

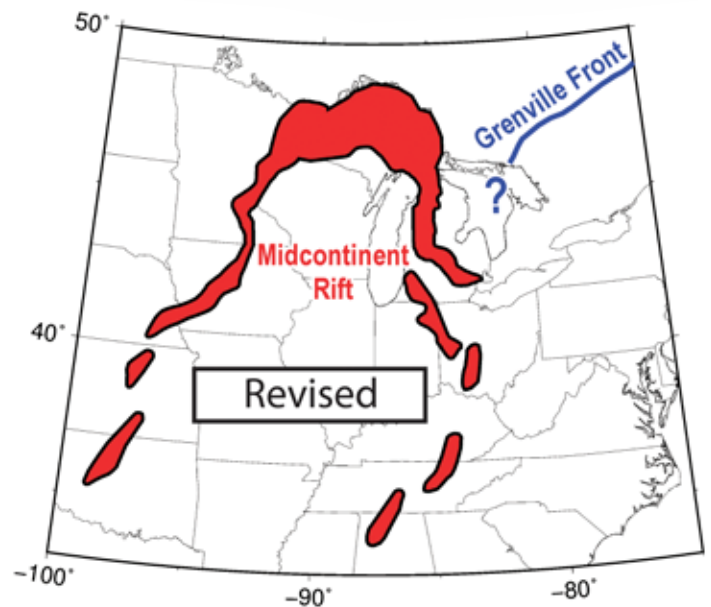


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Is the “Grenville Front” in the central United States really the Midcontinent Rift?





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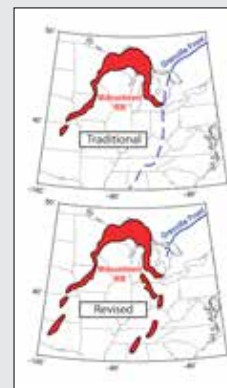


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Carol A. Stein et al.

Cover: (Top) Traditional geometry for the relationship between the Midcontinent Rift and Grenville Front. The Grenville Front truncates the east arm of the Midcontinent Rift and extends southward along a set of subsurface features indicated by gravity and magnetic anomalies. (Bottom) Revised geometry proposed in this issue by Stein et al. (2018). The previously assumed Grenville Front in the central U.S. is in fact the southward continuation of the Midcontinent Rift. See related article, p. 4–10.



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Is the “Grenville Front” in the central United States really the Midcontinent Rift?

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ABSTRACT

Two prominent Precambrian geologic features of central North America are the Midcontinent Rift (MCR) and Grenville Front (GF). The MCR, an extensive band of buried igneous and sedimentary rocks outcropping near Lake Superior, records a major rifting event at ca. 1.1 Ga that failed to split North America. In SE Canada, the GF is the continent-ward extent of deformation of the fold-and-thrust belt from the Grenville orogeny, the sequence of events from ca. 1.3–0.98 Ga culminating in the assembly of the supercontinent of Rodinia. In the central U.S., lineated gravity anomalies extending southward along the trend of the front in Canada have been interpreted as a buried Grenville Front. However, we use recent tectonic concepts and data analyses to argue that these anomalies delineate the eastern arm of the MCR extending from Michigan to Alabama, for multiple reasons: (1) These anomalies are similar to those along the remainder of the MCR and quite different from those across the front in Canada; (2) the Precambrian deformation observed on seismic reflection profiles across the presumed “front” appears quite different from that across the front in Canada, cannot confidently be assigned to the Grenville orogeny, and is recorded at least 100 km west of the “front”; and (3) during the Grenville orogeny, deformational events from Texas to Canada were not caused by the same plate interactions and were not necessarily synchronous. Hence the commonly inferred position of the “Grenville Front” in the central U.S. is part of the MCR, and should not be mapped as a separate entity.

