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VOL. 33, NO. 5 | MAY 2023

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Cover: Wind power plant reflected in the arrays of a solar power plant. Credit: iStock.com/metamorworks.

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Greetings!

We are pleased to welcome you to Pittsburgh for GSA Connects 2023! Pittsburgh is a city built on geology and steeped in history. Located at the point where the Monongahela and Allegheny rivers join to form the Ohio, this confluence forms a part of human history spanning millennia. The nearby massive sandstone overhangings of the Meadowcroft Rockshelter preserve records of Indigenous activity dating back 19,000 years, and ancient Adena burial mounds rise in conical symmetry from local landscapes. In colonial times, the strategically located settlement started its life as a series of five forts: Prince George (British, 1754); Duquesne (French, 1754); Pitt (British, 1758); Mercer, temporary during construction of Fort Pitt; and Lafayette (American, 1792). The city grew on the backs of river commerce, coal, and steel. The rich Pittsburgh Coal seam lies below the city, but the higher parts of the Pennsylvanian-age section are displayed in steep cliffs and hillsides throughout the city. The rugged topography along the three rivers leads to a transportation system that is a web of bridges and tunnels and that can also lead to a high incidence of landslides. Pittsburgh is truly an engineering marvel. A ride on the Incline up Mount Washington or a river cruise on the Gateway Clipper will give you a first-hand feel for the landscape.

The city you are visiting is much different from the last time Pittsburgh hosted the GSA Annual Meeting in 1959. Coal and steel have ceded prominence to natural gas, carbon and energy storage, technology, education, and medicine. The legacy lives on, though, in the many art, cultural, and educational resources associated with industrialists Andrew Carnegie and Henry Clay Frick, banker Andrew Mellon, and food manufacturer H.J. Heinz.

If you want a break from the meeting, you can find many fine museums that fit a variety of interests, including the avant-garde pop art of Pittsburgh native Andy Warhol, whose namesake museum is located within walking distance of the meeting venue. The heritage of European immigrants who came to mine coal and make steel lives on in great ethnic restaurants, especially German, Polish, and Italian. A stroll down Smallman Street in the nearby Strip District not only affords a cacophony of sights, smells, and all the black and gold attire you never knew you needed, but also offers a glimpse into the melting pot of cultures that shapes the city's history. Pittsburgh has a great food scene, from sandwich shops like Primanti Brothers (fries right on the sandwich!) to brats to fine dining, with local breweries and distilleries for something to wash it all down. If you have time to get out of town, Ohiopyle State Park with its Class 3 whitewater, Frank Lloyd Wright's Fallingwater, and the Drake Well Museum chronicling the birth of the petroleum industry are all an hour or two away, along with any number of other great hikes, parks, and historic sites.

Our meeting venue, the David L. Lawrence Convention Center, sits just 100 yards from the point on the Allegheny River where William Clark launched his newly constructed keelboat and sailed down the Ohio to join Meriwether Lewis and begin their Corps of Discovery Expedition into the wild expanses of the western territories. It is with that spirit of intrepid exploration, inquiry, and discovery that we welcome you to Pittsburgh for GSA Connects 2023.

Yinz have a good time!



Gale Blackmer, Pennsylvania State Geologist GSA Connects 2023 General Co-Chair



Jessica Moore, West Virginia State Geologist GSA Connects 2023 General Co-Chair

Important Dates

Now open: Abstract submissions

Now open: Non-tech event space/event listing system

June: Housing opens

Early June: Registration and Travel Grant applications open

6 June: Meeting room request deadline—fees increase after this date

25 July: Abstract submission deadline

August: Student volunteer program opens

13 September: Early registration deadline

13 September: GSA Sections Travel Grants deadline

20 September: Registration and student volunteer cancelation deadline

20 September: Housing deadline for discounted hotel rates



David L. Lawrence Convention Center / © 2015 JP Diroll.

OFFICIAL GSA LOCATIONS David L. Lawrence Convention Center (DLCC) 1000 Fort Duquesne Blvd. | Pittsburgh, PA 15222, USA

The Westin Pittsburgh at DLCC 1000 Penn Ave. | Pittsburgh, PA 15222, USA

Omni William Penn Hotel 530 William Penn Place | Pittsburgh, PA 15219, USA



Non-Technical Event Space Requests

Deadline for first consideration: 6 June

Please let us know about your non-technical events via our online event space & event-listing database at **community.geosociety.org**/ **gsa2023/plan-event**. Space is reserved on a first-come, first-served basis; in order to avoid increased fees, you must submit your request by Tuesday, 6 June. Event space/event listing submissions should be used for business meetings, luncheons, receptions, town halls, etc.

- For events held at the David L. Lawrence Convention Center (DLCC) or The Westin Pittsburgh at DLCC (HQ Hotel) or Omni William Penn Hotel (Monday evening only).
- For off-site events (events that are being held at another location in Pittsburgh that you have arranged on your own). Meeting room assignments will be sent out in July.



Exhibit at Connects 2023

Multiple rates are available to reflect a diverse range of GSA Connects 2023 exhibitors in the Resource & Innovation Center. See the exhibit space application within the prospectus at **community.geosociety.org/gsa2023/exhibitors** for complete rates and exhibit packages.

For questions, or to reserve your booth please contact:

Gavin McAuliffe Exhibit Manager, GSA Connects 2023 Corcoran Expositions Inc. +1-312-265-9649 gavin@corcexpo.com Bob Drewniak Exhibit Sales +1-312-265-9662 robert@corcexpo.com

Jumpstart Your Career with GSA

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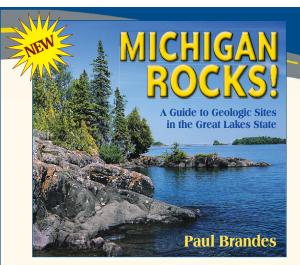
- Résumé Workshop
- Company Connection
- Mentor Roundtables
- Career Panel

GEOCAREERS CENTER

Career Guidance and Information

- Career Presentations
- Résumé Review Clinic
- Drop-in Mentoring
- Early Career Professional Coffee
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- Networking Reception
- Women in Geology Program
- Post or View Jobs





MICHIGAN ROCKS!

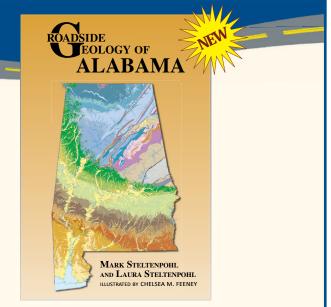
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On To the Future (OTF) Travel Awards

This year, we celebrate our 10th anniversary of supporting early-career geoscientists. Join more than 700 students who have already received this award. OTF provides funding for scholars from diverse backgrounds to attend GSA Connects, this year in Pittsburgh, Pennsylvania, USA, on 15–18 October. Awardees will be paired with mentors and have the opportunity to get to know GSA leadership. Check the OTF website (**www.geosociety.org**/ **OTF**) for eligibility guidelines and application information. GSA encourages low-income, historically excluded minority, firstgeneration, non-traditional, women, veterans, LGBTQ+, and persons with disabilities to apply. Deadline: 31 May.

Expanding Representation in the Geosciences

Undergraduate students from historically excluded backgrounds are encouraged to apply for this US\$1,500 fellowship. Up to six students receive a cash award plus a one-year GSA membership and free registration to GSA Connects 2023 in Pittsburgh, Pennsylvania, USA, on 15–18 October. Learn more at **www.geosociety.org/GSA/About/awards/GSA/Awards/erg.aspx.** Application deadline: 31 May.

The Web of Science's #1 ranked geology journal for 15 years in a row.



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GEOLOGY

Scientific Field Trips

Descriptions and leader bios are online at community.geosociety.org/gsa2023/field.

(\$) (*) (*) FT401. Underground Treasures: Exploring the Stunning Caves of Tennessee and Kentucky. Thurs.–Sat., 12–14 Oct. Cosponsor: *Edmunds Central School District*. Leader: Spencer Cody, Edmunds Central School District, Spencer.Cody@ k12.sd.us.

(\$) (*) FT402. Examining Late Paleozoic Paleosol Records across Outcrop to Nano Scales for Climatic and Environmental Signals. Fri.–Sat., 13–14 Oct. Cosponsor: Sedimentary Geology Division. Leaders: Amy Weislogel, West Virginia University, amy.weislogel@mail.wvu.edu; Jonathan Knapp.

FT403. Hydrology and Geology of the Fernow Experimental Forest. Fri.–Sat., 13–14 Oct. Leaders: Jill Riddell, 13 Chickadee Lane, jlriddell@mix.wvu.edu; Benjamin Rau; Christopher Russoniello.

(*) FT404. Geologic Setting and Organic Architecture of Fallingwater, Frank Lloyd Wright's Masterpiece. Fri., 13 Oct. Cosponsor: *Earth Science Excursions LLC*. Leader: Fred Zelt, fbzelt@aol.com.

FT405. Central Pennsylvania Springs and Karst in Honor of William B. White. Sat., 14 Oct. Cosponsors: *Laura Toran; Ellen Herman*. Leaders: Laura Toran, Temple University, ltoran@ temple.edu; Ellen Herman; James Berglund.

FT406. Drake Well: Understanding the Birthplace of the Oil Age and Its Historical Human and Environmental Impacts. Sat., 14 Oct. Cosponsors: *History of Earth Sciences Society, GSA History and Philosophy of Geology Division*. Leaders: Renee Clary, Mississippi State University, rclary@geosci.msstate.edu; William R. Brice; Christy Hyman.

(*) FT407. Overview of Environmental and Engineering Geology and Geohazards with a Virtual Field Trip to Landslides Near Pittsburgh. Sat., 14 Oct. Cosponsors: *Pittsburgh Geological Society;GSA Environmental and Engineering Geology Division*. Leader: James Hamel, jvhamel3918@gmail.com.

FT408. Paleoenvironmental and Tectonic Implications of an Upper Devonian Glaciogenic Succession from East-Central West Virginia, USA. Sat., 14 Oct. Leaders: Frank Ettensohn,



Baughman Rock Overlook at Ohiopyle State Park, Pennsylvania.

University of Kentucky, fettens@uky.edu; D. Clay Seckinger; David P. Moecher; Cortland F. Eble.

(\$) (*) FT409. The Cultural Geology of Youngstown: Geological Setting, Building and Decorative Stones, Iron and Steel Heritage, and More. Sat., 14 Oct. Leaders: Joseph Hannibal, jhannibal@uakron.edu; Brigitte Petras; Colleen McLean.

W FT410. The Warren Hamilton Field Trip: Special Geologic Features of Ohiopyle State Park, Pennsylvania. Sat., 14 Oct. Cosponsor: *Earth Science Excursions LLC*. Leaders: Fred Zelt, fbzelt@aol.com; Jim Shaulis.

FT411. A Land of Ice and Water: An Accessible Introduction to Glacial and Watershed Processes in Western Pennsylvania. Wed.–Thurs., 18–19 Oct. Cosponsor: *The International Association* for Geoscience Diversity (IAGD). Leaders: Jennifer Piatek, Central Connecticut State University, piatekjel@ccsu.edu; Anita Marshall; Yesenia Arroyo; Candace Kairies-Beatty,

T412. A Short Tour of the Fluviokarst of Southeastern West Virginia. Wed.–Fri., 18–20 Oct. Cosponsor: *West Virginia Geological Survey*. Leaders: John Tudek, hewhocaves@gmail.com; J. Wayne Perkins.

INDUSTRY TRACKS

GSA's program offers field trips relevant to applied geoscientists. Look for these icons, which identify trips in the following areas:









Hydrogeology and Environmental Geology

FT413. 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. Primary leader: Rebecca Kavage Adams, Maryland Geological Survey, rebecca.adams@maryland.gov; David K. Brezinski; Mitzy Schaney; Steve Kite.

W FT414. Acid Mine Drainage (AMD) Treatment Systems of Southwestern Pennsylvania. Thurs., 19 Oct. Leaders: Benjamin Hedin, ben.hedin@hedinenv.com; Rosemary Capo; Robert Hedin.

(b) (c) FT415. George Washington's Word Broken: Kinzua Dam and the Seneca Nation. Thurs.-Fri., 19–20 Oct. Leader: Patrick Burkhart, Slippery Rock University, patrick.burkhart@sru.edu. (b) (c) (c) FT416. Fracking in the Oldest Commercial Oil Field: From Legacy Extraction to Environmental Impacts. Thurs., 19 Oct. Cosponsor: *Pennsylvania State University*. Leaders: Susan L. Brantley, sxb7@psu.edu; Tao Wen; Sam Shaheen; Dave Yoxtheimer.

FT417. Post-Glacial Tectonism and Bluff Erosion of Northern Erie County, Pennsylvania. Thurs., 19 Oct. Cosponsors: GSA Planetary Geology Division; GSA Structural Geology and Tectonics Division; GSA Quaternary Geology and Geomorphology Division. Leaders: Nicholas Lang, nicholas.p.lang@nasa.gov; Christopher Dolanc.

(*) FT418. Special Geologic Features of the Erie Lakeshore in Northwestern Pennsylvania. Thurs., 19 Oct. Cosponsor: *Earth Science Excursions LLC*. Leaders: Frederick Zelt, Earth Science Excursions LLC, fbzelt@aol.com; Gary Fleeger.

Short Courses

Learn and explore a new topic. Build your skills.



Learn about Deep-time.org, ground-penetrating radar, geothermo-petro-chronology, modeling detrital geochronology data, and how to build a digital crust.

Explore best practices for mineral data dissemination and citation, innovative tools for project management in academia, planetary image analysis with ArcGIS Pro, medical geology fundamentals, and carbonates for sustainability and the energy transition.

Strengthen your research, data collection, and fieldwork skills using OpenTopography, virtual reality, StraboSpot and StraboMicro Data Systems, 3D video-game-style geologic field trips, resistivity surveying, and field-safety leadership. **Gain tips** on communicating science, having productive conversations about science, creating a better broader impacts section for your NSF proposal, and exploring the Voices of Integrating Culture in the Earth Sciences (VOICES) Project.

Students and early-career professionals can learn about sequence stratigraphy, and current and previous OTF awardees can find a pathway to their geoscience profession.

For details and course descriptions, check the upcoming June issue of *GSA Today* or go to **community.geosociety.org/gsa2023/short.**

This is a great opportunity to earn continuing education credits!

Pardee Keynote Symposia



Joseph Thomas Pardee

P1. Land of Our Ancestors Submerged by a Lake of Betrayal Convenors: Patrick Burkhart; Joe

Stahlman; Renee M. Clary; Stephen Boss; William Andrews; Christina DeVera

We propose to show two documentaries conveying a broader discussion than the simplistic focus upon flood control. First viewing: *Land of Ancestors* (1991), followed with discussion on experience of the Seneca. Second viewing: *Lake of Deception*

(2016), followed with reactions, concerns, discussion of lessons, and envisioning the future.

P2. Spotlight on Positive and Diverse Female Role Models

Endorsements: Association for Women Geoscientists; GSA Continental Scientific Drilling Division; GSA Energy Geology Division; GSA Environmental and Engineering Geology Division; GSA Geoarchaeology Division; GSA Geobiology and Geomicrobiology Division; GSA Geochronology Division; GSA Geoinformatics and Data Science Division; GSA Geology and Society Division; GSA Geophysics and Geodynamics Division; GSA Hydrogeology Division; GSA Karst Division; GSA Limnogeology Division; GSA Marine and Coastal Geoscience Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Planetary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Soils and Soil Processes Division Convenors: Abigail Burt; Jennifer Nocerino; Karen Fryer

This session spotlights diverse women who succeeded on their own terms, took risks, and dared to fail. These diverse speakers will come from a broad range of career interests, employment types, and backgrounds. There will be invited speakers, an animated story map, and short video clips of voices from around the globe. These amazing mentors and role models will challenge assumptions, share their stories, and demonstrate that there are women who look like you in a wide range of geoscience careers. The session will be followed by the popular Women in Geology Mentor Program.

P3. Addressing Society's Urgent Need for Critical Minerals; From Policy to Practice

Endorsements: GSA Geology and Society Division; GSA Energy Geology Division; GSA Environmental and Engineering Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geology and Public Policy Committee; Securing America's Future Energy (SAFE) Center for Critical Minerals Strategy; International Association for Promoting Geoethics

Disciplines: Geoscience and Public Policy, Energy Geology, Economic Geology

Convenors: Lily Jackson; Erin Phillips; Franciszek Hasiuk; Danielle N. Woodring; James Heller

This symposium will highlight the multidimensional topics facing society pertaining to critical minerals. Expert speakers

will address current circumstances surrounding critical minerals and policy, geopolitics and national security, roadblocks to new mining ventures, permitting processes and NEPA, and social and environmental justice. Audience members will be engaged throughout the session via interactive polling. Following talks from invited speakers, join us for a moderated panel discussion in this interactive symposium.

P4. Encouraging Positive Mental Health in the Geosciences

Endorsements: International Association for Geoscience Diversity; U.S. National Committee for Geological Sciences; U.S. National Committee for Psychological Sciences; U.S. National Committee for Soil Sciences; U.S. National Committee for Quaternary Research; U.S. National Committee for Geodesy and Geophysics; GSA Continental Scientific Drilling Division; GSA Environmental and Engineering Geology Division; GSA Geoarchaeology Division; GSA Geochronology Division; GSA Geoinformatics and Data Science Division; GSA Geology and Health Division; GSA Geology and Society Division; GSA Geophysics and Geodynamics Division; GSA Geoscience Education Division; GSA Hydrogeology Division; GSA Limnogeology Division: GSA Marine and Coastal Geoscience Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Planetary Geology Division; GSA Quaternary Geology and Geomorphology Division Convenors: Jennifer Nocerino; Ester Sztein; Marjorie A. Chan; Jennifer Lansford

Geoscientists are frequently isolated in the field, the laboratory, and in learning environments. COVID and virtual lessons and meetings have increased these feelings of exclusion and/or isolation. Discrimination due to gender, race, and/or disability, along with hidden disabilities such as chronic illness and mental health issues have increased dramatically, taking a toll on our community. This session intends to raise awareness of the challenges experienced by many geoscientists; explores the signs seen in those that are struggling; and gives examples of what universities, companies, and colleagues can do to create a safe working environment conducive to good mental health.

P5. Past, Present, and Future of Waste Management Endorsements: GSA Environmental and Engineering Geology Division; GSA Energy Geology Division; GSA Geology and Health Division; GSA Geology and Society Division; GSA History and Philosophy of Geology Division; GSA Hydrogeology Division; GSA Soils and Soil Processes Division Advocate: Syed Hasan

Environmentally safe management of waste has become a global issue. The complex stream of societal waste that includes municipal solid waste, hazardous, medical, electronic, and radioactive wastes whose safe management has been presenting scientific, economic, and political challenges to all countries. This session will bring national and international experts to discuss the issues and offer potential solution.

Call for Papers

Abstracts deadline: 25 July

SUBMITTING AN ABSTRACT

- Abstracts form opens: Monday, 1 May
- Submission deadline: Tuesday, 25 July
- Abstract non-refundable submission fee: GSA MEMBERS: professionals: US\$60; students: US\$25. NON-MEMBERS: professionals: US\$80; students: US\$50.
- To begin your submission, go to **community.geosociety.org**/ gsa2023/program/technical
- For detailed guidelines on preparing your submission, please view "preparing an online submission" at https://gsa.confex.com/gsa/2023AM/categorypreparation.cgi

TWO-ABSTRACT RULE

- You may submit two volunteered abstracts, *as long as one of the abstracts is for a poster presentation*;
- Each submitted abstract must be different in content; and
- If you are invited to submit an abstract in a Pardee Keynote Symposium or a topical session, the invited abstract does not count against the two-abstract rule.

POSTER PRESENTERS

- You will be provided with one horizontal, free-standing 8-ftwide by 4-ft-high display board and Velcro for hanging your display at no charge;
- AM Session: Posters will be displayed 9 a.m.-1 p.m., with presenters present 11 a.m.-1 p.m.
- PM Session: Posters will be displayed 2–6 p.m., with presenters present 4–6 p.m.

ORAL PRESENTERS

The normal length of an oral presentation is 12 minutes plus three minutes for questions and answers. You *must* visit the Speaker Ready Room at least 24 hours before your scheduled presentation. All technical session rooms will be equipped with a PC Windows 10/MS Office 2021. Presentations should be prepared using a 16:9 screen ratio.

IN-PERSON ONLY

Technical sessions (poster and oral) will be in-person only at GSA Connects 2023; however, all topical sessions, discipline sessions, Pardee Keynote Symposia, Noontime Lectures, and the Presidential Address will be recorded and available for on-demand viewing after the meeting.

ABSTRACTS SUBMISSION: EXPECTED BEHAVIOR

The submission of an abstract implies a sincere intent to present the submitted research during the meeting. Authors and presenters are expected to display integrity in disseminating their research; adhere to the content and conclusions of abstracts, as submitted and reviewed; remain gracious by offering collaborators the opportunity for recognition as a co-author; make sure that listed co-authors have made a bona fide contribution to the project, are aware of their inclusion, and have accepted that recognition; and be diligent in preparing a polished product that conveys high-quality scholarship. GSA strives to promote diversity among conveners and presenters when organizing panels, keynotes, and other invitational sessions.



