sentences on ethics or distributing a code of conduct right at the start of professional or society-sponsored field trips.

## **4. On Publications**

“Leave no trace” should be the core of guiding practices on samples that comprise our published research, but stronger language as part of the journal publications could raise awareness and help train authors on the importance of sampling ethics. Legalities are difficult to enforce, but even strong aspirational statements can give authors pause to reflect on their sampling practices. Ethical statements commonly exist for research practices in other science disciplines (e.g., biological animal testing), and similar guidelines on sampling practices should be developed and universally applied to the geosciences as well.

## **5. On Archiving**

This is a long-term issue involving data standards, sharing provenance, and any archiving of information as well as physical specimens. Various sample registration systems (e.g., System for Earth Sample Registration, SESAR) are aimed at standard archival and retrievable sample information. Several state surveys, museums, and government agencies have local repositories for particular samples that relate to their mission. However, it is a familiar story to hear about samples going to the dumpster after a faculty member retires.

Questions surrounding sensitive lands include: Should some rocks be repatriated in cases where they were taken from areas with cultural or spiritual significance? What are the ethical obligations of long-term care or stewardship of samples under the original sampling agreement? What should be done if conditions or sensitivities change?

What is the responsibility of the investigator after they are done with a sample? In some cases, a rock swap for teaching may be used as an example of how samples can be repurposed. Even if full metadata (i.e., any descriptive data used for discovery and identification) is not available for samples to be of value to research, these may still be representative samples that are of value for teaching collections. Many samples collected for one research project can be repurposed to enable complementary and emerging new

lines of research. A similar exchange of available research samples may be warranted, and this would have the added benefit of expanding collaborative research opportunities across the geosciences.

Along with physical samples, the power of cyberinfrastructure could be both practical and powerful for archiving, such as providing a GIS layer of samples collected (tied to geographic coordinates) with all other informational metadata. However, maintaining database management systems can be very time consuming and expensive.

## GSA'S ROLE IN MOVING ETHICS FORWARD

Multiple societies cosponsored this survey on the ethics of sampling, highlighting a widespread need and desire for collaboration to raise the integrity of our discipline. GSA could be a leader in this area. More specifics on sampling ethics can both leverage and strengthen GSA's 2022 position statement on Responsible Geologic Fieldwork Practices (GSA, 2022), as well as GSA's Code of Ethics & Professional Conduct, Section 3.1 (GSA, 2023a). Ultimately, societies can create task forces and committees to set naming or metadata conventions, as well as garnering solid recommendations and sharable resources that can benefit the science and its society memberships. One new resource recently created from the work that went into this study is a Field Ethics and Sampling checklist decal or sticker that is currently freely available at all GSA meetings (Fig. 1). GSA has also started a website ([www.geosociety.org/fieldethics](http://www.geosociety.org/fieldethics)) for field ethics resources to go with this decal, and more resources will be added to this site over time.

Now is the opportune time for the geoscience community to continue open communication and involvement on the critical topic of sampling ethics, in order to guide and train future generations, and to both conserve and protect our geoheritage.

## ACKNOWLEDGMENTS

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**Figure 1.** New field ethics and sampling checklist sticker that is freely available at GSA meetings and is a quick and easy guide for conducting research in the field.



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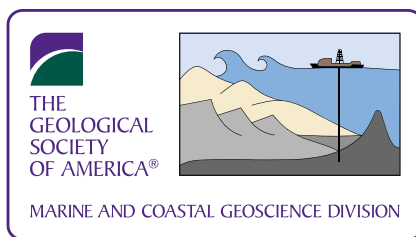
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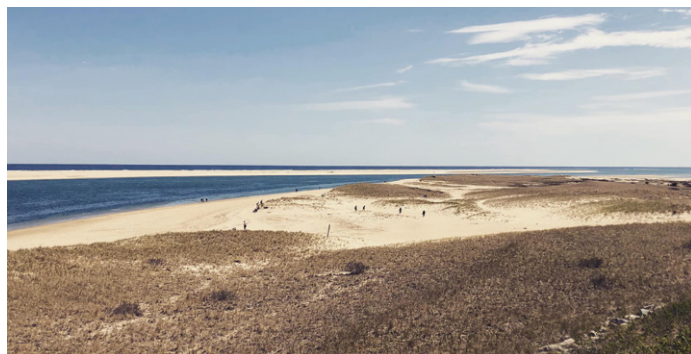


## Dive into the Marine and Coastal Geoscience Division

Whether you are new to GSA, a longtime member, or just never quite knew which division best fit your interests...we want you to know that no matter what sort of geoscience floats your boat, you are welcome aboard the Marine and Coastal Geoscience Division (MCG)!