INTRODUCTION

Two prominent Precambrian geologic features of central North America (Figs. 1

and 2) record different aspects of the Wilson cycle. One, the Midcontinent Rift (MCR), is a U-shaped band of buried igneous and sedimentary rocks that outcrops near Lake Superior. To the south, it is buried by younger sediments, but easily traced because the igneous rocks are dense and highly magnetized (Hinze et al., 1992; Merino et al., 2013). The western arm extends at least to Oklahoma, and perhaps Texas and New Mexico, as evidenced by similar-age diffuse volcanism (Adams and Keller, 1994, 1996; Bright et al., 2014). The eastern arm extends southward through lower Michigan to Alabama (Lyons, 1970; Keller et al., 1982; Dickas et al., 1992; Stein et al., 2014). Although the MCR was often viewed as two arms of a three-arm

rifting event in a plate interior, it now appears more likely that it formed as part of the rifting of the Amazonia craton (now in northeastern South America) from Laurentia, the Precambrian core of North America (Stein et al., 2014, 2016). Hence the east and west arms were analogous to the east and west branches of the East African rift, the broad zone forming one arm of the Nubia (west Africa)–Somalia (east Africa)–Arabia three-plate system.

A second major feature, east of the MCR, is the Grenville Front (GF), also known as the Grenville Front Tectonic Zone. The front is the continent-ward boundary of deformation of the fold-and-thrust belt from the Grenville orogeny, the sequence of orogenic events from

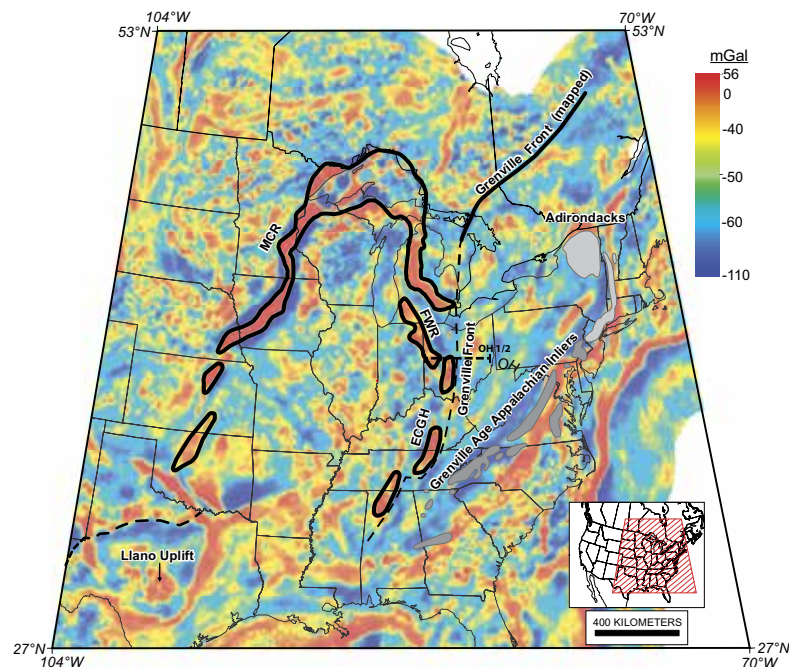


Figure 1. Gravity map showing Midcontinent Rift (MCR), Fort Wayne Rift (FWR), and East Continent Gravity High (ECGH). Grenville-age Appalachian inliers with Laurentia and Amazonia affinities are shown as light and dark gray regions. Grenville Front shown by solid line where observed and dashed line where inferred. OH 1/2 indicates location of COCORP seismic profile (Stein et al., 2014).