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Discipline Sessions

In addition to topical sessions, GSA offers vibrant discipline sessions. Discipline sessions are an essential addition to the fulfillment of the overall meeting. We will have technical sessions that relate to recent advances in:

Continental Scientific Drilling Economic Geology Energy Geology **Engineering Geology Environmental Geoscience Environmental Justice** Geoarchaeology Geobiology and Geomicrobiology Geochemistry Geochronology Geoheritage Geoinformatics and Data Science Geology and Health Geomorphology Geophysics/Geodynamics Geoscience Education Geoscience Information/Communication Geoscience and Public Policy History and Philosophy of Geology Hydrogeology Karst

Limnogeology Marine and Coastal Geoscience Mineralogy/Crystallography Paleoclimatology/Paleoceanography Paleontology, Biogeography/Biostratigraphy Paleontology, Diversity, Extinction, Origination Paleontology, Paleoecology/Taphonomy Paleontology, Phylogenetic/Morphological Patterns Petrology, Igneous Petrology, Metamorphic Planetary Geology Precambrian Geology Quaternary Geology Sediments, Carbonates Sediments, Clastic Soils and Soil Processes Stratigraphy Structural Geology Tectonics Traditional Ecological Knowledge Volcanology

Topical Sessions

ENERGY GEOLOGY

(b) T1. The Internal Structure Models of Fault and Unconformity along with Their Identification and Evaluation Technologies

Endorser: Chinese Geological Society

Disciplines: Energy Geology, Economic Geology, Engineering Geology

Advocates: Kongyou Wu Sr.; Yin Liu Sr.

The internal structures of fault and unconformity can be divided into several layers. These layers can be identified by seismic and logging technology. Every layer has different roles to control the oil and gas accumulation.

(S) (C) (C) T2. Emerging Voices in Energy Geology Research: Contributions from Students and Early Career Professionals (Posters)

Endorser: GSA Energy Geology Division

Disciplines: Energy Geology, Geoscience Education, Geoscience and Public Policy

Advocates: Denise J. Hills; Justin Birdwell; David T Wang; Marc Buursink

This session will focus on completed research and work in progress performed by students at all levels and early-career professionals relevant to geologic energy with emphasis on the expansion of non-fossil energy resources.

(\$) (T3. The Changing Landscape of Energy Geology

Endorsers: *GSA Energy Geology Division; GSA Limnogeology Division*

Disciplines: Energy Geology, Engineering Geology, Geoscience and Public Policy

Advocates: Justin Birdwell; Denise J. Hills; Marc Buursink; David T. Wang

This session seeks contributions describing research efforts around the development of geologic energy resources of all kinds, including multi-resource development efforts in petroliferous basins utilizing waste streams, carbon capture, utilization, and storage, and non-traditional resources.

(\$) (() (() T4. Deep-Time Empowered Sustainability, Energy Transition, and Carbon Solutions

Endorsers: *GSA Geoinformatics and Data Science Division; GSA Energy Geology Division; American Association of Petroleum* Geologists; SEPM (Society for Sedimentary Geology); Paleontological Society; GSA International Disciplines: Energy Geology, Environmental Geoscience,

Geoinformatics and Data Science

Advocates: Susan Nash; Manuel Pubellier; Jennifer Mckinley; Qiuming Cheng

Deep-time databases and applications are more powerful than ever, and, thanks to cloud computing, machine learning, help to solve issues in sustainability, climate, and energy transition. This session examines deep-time projects and knowledge on novel analytics, applications, visualizations, and integrations.

(C) T5. Carbon and Hydrogen Storage in Geologic Systems

Endorsers: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Energy Geology Division Disciplines: Energy Geology, Geochemistry, Geophysics/ Geodynamics

Advocates: James Gardiner; Johnathan Moore; Dustin Crandall; Angela Goodman

Geologic carbon storage and hydrogen storage are important climate change mitigation strategies. This session focuses on research addressing (1) storage formation injectivity, permeability, and reactions; and (2) monitoring techniques that track plume movement.

ECONOMIC GEOLOGY

(Solution States of Characterization Methodologies of Unconventional and Secondary Sources for Critical Minerals

Endorsers: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Energy Geology Division **Disciplines:** Economic Geology, Energy Geology, Environmental Geoscience

Advocates: Anna Wendt; Darcy K. McPhee

Geologic characterization (deposit modeling, geologic/geochemical/geophysical mapping, and AI/ML applications) of unconventional and secondary sources for critical minerals is requiring modified and innovative techniques from those used to characterize conventional deposits.

(\$) T7. Linking Critical Minerals and the Geologic Framework of North America: The U.S. Geological Survey Earth Mapping Resources Initiative (Earth MRI) and Related Activities

INDUSTRY TRACKS

GSA's technical program offers sessions relevant to applied geoscientists. Look for these icons, which identify sessions in the following areas:









Hydrogeology and Environmental Geology Endorsers: GSA Geology and Society Division; GSA Structural Geology and Tectonics Division; Society of Economic Geologists; American Association of State Geologists; GSA Energy Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geophysics and Geodynamics Division Disciplines: Economic Geology, Tectonics, Geophysics/ Geodynamics

Advocates: James V. Jones III; Benjamin Drenth; Douglas C. Kreiner; Arthur J. Merschat; Anjana Shah; Laurel Woodruff

Earth MRI is improving knowledge of the geologic framework of critical mineral resources through new geologic mapping, airborne geophysics, geochemistry, and lidar acquisition. We welcome submissions linking critical minerals and their host geologic framework.

Endorsers: GSA Energy Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Environmental and Engineering Geology Division; GSA Geology and Society Division

Disciplines: Economic Geology, Energy Geology, Geochemistry **Advocates:** Erin Phillips; Franciszek Hasiuk; Lily Jackson

This session will focus on new research addressing the occurrence, distribution, and enrichment mechanisms of critical minerals in western North America, from the Mississippi River to the Pacific coast.

(\$) (() T9. Regional Characterization of Critical Mineral Potential

Endorsers: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Energy Geology Division Disciplines: Economic Geology, Geoscience Information/ Communication, Geoscience and Public Policy Advocate: Levi Knapp

This session will highlight recent advances in jurisdictionalscale efforts to characterize critical mineral potential, with focus on case studies, data dissemination methods, use of 3D modeling applications, and the evolving role of government agencies.

(\$) (⁽⁾) T10. Characterization of Critical Metals in Unconventional Ores to Inform Recovery Potential

Endorsers: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Energy Geology Division; GSA Environmental and Engineering Geology Division; GSA Geobiology and Geomicrobiology Division; Geochemical Society; Mineralogical Society of America

Disciplines: Economic Geology, Environmental Geoscience, Mineralogy/Crystallography

Advocates: Christina Lopano; Mengling Stuckman; Rosemary C. Capo; Camille Sicker; Tashane Boothe

This session addresses the critical need for research on fundamental properties and occurrence of critical metals (CM) in unconventional ores. Studies that explore CM behavior in natural or engineered ecosystems are encouraged.

ENVIRONMENTAL GEOSCIENCE

T11. **35th Annual Undergraduate Research Exhibition** (Posters)

Endorsers: Sigma Gamma Epsilon; GSA Quaternary Geology and Geomorphology Division; GSA Limnogeology Division **Discipline:** Environmental Geoscience

Advocates: Steve Bennett; Richard Ford; Diane Burns; Alexander K. Stewart; Michael Gibson

All students are encouraged to submit research to this poster session. All geological investigations, from archaeological geology to volcanology, are welcome. Presenters who are Sigma Gamma Epsilon members are eligible to compete for monetary awards that will be distributed at the meeting.

T12. Novel Stable Isotope Applications and Methods for Understanding Human Impacts to Elemental Distributions across the Atmospheric-Aquatic-Terrestrial Continuum

Endorsers: GSA Geobiology and Geomicrobiology Division; GSA Soils and Soil Processes Division; GSA Hydrogeology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Limnogeology Division

Disciplines: Environmental Geoscience, Geochemistry, Geobiology and Geomicrobiology

Advocates: Emily Elliott; Julie Weitzman

In this session, we highlight key advances in innovative techniques and applications of light stable isotopes (in liquids, solids, and gases) to unravel complexities of elemental distributions along the aquatic-terrestrial-atmospheric continuum.

W T13. Characteristics, Reactivity and Role of Natural Organic Matter (NOM) in Elemental Cycling in the Environment

Endorsers: GSA Geology and Health Division; GSA Geobiology and Geomicrobiology Division; GSA Limnogeology Division; GSA Hydrogeology Division; International Society of Groundwater for Sustainable Development

Disciplines: Environmental Geoscience, Geochemistry, Geobiology and Geomicrobiology

Advocates: Harshad Vijay Kulkarni; Thomas Varner; Kato Dee; Brady Ziegler; Natalia Malina; Ann Ojeda; Mohammad Alauddin; Robert Finkelman; Karen Johannesson; Saugata Datta

This session will enhance our understanding of the characteristics, reactivity, and role of natural organic matter (NOM) in cycling of elements of human health concern in the environment.

(\$) (>) (*) T14. Innovation in Event Monitoring for Environmental and Resiliency Applications

Endorsers: Field Environmental Instruments Inc.; Field Data Solutions; Groundswell Technologies; 212 Environmental Consulting; Cox-Colvin & Associates Inc.

Disciplines: Environmental Geoscience, Geoinformatics and Data Science, Geoscience Information/Communication Advocate: Mitchell Brourman

This session will feature technical presentations that include applications of real-time multi-dimensional environmental monitoring to capture potential environmental exposures and monitoring for infrastructure resiliency preparedness and notification.

T15. Geology and Society Division at 20: How Geology Shapes Society—Past, Present, and Future

Endorser: *GSA Geology and Society Division* **Disciplines:** Environmental Geoscience, Energy Geology, Geoscience and Public Policy

Advocates: James Heller; M. Harris; Alan Benimoff; Lily Jackson This session seeks to highlight geology's role in shaping society.

Topics may include natural resources, natural disasters, environmental quality, planetary exploration, geoarchaeology, climate and paleoclimate, geoinformatics, geoworkforce issues, and geoscience policy.

(\$) (*) (*) T16. No Well Left Behind: Quantifying Impacts and Improving Management of Active, Abandoned, and Orphaned Oil and Gas Wells to Safeguard Air, Water, and Land Resources

Endorsers: *GSA Hydrogeology Division; GSA Energy Geology Division*

Disciplines: Environmental Geoscience, Energy Geology, Geology and Health

Advocates: Tao Wen; Gregory Lackey; Samuel Shaheen

This session seeks abstracts applying field, laboratory, and modeling efforts (physics-based, data-driven) using multidisciplinary datasets to quantify impacts and improve management of oil/gas wells in all statuses (active, abandoned, orphaned) and types (unconventional, conventional).

🚯 T17. Environmental Geochemistry and Health

Endorsers: GSA Geology and Health Division; GSA Environmental and Engineering Geology Division; GSA Karst Division; GSA Hydrogeology Division; GSA Geology and Society Division; GSA Geobiology and Geomicrobiology Division; GSA Soils and Soil Processes Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Limnogeology Division Disciplines: Environmental Geoscience, Geology and Health, Geochemistry

Advocates: Sarah Hayes; Jean Morrison; Ann Ojeda

We encourage presentations on the environmental fate of contaminants and their impact on human and environmental health. Transdisciplinary contributions—those examining the rock-soilwater-human nexus at all scales having strong public outreach or societal impact are welcome.

ENVIRONMENTAL JUSTICE

T18. Teaching Environmental Justice "In and Beyond" the Classroom

Endorsers: National Association of Geoscience Teachers (NAGT); National Association of Geoscience Teachers (NAGT) Geoscience Education Research (GER) Division; National Association of Geoscience Teachers (NAGT) Teacher Education Division (TED); National Association of Geoscience Teachers (NAGT) Geo2YC Division; GSA Geoscience Education Division

Disciplines: Environmental Justice, Geoscience Education, Geoscience and Public Policy

Advocates: Dominick Ciruzzi; Deron Carter; Jennifer Latimer; Samuel Nyarko

This session brings together research, teaching, and actionable interventions integrating environmental justice concepts, including climate justice, in stand-alone disciplinary and interdisciplinary courses, throughout the curriculum in undergraduate/graduate/K-12 programs, museums, community work, and other settings.

ENGINEERING GEOLOGY

(*) (*) T19. Environmental and Engineering Geology Division: Poster Session for Graduate and Undergraduate Students (Poster)

Endorser: GSA Environmental and Engineering Geology Division Disciplines: Engineering Geology, Environmental Geoscience Advocates: Francis Rengers; Arpita Nandi; Ann Youberg; W. Paul Burgess

We encourage graduate and undergraduate students to submit poster presentations on topics related to applied research in environmental and engineering geology. Monetary awards will be given to the top presenters at the Division awards ceremony.

(3) (b) T20. From Drought to Flood: Variable Impacts from the Devastating 2022–2023 Atmospheric Rivers in California That Offer a Glimpse of Possible Future Climate Conditions and Effects

Endorsers: GSA Environmental and Engineering Geology Division; GSA Marine and Coastal Geoscience Division; GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Limnogeology Division Disciplines: Engineering Geology, Environmental Geoscience, Geomorphology

Advocates: Don Lindsay; W. Paul Burgess; Jonathan Perkins; Matthew Thomas; James Guilinger

Multiple atmospheric rivers battered California in December 2022 and January 2023, producing a variety of impacts. This session encourages submissions of applied research on weather-induced impacts related to physical processes, wildfire, and engineered infrastructure.

(3) (3) T21. Environmental and Engineering Geology Division

Endorser: *GSA Environmental and Engineering Geology Division*

Disciplines: Engineering Geology, Environmental Geoscience **Advocates:** Francis Rengers; Arpita Nandi; Ann Youberg; W. Paul Burgess

This session for the Environmental and Engineering Geology Division (EEGD) gives an opportunity to the geosciences community to present their research, data, and work pertaining to environmental and engineering geology.

(③) (④) T22. The Field Accuracy of Geotechnical Instrumentation

Endorsers: GSA Environmental and Engineering Geology Division; GeoKon; RST Instruments; Measurand Disciplines: Engineering Geology, Geoinformatics and Data Science, Continental Scientific Drilling Advocate: Garrett Bavrd

This session presents accuracy data from field installations of geologic and geotechnical sensors. By collaborating and sharing field accuracy levels, we can better understand, analyze, and visualize sensor and instrumentation data.

GEOLOGY AND HEALTH

(2) (b) T23. Research and Practice: Per- and Polyfluoroalkyl Substances (PFAS) Contamination in the Environment

Endorsers: GSA Geology and Health Division; GSA Hydrogeology Division; GSA Environmental and Engineering Geology Division; GSA Limnogeology Division

Disciplines: Geology and Health, Hydrogeology, Environmental Geoscience

Advocates: James Connors; Mark Mitchell; Michael Pouncey

Our understanding of per- and polyfluoroalkyl substances (PFAS) contamination is rapidly changing, and many geoscientists are at the forefront of this work. This session offers a forum to exchange up-to-date PFAS information, experience, and insights.

GEOSCIENCE EDUCATION

(\$) (>) (>) T24. Field-Based Geoscience Education: Advances in Research, Program Evaluation, Pedagogy, and Curriculum

Endorsers: GSA Geoscience Education Division; National Association of Geoscience Teachers (NAGT); National Association of Geoscience Teachers (NAGT) Geoscience Education Research (GER) Division; National Association of Geoscience Teachers (NAGT) Geo2YC Division **Discipline:** Geoscience Education

Advocates: Laura Lukes; Alison Jolley

This session aims to advance the conversation about creating effective field-based learning experiences by exploring strategies, design, results, etc., from evidence-based studies about field trips, courses, and other related experiences. Diverse perspectives and approaches welcome!

T25. Metacognition in the Trenches

Endorsers: *GSA Geoscience Education Division; National Association of Geoscience Teachers (NAGT) Geo2YC Division* **Disciplines:** Geoscience Education, Geoscience Education, Geoscience Education

Advocates: David Voorhees; Lynsey E. LeMay; Elizabeth Nagy

Metacognition is a well-documented component of student success, which varies by classes and instructors. Show us how you increase the metacognitive skills of your students. We welcome all colleagues, especially 2YC, modalities, and encourage handouts.

T26. Bringing Ocean Expeditions and Science at Sea to the Classroom and Community (Posters)

Endorsers: National Association of Geoscience Teachers (NAGT); GSA Geoscience Education Division; GSA Marine and Coastal Geoscience Division

Disciplines: Geoscience Education, Marine and Coastal Geoscience **Advocates:** Laura Guertin; Maya Pincus; Carol Cotterill

From classroom exercises to outreach programs, we encourage scientists and educators to provide examples of effective strategies in sharing the process of science, research data, and career opportunities from ocean expeditions.

T27. Making Sense of Methodologies and Theoretical Frameworks in Geoscience Education Research

Endorsers: GSA Quaternary Geology and Geomorphology Division; GSA Geoscience Education Division; National Association of Geoscience Teachers (NAGT); National Association of Geoscience Teachers (NAGT) Geoscience Education Research (GER) Division Discipline: Geoscience Education

Advocates: Leilani Arthurs; Kristen Foley; Peggy McNeal; Samuel Nyarko; Emily Scribner

Methods and theoretical frameworks from within and outside of geoscience education research shape our field. Presenters are encouraged to highlight their decision-making process in research studies. New approaches and applications of established methods/ frameworks are welcome.

T28. 7th–12th Grade and Higher Education/ Industry: Partnerships and Programs that Build Opportunities, Equity, or Inclusivity to Inspire Future Geoscientists

Endorsers: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geoscience Education Division; National Association of Geoscience Teachers (NAGT) **Disciplines:** Geoscience Education, Geoscience Information/ Communication

Advocate: Christopher Thomas

This session welcomes partnerships and programs between precollege students and community college, university, or industry to share best practices and models that build deep connections with students, especially with broadening diversity and representation in geosciences.

T29. Expanding the Tent: Understanding Spatial Reasoning to Increase Equity in Geoscience Education Across Disciplines

Endorsers: National Association of Geoscience Teachers (NAGT); GSA Quaternary Geology and Geomorphology Division; GSA Geoscience Education Division; National Association of Geoscience Teachers (NAGT) Geoscience Education Research (GER) Division

Discipline: Geoscience Education

Advocates: Katharine Johanesen; Elijah Johnson; Peggy McNeal; Annie Klyce

Spatial reasoning is crucial to learning across geoscience and STEM overall. This session brings together research on spatial reasoning in students and scientists and supporting spatial reasoning skill development in both formal and informal education.

T30. Highlighting Successful Mentoring Strategies in the Geosciences

Endorsers: American Geophysical Union; EarthScope Consortium; GSA Quaternary Geology and Geomorphology Division; National Association of Geoscience Teachers (NAGT) Disciplines: Geoscience Education, Geoscience and Public Policy Advocates: Pranoti Asher; Liz Gilden

This session will highlight impactful mentoring stories and supporting projects that have demonstrated success and coordinated change within the geoscience enterprise. Presentations may be from funders, program leaders, students, and alumni who want to share challenges, successes, and visions.

T31. **2YC and 4YCU Geoscience Student Research Exhibition (Posters)**

Endorsers: National Association of Geoscience Teachers (NAGT) Geo2YC Division; National Association of Geoscience Teachers (NAGT) Geoscience Education Research (GER) Division; GSA Geoscience Education Division

Discipline: Geoscience Education

Advocates: Adrianne Leinbach; Stephanie Rollins; Gretchen L. Miller

This session is designed for two-year college (2YC) and fouryear college and university (4YCU) students presenting research posters in any subdiscipline of geoscience.

T32. Engaging the Public in Science: Promoting a Deeper Understanding of Our World and Beyond

Endorsers: GSA Planetary Geology Division; GSA Geoscience Education Division; GSA Quaternary Geology and Geomorphology Division; GSA Limnogeology Division **Disciplines:** Geoscience Education, Planetary Geology, Geoscience Information/Communication

Advocates: Andy Shaner; Jessica Swann; Emily Law

The session highlights programs and projects utilizing evidence-based strategies to engage public audiences, particularly underrepresented communities, in science disciplines across the geosciences. Evaluation data demonstrating program/project success will also be shared.

T33. Outside the Classroom, Beyond Fieldwork: Innovative Approaches to Informal Geoscience Education in Non-Traditional Settings

Endorser: Paleontological Society

Disciplines: Geoscience Education, Geoscience Information/ Communication, Geoscience and Public Policy **Advocates:** Gabriel-Philip Santos; Lisa Lundgren

This session highlights informal education projects that combine innovative approaches to geoscience education with non-traditional settings and open unique opportunities to reach novel audiences.

(5) (2) (3) T34. Early Involvement in Geoscience Research among K9–16 Students Can Ensure Sustained Growth of the Discipline (Posters)

Endorsers: GSA Environmental and Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division; GSA Geoscience Education Division; National Association of Geoscience Teachers (NAGT); National Earth Science Teachers Association; GSA Energy Geology Division; GSA Hydrogeology Division; GSA Soils and Soil Processes Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geoscience Education, Geoscience Information/ Communication, Geoscience and Public Policy

Advocates: Nazrul Khandaker; Taufique Mahmood; Noshin Sharmili

Students (both undergraduates and high school) are encouraged to submit environmental and geoscience abstracts based on faculty and/or student-initiated research activities. Best practices on innovative pedagogies are welcome as well.

(\$) (\$) T35. Exploring the Borders and Boundaries of Mixed Reality in the Geosciences

Endorsers: GSA Quaternary Geology and Geomorphology Division; GSA Geoscience Education Division; National Association of Geoscience Teachers (NAGT); National Association of Geoscience Teachers (NAGT) Geoscience Education Research (GER) Division; National Association of Geoscience Teachers (NAGT) Teacher Education Division (TED)

Disciplines: Geoscience Education, Geoinformatics and Data Science, Geoscience Information/Communication

Advocates: Michael Meyer; Rose-Anna Behr; Matthew Rissler Discussing the challenges, potential, best practices, and advancements of mixed reality in the geosciences.