Established in 2019, the Marine and Coastal Geoscience Division aims to raise the profile of marine and coastal research at GSA. We aspire to create an inclusive and diverse community of scientists working in all areas of geoscience related to the oceans and coasts. Marine and coastal geoscience encompasses the geology and tectonics of the ocean basins; the geology, geomorphology, and environmental processes/hazards affecting the coasts; waves, tides, and currents in the oceans; ocean-land and ocean-atmosphere interactions; geobiology of the oceans; the ocean's role in the climate system, both modern and ancient; and much, much more.

Our goal is to facilitate discussions of questions, ideas, and opportunities in marine and coastal geoscience and promote research and publication in these fields, particularly for early career and student researchers. Check out our biannual newsletter, which regularly features stories and student spotlights from marine and coastal geoscience researchers, teachers, and retirees ([community.geosociety.org/mcgd/resources/newsletters](https://community.geosociety.org/mcgd/resources/newsletters)). Please consider sharing your cool/funny research stories and photos in the Salty Tales and Salty Takes sections of our newsletter and help us promote student research by notifying us of new student-led publications. We are also very excited about our upcoming events at GSA Connects 2023 in Pittsburgh, Pennsylvania! We will be convening the fifth annual Advances and New Voices in Marine and Coastal Geoscience session (GSA early registration deadline is 13 Sept.), and we encourage you to cruise by our booth (in the GSA Bookstore area) and social event to meet the officers (16 Oct.,



5–7 p.m., at Bakersfield, 940 Penn Ave., Pittsburgh, Pennsylvania 15222) and learn more about the division and our goals. We recently launched an annual student art contest where students can design a creative logo for the division. The winning artist will receive free registration for GSA Connects 2023, and their art will be featured on purchasable division goods (T-shirts, bottles, stickers, etc.).

Since we are a new-ish division, we continue to grow and learn how to best support our members, so please communicate with us ([GSAMCGD@gmail.com](mailto:GSAMCGD@gmail.com)). If you would like to be more involved, think about becoming a division member ([community.geosociety.org/mcgd/join](https://community.geosociety.org/mcgd/join)) or joining MCG as a division officer and consider supporting the division student grant efforts ([gsa-foundation.org/fund/marine-and-coastal-geoscience/](https://gsa-foundation.org/fund/marine-and-coastal-geoscience/)). Don't forget to follow us at GSAMCG on Facebook, GSA\_MCG on Twitter, and gsa-marinecoastal on Instagram.

So, whether you're just getting your feet wet in your geoscience career, or you're an old salt, we hope you're ready to dive into the Marine and Coastal Geoscience Division with us!

# 2023 GSA Scientific Division Milestones

GSA would like to acknowledge and congratulate these GSA Divisions for reaching these milestones:



The **Geochronology Division**, established in 2018, is celebrating its fifth anniversary this year. The mission of the division is to bring together scientists interested in geochronology, to provide a suitable forum for presentation and discussion of problems and opportunities in geochronology, to stimulate research and teaching in geochronology, and to act as an organized group in promoting these objectives within the framework of The Geological Society of America. The division also aims to bring together those who use geochronology with those who identify as geochronologists so that we can better address community-wide issues.



The **Geology and Society Division** is 20 years old this year. Established in 2003 the Geology and Society Division's mission is to advance the concept of "Geology Working for Society" by providing GSA members with opportunities to bring together multiple fields of geoscience in order 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, administers the E-an Zen Fund for Geoscience Outreach Grant, and honors professional achievement in enhancing public policy by presenting a Distinguished Lecture at the GSA annual meeting. Each year, the Geology and Society Division offers two awards to help fund projects that seek to promote the geosciences to the general public.

By increasing the geoscience community's knowledge about how their disciplines combine to help address societal issues and by helping the community to more effectively communicate outside of their academic disciplines, this division works to improve the utilization of accurate geologic information for societal benefit. The division also works closely with the Geology and Public Policy Committee in developing and distributing GSA's position statements.

*Visit all 22 GSA Scientific Divisions in the Headquarters area  
in the Resource & Innovation Center at GSA Connects 2023!*



# Rocks Are Relevant: Amplifying the Voices of Geoscientists



**Laura Fattarusio,**  
2022–2023 GSA  
Science  
Communication  
Fellow

Recently, I was telling a friend about a press release I was working on for GSA about a paper in *Geology* that evaluated the potential for an extinct offshore volcano to store carbon dioxide.\* Experiments in Iceland a few years prior had shown that carbon dioxide could react with volcanic rocks to form carbonate minerals in just a couple of years, permanently pulling carbon dioxide from the atmosphere. While climate change poses an ever-increasing existential threat, these experiments and studies offer some

hope that humanity can find viable solutions to reduce the harm of the climate crisis. My friend interrupted me and said, “I like when you talk to me about rocks—you make me feel like they are relevant to my life.” It was exactly what I needed to hear—this is why we communicate science.