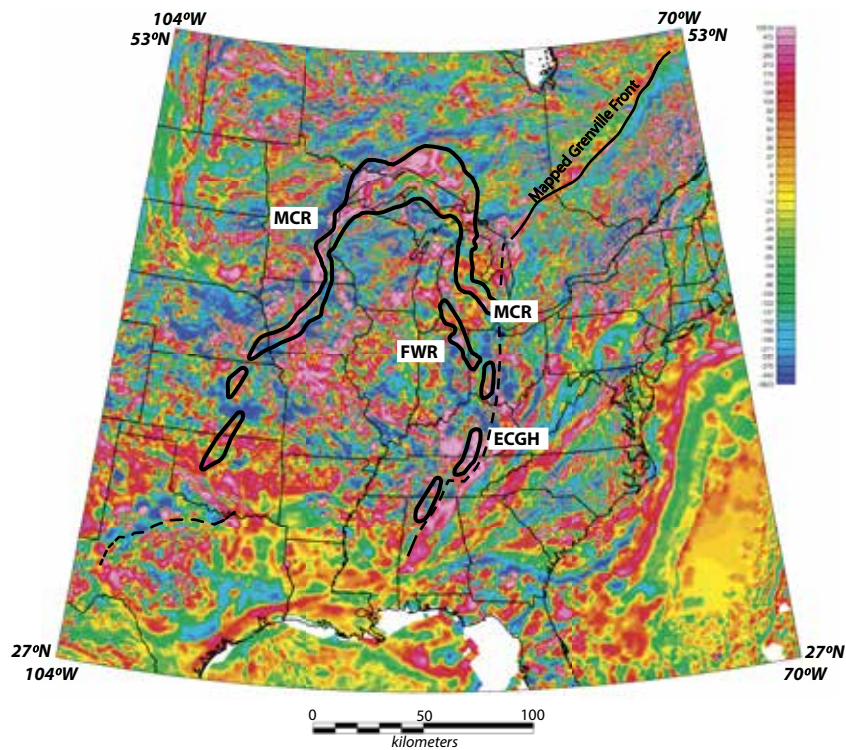


Figure 2. Magnetic anomaly map of the region. Outlines of Midcontinent Rift (MCR), Fort Wayne Rift (FWR), and East Continent Gravity High (ECGH) are from gravity data (Fig. 1). Data source <https://pubs.usgs.gov/of/2002/ofr-02-414/> (Bankey et al., 2002).

ca. 1.3–0.98 Ga culminating in the assembly of the supercontinent of Rodinia (Li et al., 2008) (Fig. 3). Studies in SE Canada, where Grenville rocks are exposed, find that the orogeny involved discrete contractional phases, notably the Shawinigan from ca. 1200–1140 Ma, Ottawan from ca. 1090–1030 Ma, and Rigolet from ca. 1010–980 Ma (Rivers, 2012; McLelland et al., 2013) (Fig. 4A). In SE Canada, erosion has exposed deformed rocks from these orogenic events, from ~54°N to Lake Ontario.

The orogeny’s phases presumably reflect a series of continental blocks and arcs colliding with and accreting to Laurentia at various locations along its eastern margin. However, the specifics of the plate interactions remain unresolved because the limited paleomagnetic data allow a range of scenarios. In one (Fig. 4B), Amazonia collided with Texas and then moved northward by strike-slip motion relative to Laurentia from ca. 1.18–1.12 Ga (Tohver et al., 2002, 2006). It then rifted from Laurentia, leaving the MCR as a failed third arm, with extension ending ca. 1.096 Ga (Stein et al., 2014, 2015). Amazonia is thought to have recollided with Laurentia somewhat later, causing the Ottawan phase in Canada (McLelland et al., 2013). The southern extent of this collision varies between reconstructions (Li et al., 2008, 2013; Cawood and Pisarevsky, 2017; Merdith et al., 2017).

Even greater uncertainties arise in inferring what occurred during the Grenville orogeny in the U.S. Although the front does not outcrop in the U.S., it has been assumed to extend southward into the U.S. on geological and geophysical grounds. McLaughlin (1954) proposed that it continued through Michigan and Indiana to the New Madrid seismic zone because he considered features such as the Cincinnati Dome to be Grenvillian, which are now considered to be much younger. Bass (1960) suggested that the GF was located to the east, in western Ohio, because data from deep drill holes indicated high-grade metamorphic rocks to the east and unmetamorphosed igneous and sedimentary rocks to the west.

Geophysical data provide the other argument for southward extension of the Grenville Front. In Canada the front is associated with weak gravity and magnetic anomalies (Figs. 1 and 2). Zietz et al. (1966) noted that the proposed front in Ohio coincided with the eastern edge of