T36. Iris Moreno Totten Research in Geoscience Education Session

Endorsers: GSA Geoscience Education Division; National Association of Geoscience Teachers (NAGT); National Association of Geoscience Teachers (NAGT) Geoscience Education Research (GER) Division **Discipline:** Geoscience Education

Advocate: Charles Doug Czajka

This session will highlight empirical research being done in the field of geoscience education. Early-career and student presenters will be considered for the Geoscience Education Division's Totten Award.

T37. G-IRL: Collaborations and Conversations on Practicing Geoscience and In-Real-Life Applications for Dismantling Scientific Siloes

Disciplines: Geoscience Education, Geoscience Information/ Communication, Geoscience and Public Policy

Advocates: Elizabeth Long; Darryl Reano; Akilah Alwan; Leila Joyce Seals

This session will answer calls for more authentic collaborations between geoscientists and historically marginalized communities, focusing on contributions from students, early-career professionals, and On To the Future alumni.

INDUSTRY TRACKS

GSA's technical program offers sessions relevant to applied geoscientists. Look for these icons, which identify sessions in the following areas:









Hydrogeology and Environmental Geology

T38. Inclusive Geoscience Teaching for Today's Students

Endorsers: National Association of Geoscience Teachers (NAGT); National Association of Geoscience Teachers (NAGT) Geoscience Education Research (GER) Division; GSA Energy Geology Division **Discipline:** Geoscience Education

Advocates: Karen M. Layou; Eric Baer; Peter J. Berquist

Share and learn innovative teaching strategies to meet the needs of all students across teaching modalities. Emphasis will be placed on implementation and assessment of practices that promote student success with a lens toward equity.

GEOSCIENCE INFORMATION/COMMUNICATION

W T39. Geoscience and Hydrology of Your Public Lands: STEM Internships, Research, Science, Mapping, Resource Management, and Education

Endorsers: *GSA Quaternary Geology and Geomorphology Division; GSA Geoscience Education Division; National Association of Geoscience Teachers (NAGT)*

Disciplines: Geoscience Information/Communication, Geoheritage, Geoscience and Public Policy

Advocates: Jason Kenworthy; Matthew Dawson; Limaris Soto; Chelsea Bitting; Lesley Petrie; Brent H. Breithaupt; F. Edwin Harvey

This will be an interdisciplinary forum for geoscientists, land managers, Geoscientists in the Parks, Scientists in Parks, and GeoCorps[™] America participants or sponsors, as well as educators, to present their work and describe its relevance to the public and land managers.

PALEOCLIMATOLOGY/PALEONCEANOGRAPHY

(C) T40. Integrated Evaluations of the Depositional Processes Driving Carbon Burial in Ancient Marine Environments (Posters)

Endorsers: GSA Energy Geology Division; SEPM (Society for Sedimentary Geology); Geochemical Society; GSA Geobiology and Geomicrobiology Division; GSA Continental Scientific Drilling Division; GSA Sedimentary Geology Division Disciplines: Paleoclimatology/Paleoceanography, Sediments, Clastic, Sediments, Carbonates

Advocates: Jason Flaum; K.J. Whidden; Kira K. Timm; Justin Birdwell; Katherine French

This session seeks submissions utilizing an integrated approach including geochemistry, modeling, paleontology, and sedimentologic observation to address the depositional processes and environments associated with carbon burial in the geologic past, including during extreme climate events.

T41. Cycles of Climate and Layers of Time: The Scientific Legacies of Roger Y. Anderson and Walter E. Dean Jr.

Endorsers: GSA Limnogeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; GSA Marine and Coastal Geoscience Division; American Quaternary Association; GSA Soils and Soil Processes Division; GSA Continental Scientific Drilling Division Disciplines: Paleoclimatology/Paleoceanography, Limnogeology, Quaternary Geology Advocates: Kirsten Menking; Lesleigh Anderson; Peter Fawcett

This session explores climatic cycles encoded in the geologic record at all time scales and honors the memories of Roger Y. Anderson and Walter E. Dean, Jr., who pioneered many innovative techniques in paleoclimatology/paleoceanography.

W T42. Records of Quaternary Climate, Hydrology, and Landscape Evolution in the Great Basin, USA

Endorsers: GSA Quaternary Geology and Geomorphology Division; GSA Geobiology and Geomicrobiology Division; GSA Hydrogeology Division; GSA Limnology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Sedimentary Geology Division; GSA Soils and Soil Processes Division; Geochemical Society; AASP - The Palynological Society; GSA Continental Scientific Drilling Division

Disciplines: Paleoclimatology/Paleoceanography, Quaternary Geology, Limnogeology

Advocates: Brian Stewart; Tim K. Lowenstein; Kristian J. Olson; Adam Hudson; David McGee

The Great Basin (USA) contains a rich record of climate change, palaeohydrology, and landscape evolution in an arid environment. This session will focus on proxies for Great Basin hydrologic and geomorphological changes during the Quaternary.

T43. Oceans and Climates through Earth History: Modeling, Proxy, and Proxy Development Studies (Posters)

Endorsers: Cushman Foundation; Paleontological Society; Geochemical Society; Paleontological Research Institution; GSA Marine and Coastal Geoscience Division; AASP - The Palynological Society; GSA Geobiology and Geomicrobiology Division; SEPM (Society for Sedimentary Geology); GSA Limnogeology Division; GSA Soils and Soil Processes Division Disciplines: Paleoclimatology/Paleoceanography, Geochemistry, Paleontology, Diversity, Extinction, Origination Advocates: Megan Fung; Miriam E. Katz

This session brings together modeling, proxy, and proxy development studies to improve our understanding of rapid ocean and climate events, and shifts between long-term climate/ocean states, within the context of normal variability throughout Earth history.

T44. Insights from Microfossils and Their Modern Analogs: From Traditional and Emerging Approaches to Critical Re-Evaluations (Posters)

Endorsers: GSA Marine and Coastal Geoscience Division; Cushman Foundation; Paleontological Society; AASP - The Palynological Society; Geochemical Society; Paleontological Research Institution; GSA Geobiology and Geomicrobiology Division; GSA Limnogeology Division

Disciplines: Paleoclimatology/Paleoceanography, Geochemistry, Paleontology, Biogeography/Biostratigraphy

Advocates: Robert Poirier; Chiara Borrelli

Assemblage- and proxy-based (i.e., geochemical) records derived from microfossils comprise two foundational pillars paleoclimate research. We encourage studies applying traditional and novel microfossil-based reconstructions, including those seeking to revisit old assumptions that may bias paleo-reconstructions.

T45. Cushman Foundation Symposium: In Pursuit of Understanding the Distribution of Benthic Foraminifera: Honoring the Career of Martin A. Buzas

Endorsers: Cushman Foundation; Paleontological Society; AASP - The Palynological Society; Geochemical Society; SEPM (Society for Sedimentary Geology); GSA Marine and Coastal Geoscience Division; GSA Geobiology and Geomicrobiology Division Disciplines: Paleoclimatology/Paleoceanography, Paleontology, Biogeography/Biostratigraphy, Paleontology, Paleoecology/ Taphonomy

Advocates: Scott Ishman; Laurel Collins

Benthic foraminifera occur globally in coastal to deep-sea environments. In dedication to the career of Martin A. Buzas, this Cushman Foundation Symposium explores the studies and methods used to understand their global distributions.

T46. Pleistocene–Holocene Climate Variability of Western North America

Endorsers: GSA Limnogeology Division; GSA Soils and Soil Processes Division; GSA Quaternary Geology and Geomorphology Division; GSA Continental Scientific Drilling Division Disciplines: Paleoclimatology/Paleoceanography, Limnogeology, Continental Scientific Drilling

Advocates: Jamie Vornlocher; Laura Lopera Congote; Hailey Sinon

This session focuses on Pleistocene–Holocene climate variability in continental and marine western North American paleoclimate archives. We will discuss the driving mechanisms of past environmental change to better predict future impacts in a warming world.

(b) (c) T47. Global Environmental Change as an Analogue Linking the Climate and Upwelling Pattern in the Tropical Eastern Pacific Ocean

Endorsers: GSA International; GSA Geology and Society Division; GSA Quaternary Geology and Geomorphology Division; American Society of Limnology and Oceanography; AASP - The Palynological Society; Paleontological Society; Geochemical Society; Paleontological Research Institution; GSA Marine and Coastal Geoscience Division; Cushman Foundation Disciplines: Paleoclimatology/Paleoceanography, Geobiology and Geomicrobiology, History and Philosophy of Geology Advocates: Onema Adojoh; Henry Agbogun; Walaa Awad; Rebecca Totten Minzoni

The formation of the Isthmus of Panama and consequent isolation of the Caribbean Sea from the tropical eastern Pacific is of interest to scientists. Yet, the paleoclimate, paleogeography, and timing of the uplift of the Isthmus is poorly understood.

T48. Exploring Changes in Climate, Flora, and Fauna of Africa through the Cenozoic

Endorsers: GSA Soils and Soil Processes Division; GSA Continental Scientific Drilling Division; GSA Limnogeology Division; Paleontological Society; SEPM (Society for Sedimentary Geology); GSA Geobiology and Geomicrobiology Division; Paleontological Research Institution

Disciplines: Paleoclimatology/Paleoceanography, Paleontology, Paleoecology/Taphonomy, Continental Scientific Drilling **Advocates:** William Lukens; Mae Saslaw; Emily Jane Beverly

This session will highlight research focused on climate, vegetation, ecology, and geologic processes in Africa. Contributions are encouraged from work focusing on the Cenozoic through today, including outcrop, core, and modern analog studies.

(b) T49. Integrated Evaluations of the Depositional Processes Driving Carbon Burial in Ancient Marine Environments

Endorsers: GSA Energy Geology Division; SEPM (Society for Sedimentary Geology); Geochemical Society; GSA Geobiology and Geomicrobiology Division

Disciplines: Paleoclimatology/Paleoceanography, Sediments, Clastic, Sediments, Carbonates

Advocates: Jason Flaum; K.J. Whidden; Kira K. Timm; Justin Birdwell; Katherine French

This session seeks submissions utilizing an integrated approach including geochemistry, modeling, paleontology, and sedimentologic observation to address the depositional processes and environments associated with carbon burial in the geologic past, including during extreme climate events.

QUATERNARY GEOLOGY

T50. These Old Mountains Still Got It: Natural Hazards of the Evolving Appalachian Mountain Belt

Endorsers: GSA Quaternary Geology and Geomorphology Division; GSA Environmental and Engineering Geology Division; GSA Environmental and Engineering Geology Division Landslide Committee; GSA Karst Division; GSA Structural Geology and Tectonics Division; GSA Soils and Soil Processes Division Disciplines: Quaternary Geology, Geomorphology, Engineering Geology

Advocates: Corey Scheip; Matthew Crawford; Charles Shobe; Mark Zellman

Though active mountain building ended >200 million years ago, the modern-day Appalachian Mountains are ripe for natural hazards. This session will focus on how geological and meteorological hazards continue to shape the Appalachian landscape.

T51. Lakes and Wetlands in the Drylands of Western North America: Late Quaternary Hydroclimate Reconstructions from Dryland Paleohydrology

Endorsers: GSA Quaternary Geology and Geomorphology Division; GSA Hydrogeology Division; GSA Limnogeology Division Disciplines: Quaternary Geology, Paleoclimatology/ Paleoceanography, Limnogeology

Advocate: Brendan Fenerty

This session features reconstructions of late Quaternary hydroclimate variability based on the timing and magnitude of hydrologic changes recorded by the expansion and contraction of lakes and wetlands in contemporary drylands throughout western North America.

T52. Aeolian Systems in Time and Space

Endorsers: GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division

Disciplines: Quaternary Geology, Geomorphology, Sediments, Clastic

Advocates: Mark Sweeney; Nicholas Lancaster

This session will explore research focused on all aspects of aeolian processes and landforms including dunes, dust, and loess in modern and ancient aeolian systems.

HISTORY AND PHILOSOPHY OF GEOLOGY

T53. Rock Art Throughout History

Endorsers: GSA History and Philosophy of Geology Division; GSA Geoarchaeology Division; GSA Karst Division; American Quaternary Association; National Cave and Karst Research Institute Disciplines: History and Philosophy of Geology, Geoarchaeology, Geoheritage

Advocate: Patricia Bobeck

We present sites worldwide where humans have created art on rock. Sites include cave paintings, petroglyphs, rock reliefs, geoglyphs, with geologic focus: rock types, settings, pigment/engraving materials, and the role of climate and erosion.

T54. Great Books in Geology Revisited

Endorsers: GSA History and Philosophy of Geology Division; History of Earth Sciences Society

Disciplines: History and Philosophy of Geology, Geoscience Education, Geoheritage

Advocate: Patricia Bobeck

Ten years after the Great Books sessions held during the 125th GSA anniversary celebration, it's time to praise books published since then and books published in centuries past that have added to geologic knowledge.

(\$) (>) (>) T55. The History of Geologic Discovery in the Pittsburgh Region: Past and Present Advances to the Discipline

Endorser: *Pittsburgh Geological Society* Discipline: History and Philosophy of Geology Advantes: Daniel Harris: John Harner: Wondy

Advocates: Daniel Harris; John Harper; Wendy Noe

The Pittsburgh Geological Society would like to welcome a national audience to Pittsburgh through this session featuring modern and historic advances in geology relevant to the Pittsburgh region.

T56. Celebrating State Geological Surveys, State Geologists, and Exceptional State Projects

Endorsers: GSA History and Philosophy of Geology Division; Association of American State Geologists; History of Earth Sciences Society; GSA Energy Geology Division

Disciplines: History and Philosophy of Geology, Geoscience and Public Policy, Geoheritage

Advocates: Patricia Bobeck; Stephen Testa

Presentations will explore contributions made by state geologists and state surveys throughout American history. Examples include geologists who founded state surveys, state survey geologists whose work surpassed state boundaries, and historic projects accomplished by state surveys.

GEOHERITAGE

T57. The Geoheritage of Planetary Exploration

Endorsers: GSA Planetary Geology Division; GSA History and Philosophy of Geology Division

Disciplines: Geoheritage, Planetary Geology, History and Philosophy of Geology

Advocates: Nicholas Patrick Lang; Jennifer Piatek; Eric Pyle

We welcome submissions that discuss events, people, places, and programs that have been or will be significant in space exploration. Submissions tying processes and landforms on other bodies to understanding Earth's history are also welcome.

T58. The Stories of Geoheritage

Endorsers: *History of Earth Sciences Society; GSA History and Philosophy of Geology Division*

Disciplines: Geoheritage, History and Philosophy of Geology, Environmental Justice

Advocates: Renee M. Clary; Christina DeVera; William Andrews Presentations explore the excluded histories of Geoheritage from our homogenized historical accounts. Marginalized voices are welcomed to illuminate cultural accounts related to landscape and human impact resulting from geoscientific exploration and "resource" extraction.

GEOARCHAEOLOGY

T59. Microbotanical and Macrobotanical Analyses in Geoarchaeology: Approaches, Methods, and Applications

Endorsers: GSA Geoarchaeology Division; GSA Soils and Soil Processes Division; GSA Geobiology and Geomicrobiology Division Disciplines: Geoarchaeology, Paleontology, Biogeography/ Biostratigraphy, Geomorphology

Advocates: Carlos Cordova; Alison Damick

This session aims at discussing current and innovative applications of the analysis of microbotanical remains (pollen, phytoliths, microcharcoal, and diatoms) and macrobotanical remains from on-site and off-site settings are integrated into geoarchaeological research.

T60. New Technology, Directions, and Opportunities in Geoarchaeology

Endorser: GSA Geoarchaeology Division

Disciplines: Geoarchaeology, Geoinformatics and Data Science, Geoscience Education

Advocates: Samantha Marie Krause; Rebecca Taormina The discipline of geoarchaeology is becoming more diverse in recent years. This session brings together researchers at the forefront of that expansion. We are specifically targeting papers from diverse voices using new and critical technologies to expand our discipline.

(S) T61. Ancient Alluvial Gold Mining: The Present is Key to the Past

Endorser: GSA Geoarchaeology Division

Disciplines: Geoarchaeology, Economic Geology, Geoheritage **Advocate:** William Brooks

Mansa Musa (Mali), Atahualpa (Peru), and King Croesus (Türkiye) are listed as having incredible gold wealth; however, little is known about ancient gold mining in these respective regions. Papers are requested that address ancient alluvial gold mining.

T62. Coastal and Island Geoarchaeology

Endorsers: GSA Geoarchaeology Division; GSA Quaternary Geology and Geomorphology Division

Disciplines: Geoarchaeology, Paleoclimatology/

Paleoceanography, Quaternary Geology

Advocate: Charles Andrus

Coastal and island archaeological sites display characteristics amendable to investigation via geomorphology, sclerochronology,

geophysics, and other geoarchaeological approaches. Interdisciplinary researchers addressing any questions or methods related to coastal geoarchaeology are encouraged to participate.

T63. Down By the River: Recent Interdisciplinary Geoarchaeological and Paleoenvironmental Research in North American River Valleys

Endorsers: GSA Geoarchaeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geobiology and Geomicrobiology Division; GSA Soils and Soil Processes Division; GSA Continental Scientific Drilling Division Disciplines: Geoarchaeology, Geomorphology, Quaternary Geology Advocates: Todd Grote; Lara Homsey-Messer; Benjamin Cross

We welcome presentations that present new data and use innovative techniques to help unravel the archaeological and paleoenvironmental record of river valleys throughout North America. Interdisciplinary studies that highlight recent advances in understanding human-climate-environment interactions are highly encouraged.

PALEONTOLOGY

T64. Celebrating the Diverse Utility of Conodonts in the Birthplace of the Color Alteration Index, the Appalachian Basin: Integrated Studies of the Biosphere, Stratigraphy, and Geochemistry

Endorsers: *GSA Geobiology and Geomicrobiology Division; GSA Sedimentary Geology Division*

Disciplines: Paleontology, Biogeography/Biostratigraphy, Paleontology, Diversity, Extinction, Origination, Paleontology, Paleoecology/Taphonomy

Advocates: Martyn Golding; Nicholas Hogancamp; Neo E.B. McAdams; Pilar Navas-Parejo

Celebrating the pioneering work on the color alteration index and Paleozoic biostratigraphy conducted in the Appalachian Basin, this session will highlight new studies utilizing conodonts. Presentations on all aspects of conodont paleontology and all time periods are welcome.

T65. Future Leaders in Paleontology

Endorser: Paleontological Society

Disciplines: Paleontology, Biogeography/Biostratigraphy, Paleontology, Diversity, Extinction, Origination, Paleontology, Paleoecology/Taphonomy

Advocate: John Huntley

The Paleontological Society is pleased to offer the fifth annual "Future Leaders in Paleontology" topical session. This session will showcase the outstanding work of our student members in a high-profile setting.

(\$) (1) T66. Evolution of the Western Interior Basin: New Advances and Fresh Perspectives

Disciplines: Paleontology, Biogeography/Biostratigraphy, Paleoclimatology/Paleoceanography, Stratigraphy

Advocates: Joshua Slattery; Benjamin Linzmeier; Jessie Mccraw; Keith P. Minor; Peter J. Harries; Neil Landman; Claudia Johnson

Since the publication of *Evolution of the Western Interior Basin*, major advancements have been made in understanding the paleontology and geology of the Western Interior Basin. We seek contributions on topics related to this basin.

T67. The Early Paleozoic: Radiations, Extinctions, and Environment

Endorsers: *GSA Geobiology and Geomicrobiology Division; GSA Soils and Soil Processes Division; GSA Sedimentary Geology Division*

Disciplines: Paleontology, Diversity, Extinction, Origination, Geobiology and Geomicrobiology, Geochemistry **Advocates:** Benjamin Gill; Sara Pruss; Lidya Tarhan

This session will focus on research exploring evolutionary, ecological, and environmental changes during the early Paleozoic, with the goal of fostering multidisciplinary approaches that address key questions concerning the Cambrian through the Devonian Earth System.

T68. Temperature, Oxygen, and Their Synergistic Effects on Animal Ecosystems

Endorsers: *GSA Geobiology and Geomicrobiology Division; Paleontological Society*

Disciplines: Paleontology, Diversity, Extinction, Origination, Geobiology and Geomicrobiology, Paleoclimatology/ Paleoceanography

Advocates: Erik Sperling; Corinne Myers; Kristin D. Bergmann Oxygen and temperature are the two main environmental controls on metazoan habitability. We seek paleontological, geochemical, and physiological studies investigating how changes and interactions among these parameters influenced animal life from the Neoproterozoic to present.

T69. Disabled and Neurodivergent Perception, Community, and Identity in the Geosciences

Endorsers: International Association for Geoscience Diversity; Paleontological Society; GSA Energy Geology Division; GSA Geoscience Education Division

Disciplines: Paleontology, Diversity, Extinction, Origination, Geoscience Information/Communication, Geoscience Education **Advocates:** Taormina Lepore; Matthew Brueseke

We encourage contributors and audience participants of all backgrounds to learn, lead, and celebrate disability and

INDUSTRY TRACKS

GSA's technical program offers sessions relevant to applied geoscientists. Look for these icons, which identify sessions in the following areas:









Hydrogeology and Environmental Geology neurodivergence as core to our fields and our collective and intersectional science identities.

T70. Mass Extinctions as Natural Experiments in Earth System Perturbations

Endorsers: GSA Geobiology and Geomicrobiology Division; Paleontological Society; GSA Soils and Soil Processes Division Disciplines: Paleontology, Diversity, Extinction, Origination, Geobiology and Geomicrobiology, Paleoclimatology/ Paleoceanography

Advocates: Brian Kelley; Kimberly Lau; Thomas J. Algeo

Mass extinction intervals are perturbations of the Earth system analogous to natural experiments in environmental and biological evolution. Integrating the study of different extinction events using diverse techniques can reveal fundamental and generalizable geobiological processes.