Another friend asked if the carbonated water pumped into the volcano is the same as seltzer. I emailed the authors of the study with a final question—is this basically pumping seltzer into an extinct volcano? Ricardo Pereira quipped back, “Yes, it’s seltzer on the rocks.”

I started my journey into science communication because as a graduate student I was in awe of the opportunities and experiences that my studies in earth science had exposed me to—traveling to new places to investigate questions about the history and future of Earth. I had done field work among the stunningly folded and faulted sedimentary rocks of Mecca Hills in Southern California, and I had interned on a research cruise off the coast of Oregon, collecting ocean bottom seismometers with the Cascadia Initiative. I felt a strong urge, a responsibility even, to share the world of science and exploration that had opened up to me. As much as I am in awe of the discipline of geoscience, I am equally in awe of the people who do the work. That is why, several years ago, I started producing a radio show and podcast featuring interviews with scientists across disciplines and career stages, amplifying the stories and work of scientists in their own words.

What I’ve loved most about my 11 months as the GSA Science Communication Fellow is the opportunity to speak directly with scientists about their work in research and policy. Interviewing

researchers across the globe is an incredible privilege and, at a time when the world may feel fractured, a reminder that we as humans have many shared goals, regardless of which part of the globe we inhabit.

During my fellowship, I spoke with many incredible scientists. I got to interview Yi Xu about imaging of the subsurface of Mars using the Chinese rover *Zhurong*. At GSA Connects 2022, I spoke with Hermann Bermúdez about his work analyzing the events and aftermath of the Chicxulub impact that killed the dinosaurs, using new data from outcrops on Colombia’s Gorgonilla Island. Elizabeth Holley talked to me about the places where we source cobalt, which faces rising demand as a key ingredient in lithium-ion batteries, which in turn represent a critical part of the clean energy transition. Carrie Frantz shared her work with undergraduate students documenting the impacts of drought and increasing salinity on the ecosystem of the Great Salt Lake in Utah, which was on the brink of ecosystem collapse in the fall but has been at least temporarily rejuvenated by a record-breaking spring melt this year.

At the beginning and end of the fellowship, I also had the opportunity to tap my radio skills to produce two podcasts for GSA that share the work being done to dismantle persistent obstacles to inclusion within our discipline. Last August, I attended the Second National Conference for Justice in Geoscience and produced a podcast featuring interviews with conference organizers Raquel Bryant, Rachel Bernard, and Benjamin Keisling, attendee Edith Davis, and GSA president Mark Little about the work and community fostered at the conference aimed at shaping long-term changes within the field of geoscience. My final contribution for the fellowship was a podcast featuring interviews with David Davis and Ángel Garcia, the incoming and outgoing chairs of GSA’s Diversity Committee, and alumni of the GSA On To the Future program, which celebrates its 10-year anniversary this year.

It’s been an incredible journey this past year working with GSA Marketing and Communications Director Justin Samuel and everyone at the Society. I have learned so much from the people I’ve met and the conversations I’ve had as part of this fellowship, and it has been a joy to share those conversations with the geoscience community and beyond. Thank you to Bruce and Karen Clark for their generous support of this amazing program.

\*Pereira, R., and Gamboa, D., 2023, In situ carbon storage potential in a buried volcano: *Geology*, <https://doi.org/10.1130/G50965.1>.

# Become a GSA Reviewer!

## Tips for Early Career Professionals

Thinking about reviewing your first paper can be daunting, but peer review is an invaluable service, and at GSA, we rely on peer review to uphold the quality and integrity of our publications. As a reviewer, your insights and expertise can help authors improve their manuscripts and editors ensure that only high-quality research gets published. Reviewing is a rewarding responsibility that can improve your research and help advance your career.

If you've considered reviewing for GSA but have wondered how to begin, this overview should clear up uncertainties and help you take the first steps.

### Who can become a reviewer?

A scientist *at any stage* in their career who has enough knowledge of the field to evaluate a paper and provide constructive criticism should consider being a reviewer.