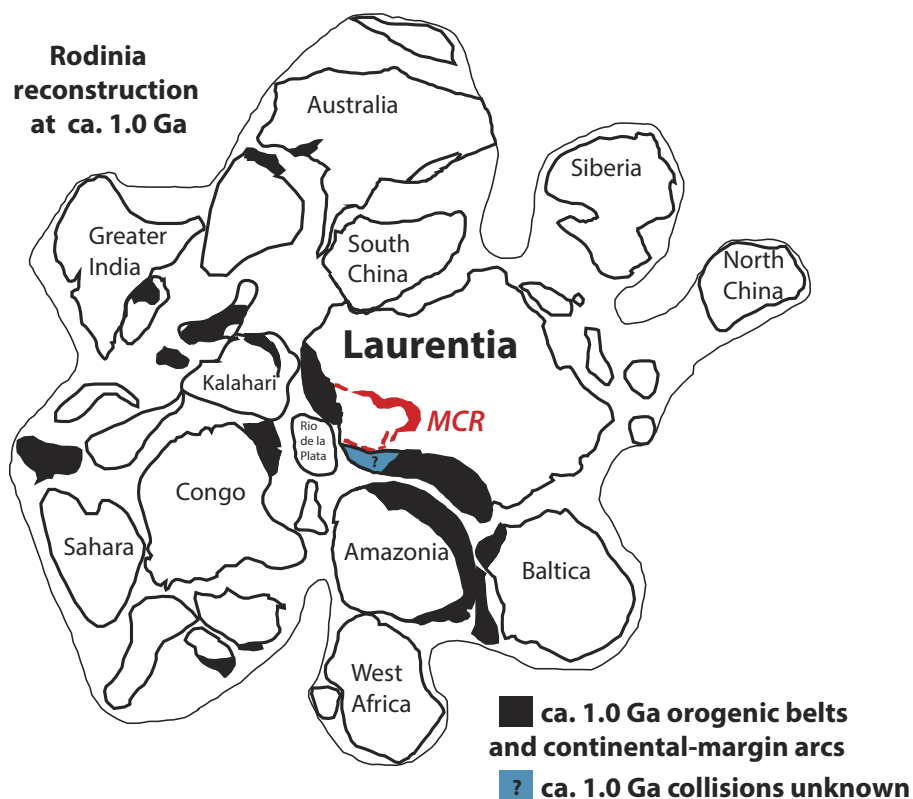


Figure 3. Rodinia reconstruction showing major blocks. After Li et al. (2008). MCR—Midcontinent Rift.

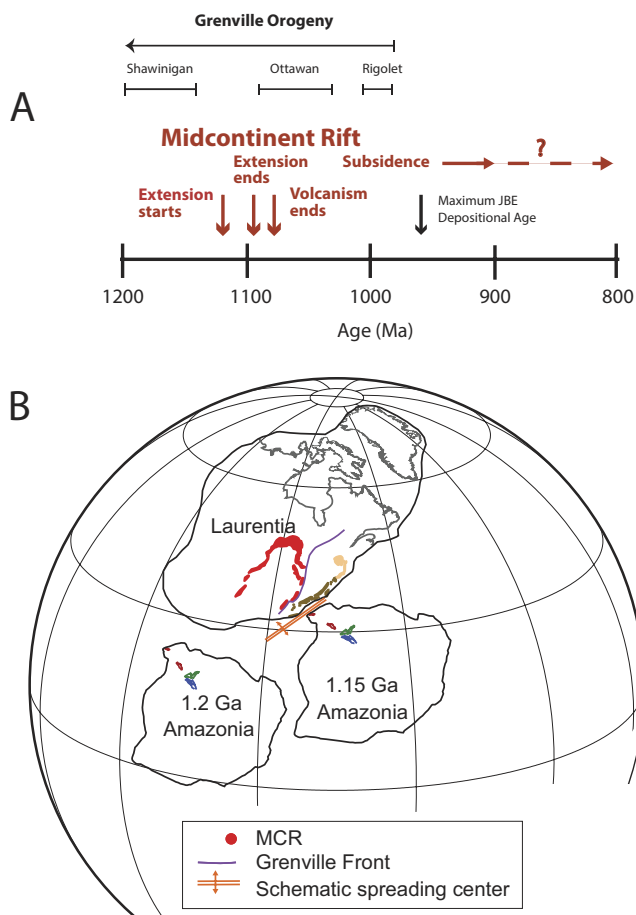


Figure 4. (A) Timeline for evolution of the Midcontinent Rift (MCR) and major phases of the Grenville Orogeny (Malone et al., 2016). **(B)** Reconstruction of plate positions before Laurentia-A Amazonia separation, schematic spreading center geometry, and relevant features (Stein et al., 2014). JBE—Jacobsville Sandstone, Bayfield Group, and other equivalent sandstones.

magnetic and gravity anomalies. Subsequent studies inferred that the GF extended along the East Continent Gravity High (ECGH) through Kentucky and Tennessee to southwest Alabama (Fig. 1). As a result, the GF is often drawn accordingly, although its position varies (e.g., Whitmeyer and Karlstrom, 2007; Baranoski et al., 2009; Bartholomew and Hatcher, 2010; Stein et al., 2014). The absence of the GF between Alabama and the Grenville-age Llano uplift zone in Texas has been attributed to the front's being rifted away from Laurentia during the latest Precambrian/Cambrian rifting event (Thomas et al., 2012).