T71. Past and Future Organism-Environment Interactions: Paleobiological and Geochemical Insights from Physiology, Macroecology, and Earth-System Modeling

Endorsers: *GSA Geobiology and Geomicrobiology Division; Paleontological Society*

Disciplines: Paleontology, Diversity, Extinction, Origination, Paleontology, Paleoecology/Taphonomy, Paleoclimatology/Paleoceanography

Advocates: Richard Stockey; Thomas Boag; Jose Marquez; Jood Al Aswad; Justin Penn

Methods adapted from climate science and global-scale ecological studies are providing new mechanistic insights into Earth's history. This session will explore how such approaches can enhance reconstructions of organism-environment interactions from the geological record.

(W) T72. From Coastal Lowlands to Shallow Shelf: Environmental Processes of the Coastal Critical Zone through Time and Space

Endorsers: Paleontological Society; GSA Marine and Coastal Geoscience Division; GSA Energy Geology Division; Cushman Foundation; GSA Soils and Soil Processes Division; GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division

Disciplines: Paleontology, Paleoecology/Taphonomy, Marine and Coastal Geoscience, Energy Geology

Advocates: Samuel Neely; Michelle Chrpa

This session explores paleoecological, paleobotanical, palynological, micropaleontological, archaeological, biogeochemical, geological, petrographic, and biomarker analyses from modern and ancient data to interpret environmental processes that impact coastal critical zone communities through time and space.

T73. Innovative Ichnology: Recent Advances in the Study of Modern and Ancient Behavior

Endorsers: Paleontological Society; GSA Geobiology and Geomicrobiology Division; GSA Sedimentary Geology Division; GSA Limnogeology Division

Disciplines: Paleontology, Paleoecology/Taphonomy, Sediments, Clastic, Sediments, Carbonates

Advocates: Daniel Hembree; Ilya V. Buynevich; Brian Platt; Jon Smith

The analysis of ichnofossils is vital to paleoecological and paleoenvironmental interpretations. We encourage research on ichnological research at all scales in marine and continental settings, novel techniques of ichnofossil analysis, and neoichnological experiments.

T74. Laws of the Grave: Advances in Taphonomy across the Paleontologic Record

Endorsers: Paleontological Society; GSA Geobiology and Geomicrobiology Division

Disciplines: Paleontology, Paleoecology/Taphonomy, Geobiology and Geomicrobiology, Stratigraphy

Advocates: Broc Kokesh; Rachel Laker

This session emphasizes the interdisciplinary and ubiquitous nature of taphonomy for analysis of the fossil record. We welcome submissions focused on understanding taphonomic processes or its impacts across any paleontologic subdiscipline, taxon, or geologic era.

T75. Honoring the Legacy of Teaching, Mentoring, and Research by Patricia Kelley: Predation, Conservation, Evolution, Education, and Diversity in the Geosciences

Endorsers: Paleontological Society; Paleontological Research Institution; Association for Women Geoscientists; National Association of Geoscience Teachers (NAGT); GSA Geobiology and Geomicrobiology Division

Disciplines: Paleontology, Paleoecology/Taphonomy, Geoscience Education

Advocates: Adiel A. Klompmaker; Gregory P. Dietl; Christy C. Visaggi; Rene Shroat-Lewis

This session requests presentations inspired by contributions made by Patricia Kelley. Research on predation and conservation paleobiology, efforts to enhance the understanding of evolution, engaging classroom approaches, and strategies to support DEI are welcome.

T76. Recent Advancements in Understanding of Ediacaran Multicellular Life and Related Insights into Paleobiology and Phylogeny

Endorsers: Paleontological Society; Paleontological Research Institution; LIFE Research Coordination Network; GSA Geobiology and Geomicrobiology Division

Disciplines: Paleontology, Phylogenetic/Morphological Patterns, Paleontology, Paleoecology/Taphonomy, Paleontology, Diversity, Extinction, Origination

Advocates: Rachel Surprenant; Heather McCandless; Tory L. Botha

This session will highlight recent advances in understanding of Ediacaran multicellular life including the description of new taxa and the application of diverse methods to known taxa that inform understanding of the paleobiology and phylogeny of these early organisms.

T77. Phylogenetic and Computational Approaches in Paleobiology and Paleoecology

Endorsers: Paleontological Society; Paleontological Research Institution; GSA Geobiology and Geomicrobiology Division; GSA Geoinformatics and Data Science Division

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Disciplines: Paleontology, Phylogenetic/Morphological Patterns, Paleontology, Diversity, Extinction, Origination, Paleontology, Biogeography/Biostratigraphy

Advocates: Katherine Jordan; Mark Nikolic

This session highlights recent advances integrating phylogenetics, modeling, and computational methods with fossil data to address evolutionary and ecological questions through deep time. Topics include macroevolutionary trends, diversification dynamics, trait evolution, macroecology, and paleobiogeography.

T78. Advances in Arthropod Paleobiology: Honoring the Illustrious Career of Rodney Feldmann

Endorsers: Paleontological Society; Paleontological Research Institution; GSA Geobiology and Geomicrobiology Division Disciplines: Paleontology, Phylogenetic/Morphological Patterns, Paleontology, Diversity, Extinction, Origination, Paleontology, Paleoecology/Taphonomy

Advocates: Adiel A. Klompmaker; Carrie Schweitzer; Dale Tshudy; Ovidiu Frantescu

This session celebrates the enormous contributions to arthropod paleontology by Dr. Rodney Feldmann for over five decades. Research in any area within the incredibly diverse arthropod clade is more than welcome.

T79. Better Together: Coloniality as a Way of Life and of Generating New Tools and Insights across Fields

Endorsers: *Paleontological Society; GSA Geobiology and Geomicrobiology Division*

Disciplines: Paleontology, Phylogenetic/Morphological Patterns, Paleontology, Paleoecology/Taphonomy, Paleontology, Diversity, Extinction, Origination

Advocates: Emanuela Di Martino; Lee Hsiang Liow; Nadia Santodomingo Aguilar

This session aims to highlight the power of colonial organisms as model systems in understanding general ecological and evolutionary patterns and processes, showcasing new methods and approaches.

T80. Friend to the Cephalopods: Honoring Neil Landman's Contributions to Cephalopod Paleobiology

Endorsers: Paleontological Society; Paleontological Research Institution; GSA Geobiology and Geomicrobiology Division Disciplines: Paleontology, Phylogenetic/Morphological Patterns, Paleontology, Diversity, Extinction, Origination, Paleontology, Paleoecology/Taphonomy

Advocates: Margaret Yacobucci; Corinne Myers; James Witts; Benjamin J. Linzmeier

This session honors and celebrates paleontologist and museum curator Neil Landman, whose work has fundamentally shaped how we understand cephalopod paleobiology. Contributions on any related topic, including applications to paleoenvironmental reconstruction, are welcome.

STRUCTURAL GEOLOGY

T81. Perspectives on Feedbacks between Deformation and Metamorphism within Plate Boundaries and Orogens

Endorser: *GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division*

Disciplines: Structural Geology, Petrology, Metamorphic, Geochronology

Advocates: Drew Levy; Michael A. Stearns

Deformation at plate boundaries and orogens is influenced by metamorphic processes that localize strain, modify rheology and enhance fluid flow, and vice versa. We welcome presentations applying structural, petrochronology, and microanalytical techniques to these processes.

T82. What's in a Fault? Fault Structure, Deformation Mechanisms, and Why Fault Zones Matter to Society: In Honor of James P. Evans

Endorsers: GSA Structural Geology and Tectonics Division; GSA Environmental and Engineering Geology Division; GSA Hydrogeology Division

Disciplines: Structural Geology, Tectonics, Hydrogeology **Advocates:** Elizabeth S. Petrie; Kelly K. Bradbury; David Ferrill; Jonathan S. Caine

This session honors the contributions of James P. Evans, highlighting interconnections among faults, deformation mechanisms, seismicity, and fluid flow from tectonic to microstructural scales in natural and experimental examples of research and implications for society.

© 🕲 🚯 T83. Best Student Geologic Mapping Competition (Posters)

Endorsers: Association of American State Geologists; U.S. Geological Survey National Cooperative Geologic Mapping Program; Geological Society of America; GSA Foundation; American Institute of Professional Geologists; American Geosciences Institute

Disciplines: Structural Geology, Stratigraphy, Geomorphology **Advocates:** Michael Marketti; Jenna Shelton

Students will present their research through geologic mapping projects that have a significant field component that addresses scientific or societal issues. The top three geologic maps will be awarded.

(b) T84. Fracture Patterns and Diagenesis in Low-Enthalpy Geothermal Reservoirs and Outcrop Analogs

Endorser: GSA Energy Geology Division

Disciplines: Structural Geology, Sediments, Clastic, Energy Geology **Advocate:** Stephen Laubach

This session will cover core and log assessment of fractures in sedimentary rock geothermal reservoirs, new methods in 2D and diagenesis-cognizant fracture pattern quantification, and geomechanical and heat exchange models for simulation and evaluation.

T85. More Than Just a Pretty Map: Innovation at State Geological Surveys

Endorser: Association of American State Geologists

Disciplines: Structural Geology, Geomorphology, Geoscience Information/Communication

Advocates: Adam Ianno; Kyle Rybacki

From large-scale, multi-state carbon capture, utilization, and storage studies to detailed 7.5-minute bedrock and surficial mapping—geological surveys really do it all. This session spotlights

the fundamental contributions of state, provincial, and territorial geological surveys.

PETROLOGY, METAMORPHIC

(\$) T86. Role of Fluids and Melts during Subduction and Exhumation, and Implications for Orogenesis, Crustal Evolution, and Metallogenesis

Endorsers: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Structural Geology and Tectonics Division

Disciplines: Petrology, Metamorphic, Structural Geology, Geochemistry

Advocates: Lu Wang; Chris Mattinson; Di-cheng Zhu

Fluids and melts are agents of mass transfer, influencing the earthquake cycle, arc magmatism and metallogenesis, and ductile deformation during subduction. We encourage contributions that integrate structural, petrological, and geochemical studies to understand these processes.

T87. Unravelling Timescales of Magmatism, Metamorphism, and Crustal Evolution

Endorsers: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geochronology Division Disciplines: Petrology, Metamorphic, Geochronology, Petrology, Igneous

Advocates: Charlotte Connop; Mark Caddick; Robert Holder

This session welcomes abstracts applying geochronology in combination with geochemical, petrological, structural, or modeling techniques to investigate the evolution of Earth's crust.

GEOCHEMISTRY

🔘 🐵 🚯 T88. Urban Geochemistry

Endorsers: International Association of GeoChemistry; GSA Hydrogeology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geochemistry, Environmental Geoscience, Hydrogeology

Advocates: W. Lyons; David Long

This session will include presentations on the geochemistry, environmental geosciences, hydrogeology, geohealth, and geomorphology of urban and suburban environments. It will address the impact of human activities on biogeochemical cycles in urban settings from the plot to the global scale.

(\$) (*) T89. Constraints on the Origin(s) of Deposits of White Clay (Adjacent to Faults), Manganese and Iron Deposits, Clay Beds, and "Blueberries"—Do Hydrothermal, Orogenic, Fluid Movements Play a Role that Drives Chemical Reactions and Forms Deposits that Are Locally Redistributed during Weathering Processes?

Endorser: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geochemistry, Economic Geology, Geophysics/ Geodynamics

Advocate: Thomas Anderson

Are deposits of white clay (adjacent to faults), manganese and iron deposits, clay beds, and "blueberries" related to hydrothermal, orogenic, Fluid movements that drive chemical reactions and form deposits that are locally redistributed during weathering processes?

(\$) (2) (3) T90. Advances in Geochemistry of Energy-Critical Elements: Their Impacts on Mineral Deposits, Hydrometallurgical Extraction, and the Nuclear Fuel Cycle

Endorsers: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Energy Geology Division Disciplines: Geochemistry, Mineralogy/Crystallography, Economic Geology

Advocates: Yongliang Xiong; Tammy Yang; Dien Li; Philippe Weck

This session focuses on geochemistry of energy-critical elements (ECE). We welcome contributions ranging from geological investigations of ECE mineralization, to fundamental experimental, and theoretical approaches investigations of ECE, and to thermodynamic modeling of natural systems.

(5) (6) T91. Advances in Non-Traditional Stable Isotope Measurements and Utility as Proxies in Modern and Paleo-Settings

Endorsers: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geobiology and Geomicrobiology Division; GSA Quaternary Geology and Geomorphology Division; GSA Soils and Soil Processes Division Disciplines: Geochemistry, Sediments, Carbonates, Geobiolog

Disciplines: Geochemistry, Sediments, Carbonates, Geobiology and Geomicrobiology

Advocates: Jiuyuan Wang; Yi Wang; Jordan Wostbrock

Non-traditional stable isotopes greatly advance our understandings in geological processes. In this session, we welcome all contributions that cover analytical methodology, proxy development, and application of non-traditional stable isotope systems.

(\$) (🕲 🚯 T92. Geologic Fluids: Agents of Change

Disciplines: Geochemistry, Economic Geology, Planetary Geology

Advocates: Matthew Steele-Macinnis; Pilar Lecumberri-Sanchez; Hector Lamadrid; Andras Fall

Virtually all geologic processes are governed by the properties of these fluids, how they flow, and how they interact with rocks. This session focuses on analyzing geologic fluids to interpret processes.

T93. Ophiolite Debate 50 Years after Miyashiro's Disclosure (1973) that the Troodos Massif (Cyprus) Likely Formed in an Island Arc

Endorsers: GSA History and Philosophy of Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geophysics and Geodynamics Division; Geological Society, London; American Geophysical Union

Disciplines: Geochemistry, History and Philosophy of Geology, Petrology, Igneous

Advocates: Yildirim Dilek; James MacDonald Jr.

We encourage contributions on the evolution of the ophiolite concept and the nature of future studies that would further enhance our understanding of ophiolites as the best repositories of oceanic crust in the Earth's rock record.

T94. GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division Awards Session

Endorser: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geochemistry, Mineralogy/Crystallography, Volcanology

Advocates: Alan Whittington; Amanda B. Clarke

The GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division honors their 2023 student research, Distinguished Geological Career (DGCA) and Early Geological Career (EGCA) awardees.

T95. Recent Advances in the Application of Redox Proxies to the Sedimentary Record

Endorsers: GSA Energy Geology Division; GSA Geobiology and Geomicrobiology Division; GSA Sedimentary Geology Division; GSA Continental Scientific Drilling Division; GSA Limnogeology Division

Disciplines: Geochemistry, Paleoclimatology/Paleoceanography, Stratigraphy

Advocates: Justin Birdwell; Katherine French; Clint Scott; Jason Flaum; Katherine Whidden

This session will feature new research and critical reviews of geochemical and paleontological redox indicators applied to ancient depositional environments, emphasizing their strengths and limitations, integration of multiple proxies, and interpretations linked to sedimentological observations.

(W) T96. Salinization of Freshwater

Endorsers: *GSA Geobiology and Geomicrobiology Division; GSA Hydrogeology Division*

Disciplines: Geochemistry, Environmental Geoscience, Hydrogeology

Advocates: Nathaniel Warner; Katharina Pankratz; Charles Cravotta

This session requests research on increases in salinity of groundwater and the identification of potential sources and impacts. Examination of bioavailability, mobilization of contaminants, biological or ecological impacts across both spatial and temporal timescales are welcome.

CONTINENTAL SCIENTIFIC DRILLING

(\$) (() T97. Investigating Earth's Past, Present, and Future with Continental Scientific Drilling

Endorsers: *GSA Continental Scientific Drilling Division; GSA Soils and Soil Processes Division* **Disciplines:** Continental Scientific Drilling, Tectonics,

Limnogeology Advocates: Michael McGlue; Brett Carpenter; Madison Rafter This session showcases diverse research that explores the Earth and its history using subsurface geological, geophysical, and geochemical datasets acquired through continental scientific drilling and other deep sampling techniques.

GEOMORPHOLOGY

(2) (3) T98. Geomorphology and Interdisciplinary Science: In Memory of Edward A. Keller

Endorsers: *GSA Quaternary Geology and Geomorphology Division; GSA Environmental and Engineering Geology Division* **Disciplines:** Geomorphology, Environmental Geoscience, Geoscience Education

Advocates: Joan Florsheim; Anne Macdonald; Nicholas Pinter; Mark Capelli

This session welcomes all submissions committed to a better understanding of fluvial and tectonic geomorphology, geologic hazards, and interdisciplinary geoscience that advances understanding of earth-surface dynamics, ecological functions, and social relevance.

() T99. Non-Perennial Streams and the Fluvial System

Endorser: *GSA Quaternary Geology and Geomorphology Division* **Disciplines:** Geomorphology, Quaternary Geology, Hydrogeology **Advocates:** Julianne Scamardo; John Kemper

We encourage submissions of all aspects of non-perennial stream research, including non-perennial stream dynamics and processes, the role of non-perennial streams in shaping landscapes, and the impacts of non-perennial streams on downstream waterbodies and communities.

(2) (3) T100. Advancements in the Science and Management of Wildfire Impacts on the Critical Zone

Endorsers: GSA Quaternary Geology and Geomorphology Division; GSA Environmental and Engineering Geology Division; GSA Geology and Society Division; GSA Soils and Soil Processes Division; GSA Hydrogeology Division

Disciplines: Geomorphology, Soils and Soil Processes, Engineering Geology

Advocates: James Guilinger; Natalie Collar; Alexander Gorr; Andrew Graber

Wildfire is increasingly a catalyst for change in the Earth's critical zone. This session encourages submissions of research and management frameworks related to fire impacts on hydrologic, geomorphic, and biophysical processes.

INDUSTRY TRACKS

GSA's technical program offers sessions relevant to applied geoscientists. Look for these icons, which identify sessions in the following areas:









Hydrogeology and Environmental Geology

(W) T101. Geomorphic Evolution of River Corridors in the Eastern United States, Pleistocene to Anthropocene

Endorser: *GSA Quaternary Geology and Geomorphology Division* **Disciplines:** Geomorphology, Quaternary Geology, Hydrogeology **Advocates:** Bradley Johnson; Max Huffman; Samantha Dow

This session explores how river corridors throughout the eastern U.S. have evolved from the Pleistocene through urbanization. We encourage submissions using variety of approaches including geomorphic, geochronologic, and numerical modeling.

T102. Geomorphology and Landscape Evolution of Mars

Endorsers: GSA Planetary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Limnogeology Division Disciplines: Geomorphology, Planetary Geology, Stratigraphy Advocates: Elena Favaro; Matthew Chojnacki; Sharon Wilson; Rebecca Williams; Nicholas Warner

This session focuses on aeolian, fluvial, glacial, lacustrine, and crater degradation processes to investigate the geomorphology and landscape evolution of Mars. We welcome research using martian orbital and rover data, as well as terrestrial analogues.

T103. Sedimentary Archives of Mountain Building from the Fault-Scarp to the Range-Front: Interpreting Colluvial Wedge and Alluvial Fan Systems

Endorsers: *GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division*

Disciplines: Geomorphology, Sediments, Clastic, Geochronology **Advocates:** Andrew Cyr; Sylvia Nicovich; Harrison J. Gray

This session seeks submissions related to interpreting earthquake hazard, tectonic evolution, and climatic variability at individual fault-scarp to range-front scales using sedimentary records preserved in colluvial wedges, alluvial fans, or other similar source-proximal deposits.

T104. Sources, Sinks, Transport, and Storage of Sediment in Fluvial Systems

Endorsers: *GSA Quaternary Geology and Geomorphology Division; GSA Soils and Soil Processes Division; GSA Hydrogeology Division*

Disciplines: Geomorphology, Sediments, Clastic, Environmental Geoscience

Advocates: Nicholas Sutfin; Allen C. Gellis; Lisa L. Ely

This session includes field-based work, laboratory analyses, sediment budgets, fingerprinting and sediment sourcing, remotely sensed analyses, meta-analyses and syntheses, and/or modeling of sediment sources, sinks, storage, and transport into, from, or within fluvial systems.

(\$) (105. Quaternary Glaciations of the Great Lakes Region: Progress in Understanding Sediments, Landforms, Chronology, and Landscape Evolution through Space and Time

Endorser: *GSA Quaternary Geology and Geomorphology Division* **Disciplines:** Geomorphology, Geochronology, Quaternary Geology

Advocates: Andrew Kozlowski; Brandon Graham; Byron Stone

This session focuses on societal need for improved resolution of complex landforms, processes, and time-stratigraphic relationships of the Pleistocene glaciations to address water resources, aggregates, and health and safety concerns in the Great Lakes Region.

SEDIMENTS, CLASTIC

T106. Sedimentary Geology Division/SEPM Student Research Poster Competition: Dynamics of Stratigraphy and Sedimentation (Posters)

Endorsers: GSA Sedimentary Geology Division; GSA Structural Geology and Tectonics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; SEPM (Society for Sedimentary Geology); GSA Limnogeology Division; GSA Geochronology Division

Disciplines: Sediments, Clastic, Sediments, Carbonates, Stratigraphy

Advocates: Brian Hampton; Joel E. Saylor; Andrew Leier; Amy Weislogel

Students may present posters of original research on any topics within sedimentary geology: carbonates, clastics, chemical sediments, ancient and/or modern systems. Posters are judged for monetary awards distributed at the "Seds and Suds" reception.