### How does one become a reviewer?

- Let your supervisor or advisor know that you're interested in reviewing. They may be able to guide you through the process and even recommend you to editors they know.
- Join a professional society like GSA and network with other members at conferences or online.
- Send your curriculum vitae (CV) to the journal editor or staff and note your areas of expertise. Editors' names and email addresses are available at [www.geosociety.org/GSA/Publications/Info\\_Services/GSA/Pubs/editors.aspx](http://www.geosociety.org/GSA/Publications/Info_Services/GSA/Pubs/editors.aspx).
- Submit your own paper(s) for publication and gain experience with the author side of peer review. Many editors look for recently published, peer-reviewed work in a similar area when searching for reviewers.
- Ask a colleague who reviews for a journal to recommend you to the journal's editor.
- Sign up! Register with the publication's online submission system (see below box). This will automatically add your name and contact details to the GSA reviewer database. Be sure to add classifications and areas of expertise to your profile so editors can find you. ***Make sure your contact info is up to date.***



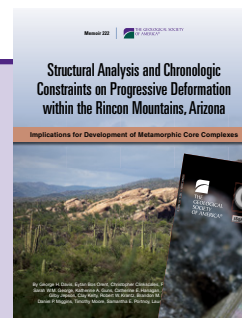
### What are the benefits of being a reviewer?

- The experience of peer review will help you improve your own research methods, writing, critical thinking skills, and confidence.
- Reviewing could lead to a role as an editorial board member, an associate editor, and someday even a science editor.
- You can have a direct impact on your field.
- Reviews for GSA journals count toward the service requirement at many universities and for GSA fellowships.
- Authors commonly recognize and highlight reviewers' help in their acknowledgments.
- Reviewing builds relationships with colleagues.
- Supporting your field and helping it thrive as a peer reviewer can result in more funding and more opportunities for everyone!

Please visit [www.geosociety.org/GSA/Publications/GSA/Pubs/becomeaGSAreviewer.aspx](http://www.geosociety.org/GSA/Publications/GSA/Pubs/becomeaGSAreviewer.aspx) to discover more about the review process and expectations and/or email [editing@geosociety.org](mailto:editing@geosociety.org) with questions.

### Reach the next step on your geoscience journey by reviewing for GSA Publications!

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GSA Books | [gsabooks.msubmit.net/](http://gsabooks.msubmit.net/)



# Position Statements Updated

GSA Council recently approved minor revisions to three position statements: Removing Gender Barriers to Career Progression in the Geosciences, Promoting Earth Science Literacy for Informed Public Decision Making, and Critical Mineral Resources. GSA Council also voted to continue to endorse the Seismological Society of America and the American Geophysical Union position statement: The Capability to Monitor the Comprehensive Nuclear-Test-Ban Treaty (CTBT) Should Be Expanded, Completed, and Sustained.

Summary statements are below, and full versions of all position statements are available online ([www.geosociety.org/position-statements/](http://www.geosociety.org/position-statements/)). GSA members are encouraged to use the statements as communication tools when interacting with policymakers, students, colleagues, and the general public.

## REMOVING GENDER BARRIERS TO CAREER PROGRESSION IN THE GEOSCIENCES

GSA strongly endorses the right for all to work in a safe, supportive, welcoming, nondiscriminatory, and reprimand-free environment where trust, respect, equity, fairness, accountability, and justice are honored. Historically, white males have dominated the geosciences, and even today, the geosciences are the least diverse of any of the STEM (science, technology, engineering, and mathematics) fields (Bernard and Cooperdock, 2018). The geosciences are unique in that many undergraduate degrees and professional job responsibilities include field work in remote areas. These situations may pose a risk to individuals who do not conform to the traditional geoscientist stereotype of white, able-bodied, cisgender, straight men. Data reveal that women are underrepresented in the geoscience workplace, and women of color are even more so. Gender discrimination can impact professionals in a variety of ways, including less pay for the same work; fewer professional awards; a disproportionate expectation to assume service roles; disadvantages for following alternative career paths due to life circumstances; and implicit or explicit biases on perceived competence regardless of accomplishments and qualifications. Intersections with race, sexual identity, religion, and class can create further challenges for women and gender nonbinary individuals in the geosciences, as noted in GSA's position statement, Diversity in the Geosciences Community. Therefore, GSA is committed to policies, programs, and services that will ensure the success of all individuals in the geoscience professions, and GSA considers sexual harassment, violence, and all forms of discrimination unacceptable.

This position statement (1) affirms the pressing need for a change in professional culture so that all people are welcomed, supported, and able to thrive in the geoscience profession, and for policies that aspire to the highest standards of conduct as a professional society; (2) advocates for resolving implicit and explicit biases and the elimination of harassment, bullying, and sexual misconduct in the workplace; (3) recommends elevated personal and professional responsibility and evidence-based policies that extend beyond civil and legal remedies to promote inclusive, safe, and productive environments in the geoscience classroom, laboratory, field, and office; and (4) establishes GSA's commitment to identifying and implementing reporting procedures and clear

consequences for members who discriminate, harass, bully, retaliate, and commit sexual misconduct or violence.