REEVALUATING THE “GRENVILLE FRONT” IN THE U.S.

In this paper we argue that the inferred “Grenville Front” in the central U.S. is part of the MCR, rather than the western edge of deformation from the Grenville orogeny. This interpretation is based on several aspects:

1. Gravity anomalies in the “front” are similar to those along the remainder of the MCR and quite different from those across the front in Canada;
2. Although seismic reflection data near the presumed “front” show faults and possibly suture zones, this deformation

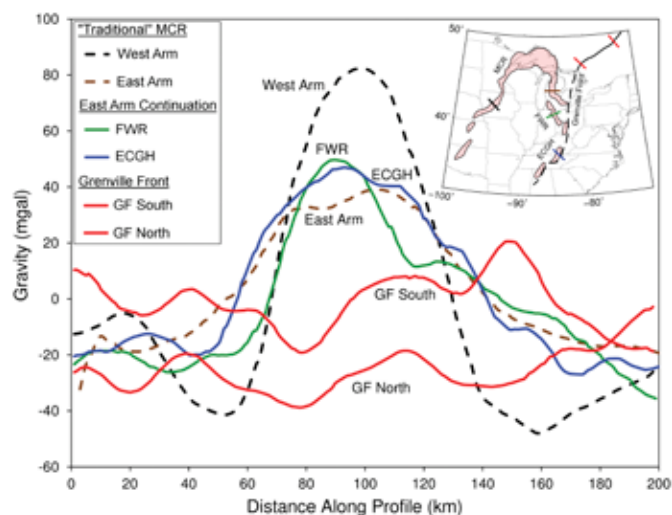


Figure 5. Gravity profiles across Midcontinent Rift (MCR), Fort Wayne Rift (FWR), East Continent Gravity High (ECGH), and Grenville Front (GF) in Canada at locations shown. The gravity highs along the FWR and ECGH seem to be the continuation of the east arm because they are similar in dimensions and magnitude to those elsewhere along the MCR in showing a distinct central high. No similar high occurs across the Grenville Front.

appears quite different from the SE-dipping layered structures at the front in Canada, and need not be Grenville age; and

3. The Grenville-age events in the Llano uplift area of Texas and much of the eastern U.S. differ, involved different continental fragments, and may have occurred at different times from those in Canada.

THE “FRONT,” THE EAST ARM OF THE MCR, AND WELL DATA

The often-assumed southward continuation of the “front” in the U.S. is based on gravity and—to a lesser extent—magnetic lineaments. Hence a key question is whether the gravity anomalies along the Fort Wayne Rift and ECGH are associated with the GF or the east arm of the MCR. If they reflect the front, then its assumed location near southeast Michigan implies that the east arm of the MCR ends there (Cannon et al., 1989). However, the gravity highs along the Fort Wayne Rift and ECGH seem to be the continuation of the east arm (Lyons, 1970; Keller et al., 1982; Dickas et al., 1992; Stein et al., 2014), because they are similar in dimensions and magnitude to those elsewhere along the MCR (Figs. 1 and 5) in showing a distinct central high. No similar high occurs across the GF in Canada.

The GF exposed in Canada is severely eroded and represents a deep level of the basal shear zone, not the deformation front observed in modern orogens. The actual deformation front of the Grenville orogen must have been at least several tens of kilometers northwest of the front. As discussed, the gravity highs in the U.S. reflect the MCR's east arm, so it is unlikely that the GF lay immediately to their east. Shallow-level thrusting of Grenville age would have directly impinged on the recently formed MCR. This seems unlikely given that the gravity data imply that the structure of the MCR's east arm is similar to that of the west arm, far from any possible GF.