T107. Appalachian Paleozoic Stratigraphy and Tectonics: A Special Session to Honor the Career of Richard (Rick) Diecchio

Disciplines: Sediments, Clastic, Sediments, Carbonates, Stratigraphy

Advocates: Alan Pitts; Linda A. Hinnov

This session recognizes Richard (Rick) Diecchio's career and contributions to research, education, and outreach in Appalachian geology. We encourage presentations exploring connections between the stratigraphic rock record and the Paleozoic tectonic evolution of the Appalachians.

(\$) () T108. Significance of Distribution of Sheet-Like Quartzose Formations in Time and Space

Disciplines: Sediments, Clastic, Geophysics/Geodynamics **Advocate:** Thomas Anderson

The focus of this session has to do with (1) the identification of post-orogenic, sheet-like sandstone formations overlying regional unconformities, and (2) their ages relative to widespread orogenic episodes.

T109. Advances in Detrital Heavy Minerals: Applications and Methods

Endorsers: GSA Sedimentary Geology Division; GSA Geochronology Division; GSA Structural Geology and Tectonics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Sediments, Clastic, Geochronology, Tectonics **Advocates:** Emily Finzel; Sarah W.M. George; Megan Mueller; Shay Ridl

Detrital heavy minerals are used to investigate many fundamental earth-system processes. We welcome submissions that highlight advances in the acquisition and analysis of detrital modal counts and single grain isotopic and geochemical data.

VOLCANOLOGY

T110. Creative Contributions in Volcanology and Petrology: In Honor of Katharine V. Cashman, Recipient of the 2023 Distinguished Geological Career Award from the GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Endorser: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Volcanology, Petrology, Igneous, Geochemistry **Advocate:** Rebecca Lange

This session honors the creative and interdisciplinary career of Katharine Cashman. Contributions on a wide variety of topics are welcome from volcanic processes and hazards to insights into magmatic systems from petrological and geophysical perspectives.

T111. New Voices in Subduction Zone Science

Endorser: Subduction Zones in Four Dimensions (SZ4D) Disciplines: Volcanology, Tectonics, Geomorphology Advocates: Michael Murphy; Tamara Aranguiz; Jade Bowers; Emilie Bowman; Emma Burkett; Nathaniel Klema; Valeria Cortés-Rivas; Aubrey Laplante; Behnaz Hosseini; Fan Wang

We seek abstracts for new perspectives on areas highlighted by SZ4D: (1) earthquakes and faulting, (2) landscapes and seascapes, (3) magmatic drivers of eruption, (4) modeling collaborations for subduction, and (5) building equity and capacity within the geosciences.

SOILS AND SOIL PROCESSES

T112. Emerging Voices in Soil and Paleosol Science (Posters)

Endorsers: *GSA Soils and Soil Processes Division; GSA Quaternary Geology and Geomorphology Division* **Disciplines:** Soils and Soil Processes, Geoarchaeology, Geochemistry

Advocates: Lauren Michel; Zsuzsanna Balogh-Brunstad; Rebecca Taormina

This session highlights undergraduate and graduate student research related to soils or paleosols. We encourage submissions of any soil related topics including Critical Zone science, geochemistry, soil physics, mineral weathering and soil formation, and paleoclimatology.

T113. Recent Advances in Soil and Paleosol Science

Endorsers: GSA Soils and Soil Processes Division; GSA Quaternary Geology and Geomorphology Division Disciplines: Soils and Soil Processes, Karst, Geomorphology Advocates: William Lukens; Arnaud Temme

This session gathers recent research in soil and paleosol science. We welcome submissions from field, laboratory, and modeling studies that leverage or examine pedogenic processes and archives, from deep time through modern systems.

PLANETARY GEOLOGY

T114. Impact Cratering Across the Solar System

Endorsers: *GSA Planetary Geology Division; GSA Structural Geology and Tectonics Division; GSA Mineralogy, Geochemistry,*

Petrology, and Volcanology Division; GSA Continental Scientific Drilling Division; GSA Geophysics and Geodynamics Division **Disciplines:** Planetary Geology, Continental Scientific Drilling, Structural Geology

Advocates: Jeffrey Plescia; Christian Koeberl

Impact cratering is a primary geologic process across the solar system. The session focuses on the recognition and understanding of the geologic, geochemical, and geophysical impact signatures, impact flux, and implications for planetary geologic evolution.

T115. Friends of Hoth, Episode VII: Small, Icy, and Ocean Worlds Awaken

Endorser: *GSA Planetary Geology Division* **Discipline:** Planetary Geology

Advocates: Erin Leonard; Emily S. Martin; Alex Patthoff

We seek abstracts relating to surface, structural, and tectonic processes; interior, and thermal evolution; and planetary analogs as they pertain to icy satellites in the outer solar system. This includes experimental, observational, and theoretical approaches.

T116. Best Practices and Exciting Discoveries in Identifying, Mapping, and Analyzing Planetary Landforms and Terrestrial Analogues

Endorsers: *GSA Planetary Geology Division; GSA Quaternary Geology and Geomorphology Division*

Disciplines: Planetary Geology, Geoscience Education, Geomorphology

Advocates: Kelsey Crane; Leta McCullough; Jonathan Rich

We welcome abstracts that investigate the methodology of planetary and terrestrial landform analysis or that explore these methodologies as a means of achieving insight into the evolution of those landforms.

T117. The Cretaceous-Paleogene Boundary: From Impact Cratering Processes to Mass Extinction Mechanisms

Endorsers: *GSA Planetary Geology Division; Paleontological* Society; *GSA Geobiology and Geomicrobiology Division; GSA* Sedimentary Geology Division

Disciplines: Planetary Geology, Paleontology, Diversity, Extinction, Origination, Stratigraphy

Advocates: Pim Kaskes; James Witts

Cretaceous-Paleogene boundary records within and outside the Chicxulub impact crater reveal new insights into mass extinction mechanisms. We welcome contributions varying from K-Pg proxy records to modeling and settings ranging from crater to distal sites.

T118. Latest Science Results and Updates in Planetary Science Research, Programs, and Flight Projects

Endorser: GSA Planetary Geology Division

Disciplines: Planetary Geology, Geomorphology, Volcanology **Advocates:** Michael Kelley; Mitchell Schulte

This session welcomes presentations of scientific results from planetary science investigations, including both fundamental research and data analysis from spacecraft missions to other solid bodies throughout the Solar System.

T119. Tiny Worlds with Big Potential

Endorser: GSA Planetary Geology Division

Disciplines: Planetary Geology, Geomorphology, Geochemistry **Advocates:** Debra Buczkowski; Jennifer Scully; Kynan Hughson

We encourage abstracts related to geologic, spectroscopic, geophysical, and compositional analyses of small bodies in the Solar System, including comparative studies of more than one body or in-depth studies of a single body.

T120. GSA Planetary Geology Division: G.K. Gilbert Award Session

Endorser: GSA Planetary Geology Division

Discipline: Planetary Geology

Advocates: Nicholas Patrick Lang; Marisa Palucis; Jennifer Piatek; Samuel Birch; Lauren Jozwiak

This session honors this year's recipient of the G.K. Gilbert Award from the Planetary Geology Division of GSA. Oral presentations that celebrate and amplify the work of this year's recipient are encouraged.

T121. The Interplay of Volcanism and Tectonism Across the Solar System

Endorsers: GSA Planetary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Structural Geology and Tectonics Division

Disciplines: Planetary Geology, Volcanology, Structural Geology **Advocates:** Mallory Kinczyk; Kelsey Crane

Volcanism and tectonism are major processes that shape the surfaces of terrestrial planets, asteroids, and icy satellites. This session will host a variety of research investigations into any aspect of planetary volcanic and tectonic activity.

T122. Planetary Exploration and Education: How We Learn about Our Solar System and Beyond

Endorsers: GSA Planetary Geology Division; GSA Geoscience Education Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; National Association of Geoscience Teachers (NAGT)

Disciplines: Planetary Geology, Geoscience Education, Geoscience Information/Communication

Advocate: Nicholas Patrick Lang

This session links how we teach and learn about the solar system to how we have gained that information (i.e., space missions). Descriptions of teaching activities/courses and strategies for working with students are encouraged.

🚯 T123. Hydrology on Titan and Mars

Endorsers: GSA Planetary Geology Division; GSA Hydrogeology Division

Disciplines: Planetary Geology, Geomorphology, Hydrogeology **Advocates:** Gaia Stucky de Quay; Samuel Birch

Only two planetary bodies outside Earth contain evidence for climate-driven surface flow: Titan and Mars. This session focuses on the formation and evolution of hydrological features (e.g., rivers, lakes, coasts) in these contrasting worlds.

T124. Venus: Earth's Hotter Twin

Endorsers: *GSA Planetary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division* **Disciplines:** Planetary Geology, Volcanology, Structural Geology Advocates: Debra Buczkowski; Nicholas Patrick Lang

This session solicits abstracts on volcanism, tectonism, impact cratering, and geologic mapping of Venus. It encompasses surface geology, interior evolution, and comparative planetary studies with observational, experimental, or theoretical approaches.

KARST

T125. Karst Hazards and Monitoring

Endorsers: GSA Karst Division; GSA Karst Division; GSA Environmental and Engineering Geology Division; GSA Geophysics and Geodynamics Division; National Cave and Karst Research Institute; Karst Waters Institute; GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division Disciplines: Karst, Engineering Geology Advocates: Daniel Jones; Jeanne Sumrall

Hazards (e.g., sinkholes, pollution, radon, development) and monitoring approaches (e.g., GIS applications, historical data analyses) in karst landscapes, including technical applications (e.g., LiDAR, 3D scanning, geodatabase development) and management implications (resource management, education, policy, regulation).

W T126. Characterization of Karst Aquifers Using Chemical, Biological, and Hydrogeological Data

Endorsers: *GSA Karst Division; GSA Geobiology and Geomicrobiology Division; GSA Hydrogeology Division* **Disciplines:** Karst, Hydrogeology

Advocates: Traugott Scheytt; Ferry Schiperski

This session focuses on state-of-the-art approaches for karst aquifer characterization. We welcome all research on karst vulnerability assessment, pollution, modeling, and field methods from all disciplines.

W T127. Karst Sedimentary, Paleoclimate, and Historical Records

Endorsers: GSA Karst Division; GSA Geochronology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; National Cave and Karst Research Institute; Karst Waters Institute; Geochemical Society Disciplines: Karst, Paleoclimatology/Paleoceanography, Geoarchaeology

Advocates: Natasha Sekhon; Daniel Jones

Cave deposits (sediments, speleothems, tufa, etc.), karst environmental records (sedimentary, carbonate stratigraphy, etc.), and geoarchaeological and historical investigations to interpret past climates, landscapes, extreme events, and land-use histories, and to model or predict future changes.

No. T128. Karst Ecosystems and Biogeochemistry

Endorsers: GSA Karst Division; GSA Environmental and Engineering Geology Division; GSA Geobiology and Geomicrobiology Division; GSA Hydrogeology Division; National Cave and Karst Research Institute; Karst Waters Institute; Geochemical Society

Disciplines: Karst, Geobiology and Geomicrobiology, Geochemistry **Advocates:** Daniel Jones; Jeanne Sumrall

This session seeks abstracts that deal with the study of cave and karst ecosystems, including the identification, quantification, and/

or discussion of biota, flora, microbial, and related biogeochemical processes or environments in or near karst features.

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Endorsers: GSA Karst Division; GSA Environmental and Engineering Geology Division; GSA Hydrogeology Division; National Cave and Karst Research Institute; Karst Waters Institute; Geochemical Society

Disciplines: Karst, Hydrogeology

Advocates: Natasha Sekhon; Lewis Land; Daniel Jones

This session covers fundamental aspects of fluid-rock interactions within karst landscapes, including geologic, hydrogeologic, and hydrologic investigations. Appropriate topics range from dye tracing and aquifer processes to surface-subsurface hydrologic interactions and quantitative modeling.

(\$) (Arst Processes and Speleology

Endorsers: GSA Karst Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Quaternary Geology and Geomorphology Division; National Cave and Karst Research Institute; Karst Waters Institute; Geochemical Society; GSA Hydrogeology Division

Disciplines: Karst, Geomorphology, Geochemistry **Advocates:** Patricia Kambesis; Daniel Jones

This session covers the myriad of cave- and karst-forming processes, geomorphic evolution of karst landscapes, and cave-system development. This includes carbonate weathering, diagenesis, hypogene processes, carbonate mineralogy, structural controls, and pseudokarst processes and features.

GEOBIOLOGY AND GEOMICROBIOLOGY

T131. New Advances in Geobiology

Endorser: GSA Geobiology and Geomicrobiology Division Disciplines: Geobiology and Geomicrobiology, Paleontology, Biogeography/Biostratigraphy, Paleontology, Phylogenetic/ Morphological Patterns

Advocates: Trinity Hamilton; Victoria A. Petryshyn; Emmy Smith; Lydia Schiavo Tackett; Zoe Havlena; Lucy Webb

This session will focus on new research at the intersection between geologic and biologic processes with special emphasis on novel materials and methods, new field sites, and advances at the intersections of scientific fields.

T132. New Voices in Geobiology

Endorsers: *GSA Geobiology and Geomicrobiology Division; GSA Limnogeology Division*

Disciplines: Geobiology and Geomicrobiology, Paleontology, Diversity, Extinction, Origination, Paleontology, Biogeography/ Biostratigraphy

Advocates: Trinity Hamilton; Victoria A. Petryshyn; Emily F. Smith; Lydia Schiavo Tackett; John R. Spear; Dylan Wilmeth; Nagissa Mahmoudi; Lucy Webb; Zoe Havlena

This session will bring together new research focusing on the interplay between geologic and biologic processes with a special emphasis on work by early-career scientists exploring new questions and hypotheses.

T133. New Advances in the Study of Microbialites

Endorsers: GSA Geobiology and Geomicrobiology Division; SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division; GSA Limnogeology Division

Disciplines: Geobiology and Geomicrobiology, Stratigraphy, Geochemistry

Advocates: Victoria Cassady; Dylan Wilmeth; Hanna Leapaldt; Frank Corsetti

Despite their importance as some of the oldest evidence of life on Earth, many aspects of microbialites (formation/distribution/ texture/microbial influence, etc.) remain unknown. This session will showcase new research to better understand microbialites and their significance.

GEOINFORMATICS AND DATA SCIENCE

T134. Making Meaning from Geologic Observations: Data-Driven Interpretive and Analysis Methods in Geosciences

Endorsers: GSA Geoinformatics and Data Science Division; GSA Geobiology and Geomicrobiology Division; GSA Geochronology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; GSA Structural Geology and Tectonics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geoinformatics and Data Science, Tectonics, Stratigraphy

Advocates: Alex Tye; Snir Attia

As geologic datasets and interconnections grow, interpretation based on rigorous and comprehensive analysis becomes ever more important. We encourage submissions from all disciplines highlighting novel quantitative and statistical approaches to extracting insights from geologic observations.

INDUSTRY TRACKS

GSA's technical program offers sessions relevant to applied geoscientists. Look for these icons, which identify sessions in the following areas:





Energy





Hydrogeology and Environmental Geology

T135. The Past, Present, and Future of the Digital Data Revolution and Its Effect on the Geosciences

Endorsers: GSA Geoinformatics and Data Science Division; Earth Science Information Partners; GSA Energy Geology Division Disciplines: Geoinformatics and Data Science, Geoscience Education, Geoscience Information/Communication Advocates: Andrew Zaffos; Megan Carter Orlando; Shanan Peters; Denise J. Hills

Past, present, and future advances in geoinformatics can greatly improve scientific workflows and decrease "time to science." This session highlights examples that researchers can leverage now to access, maintain, and re(use) data and more.

MARINE AND COASTAL GEOSCIENCE

T136. Current Research in Coastal Processes and Shoreline Change

Endorsers: *GSA Marine and Coastal Geoscience Division; GSA Quaternary Geology and Geomorphology Division; GSA Limnogeology Division*

Disciplines: Marine and Coastal Geoscience, Paleoclimatology/ Paleoceanography, Sediments, Clastic

Advocates: Bryan Oakley; James A. Hyatt

This session welcomes all research on coastal and nearshore processes using field, laboratory, engineering, remote sensing, and modeling studies and especially encourage submissions focused on measuring coastal change using photogrammetry, terrestrial scanning, and airborne LiDAR.

(*) T137. Advances and New Voices in Marine and Coastal Geoscience

Endorsers: GSA Marine and Coastal Geoscience Division; GSA Quaternary Geology and Geomorphology Division Disciplines: Marine and Coastal Geoscience, Paleoclimatology/ Paleoceanography, Quaternary Geology

Advocates: Andrea Hawkes; Kelly Best Lazar; Katya Beener; Lauren Toth; Scott W. Starratt; Patricia Standring; Ashley McCleaf Long

Marine and coastal geoscience embraces many topics. We seek abstracts on physical oceanography, marine geology, geomorphology, sediment transport, marine geophysics, tectonic or glaciomarine processes, climate change, marine paleobiology, or any aspect of oceans and coasts. We encourage students to join this session.

(*) T138. Coastal and Marine Hydrogeology in an Age of Rising Seas: From the Shore to the Oceanic Ridge

Endorsers: GSA Hydrogeology Division; GSA Environmental and Engineering Geology Division; GSA Geobiology and Geomicrobiology Division; GSA Geoinformatics and Data Science Division; GSA Marine and Coastal Geoscience Division; GSA Geophysics and Geodynamics Division; GSA Geology and Society Division; GSA Karst Division; GSA Quaternary Geology and Geomorphology Division; GSA Soils and Soil Processes Division Disciplines: Marine and Coastal Geoscience, Environmental Geoscience, Engineering Geology

Advocates: Michael Sukop; Martina Rogers; Shellie Habel; Christopher Russoniello; Kevin Befus As sea levels rise, hydrogeology is crucial in coastal areas. Seawater intrusion can lead to loss of potable or agricultural water supplies. Water-table rise from sea-level rise can increase flooding and affect infrastructure.

PRECAMBRIAN GEOLOGY

(\$) T139. Assembling a Craton: Recent Insights into Precambrian Assembly and Growth of Laurentia and its Cratonic Components

Endorsers: GSA Structural Geology and Tectonics Division; GSA Geochronology Division; GSA Geology and Society Division; GSA Geophysics and Geodynamics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Sedimentary Geology Division

Disciplines: Precambrian Geology, Tectonics, Economic Geology **Advocates:** Amy Radakovich Block; Benjamin Drenth; James V. Jones III

Recent geochronologic, geochemical, paleomagnetic, geophysical, and geologic mapping studies have advanced our understanding of the assembly of Laurentia. We welcome submissions of crossdisciplinary research that shed light on the evolution of the craton.

HYDROGEOLOGY

T140. Hydrothermal Systems and Their Geologic Records

Endorser: *GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division*

Disciplines: Hydrogeology, Volcanology, Planetary Geology **Advocates:** Shaul Hurwitz; Michael Manga; Benjamin Black; Martin Reich; Adam Simon; Wendy Calvin

This session seeks multidisciplinary contributions on the chemistry, hydrogeology, biology, and dynamics of hydrothermal systems. We welcome contributions ranging from arc and intracontinental settings on Earth to hydrothermal systems on other solar system bodies.

W T141. Arsenic, Fluoride, and Other Geogenic Contaminants in Groundwater: Advances in Application of Data Science, Machine Learning for Risk Assessment, and Monitoring for Sustainable Mitigation of Associated Health Hazards

Endorsers: GSA Hydrogeology Division; GSA Geology and Health Division; GSA Geology and Society Division; GSA International; International Society of Groundwater for Sustainable Development; International Medical Geology Association; International Water Association Specialist Group; Metals and Related Substances in Drinking Water (METRELS); Geochemical Society; GSA Environmental and Engineering Geology Division; GSA Geoinformatics and Data Science Division; International Environmental & Health Sciences Consortium; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division Disciplines: Hydrogeology, Geology and Health, Geoinformatics and Data Science

Advocates: Prosun Bhattacharya; Mohammad Ayaz Alam; Laura Richards; Abhijit Mukherjee; Saugata Datta; Joseline Tapia; Kazi Matin Ahmed; Julian Ijumulana; Jyoti Prakash Maity; Harshad Vijay Kulkarni

GSA CONNECTS 2023

Data aggregation and analysis with emerging technologies like machine learning in recent years enables us to better our understanding of the specificities of groundwater basins in terms of water qualitative perspectives for direct consumption and or treatment for groundwater supplies.

(6) T142. Achieving Groundwater Security across Local-to-Regional Scales in the Anthropocene

Endorsers: *GSA* Hydrogeology Division; *GSA* Environmental and Engineering Geology Division; *GSA* Geoinformatics and Data Science Division; *GSA* Geology and Health Division; *GSA* International; International Association of Hydrogeologists; International Society of Groundwater for Sustainable Development; Groundwater Solutions Initiative for Policy and Practice; International Union of Geological Sciences Deep-Time Digital Earth

Disciplines: Hydrogeology, Environmental Geoscience, Geology and Health

Advocates: Abhijit Mukherjee; Alice Aureli; Prosun Bhattacharya; Karen G. Villholth; David Kreamer; Alan MacDonald; Roger Sathre

We seek interdisciplinary studies on groundwater resources in the Anthropocene to enhance solutions and sustainability, from science and technology to clean water and food, through pathways of transforming groundwater knowledge to policy and governance.

T143. A Hydrogeologic Career Well Lived: A Session on the Research Topics of Ken Bradbury

Endorser: GSA Hydrogeology Division

Disciplines: Hydrogeology, Geology and Health, Geoscience Education

Advocates: Randy Hunt; David Hart

This session covers historical and current views on the research areas of Ken Bradbury, such as flow in karst and fractured rock, aquitard hydrology, recharge estimation, modeling, field methods, and pathogens in drinking water.