## REFERENCE

Bernard, R.E., and Cooperdock, E.H.G., 2018, No progress on diversity in 40 years: *Nature Geoscience*, v. 11, p. 292–295, <https://doi.org/10.1038/s41561-018-0116-6>.

## PROMOTING EARTH SCIENCE LITERACY FOR INFORMED PUBLIC DECISION MAKING

GSA recognizes the critical need for citizens and policymakers to understand important aspects of Earth's systems as they face issues related to natural resources, energy, natural hazards, and human impacts on the environment. GSA supports the active involvement of geoscientists and geoscience educators in helping to improve the knowledge and understanding of the geosciences among members of the general public in order to support informed decision making by citizens and communities. GSA and GSA members should contribute to education and outreach about fundamental concepts of earth science, issues related to long-term human sustainability (such as the use and availability of water, critical minerals, and energy resources), and socially prominent topics (such as climate change and natural hazards preparedness).

## CRITICAL MINERAL RESOURCES

Mineral resources, in general, are important, but "critical" minerals are officially defined as "any non-fuel mineral, element, substance, or material essential to our economic or national security, have a supply chain vulnerable to disruption, serve an essential function in the manufacturing of a product, the absence of which would have significant consequences for the economic or national security of the United States" (U.S. Code, 2020). In addition, critical minerals are required for the transition to a low-carbon economy based on clean energy technologies and are essential for defense and consumer technologies. The United States is overwhelmingly dependent on foreign countries for critical mineral supplies. As such, a thorough understanding of their national and global distribution and abundance, impacts of extraction and processing, and the potential effects of mineral supply disruption is important for sound public policy.

This position statement (1) summarizes the consensus view of The Geological Society of America on critical mineral resources; (2) advocates for better understanding of their distribution, the potential for disruption of their supply, and the consequences of their extraction and use; (3) encourages educational efforts to help the general public, lawmakers, and other stakeholders understand that mineral resources are used in almost every aspect of their daily lives, including modern technology, housing, transportation, information systems, and defense; and (4) recommends scientific investigation of nonconventional resources, better understanding of the full life-cycle consequences of their use, and international collaboration.

## REFERENCE

U.S. Code, 2020, Section 1606: Mineral security, in Title 30—Minerals Lands and Mining: Washington, D.C., U.S. Government, 30 USC 1606: Mineral security ([house.gov](http://house.gov)).