Crustal thickness along the ECGH and FWR is similar to that beneath the MCR. Teleseismic P-wave studies in Tennessee (Owens et al., 1984) show thick crust similar to that beneath the MCR's west arm (Moidaki et al., 2013; Zhang et al., 2016) and Lake Superior (Green et al., 1989). In southern Ohio, seismic reflection and drilling data support a half-graben structure similar to other parts of the MCR (Dickas et al., 1992). Gravity studies also suggest a thick crust (Keller et al., 1982; Mayhew et al., 1982; Buening, 2013), similar to that on the MCR's west arm (Merino et al., 2013; Levandowski et al., 2015).

Moreover, new interpretation of the data from wells in Ohio used initially to define the "front" (Bass, 1960) indicates that the geophysical lineament defining the "front" is not a Grenville-age tectonic front but rather part of the MCR, with pre-Grenville Laurentia to the east (Pettersson et al., 2015). In Ohio and Kentucky, many of the wells bottom in mafic rocks (Drahovzal et al., 1992; Buening, 2013) similar to MCR rocks exposed near Lake Superior and in the buried west arm (Walker and Misra, 1992; Lidiak, 1996).

DID DEFORMATION NEAR THE "FRONT" OCCUR DURING THE GRENVILLE OROGENY?

In SE Canada, seismic reflection profiles show parallel southeast-dipping reflectors extending at least 100 km south-eastward from the surface trace of the front (Rivers et al., 2012) to at least 20 km depth. However, reflection data across the presumed "front" in the central U.S. look quite different.

Much of the Precambrian tectonic history of Ohio and the "front" is based on the COCORP OH-1 and 2 lines (Fig. 1). Several subsurface features had been interpreted as part of the deformation. In this interpretation, the area to its west was part of the ca. 1.5–1.4 Ga Granite-Rhyolite Province of Laurentia, whereas rocks to the east were similar to provinces of Canada's exposed Grenville orogen (Culotta et al., 1990). However, recent gravity modeling (Buening, 2013) and analysis of rocks from wells (Pettersson et al., 2015) suggest that the Granite-Rhyolite Province continues ~100–150 km eastward beyond the "front," indicating that this area is not a terrane added during the Grenville Orogeny.

The seismic lines crossing the "front" lack the layered structure seen in Canada, implying a different history. Although they have been interpreted as suggesting Precambrian compression similar to that in Canada, it is unclear whether the compression is of Grenville age. In Canada, Grenville-age metamorphism and shearing of the front are superimposed on rocks recording older events of west-directed thrusting (Bethune, 1997; Rivers et al., 2012). Baranoski et al. (2009) interpreted data at the western end of OH-1 as showing rift development followed by thrust faulting at least ~100 km west of the front.

The inferred age of compressional faulting depends on the age of the faulted Precambrian sedimentary rocks. By default, it has been assumed that the compression must be Grenville in age, so the faulted sediment must be older than 980 Ma (e.g., Drahovzal, 1997). The Proterozoic sandstone Middle Run Formation, observed only in wells, is thought to have similar age to the Jacobsville Sandstone and Bayfield Formation around Lake Superior. The Jacobsville and Middle Run have some similar distributions of Grenville-age zircons. However, detrital zircon dating shows that the Jacobsville must be younger than 959 ± 19 Ma and is probably several hundred million years younger (Malone et al., 2016). Schneider Santos et al.'s (2002) zircon analysis for the Middle Run finds a maximum age of 1048 ± 22 Ma, but they also argue that it must be significantly younger than the Grenville orogeny. If the Jacobsville and Middle Run are about the same age, much of the Middle Run faulting must be younger than Grenville age. These ages show that the "front" in Ohio is not the western edge of the Grenville fold-and-thrust belt and that the deformation near it may be younger, probably reflecting the same post-Jacobsville event that inverted the MCR near Lake Superior (Stein et al., 2015).

GRENVILLE-AGE APPALACHIAN INLIERS AND LLANO UPLIFT COMPARED TO CANADA

The argument for a "Grenville Front" in the U.S. assumes that the entire U.S. East Coast was affected by collisions in the Grenville orogeny. Grenville-age events are recorded in Canada and the northeastern U.S. and in exposures in the Llano

uplift zone in Texas. It has thus been assumed that similar events occurred between these two areas in the eastern U.S. However, the deformational events in Texas and Canada/NE U.S. were not caused by the same plate collisions and were not necessarily synchronous. Moreover, in the central U.S., although some Grenville-age deformation may have occurred, there is no clear evidence of collisions or of a coherent deformation front, much the less where one has been assumed to be.