(W) T144. Showcase of Undergraduate Research in Hydrogeology (Posters)

Endorser: GSA Hydrogeology Division

Disciplines: Hydrogeology, Environmental Geoscience, Geochemistry

Advocates: Jobel Villafañe-Pagán; Desire Piphus; Miguel Valencia

This session is designed for undergraduates presenting research and senior theses in the field of hydrogeology. Prizes will be awarded for top presentations. Employers and graduate advisers are encouraged to attend.

🕲 🚯 T145. Advances in Managed Aquifer Recharge

Endorsers: GSA Hydrogeology Division; GSA Geology and Society Division; GSA Environmental and Engineering Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geophysics and Geodynamics Division; International Association of Hydrogeologists Disciplines: Hydrogeology, Geochemistry, Environmental Geoscience

Advocates: Deborah Leslie; Scott Bradford; Jian Luo

This session aims to bring together interdisciplinary researchers to better understand the hydrological, geochemical, and geobiological processes and interactions associated with the implementation and operation of managed aquifer recharge strategies.

T146. Advances in Monitoring, Mapping, and Modeling Saltwater Intrusion and Groundwater Salinity

Endorsers: *GSA Hydrogeology Division; The International Society of Groundwater for Sustainable Development* **Disciplines:** Hydrogeology, Marine and Coastal Geoscience, Geophysics/Geodynamics

Advocates: Tara Root; Frederick Stumm; Miguel Angel Marazuela This session focuses on monitoring, mapping, and modeling saltwater intrusion and groundwater salinity. All types of research, including water quality, geophysical, and modeling studies, are welcome.

GEOCHRONOLOGY

T147. Application of Bayesian Analysis to Earth Systems Science

Endorsers: GSA Geochronology Division; GSA Geoinformatics and Data Science Division; GSA Quaternary Geology and Geomorphology Division; GSA Geophysics and Geodynamics Division; GSA Structural Geology and Tectonics Division; GSA Soils and Soil Processes Division; GSA Limnogeology Division Disciplines: Geochronology, Paleoclimatology/Paleoceanography, Geoinformatics and Data Science

Advocates: Robin Trayler; C. Brenhin Keller; Mark D. Schmitz; William Guenthner

This session aims to bring together diverse applications of Bayes rule to fields that reconstruct past earth processes, including paleoclimatology, geochronology, thermochronology, geophysical inversions, and others.

GEOPHYSICS/GEODYNAMICS

T148. Advances in Explosion Source Monitoring

Endorser: *GSA Geophysics and Geodynamics Division* **Disciplines:** Geophysics/Geodynamics, Structural Geology, Tectonics

Advocates: Ting Chen; Catherine M. Snelson; Miles Bodmer; Christine Downs; Souheil Essedine; Moira Pyle; Michelle Scalise; Nicholas Downs

The session solicits abstracts on studies for explosion sources, which are important monitoring targets related to national and global security, also useful for imaging the subsurface geological structure.

T149. Geologic Carbon Storage

Endorsers: GSA Geophysics and Geodynamics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Continental Scientific Drilling Division; GSA Energy Geology Division

Disciplines: Geophysics/Geodynamics, Environmental Geoscience

Advocates: Lianjie Huang; Ting Chen; Delphine Appriou; William Ampomah

This geologic carbon storage session solicits abstracts on site selection, geologic and geophysical site characterization, modeling and monitoring of CO_2 injection/migration, risk evaluation, and case studies of large-scale geologic carbon storage projects.

T150. Advancing the Use of Geophysical Methods for Geological Mapping

Endorsers: *GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division*

Disciplines: Geophysics/Geodynamics, Geomorphology, Quaternary Geology

Advocates: Daniel Blake; Tyler Norris; Brian Currie

This session seeks scientists working in academia, industry, and government who use similar near-surface geophysical techniques to better understand geology on local and regional scales.

(2) (3) T151. Applications of Geophysics to Solve Near Surface Geological Problems

Endorsers: GSA Geophysics and Geodynamics Division; GSA Quaternary Geology and Geomorphology Division; GSA Hydrogeology Division; GSA Environmental and Engineering Geology Division; GSA Karst Division

Disciplines: Geophysics/Geodynamics, Environmental Geoscience, Engineering Geology

Advocate: Kevin Mickus

Abstracts are requested that use all type of geophysics to investigate near-surface environmental, geological, hydrological, archaeological, engineering, and karst problems.

(\$) (1) T152. Applied Geophysics in Resource Exploration and Evaluation

Endorsers: GSA Geophysics and Geodynamics Division; GSA Hydrogeology Division; Society of Economic Geologists Disciplines: Geophysics/Geodynamics, Economic Geology, Energy Geology

Advocate: Kevin Mickus

Abstracts are requested that use all types of geophysics (e.g., seismic, electrical, gravity, magnetics, EM) to explore for and/or evaluate mineral, energy, and groundwater resources.

MINERALOGY/CRYSTALLOGRAPHY

T153. Mineral Informatics and the Evolution of Earth, Planets, and Life: In Honor of MSA Awardee Shaunna M. Morrison

Endorsers: Mineralogical Society of America (MSA); International Mineralogical Association; GSA Geobiology and Geomicrobiology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Mineralogy/Crystallography, Geoinformatics and Data Science, Planetary Geology

Advocates: Robert Hazen; Alexandra Ostroverkhova; Anirudh Prabhu; Nathan Yee

Mineral data are critical to understanding Solar System history. This session will explore powerful methods of data analysis and visualization in the quest to explore the origins and evolution of Earth, other planets, and life.

(\$) (\$) T154. A Session in Honor of Georges Calas, Professor Emeritus, Sorbonne Université, Paris, France, and 2023 Roebling Medalist of the Mineralogical Society of America

Endorsers: *GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Mineralogical Society of America*

Disciplines: Mineralogy/Crystallography, Geochemistry, Environmental Geoscience

Advocates: Gordon Brown Jr.; Frank Hawthorne

This session honors Prof. Georges Calas, Sorbonne Université, Paris, and 2023 Roebling Medalist of the Mineralogical Society of America for his outstanding body of work in the fields of mineralogy, inorganic geochemistry, and materials science.

(\$) T155. Gemological Research in the Twenty-First Century—Gem Minerals and Localities

Endorsers: *Mineralogical Society of America; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division* **Disciplines:** Mineralogy/Crystallography, Economic Geology,

Geoscience Information/Communication

Advocates: James Shigley; Wuyi Wang; Barbara Dutrow; John Valley; Caroline Nelms

Gemstones are among the most recognized of all minerals. This session focuses on diverse aspects of gems, including exploration, deposits and their formation, identification, and mineral inclusions in gems and their geological implications.

T156. Transforming the Mineral Sciences with Raman Spectroscopy

Endorsers: Mineralogical Society of America; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division **Discipline:** Mineralogy/Crystallography

Advocates: Tyler Spano; C. Marshall

This session highlights applications of Raman spectroscopy for mineral sciences. Abstracts related to new techniques, methods for data analysis, polarized Raman spectroscopy, underlying crystallographic and physiochemical effects on spectral observations, and interpretation methods are welcome.

T157. Early Career Investigators in Mineralogy and Crystallography

Endorsers: *Mineralogical Society of America; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division* **Disciplines:** Mineralogy/Crystallography, Petrology, Metamorphic,

Disciplines: Mineralogy/Crystallography, Petrology, Metamorphic, Petrology, Igneous

Advocates: Tyler Spano; Si Chen

This session provides a platform for early-career mineralogists and crystallographers to share their research. Early-career, postdoctoral, and student researchers are encouraged to submit abstracts and provide fresh perspectives, new ideas, and creative answers to mineralogical problems.

LIMNOGEOLOGY

(5) (2) (3) (3) T158. Lakes of the World through Time and Space: Archives of Climate Variability, Paleoenvironment, Geohazards, and Economic Resources

Endorsers: GSA Limnogeology Division; GSA Continental Scientific Drilling Division; GSA Geobiology and Geomicrobiology Division; GSA Marine and Coastal Geoscience Division; GSA Geochronology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geoarchaeology Division; American Quaternary Association; International Association of Limnogeology; Paleontological Society; American

GSA CONNECTS 2023

Association of Stratigraphic Palynologists; GSA Hydrogeology Division

Disciplines: Limnogeology, Stratigraphy, Paleoclimatology/ Paleoceanography

Advocates: Scott W. Starratt; Eva Lyon; Christopher Schiller

This session celebrates lacustrine research across the globe. Lake sediments are excellent archives of changing climate, landscapes, ecosystems, and human impacts, and they host key economic resources. This session explores terrestrial and extraterrestrial lacustrine research.

TECTONICS

T159. Do Correlations of Ages of Principal Orogenic Events with Those of Eclogite, Felsic Granulite, Migmatite, and "Flat Slabs" Indicate Induced Subduction of Crust Linked to Mantle Flow?

Endorser: *GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division*

Disciplines: Tectonics, Structural Geology, Geophysics/ Geodynamics

Advocate: Thomas Anderson

Analyze the implications of passive subduction versus induced (forced) subduction and consider the complex interactions between the passive, gravity-driven process and wave-like mantle flow, which results from plate capture but is completely independent in terms of scope and effects.

T160. Convergent Margin Systems

Endorsers: GSA Structural Geology and Tectonics Division; GSA Geochronology Division; GSA International; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Energy Geology Division

Disciplines: Tectonics, Geochronology, Structural Geology Advocates: Chelsea Mackaman-Lofland; Caden Howlett; Chance Ronemus; Mary Braza

This session highlights research across a range of geoscience disciplines that help further the understanding of the processes governing deformation, crustal evolution, seismicity, topography, and sedimentation during tectonic plate convergence.

T161. Deformation in Continental Interiors from the Rock Record to Modern Intraplate Seismicity

Disciplines: Tectonics, Geophysics/Geodynamics, Structural Geology

Advocates: Will Levandowski; Seth Carpenter; Basil Tikoff This session examines continental deformation in both modern and ancient settings. Studies at grain, laboratory, outcrop, and regional scales, as well as geophysical and paleoseismic investigations from intraplate regions worldwide, are encouraged.

T162. The Andes from Top to Bottom

Endorsers: GSA Structural Geology and Tectonics Division; GSA Geochronology Division; GSA Geophysics and Geodynamics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division Disciplines: Tectonics, Geophysics/Geodynamics, Petrology, Igneous

Advocates: Tomas Capaldi; Nicholas Perez; Emilie Bowman This session seeks contributions that connect surface, crustal, and mantle processes associated with the Andes, specifically addressing geodynamics, kinematics, magmatism, uplift, erosion, basin subsidence, and sediment dispersal in ancient and modern systems.

T163. Significance of Subduction-Accretion Complexes and Mélanges in Orogenic Belts and in Continental Growth during the Precambrian and Phanerozoic

Endorsers: GSA Structural Geology and Tectonics Division; GSA Geophysics and Geodynamics Division; GSA Geochronology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Tectonics, Geophysics/Geodynamics, Structural Geology

Advocates: Andrea Festa; Yildirim Dilek

We welcome interdisciplinary contributions, documenting the occurrence/significance of subduction-accretion complexes and mélanges in the evolution of orogenic belts, and quantifying the rates of crustal growth in subduction–accretion complexes during the Precambrian and Phanerozoic.

T164. Geological and Geophysical Constraints on Orogenic Architecture as Windows to Tectonic Style through Time

Endorsers: GSA Structural Geology and Tectonics Division; GSA Geophysics and Geodynamics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division Disciplines: Tectonics, Structural Geology, Petrology, Metamorphic

Advocates: Tim Kusky; Sylvia Volante; Andrea Festa

Styles of tectonics on Earth through time are debated. We welcome contributions defining components and geometry of orogenic belts through time, seeking rigorous solutions on the presence or absence of plate tectonics throughout Earth history.

INDUSTRY TRACKS

GSA's technical program offers sessions relevant to applied geoscientists. Look for these icons, which identify sessions in the following areas:









Hydrogeology and Environmental Geology

T165. Tectonics of Orogenic Plateaus from the Modern to Ancient

Endorsers: *GSA Geochronology Division; GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division* Disciplines: Tectonics, Stratigraphy, Structural Geology Advocates: Kurt Sundell; Sarah W.M. George; Alexandra Pye

Orogenic plateaus play an important role in modulating climate with a wide range of the tectonic processes that lead to their growth. This session welcomes field-based, analytical, and numerical studies centered on understanding plateau development in the modern and ancient.

(S) T166. The Neoproterozoic to Paleozoic Evolution of the Eastern Laurentian Margin— Tectonic, Stratigraphic, Sedimentologic, and Geochronologic Evidence: In Honor of William A. "Bill" Thomas

Endorsers: *GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division*

Disciplines: Tectonics, Stratigraphy, Geochronology **Advocates:** David Moecher; Joseph Allen

Bill Thomas's career encompassed the evolution of eastern Laurentia, including rifting and collisional events. We welcome contributions incorporating structural geology, tectonics, stratigraphy, sedimentology, and geochronology that further our understanding of the tectonic history eastern Laurentia.

T167. New Insights into Controls on the Behavior of Orogenic Systems and Their Associated Basins

Endorsers: GSA Sedimentary Geology Division; GSA Geochronology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Structural Geology and Tectonics Division; GSA Continental Scientific Drilling Division Disciplines: Tectonics, Geochemistry, Sediments, Clastic Advocates: Samuel Martin; Julie Fosdick; Nicholas Perez

We seek diverse contributions examining stratigraphic signatures of geodynamic, structural, climatic, and other influences on the kinematics, exhumation, sedimentation, and surface uplift of modern and ancient orogenic systems.

T168. Topographic Signatures of Active Tectonics

Endorser: *GSA Quaternary Geology and Geomorphology Division*

Disciplines: Tectonics, Geomorphology, Geochronology Advocates: Nadine McQuarrie; Brian Yanites; Jennifer Johnsen

This session seeks contributions that explore the ways in which the Earth's surface reflects underlying tectonic activity. We encourage presentations focused on quantifying relationships between tectonics, climate, and erosional processes on landscape evolution.

(W) T169. Do Carbon Sources or Sinks Drive the Phanerozoic Carbon Cycle?: Understanding Geobiologic Forcings and Feedbacks

Endorsers: GSA Geobiology and Geomicrobiology Division; GSA Soils and Soil Processes Division

Disciplines: Tectonics, Geochemistry, Paleoclimatology/ Paleoceanography **Advocates:** Kimberly Lau; Tyler Kukla; Daniel Ibarra;

Jeremy Rugenstein

Recent research has cast light on new carbon cycle processes and underappreciated feedbacks between the solid Earth, climate, and biology; new approaches are necessary to integrate these findings into understanding the long-term carbon cycle and climate.

T170. Exploring Strain Partitioning and Kinematic Evolution of the Lithosphere: In Honor of Micah Jessup

Endorsers: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Structural Geology and Tectonics Division

Disciplines: Tectonics, Structural Geology, Petrology, Metamorphic

Advocates: Tyler Grambling; Dennis L. Newell

To honor Micah Jessup's career and contributions to structural geology, tectonics, and mid-crustal flow, we seek contributions related to strain localization, kinematics, rheology, microstructural analysis, metamorphic petrology, and chronology of deformation and mountain building processes.

SEDIMENTS, CARBONATES

(S) (171) T171. Rethinking the Dolomite Problem (Again)

Endorsers: Mineralogical Society of America; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geobiology and Geomicrobiology Division; GSA Sedimentary Geology Division

Disciplines: Sediments, Carbonates, Geochemistry, Mineralogy/ Crystallography

Advocates: Cole McCormick; Mohammed Hashim; Dalton Hardisty; Kimberly Lau

Considerable advancements have been made in our understanding of dolomite and the process of dolomitization. Thus, we welcome abstracts that address the geological significance of novel analytical techniques that are used to study dolomite.

STRATIGRAPHY

(S) (C) T172. Time Machine: Earth's Deep-Time Geography—Data, Reconstructions, Challenges

Endorsers: GSA Energy Geology Division; Paleontological Society; GSA Geobiology and Geomicrobiology Division; GSA Geophysics and Geodynamics Division; GSA Sedimentary Geology Division; GSA International; GSA Geoinformatics and Data Science Division; SEPM (Society for Sedimentary Geology); American Association of Petroleum Geologists; International Union of Geological Sciences Deep-Time Digital Earth; GSA Soils and Soil Processes Division

Disciplines: Stratigraphy, Tectonics, Paleontology, Biogeography/ Biostratigraphy

Advocates: Sabin Zahirovic; James Ogg; Haipeng Li

We welcome submissions, both field- and model-based, from areas of stratigraphy, paleontology, paleoclimatology, tectonics, geodynamics, and all fields related to constraining Earth's ancient geographies and the processes that shape them.

(S) O T173. Maximum Depositional Ages (MDAs) from Detrital Mineral Geochronology: Recent Advances in Sampling, Experimental Designs, Interpretive Tacts, and Chronostratigraphic Applications

Endorsers: GSA Sedimentary Geology Division; GSA Geochronology Division; GSA Structural Geology and Tectonics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Limnogeology Division Disciplines: Stratigraphy, Geochronology, Sediments, Clastic Advocates: Trystan Herriott; Emily Finzel; Theresa Schwartz; Matthew A. Malkowski

MDA research remains a rapidly developing field. We welcome contributions from diverse perspectives that provide new insights and propel this research community closer to a necessarily flexible yet carefully considered best-practices framework for MDA studies.

T174. Paleozoic Stratigraphic and Tectonic Evolution of the Appalachian Foreland: In Honor of Frank Ettensohn

Endorsers: GSA Soils and Soil Processes Division; GSA Sedimentary Geology Division; GSA Continental Scientific Drilling Division **Disciplines:** Stratigraphy, Tectonics, Sediments, Carbonates **Advocates:** Jack Pashin; Stephen Greb; Gustavo Martins

This session is presented in honor of Frank Ettensohn's distinguished career, which features a broad range of contributions on the stratigraphic, sedimentologic, and tectonic evolution of the Appalachian foreland.

PETROLOGY, IGNEOUS

T175. Mineralogy, Geochemistry, Petrology, and Volcanology Division: Session for Graduate and Undergraduate Students (Posters)

Endorsers: *GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division*

Disciplines: Petrology, Igneous, Mineralogy/Crystallography, Geochemistry

Advocates: Emily Fischer; Madeline Murchland; Charles Lewis

GSA's Mineralogy, Geochemistry, Petrology, and Volcanology Division student representatives welcome the Division's student population to present their research in this poster session. We encourage applications from any subdiscipline within our respective fields with the hopes of stimulating a multidisciplinary ECR community within MGPV.

INDUSTRY TRACKS

GSA's technical program offers sessions relevant to applied geoscientists. Look for these icons, which identify sessions in the following areas:









Hydrogeology and Environmental Geology

Understanding the Monterey Formation and Similar Biosiliceous Units across Space and Time

Edited by Ivano W. Aiello, John A. Barron, and A. Christina Ravelo

The Monterey Formation is a Miocene marine unit that occurs extensively in the Coast Ranges and in the continental margins of California, and analogous biosiliceous deposits are found around the Pacific Rim and elsewhere in the world. Classic studies on the diatomaceous deposits that characterize the hemipelagic/pelagic facies of the Monterey Formation have been key to understanding the oceanographic and tectonic conditions that lead to the preservation of large volumes of organic-rich hemipelagic biosiliceous sediments, and the properties of these sedimentary deposits once they convert into rocks. This volume presents a collection of recent studies on the Monterey and other similar biosiliceous deposits that offer modern and updated interpretations of this classic unit and its analogues. The volume is dedicated to the memory of Professor Bob Garrison.

SPE556, 315 p., ISBN 9780813725567 | list price \$80.00 | member price \$56.00

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2023 Joint Technical Program Committee (JTPC)

Technical Program Chair: Patrick Burkhart, patrick.burkhart@sru.edu Technical Program Vice-Chair: Kevin Mickus, kevinmickus@missouristate.edu

| JTPC CONTACT(S) | DISCIPLINE | REVIEW GROUP |
|--|---|--|
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| Samantha Marie Krause | geoarchaeology | GSA Geoarchaeology Division |
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| Will Jackson; Howard Harper | sediments, carbonates; sediments, clastic; stratigraphy | GSA Sedimentary Geology Division |
| Tim Beach; Emily Jane Beverly; Lauren Michel | soils and soil processes | GSA Soils and Soil Processes Division |
| Rebecca Dorsey; John Singleton; Juliet Crider; Ramon Arrowsmith | structural geology; tectonics | GSA Structural Geology and Tectonics Division |

(continued...)

| JTPC CONTACT(S) | DISCIPLINE | REVIEW GROUP |
|---|---|---|
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| Elizabeth A. Heise; Claire McLeod | | Council on Undergraduate Research Geosciences Division |
| Frank Ramos | geochemistry | Geochemical Society |
| Robert Tolliver | geoscience information/communication | Geoscience Information Society |
| Philip Brown | mineralogy/crystallography; petrology, igneous; petrology, metamorphic; volcanology | Mineralogical Society of America |
| Katherine Ryker | geoscience education | National Association of Geoscience Teachers (NAGT) |
| John Huntley; Sarah Jacquet; René Lewis; Jim Schiffbauer | paleontology, biogeography/biostratigra- phy; paleontology, diversity, extinction, origination; paleontology, paleoecology/ taphonomy; paleontology, phylogenetic/ morphological patterns | Paleontological Society |
| Howard Harper | sediments, carbonates; sediments, clastic; stratigraphy | SEPM (Society for Sedimentary Geology) |
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| Kenneth Ridgway | environmental justice; Geoheritage; traditional ecological knowledge | Traditional Ecological Knowledge |

GSA Expands its Focus on Associated Societies for GSA Connects 2023

This is an exciting time of strategic growth and transformation for GSA, and our relationships with like-minded organizations have never been more important. To underscore the importance of these relationships, GSA recently appointed Nan Stout as GSA's Associate Director of Scientific Integrity & Strategic Partnerships. In this expanded role for GSA, Stout will work closely with Melanie Brandt, GSA's Executive Director and CEO, to increase the mutual impact of GSA's Associated Societies program.