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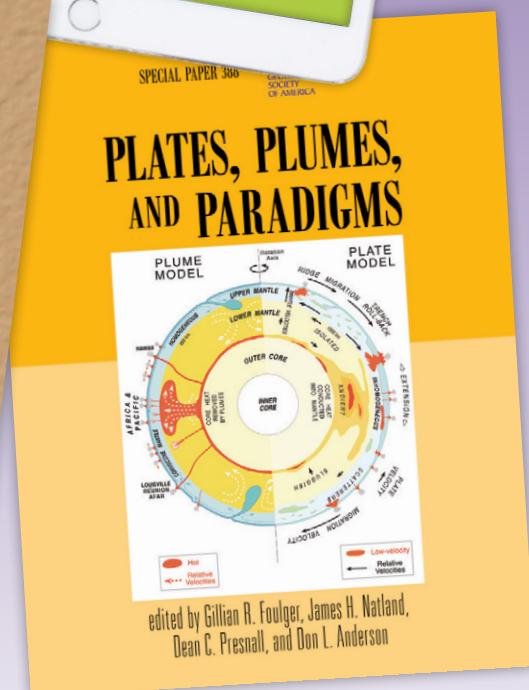
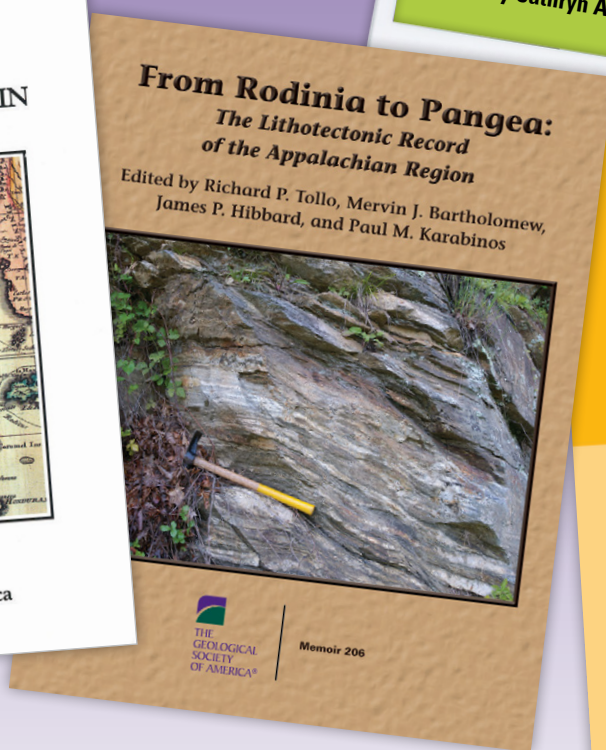
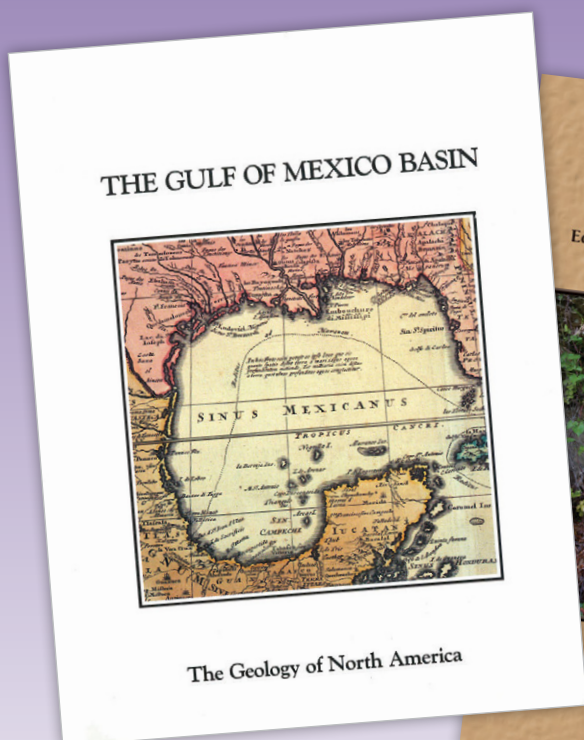
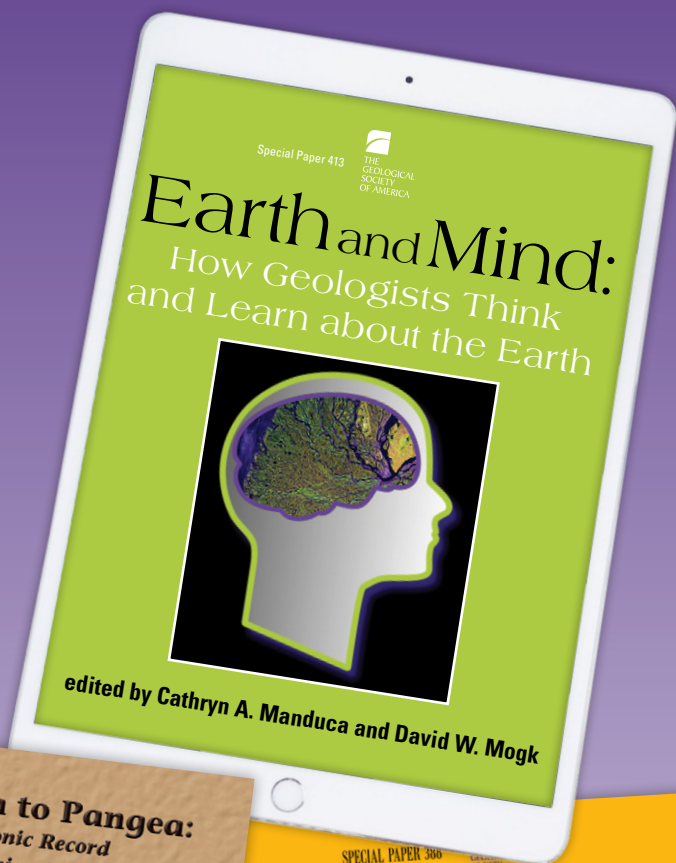
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Students who have participated in the GSA mentor programs say that they come away from their experience with new professional connections, invaluable shared institutional knowledge, and clearer roadmaps for their future careers. Some mentees even come back as mentors after beginning their careers to create opportunities for other students.

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Whether you choose to mentor a student attending their first GSA Connects meeting, provide career advice, or give financially, your dedication and contribution are invaluable to our students and future workforce. Together, let's inspire and empower the next generation of professionals in the geosciences.

If you would like more information on making a contribution to support these programs, please contact Sara Werner at [swerner@geosociety.org](mailto:swerner@geosociety.org) or +1-303-357-1007. If you would like to discuss corporate opportunities, please contact Debbie Marcinkowski at [dmarcinkowski@geosociety.org](mailto:dmarcinkowski@geosociety.org) or +1-303-357-1047.



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The Department of Geosciences at Oberlin College invites applications for a full-time tenure-track faculty position in the College of Arts and Sciences in general area of deformation and tectonics. Initial appointment to this position will be for a term of four years, beginning fall semester of year 2024, and will carry the rank of Assistant Professor.

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Among the qualifications required for appointment is the Ph.D. degree (in hand or expected by first semester of academic year 2024).

Quick link to posting: <https://jobs.oberlin.edu/postings/14123>

Review of applications will begin on September 1, 2023, and will continue until the position is filled. Completed applications received by the September 1 deadline will be guaranteed full consideration.

#### **Tenure-Track Assistant Professor, Subsurface Energy Resources, Department of Earth and Environmental Sciences, The University of Texas at Arlington**

The Department of Earth and Environmental Sciences in the College of Science at The University of Texas at Arlington (UTA) invites applications for a tenure-track faculty position in green subsurface energy resources with broadly construed areas of expertise in economic geology, geochemistry, or geomechanics at the level of Assistant Professor. Faculty candidates for higher ranks with exceptional track records will also be considered. While

candidates from all subdisciplines of geosciences are encouraged to apply, we are particularly interested in candidates with expertise in sustainable energy transition including economic geology, critical Earth and mineral resources, carbon capture and sequestration, energy/hydrogen storage, geothermal energy, and geophysical monitoring. Opportunities for collaboration exist with departmental research strength in geochemistry, geochronology, sedimentary geology, environmental chemistry and toxicology, climate change and paleoclimatology, paleontology, tracer hydrology, hydrogeology, and other research groups of data science, analytical chemistry in the College of Science. Our geochemical and analytical strengths include the Center for Environmental, Forensics, and Material Science and an ultraclean laboratory within the Earth and Environmental Sciences building, as well as other facilities at the UTA Science & Engineering Innovation & Research (SEIR) building.

Applicants should have a doctoral degree in the geosciences subdisciplines. Successful candidates are expected to demonstrate a commitment to diversity and equity in education through their scholarship, teaching, and/or service. We are deeply committed to increasing diversity and especially encourage applications from women and minority scholars.

We seek an individual with an established research and mentorship record who will develop new and expand existing collaborations among faculty, researchers, and students within the Department of Earth and Environmental Sciences, across the UTA campus, and around the globe. Candidates are encouraged to describe how their work will address topics of acute scientific interest and critical societal importance related to the dual challenge of supplying the world with affordable, reliable sustainable energy while also reducing the environmental impacts of all forms of energy.

Situated within the Dallas-Fort Worth Metroplex area, UTA is a diverse academic community of students working together with faculty committed to outstanding teaching, research, and scholarship. With a global enrollment of approximately 60,000 students, UTA is the largest institution in North Texas. It is one of 131 universities nationwide to receive the R-1: Doctoral Universities—Very High Research Activity designation by the Carnegie Classification of Institutions of Higher Education, the definitive list for the top doctoral research universities in the United States. In 2021,

UTA received the Texas Tier One designation reserved for the state's top institutions for academic and research excellence and the Higher Education Excellence in Diversity Award (HEED) for outstanding commitment to diversity, equity, and inclusion in higher education. UTA ranks No. 1 nationally in the *Military Times'* annual "Best for Vets: Colleges" list, is designated as a Hispanic-Serving Institution and an Asian American and Native American Pacific Islander-Serving Institution and has approximately 240,000 alumni making an impact across Texas and beyond.

Successful candidates are expected to demonstrate a commitment to diversity and equity in education through their scholarship, teaching, and/or service as well as a strong commitment to teaching, advising, and mentoring undergraduate and graduate students from diverse backgrounds.

To apply, applicants should go to <https://uta.peopleadmin.com/postings/23254> and submit the following materials: 1) curriculum vitae, 2) summary of current and proposed research (max. two pages), 3) statement of teaching interests (max. one page), 4) cover letter, and 5) names and email addresses of three references.

Review of applications will begin immediately and will continue until the position is filled.

Question regarding this position may be addressed to Dr. Nathan Brown, Search Committee Chair ([nathan.brown@uta.edu](mailto:nathan.brown@uta.edu)) or Linda Panther, Earth and Environmental Sciences administrator ([lpanther@uta.edu](mailto:lpanther@uta.edu)).

For more information about UTA, please visit <http://www.uta.edu/uta>.

The University of Texas at Arlington is an Equal Opportunity/Affirmative Action Employer committed to fostering a diverse, equitable, and family-friendly environment in which all faculty and staff can excel irrespective of race, national origin, age, genetic or family medical history, gender, faith, gender identity and expression as well as sexual orientation. A criminal background check will be conducted on finalists. UTA is a tobacco-free campus. UTA also encourages applications from veterans.