As GSA looks to the future, it aims to build strong, meaningful partnerships with other societies and organizations across the country and around the world in service to members and the global geoscience community. National and international societies with consistent aims and missions of advancing the geosciences and/or science in general are invited to affiliate with GSA as an Associated Society.

We offer our 78 Associated Societies the opportunity to engage with us and the broader geoscience community at GSA Connects 2023, our annual meeting in Pittsburgh, Pennsylvania, USA, from 15 to 18 October. There they will present their representative science, hold tailored events, and have exhibit booths.

If you would like to learn more about GSA's Associated Societies or discuss collaboration opportunities, contact Nan Stout at nstout@geosociety.org, or go to www.geosociety.org/GSA/ About/Who_We_Are/Associated_Societies/GSA/About/ Associated_Societies.aspx.

GSA Division Awards

Curtis-Hedberg Award

Nominations due 1 May

Submit nominations to the Curtis-Hedberg Award chair.

The inaugural Curtis-Hedberg Award will be considered annually in accordance with the bylaws of the Society. The award will be made for outstanding contributions in the field of petroleum geology. Learn more at **community.geosociety.org/energydivision/ awards/curtishedberg.**

GEOARCHAEOLOGY DIVISION

Richard Hay Student Paper/Poster Award

Nominations due 1 Sept.

Submit nominations to gsa.agd@gmail.com.

The award is a travel grant for a student (undergraduate or graduate) presenting a paper or poster at GSA's annual meeting. The grant is competitive and will be awarded based on the evaluation of the scientific merit of the research topic and the clarity of an expanded abstract for the paper or poster prepared by a student for presentation in the Division's technical session at the meeting.

HISTORY AND PHILOSOPHY OF GEOLOGY DIVISION

History and Philosophy of Geology Student Award Nominations due 15 June

Submit nominations to the division's secretary/treasurer.

The History and Philosophy of Geology Division provides a student award in the amount of US\$1000 for a paper to be given at the national GSA meeting. Awards may also be given for second place. The award, established in 2004, is made possible by a bequest from the estate of Mary C. Rabbitt. Oral presentations are preferred. Faculty advisors may be listed as second author, but not as the lead author of the paper. The proposed paper may be (1) a paper in the history or philosophy of geology; (2) a literature review of ideas for a technical work or thesis/dissertation; or (3) some imaginative aspect of the history or philosophy of geology we have not thought of before. Students should submit an abstract of their proposed talk and a 1,500-2,000-word prospectus for consideration. The award is made possible by a bequest from the estate of Mary C. Rabbitt. Monies for the award are administered by the GSA Foundation. For more information, go to community .geosociety.org/histphildiv/awards/student.

PLANETARY GEOLOGY DIVISION

Shoemaker Award

Nominations due in August

The Eugene M. Shoemaker Impact Cratering Award is for undergraduate or graduate students, of any nationality, working in any country, in the disciplines of geology, geophysics, geochemistry, astronomy, or biology. The award, which will include US\$2500, is to be applied to the study of impact craters, either on Earth or on the other solid bodies in the solar system. Areas of study may include but shall not necessarily be limited to impact cratering processes; the bodies (asteroidal or cometary) that make the impacts; or the geological, chemical, or biological results of impact cratering. Learn more at **community.geosociety.org/pgd/awards/shoemaker**.

Ronald Greeley Award for Distinguished Service Nominations due 1 Aug.

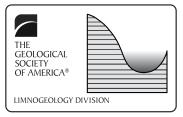
In 2011, the PGD established the Ronald Greeley Award for Distinguished Service. This award may be given to those members of the PGD, and those outside of the Division and GSA, who have rendered exceptional service to the PGD for a multi-year period. Nominations for the award, which should include a description of what the nominee has given to the PGD community, may be made by any PGD member to the management board. Learn more at **community.geosociety.org/pgd/awards/greeley.**

SEDIMENTARY GEOLOGY DIVISION

Sedimentary Geology Division and Structural Geology and Tectonic Division Joint Award: Stephen E. Laubach Structural Diagenesis Research Award

Nominations due 1 May.

The Stephen E. Laubach Structural Diagenesis Research Award Fund promotes research combining structural geology and diagenesis and curriculum development in structural diagenesis. This award addresses the rapidly growing recognition that fracturing, cement precipitation and dissolution, evolving rock mechanical properties, and other structural diagenetic processes can govern recovery of resources and sequestration of material in deeply buried, diagenetically altered and fractured sedimentary rocks. The award highlights the growing need to break down disciplinary boundaries between structural geology and sedimentary petrology, exemplified by the work of Dr. Stephen Laubach and colleagues. Graduate students, postgraduate, and faculty-level researchers are eligible. Learn more at **community.geosociety.org**/ **sedimentarygeologydiv/awards/laubach.**



Getting to Know GSA's Limnogeology Division

Kirsten Menking, Vice-Chair; Jason Price, Chair

Limnogeology is the transdisciplinary study of present-day lacustrine systems and the geologic record contained within lake sediments. The subdiscipline has broad applications to research in paleoclimatology, paleoseismology, volcanology, biogeochemical cycling, crustal dynamics, assessment of human impacts on watersheds, and freshwater resources, among other lines of inquiry.

Dozens of proxies, including, but not limited to, pollen, plant macrofossils, granulometry, leaf waxes, diatoms, ostracods, stable isotopes in carbonates and organic matter, sediment mineralogy, and magnetic susceptibility, yield detailed information on local and regional vegetation changes over time as well as variations in lake water pH, salinity, and turbidity produced by fluctuating temperature and precipitation conditions.

Lake sediments afford an opportunity to reconstruct past droughts and storms, show the extent of prehistoric volcanic eruptions in layers of ash, record human activities such as deforestation and industrialization, and help to determine the timing of ice sheet fluctuations and retreat.

Shorelines warped by isostatic rebound can be used to quantify the viscosity of Earth's mantle, and soft sediment deformation yields information on the timing and magnitude of past earthquakes. Limnogeologists have even contributed to our understanding of the evolution of the Solar System through their studies of lacustrine sediments on Mars.

The purpose of GSA's Limnogeology Division, therefore, is to promote research on terrestrial and extraterrestrial ancient and modern lakes, foster collaboration among scientists engaged in lacustrine research, facilitate the presentation and publication of lake research, and to conduct outreach to students interested in careers in lake studies. Established in 2002, the Division has a small but growing membership and enjoys synergistic relationships with the Quaternary Geology and Geomorphology, Sedimentary Geology, and Continental Scientific Drilling Divisions, among others. It also works to make the membership aware of conferences, workshops, and funding opportunities from sibling organizations such as the International Association of Limnogeology, International Paleolimnology Association, the Association for the Sciences of Limnology and Oceanography, the American and International Quaternary Associations, the International Society for Diatom Research, the Palynological Society, and the Continental Scientific Drilling Facility at the University of Minnesota.

The Division gives two awards annually. The Israel C. Russell Award is named for a late nineteenth-century geologist who conducted pioneering studies on Mono Lake in eastern California and honors scientists who have had major career achievements in limnogeology through contributions in research, teaching, and service. The Kerry Kelts Student Research Fund is named for a visionary faculty member who directed the University of Minnesota's Limnological Research Center and is open to undergraduate and graduate students on a competitive basis to help defray the costs of research projects.

Though a relatively small Division, it is typically quite visible at GSA Connects. The Division convenes one or more oral and poster sessions, endorses numerous other related sessions, provides two members to the Joint Technical Program Committee, co-hosts an awards ceremony and Division meeting, and maintains a booth in the Resource & Innovation Center.

İhsan Ketin (1914–1995): Innovative Mind in a Conservative Society with No Scientific Tradition

A.M. Celâl Şengör, İTÜ Maden Fakültesi ve Avrasya Yerbilimleri Enstitüsü, Ayazağa 34810 İstanbul, sengor@itu.edu.tr



Professor İhsan Ketin (1914-1995) in his office at the ITU.

CHILDHOOD YEARS AT THE FOOT OF A VOLCANO

İhsan Ketin, the nestor of Turkish geologists, was born in the spring of that eventful year 1914, in the central Anatolian town of Kayseri (classical Mazaca, Caesarea of the Romans), into a poor family. As a child, he was captivated by the beauty of the majestic volcano of Erciyes (Mt. Argaeus of the ancients), which towered over his city of birth. His family took summer holidays on the flanks of the volcano, creating in him a binding love of nature. Ketin's outstanding academic abilities were noticed early, and he was able to attend high school in his hometown, one of only eighteen high schools that existed in Turkey at the time. His education was supported by a state scholarship provided by the new Turkish Republic, founded in 1923 by the great visionary Mustafa Kemâl Atatürk (1881–1938) out of the ruins of the Ottoman Empire.

Atatürk was determined to transform his country into a modern society. To that end, he sent scores of young people to various European countries on state scholarships to become educated. They were to return home and become high-school teachers who would educate the youth of Turkey in the principles of modern science and humanities. Ketin was one of those chosen. In 1932, 18-year-old Ketin was sent to Berlin to study geology.

TO GERMANY IN THE 1930s

The Berlin of 1932 was a chaotic place. Raging inflation and rampant terror greatly disturbed the quiet youth from Anatolia. Adding to Ketin's discomfort was the dogmatic teaching style of Hans Stille (1876–1966), with whom he was assigned to study. A chance conversation with a more senior Turkish student gave him the idea to move to Bonn, where the great German geologist Hans Cloos (1885–1951) held sway. A more fortunate choice cannot be imagined. Ketin and Cloos rapidly warmed to one another, and Cloos realized that sending Ketin back to Turkey with only a

bachelor's diploma would be a terrible waste. He arranged with the Turkish authorities in Berlin to extend Ketin's scholarship to enable him to complete a doctorate.

Ketin's Bonn days were happy, although after the Nazis came to power in 1933, academic freedom was significantly curtailed in the universities. Cloos managed to protect both his institute and his students, especially the foreign students who came from societies such as Turkey that were not well regarded by the Nazis. Ketin fondly remembered the Saturday tea parties thrown by Mrs. Cloos in the garden of the institute, where discussion topics ranged from geology to general culture. Later, Ketin's colleagues and students (including the author) were impressed with Ketin's deep knowledge of European culture, especially classical music.

TECTONICS OF TURKEY

Ketin completed his doctorate in 1938. He returned to Turkey and was appointed an assistant professor at the University of Istanbul, which had been revitalized in 1933 by the sweeping reforms of Atatürk. A year later, in December 1939, Ketin's career research agenda was set when the North Anatolian Fault awakened from its century-long slumber. A catastrophic earthquake with a moment-magnitude of 7.8 claimed the lives of approximately 33,000 people, injuring an additional 100,000, and reducing the city of Erzincan to a heap of ruins. This was followed in rapid succession by a series of earthquakes along a zone in northern Turkey that had been interpreted as a "cratonic break" or "cicatrice" by both Turkish and foreign geologists who had been working in the country. Ketin realized that such "interpretations" were mere words; they contributed nothing to our understanding of the nature of the structure. In 1948, Ketin published his classic paper on the North Anatolian Fault, which he interpreted to be a major, active, strike-slip fault. This was a time when even the interpretation that the San Andreas Fault was a strike-slip fault was subject to debate. Ketin inferred that portions of Turkey on the south side of the North Anatolian Fault were drifting westward (he used the word "Westdrift") relative to areas to the north. He also noted that areas to the south were seismically relatively quiescent. He reasoned, therefore, that either the whole of Africa was drifting westward with respect to Eurasia, or another fault existed south of what he called the Anatolian block. That prediction was verified by another catastrophic earthquake in 1971 on a left-lateral fault (later named the East Anatolian Fault). This study and Ketin's continuing work on the neotectonics of Turkey played an important role in the development of the understanding of continental deformation (Şengör and McKenzie, 1997).

Ketin's studies also showed that the big crystalline massifs in Turkey, the Menderes in the west and the Kırşehir in the center, were young structures, products of Alpide evolution, not old "median masses." He realized that Turkey was an asymmetric orogen that developed from north to south, just as Eduard Suess had earlier surmised. That model had been rejected by Kober and



A very characteristic photograph: Ketin (fourth from left) in the field in 1987 with his colleagues A.M.C. Şengör (second from left), Bulgarian geologist Georgi Chatalov (third from left, embracing Şengör and Ketin), Ali Polat (far left, an undergraduate student at the ITU, now professor at the University of Windsor in Ontario, Canada), and Sancar Kasar (extreme right, a Turkish petroleum geologist). During this excursion Chatalov and Ketin identified a tectonic window in the Strandja Mountains.

Stille in favor of their own symmetric orogen model, which remained dominant until plate tectonics showed that it was wrong. In 1966, Ketin brought out his mature views on the tectonics of Turkey in a paper clearly delineating the main tectonic units of the country. Those views still form the basis of modern work on the paleotectonics of Turkey, similar to the fundamental role his 1948 paper played in elucidating the neotectonics of the country.

A KIND AND OPEN-MINDED MENTOR

Ketin loved to go into the field with colleagues and students. He enjoyed a good wine and a good argument in the evenings with them, perhaps harkening back to the tea parties in the garden of the Bonn institute in his student days. All of these were very uncharacteristic of most of the stuffy Turkish professors. Ketin said he acquired his free and friendly habits from Cloos, as a young student. I recall as a high-school student myself, sitting cross-legged on Ketin's desk, congenially arguing with him about the nature of the Bursa Depression, when one of his stuffier colleagues walked into the room and was clearly shocked to see a young student sitting on the master's desk, arguing with him! Such was the atmosphere Ketin had created. When a colleague or a student pointed out a mistake he had made, he was genuinely pleased and encouraged the publication of a correction. In 1984, I pointed out to him that on his 1946 map of Uludağ (one of the three mythological Olympuses), south of the city of Bursa, he had misidentified the Triassic mélange as Permian schist. After he went into the field with me and convinced himself that I was right, he asked me to publish the correction. I told him that if I did that,

in the conservative patriarchal society of Turkey, people would say that "the upstart assistant was trying to embarrass his master," and they would not believe me. But if he published it himself, admitting his mistake and correcting it, it would make an impact. He did just that in 1985, in a symposium volume published in his honor upon his retirement. Ketin was interested in truth, not authority.

Ketin was an extraordinary personality. He was kind, modest, and soft-spoken, but he did not tolerate mediocrity and idleness. In 1942, he had married the geography teacher Bedia (née Alpün). They had three sons, one who died in 1945 and another in 1969. He buried the great pain in his bosom and, while providing psychological support for his bereaved wife, did not permit his family's misfortunes to impair his work. He was a dedicated teacher and wrote the best (in some subjects, the only) geology textbooks in Turkey. When he was head of the department, he required nothing of the other members but to do good research. The research he valued most was that which contributed something genuinely new to geology. His own work, based on observations made in Turkey, significantly contributed to the development of tectonics in the twentieth century.

Ketin was honored with an honorary fellowship by The Geological Society of America, a foreign membership by the Geological Society, London, and a Steinmann Medal by the Geologische Vereinigung. The Bonn Institute renewed his doctorate with an honorary "golden doctorate" at the fiftieth anniversary of his obtaining his original degree. He also received the highest awards of the Turkish Council of Scientific Research and Technology and the Geological Society of Turkey, and he was an honorary member of the Turkish Academy of Sciences. He was one of Cloos' students to whom Cloos dedicated his delightful book *Conversation with the Earth*.

Ketin's influence on geological studies in Turkey can hardly be overstated. At the time of his return from Germany, there was very little modern geological research activity in Turkey. In contrast, by the end of his career, Ketin had played a major role in creating a globally respected, indigenous geological research community. The greatness of this accomplishment can only be appreciated properly by those closely familiar with societies in which no scientific tradition exists. One of Ketin's lasting legacies is the wide range of opportunities he created for his younger colleagues and students. He used to say that this was his attempt to pay back Atatürk for the opportunities he himself had been given.

FURTHER READING

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Help Shape the Future of Geoscience— Serve on a Committee!

Deadline: 15 June 2023

Terms begin 1 July 2024 (unless otherwise indicated)

If you are looking for the opportunity to work toward a common goal, give back to GSA, network, and make a difference, then we invite you to volunteer (or nominate a fellow GSA member) to serve on a Society committee or as a GSA representative to another organization.

Learn more and access the nomination form at **www.geosociety**.org/Committees. Committee open positions and qualifications are online at https://rock.geosociety.org/forms/viewopenpositions.asp. GSA headquarters contact: Darlene Williams, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA; fax: +1-303-357-1060; dwilliams@ geosociety.org.

ACADEMIC AND APPLIED GEOSCIENCE RELATIONS COMMITTEE

Member-at-Large Industry (3-year term; E, M)

This committee is charged with strengthening and expanding relations between GSA members in applied and academic geosciences. As such, it proactively coordinates the Society's effort to facilitate greater cooperation between academia, industry, and government geoscientists. **Qualifications:** Committee members must work in academia, industry, or government and be committed to developing a better integration of applied and academic science in GSA meetings, publications, short courses, field trips, and education and outreach programs. Professional interests: environmental and engineering geology, hydrogeology, karst, Quaternary geology and geomorphology, structural geology and tectonics, sedimentary geology. Members must also be active in one or more GSA Divisions.

ANNUAL PROGRAM COMMITTEE

Member-at-Large (4-year term; B, E, M)

This committee is charged with developing a plan for increasing the quality of the annual and other Society-sponsored meetings in terms of science, education, and outreach; evaluating the technical and scientific programs annually to identify modifications necessary for accomplishing the Society's long-range goals; conducting short and long-range planning for Society meetings as a whole; and developing a long-term logistical plan/strategy for the technical programs of all GSA meetings and other Society-sponsored meetings. **Qualifications:** This member-at-large should have previous meeting experience.

ARTHUR L. DAY MEDAL AWARD

Two Members-at-Large (3-year terms; E, T)

This committee selects candidates for the Arthur L. Day Medal. **Qualifications:** Members should have knowledge of those who have made "distinct contributions to geologic knowledge through the application of physics and chemistry to the solution of geologic problems." All the committee's work will be accomplished during the months of February and March. All committee decisions must be made by 1 April.

DIVERSITY IN THE GEOSCIENCES COMMITTEE

Three Members-at-Large; (3-year terms; E, M)

This committee provides advice and support to GSA Council, raises awareness, and initiates activities and programs that will increase opportunities for diverse groups in the geosciences, particularly in the dimensions of race, ethnicity, gender, and physical abilities. The committee is also charged with stimulating recruitment and promoting positive career development. **Qualifications:** Members must have professional or experiential knowledge of issues relevant to the goals of the committee. GSA strongly encourages nominations of members who are from the communities that this committee is expected to serve.

EDUCATION COMMITTEE

Undergraduate Student Representative (2-year term; B, E, M)

This committee works with GSA members representing a wide range of education sectors to develop informal, pre-college (K–12), undergraduate, and graduate earth-science education and outreach objectives and initiatives. **Qualifications:** Members of this committee must have the ability to work with other interested scientific organizations and science teachers' groups.

GEOLOGY AND PUBLIC POLICY COMMITTEE

Two Members-at-Large (3-year terms; E, M)

This committee provides advice on public policy matters to Council and GSA leadership by monitoring and assessing international, national, and regional science policy; formulating and recommending position statements; and sponsoring topical white papers. This committee also encourages the active engagement in geoscience policy by GSA members. **Qualifications:** Members should have experience with public-policy issues involving the science of geology; ability to develop, disseminate, and translate information from the geologic sciences into useful forms for the public and for GSA members; and familiarity with appropriate techniques for the dissemination of information.

GSA INTERNATIONAL

Two Members-at-Large (4-year terms; E, M); One Member-at-Large outside of North America (4-year term; E, M); One Member-at-Large, Student (2-year term; E, M)

Serve as GSA's coordination and communication resource seeking to promote, create, and enhance opportunities for international cooperation related to the scientific, educational, and outreach missions shared by GSA and like-minded professional societies, educational institutions, and government agencies. Build collaborative relationships with GSA Divisions and Associated Societies on international issues, and serve as channel for member generated proposals for international themes.

B—Meets in Boulder or elsewhere; E—Communicates by phone or electronically; M—Meets at GSA Connects; T—Extensive time commitment required during application review period

MEMBERSHIP AND FELLOWSHIP COMMITTEE

Member-at-Large, Industry (3-year term; B, E)

This committee contributes to the growth of the GSA membership, enhances the member experience, and serves a vital role in the selection of Fellows, with the goal of fostering a membership community as pertinent and global as our science. Committee members should understand what various segments of members want from GSA and should be familiar with outstanding achievers in the geosciences worthy of fellowship. **Qualifications:** Committee members should have experience in benefit, recruitment, and retention programs.

NOMINATIONS COMMITTEE

Two Members-at-Large (3-year terms; B, E)

This committee recommends nominees to GSA Council for the positions of GSA Officers and Councilors, committee members, and Society representatives to other permanent groups. **Qualifications:** Members must be familiar with a broad range of well-known and highly respected geoscientists.

NORTH AMERICAN COMMISSION ON STRATIGRAPHIC NOMENCLATURE

GSA Representative (3-year term; E, M)

The commission develops statements of stratigraphic principles, recommends procedures applicable to classification and nomenclature of stratigraphic and related units, reviews problems in classifying and naming stratigraphic and related unites, and formulates expressions of judgment on these matters. **Qualifications:** Members must be familiar with of the fields of paleontology, biostratigraphy, and stratigraphy. Term begins 1 Dec. 2024.

PENROSE CONFERENCES AND THOMPSON FIELD FORUMS COMMITTEE

Two Members-at-Large (3-year terms; E); One Member-at-Large, Early-Career Scientist (3-year term; E)

This committee reviews and approves Penrose Conference and Thompson Field Forum proposals and recommends and implements guidelines for the success of these meetings. **Qualifications:** Committee members must be early-career scientists/professionals.

PENROSE MEDAL AWARD COMMITTEE

Two Members-at-Large (3-year terms; E, T)

Members of this committee select candidates for the Penrose Medal Award. Emphasis is placed on "eminent research in pure geology, which marks a major advance in the science of geology." **Qualifications:** Members should be familiar with outstanding achievers in the geosciences worthy of consideration for the honor. All of the committee's work will be accomplished during the months of February and March. All committee decisions must be made by 1 April.

PROFESSIONAL DEVELOPMENT COMMITTEE One Member-at-Large (3-year term; E)

This committee directs, advises, and monitors GSA's professional development program, reviews and approves proposals, recommends and implements guideline changes, and monitors the scientific quality of courses offered. **Qualifications:** Members must be familiar with professional development programs or have adult education teaching experience.

RESEARCH GRANTS COMMITTEE

Fourteen Members-at-Large with Various Specialties (3-year terms; B, T)

The primary function of this committee is to evaluate approximately 800 graduate student research grant applications and award specific grants to chosen recipients, including some named grants supported by funds within the GSA Foundation. **Qualifications:** Members may come from any sector (academia, government, industry, etc.) and should have experience in directing research projects and in evaluating research grant applications. GSA strongly encourages nominations of geoscientists from diverse backgrounds and institutions, particularly from minority serving institutions. **Extensive time commitment required 15 Feb.– 15 April**; each member reviews approximately 40 applications. More information: www.geosociety.org/gradgrants.

YOUNG SCIENTIST AWARD (DONATH MEDAL) COMMITTEE

One Member-at-Large (3-year term; E, T)

Committee members investigate the achievements of young scientists who should be considered for this award and make recommendations to GSA Council. **Qualifications:** Members should have knowledge of young scientists with "outstanding achievement(s) in contributing to geologic knowledge through original research which marks a major advance in the earth sciences." All the committee's work will be accomplished during the months of February and March. All committee decisions must be made by 1 April.

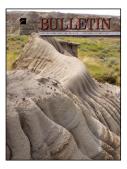
GSA COUNCIL

Councilor (4-year term; E, M); Treasurer (3-year term; E, M); President-Elect (3-year term; E, M)

The management of the affairs and the property of the Society shall be the responsibility of Council. Council shall have the authority, power, and responsibility for the general management, control, and general supervision of the affairs, business, activities, property, and assets of the Society so that the corporate activities are consistent with the stated purposes of the Society and that no act is committed by the Society in contravention of its Articles of Incorporation or Bylaws. Primary duties are to attend and participate actively in all Council meetings, active membership on an average of two GSA committees per year, and to support the GSA Foundation. Further information about GSA can be found page at www.geosociety.org/ GSA/about/Who_We_Are/GSA/About/Who_We_Are.

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GSA appreciates the many people who make its peer-reviewed journals possible: the authors, science editors, editorial board members, associate editors, and most of all, the reviewers. Peer review of papers is the cornerstone of scientific publishing, but reviewing papers is too often a thankless task. For all those who complete timely, thorough, and even-handed reviews, GSA thanks you. GSA's journal science editors have selected the following people for special recognition of the many prompt, insightful, meticulous, and tactful reviews they completed. (Photos of these colleagues are posted at **www.geosociety.org/ exceptional-reviewers.**)



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Junpeng Wang, China University of Geosciences, Wuhan

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GEOLOGY Riccardo Avanzinelli, University of Florence (Italy)

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POSITIONS OPEN

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Earth and Climate Sciences: The Dynamic Earth with Lab

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Positions may be filled by one or separate lecturers

The Department of Earth and Climate Sciences at Tufts University is seeking a part-time Lecturer or part-time Lecturers to teach ECS 1 - The Dynamic Earth for fall semester 2023 and ECS 12 – Igneous and Metamorphic Petrology with Lab in spring 2024 semester. The department is hoping to hire one person to fill both positions but welcomes applicants who would fill one of these positions. Both courses will be held in person. Classes begin on September 5, 2023 for the fall semester and final exams end on December 21, 2023. Classes begin on January 17, 2024 for the spring semester and final exams end on May 11, 2024.

ECS 1 is our introductory physical geology course with no prerequisite. The instructor will be required to teach three – 50 minute lectures/ wk as well as one of the course's 3-hr lab sections/wk. ECS 12 is an upper-level course with introductory geology as a prerequisite. The instructor will teach both the two – 75 minute lectures/wk and one 3 hr lab/wk for this course. In addition, the instructor(s) will hold weekly office hours for students as well as prepare and grade homework and exam assessments.

Candidates should have a Ph.D. or advanced doctoral training. Prior teaching experience is preferred. No relocation expenses are provided for this position.

All application materials must be submitted via Interfolio at http://apply.interfolio.com/ 121985. Please submit the following: 1) a cover letter, 2) a curriculum vitae, 3) the names (with contact addresses) of three references, and 4) a statement of teaching/learning philosophy. Please address issues of diversity and inclusion in either the cover letter or teaching statement. Review of applications will start immediately and continue until the position is filled. For questions please contact Kendra .Clifton@tufts.edu.

The Earth and Climate Sciences Department [https://eos.tufts.edu/] (ECS) has an undergraduate-only major and minor program and our faculty currently comprises 5 tenure-track professors and a full-time lecturer. The department prides itself in offering students an array of field and laboratory experiences from introductory to upper course levels. Tufts University is in the Boston area and is near a diverse array of geologic terranes that are conducive to field trips across New England and the northeastern U.S. The department takes advantage of our location to offer field trips in many of our intro to upper level courses.

All offers of employment are contingent upon the completion of a background check and meeting the University's current COVID-19 vaccination requirements.

Tufts University, founded in 1852, prioritizes quality teaching, highly competitive basic and applied research, and a commitment to active citizenship locally, regionally, and globally. Tufts University has also committed to becoming an anti-racist institution and prides itself on the continuous improvement of diversity, equity and inclusion work. Current and prospective employees of the university are expected to have and continuously develop skill in, and disposition for, positively engaging with a diverse population of faculty, staff, and students.

Tufts University is an Equal Opportunity/ Affirmative Action Employer. We are committed to increasing the diversity of our faculty and staff and fostering their success when hired. Members of underrepresented groups are welcome and strongly encouraged to apply. See the University's Non-Discrimination statement and policy here https://oeo.tufts.edu/ policies-procedures/non-discrimination/. If you are an applicant with a disability who is unable to use our online tools to search and apply for jobs, please contact us by calling the Office of Equal Opportunity (OEO) at 617-627-3298 or at oeo@tufts.edu. Applicants can learn more about requesting reasonable accommodations at https://oeo.tufts.edu/.

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Providencia Island: A Miocene Stratovolcano on the Lower Nicaraguan Rise, Western Caribbean— A Geological Enigma Resolved

By Alan L. Smith, M. John Roobol, Glen S. Mattioli, George E. Daly, and Joan E. Fryxell

Providencia is the only example of subaerial volcanism on the Lower Nicaraguan Rise. In this volume, the authors examine this volcanism and the geological history of the western Caribbean and the Lower Nicaraguan Rise, whose origin and role in the development of the Caribbean plate has been described as enigmatic and poorly understood. While the Providencia alkaline suite is similar to others within the Western Caribbean Alkaline Province, its subalkaline suite is unique, having no equivalent within the province. In order to unravel its complex history and evolution, this volume presents new and previously published results for the geology, geochemistry, petrology, and isotopic ages from the Providencia island group.

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The New Source to Sink: Opportunities for Geoscientists in Sand and Gravel Mining

Zachary T. Sickmann, Department of Geosciences, University of Texas at Dallas, Dallas, Texas 75080, USA

MOTIVATION

Sand and gravel mining, transport, and consumption in the global construction industry is arguably the world's largest "source-to-sink" (S2S) sediment dispersal system. Construction aggregates are the world's most extracted solid material resource (OECD, 2019) with 30-50 billion tons currently mined annually, largely used in concrete (UNEP, 2019). Total global sediment flux to oceans is around 19 billion tons annually, of which ~1.5 billion tons is bedload material (Syvitski et al., 2005). While crushed rock is increasingly important in construction aggregates (Torres et al., 2021), natural sand and gravel deposits are still the primary mining targets globally (Torres et al., 2021; UNEP, 2019). Given the fact that construction aggregates are generally coarser than fine sand, the most direct comparison between these two global S2S systems is bedload estimates versus construction aggregates. This makes the global construction S2S system an order of magnitude larger than all the world's natural coarse-grained S2S systems combined. Because coarse sediment is something that many geoscientists think about daily, this fact presents new opportunities for societally relevant research directions.

Defining the Components and Drivers of the New Source-to-Sink System

Construction S2S systems (Fig. 1A) begin at the mining site (source; Fig. 1B); continue through transport via trucks, trains, or barges and subsequent processing, usually mixing into concrete (transfer zones; Fig. 1C); and final use, generally pouring concrete at a construction site (sink). This S2S system has quantifiable drivers that control its evolution (Torres et al., 2021). Whereas climate and tectonics drive natural systems, economic and social forces drive the construction S2S system (Gavriletea, 2017;

GSA Today, v. 33, https://doi.org/10.1130/GSATG558GW.1. CC-BY-NC.

Torres et al., 2021). Any time a city, region, or country wants to expand infrastructure, given current concrete-centric building practices, there must be a resultant increase in sand and gravel extraction, transport, and consumption.

IMPLICATIONS AND OPPORTUNITIES

Understanding the Resource and Implications of Extraction

Natural sand and gravel can be extracted from one of two sources: old deposits or active systems (UNEP, 2019). Mining from older deposits represents a self-contained system with largely localized environmental impacts. From an S2S perspective, such networks are important to understand in terms of available resources, particularly to replace supply from more environmentally deleterious active sources. "Resource exploration" is relatively simple for sand and gravel because most economic deposits are evident at the surface. However, detailed surface mapping is not available in many places around the world. Moreover, even where surface deposits are mapped in detail, subsurface architecture and grain size distributions may be poorly known. This provides opportunity to help define the most sand- and gravel-rich locations to target to minimize even local environmental impacts.

Most sand and gravel pits are in unconsolidated Quaternary deposits, meaning an improved understanding of the history of

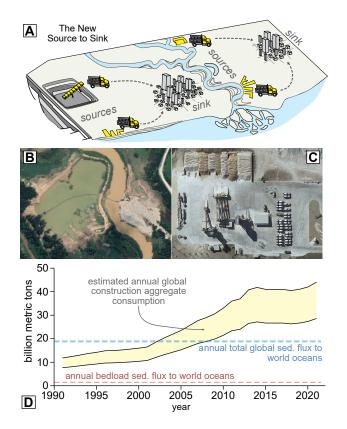


Figure 1. (A) Cartoon schematic of the new construction sand source-to-sink system. (B) Example of a river sand mine in Malavsia. (C) Example of a typical concrete batch plant. Note stockpiles of sand in upper left awaiting mixing into concrete. (D) Summary of global consumption of construction aggregates. Uncertainty envelope is estimated using the conventional proxy of 6.5-10× cement consumption (Peduzzi, 2014; UNEP, 2019). Sed.-sediment.

recent coarse sediment flux through any given system is useful in predicting the best pit locations. Developing relationships with mining companies motivated by such resource evaluation can lead to access to sedimentary records that would otherwise be lost to science. Marine extraction is also increasingly considered as an economic source for construction sand and gravel (Torres et al., 2021)-motivating new efforts to better characterize seafloor sand deposits and understand marine coarse sediment transport. While resource evaluation in older deposits is important, in many places, studying extraction from active systems is a more pressing sustainability concern.

Although known to be unsustainable, and often illegal, mining from active systems is generally the quickest and cheapest way to meet local demand. Such deposits are usually clean, unvegetated, and can even be mined by hand. In terms of research contributions, while accurate natural bedload fluxes are notoriously difficult to estimate, they are often the biggest hurdle in evaluating mining impacts in active systems (Bendixen et al., 2019). Extracted volume/ tonnage is also often difficult to estimate. Reporting systems are not common globally, and mining activity is often informal. More innovative solutions like using machine learning analysis of satellite images to track sand barges (Hackney et al., 2020) are needed to address this problem. Beyond quantifying natural supply and human extraction, we also need a better understanding of how natural systems respond to the removal of large volumes of coarse sediment.

The root cause of geomorphic change due to sand mining is an induced deficit in sediment supply that the system re-equilibrates by cannibalizing older deposits. As summarized by Koehnken et al. (2020) in their review of recent case studies, this can cause channel widening or deepening in fluvial systems, even leading to alluvial streams stripped to bedrock, and increased beach erosion and retreat in littoral systems. Other ecological impacts include destruction of aquatic habitats, increased suspended sediment, and bed coarsening (Koehnken et al., 2020). Improving our understanding of how individual local perturbations might integrate at the system scale remains an open

opportunity to aid resource management and guide environmental recovery.

Traceable Supply Networks: From Where, to Where?

Construction S2S systems can be surprisingly opaque. While most consumption occurs near extraction sites (<100 km), there are often multiple options for mining within that radius. Moreover, increasing demand in areas without their own domestic supply, like Singapore and Hong Kong, leads to longer transport, with some supply chains operated by full-fledged illicit networks (Magliocca et al., 2021). Traceable sourcing is the cornerstone of sustainability policy, yet in sand and gravel mining there are currently no reliable, scalable monitoring methods beyond self-reporting and direct observation. My research group is working on novel approaches to employ sand provenance analysis in tracing supply networks (Sickmann et al., 2022), but more innovation is required in this area.

Understanding Drivers and Predicting Areas of Concern

Without alternative building materials and methods, demand for construction aggregates is projected to double by 2060 (OECD, 2019). Identifying existing areas of environmental impact and predicting future areas of concern are crucial for understanding long-term sand and gravel exploitation sustainability. This offers the opportunity for geoscientists to work with economists, urban planners, and policymakers to evaluate the best deposits for meeting demand. Sand in the concrete of a new skyscraper will never end up back in the river from which it was taken. If we, as geoscientists, can proactively help predict areas that need to be protected and better identify acceptable resource targets, we can further demonstrate direct applications of our knowledge and skillsets to the sustainability challenges of the present and future.

CONCLUSIONS

Increasing awareness of sand and gravel mining in geoscience research and curriculum is a way to expand the influence of geoscientists in planning a more sustainable future and for motivating new ways to advance fundamental earth-systems science.

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Saving Earth, Saving Geoscience

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INTRODUCTION

Geoscience is crucial for addressing societal challenges arising from interactions between Earth and human systems. Ironically, a gap exists between the pivotal role of earth science in achieving a more sustainable future and the number of students pursuing geoscience careers. This disconnect is highlighted by closures of geoscience departments and the secondclass status of earth science in schools (e.g., Center for Geoscience and Society, 2018; Geoscience on the Chopping Block, 2021). How can geoscience education evolve in both content and pedagogy to address this disconnect?

This question, addressed in a recent report on the future of geoscience education (Mosher and Keane, 2021), inspired us to organize "An interactive walk into the future of applied geosciences education," a roundtable at the 2022 Earth Educators' Rendezvous. Seventeen participants representing diverse institutions answered six questions regarding the importance of teaching applied geoscience at the university level; responses are summarized below and in Figure 1.

RESULTS: EARTH EDUCATORS' RENDEZVOUS ROUNDTABLE

1. Why is it important to incorporate an applied approach into teaching geoscience?

Student motivation was the top answer. Participants noted that students are driven to learn how to address the challenges facing society today. An applied approach to the geosciences can develop career skills and expose students to the issues they care about as well as a broader spectrum of geoscience careers, extending far beyond traditional extractive industry career paths. Respondents identified four essential skills:

Geoethics, which is concerned with the standards and values that guide geoscience research and practice, is of high importance in connecting geoscience to society and providing a sense of humility and respect for local interests and community leadership. A geoscience education must include a foundation in professional ethics, which is required for licensing in many jurisdictions.

Promoting the scientific method and teaching students how to apply it through the various stages of investigation is essential for inspiring curiosity and creativity. Analysis and interpretation of results are other critical skills.

Communication skills were highlighted by many participants, including verbal and written communication as well as interpersonal communication that enables effective teamwork and interdisciplinary collaboration. Effective communication also helps to transcend cultural and ideological barriers and enhance inclusivity.

Specific technical skills, such as GIS and applied mathematics for problem solving, were highlighted as critical. These tools and others are needed to address present demands, continue the evolution of learning, and view problems from the perspectives of others.

3. What are the best practices for teaching applied geoscience?

The respondents mentioned active learning techniques such as **mentorship** to create working relationships with students in an apprenticeship-like capacity. Another suggestion was to **utilize case studies** that highlight real-world problems. Connecting students with issues specific to their

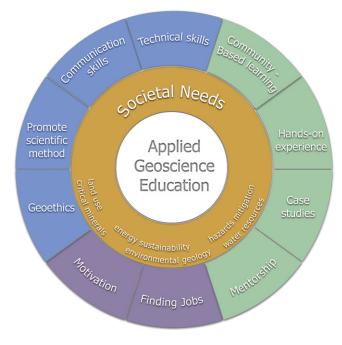


Figure 1. Applied geoscience education is a way to respond to the needs of society (in orange). To achieve this, it is essential to know why an applied education is important to students (in purple), what competencies are needed (in blue), and which teaching practices are most beneficial (in green).

^{2.} What are the most important skills we can teach to prepare students for careers?

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communities can stimulate interest, make the science feel relevant, and increase awareness and engagement. Field experiences greatly enhance engagement. Respondents emphasized that hands-on experience with technology and data management is immensely valuable.

4. What resources are the most important and what organizations can supply those resources to help facilitate an applied approach to teaching?

This question resulted in a familiar list of resources and organizations, but several are worthy of comment. First, **alumni networks** are immense sources of wisdom and experience and are often underutilized. Geoscience needs to be considered in the broadest context to include associated disciplines such as economics, ecology, land-use planning, and engineering. Colleges and universities should facilitate networking opportunities by inviting alumni with different perspectives and skill sets to connect and speak with students.

The National Association of Geoscience Teachers Science Education Resource Center at Carleton College has produced an extensive collection of high-quality teaching resources. The Geological Society of America, the American Geophysical Union, and other organizations devote attention to geoscience as a service, as do the American Geosciences Institute, the International Association for Promoting Geoethics, and Geology in the Public Interest.

Government agencies offer a wealth of information, and the U.S. Geological Survey is a vast resource. Most nations have some form of geoscience survey, and the same is true for states and provinces. Many universities host extension services that interact locally in their regions.

Last, the **sharing of experiences** and ideas with those who have "on-the-ground" experience can provide useful resources for educators at all levels.

5. What are the most relevant geoscience challenges that appeal to current students?

Responses to this question were driven by what the educators have been hearing from their students: more than ever, students want to **apply what they learn to solve problems** in the real world. These problems include the impacts of climate change, food injustice, and water availability. They also want to help further energy sustainability and address the need for critical minerals while promoting responsible mining and preserving ecosystems. Students want to balance the need for natural resources with environmental conservation and preservation.

Students are especially driven by salient experiences at home, where they have seen **local challenges** go unaddressed. They understand the need for local action and are ready to put their education to work, which is something that teaching practices should reflect.

Today's students are driven by altruism (Carter et al., 2021) and a desire to hold industry and government to higher standards. They are worried about the future of their children and people far from home. Research shows that highlighting the social relevance of geoscience also may attract more underrepresented students (Carter, et al., 2021).

6. What are the biggest barriers to instituting applied geoscience in our teaching and in engaging with society?

Respondents were nearly unanimous in their primary concern about **having neither resources nor time** to allow any workload changes or additions. Educators are stretched to the limit on all fronts, as was abundantly clear during the pandemic.

They suggested several reasons why change is difficult, including a lack of awareness of the **disconnect between classroom instruction and what graduates will need to know** (Mosher and Keane, 2021). Directly applying geoscience and engaging with society are unfamiliar territories for some instructors. The **momentum needed to overcome resistance to change** was also cited, particularly when applied geoscience is given a lower status in the academic reward structure.

Many respondents agreed that it would be easier to modify course plans if there were more **teaching resources that address the public good**, which brings us back to their primary concern: the need for more support.

SUMMARY AND CONCLUSIONS

There is an urgent need to diversify and strengthen university geoscience departments by reimagining undergraduate geoscience education to meet the needs of today's students and of society. As reflected in the responses above and the Mosher and Keane (2021) report, key barriers include resistance to change, lack of time, and the need for additional resources. Another challenge is the low visibility of geoscience both in K-12 education and among the public, emphasizing the importance of actively promoting the value of geoscience as a viable and societally relevant career path. Ongoing professional development and opportunities to share concerns and exchange resources will help to catalyze change. The annual Earth Educators' Rendezvous provides an ideal forum for open dialog around the future of geoscience education, and we hope you will join us for a three-day "Applied Geoscience Education: Engaging with Society for Sustainability" workshop at the 2023 Rendezvous.

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