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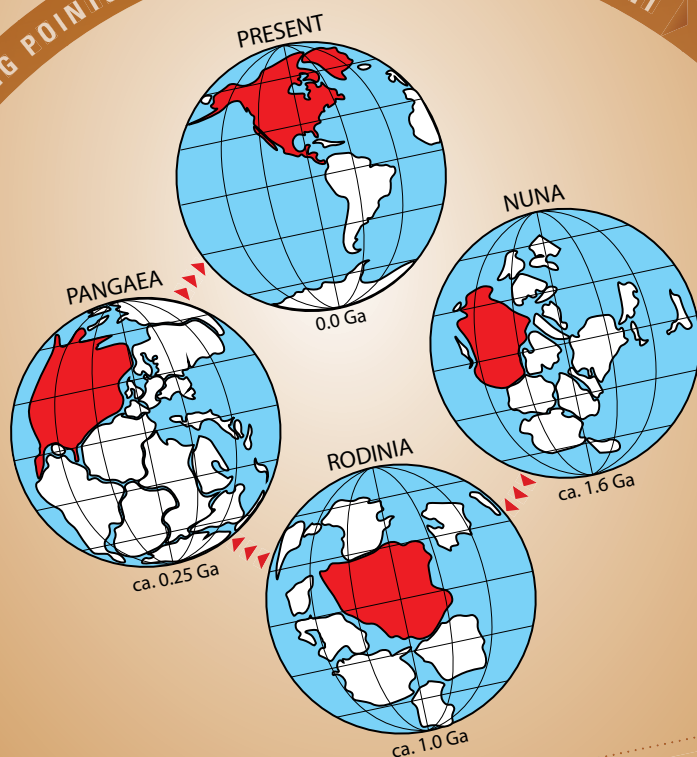
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Memoir 220



# LAURENTIA

TURNING POINTS IN THE EVOLUTION OF A CONTINENT



Edited by Steven J. Whitmeyer, Michael L. Williams, Dawn A. Kellett, and Basil Tikoff

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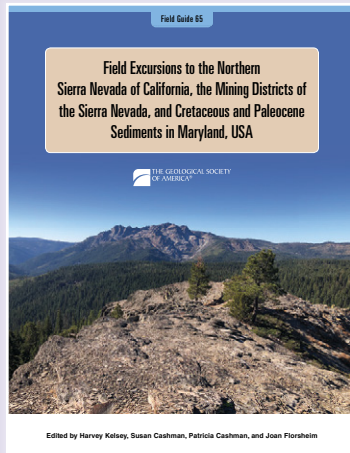
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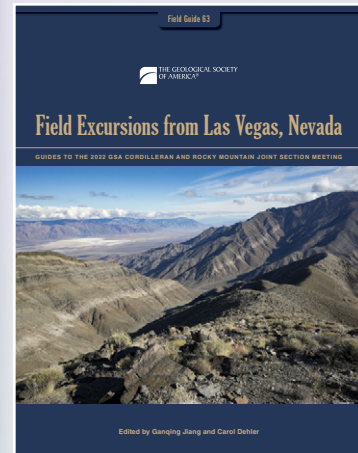
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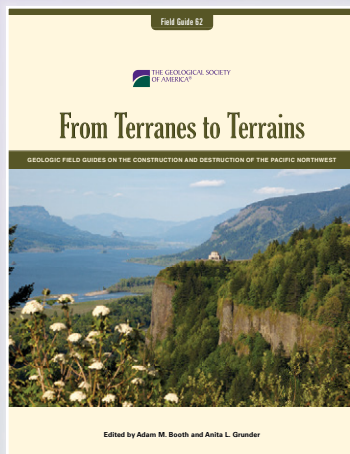
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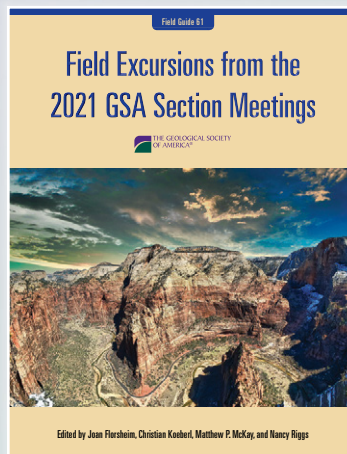
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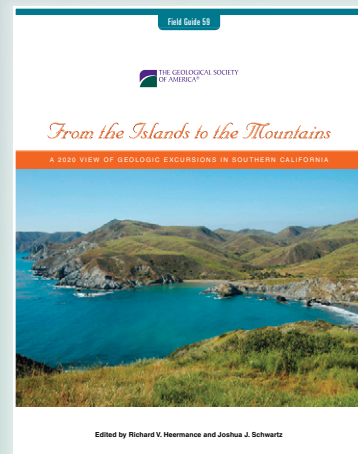
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Memoir 222



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