Although no Grenville-age fold-and-thrust belt is exposed in the central U.S., Grenville-age features proposed to reflect localized deformation are observed (Ruiz et al., 1984; Bornhorst et al., 1988; Pettersson et al., 2015). Most crucially, the Appalachian Mountains in the U.S. contain blocks called Grenville-age Appalachian inliers (GAAI) (Fig. 1). These fragments were assumed to be part of Laurentia during the Grenville orogeny that were later uplifted and exposed at the surface during Paleozoic orogenies (McLelland et al., 2013). These rocks' ages are usually assigned to phases in the Grenville orogeny (Fig. 4A).

The Llano rocks record compressional events overlapping in time with ones in Canada. However, different plate interactions were involved (Dalziel et al., 2000; Davis and Mosher, 2015). The fact that Grenville-age deformational events were not continuous along Laurentia's eastern and south margin raises the questions of when the GAAI accreted to Laurentia and whether they record the same events as in Canada.

It seems likely that different tectonic events occurred at different times along the Laurentia margin. Petrologic analyses suggest that GAAI south of about the New Jersey/Pennsylvania border have Amazonian affinity (Fisher et al., 2010; McLelland et al., 2013), implying that they were not part of Laurentia before the Grenville orogeny. In reconstructions of Rodinia (Fig. 3), Amazonia's southern extent along Laurentia is often near a transition in petrology from northern GAAI with Laurentian affinities to southern ones with Amazonian affinities. Hence, given the Grenville's complex history and Amazonia's motion, the history of collisional events in Canada probably does not describe the history of the southern GAAI, especially before the Ottawan phase.

It is worth recognizing the uncertainty in when and how the southern GAAI were sutured to Laurentia. In one interpretation, they were left behind during the 1.1 Ga breakup between Laurentia and Amazonia. Thus, they experienced the two last phases of the Grenville orogeny (Ottawan and Rigolet), assuming collisions in the eastern U.S. were the same as in Canada. Alternatively, they may have collided with Laurentia during the last ~100 m.y. of the Grenville orogeny, but were not on the block that caused deformation in Canada. Another possibility is that the southern GAAI accreted during Rodinia's breakup. As observed elsewhere, continental fragments can rift off before major breakup (Veevers, 2004). Some GAAI show evidence of rifting and volcanic events starting ca. 760 Ma (McClellan and Gazel, 2014), so if these events are related to others in Laurentia, the southern GAAI accreted to Laurentia before this time. In summary, during the Grenville orogeny the southern GAAI need not have been part of North America. Thus, they cannot with confidence be used to support deformation of the eastern U.S. during the Grenville orogeny (ending ca. 980 Ma).

Grenville deformation south of Amazonia may have involved the Rio de la Plata craton (Fig. 3). Some reconstructions place this block along the southern part of Laurentia's eastern margin during the Grenville orogeny, but there is much uncertainty about its position owing to the limited paleomagnetic data (Li et al., 2008; Teixeira et al., 2013; Rapalini et al., 2015). Gaucher et al. (2011) argue that detrital zircon distributions of late Neoproterozoic sandstones show that the Rio de la Plata craton was in contact with Laurentia and Amazonia ca. 1 Ga. However, much geographic uncertainty remains, and little is known about the river system distributing these sediments.

DISCUSSION

It seems implausible that the traditionally mapped "Grenville Front" in the central U.S. is the western edge of a Grenville-age fold-and-thrust belt. Recent reinterpretation of well data indicates that this crust was attached to Laurentia before the Grenville orogeny began. Precambrian faulting occurs substantially west of the "front" and may not be of Grenville age. Although some Grenville-age deformation may have occurred in the central U.S.,

there is no evidence of a coherent front anywhere, much the less where one has been assumed to be. The situation may have been analogous to the isolated pockets of deformation identified in the Midwestern U.S. far inland from the Paleozoic deformation fronts (Marshak et al., 2000; Craddock et al., 2017).

Discarding the "front" makes sense given recent insights into the evolution of the Midcontinent Rift. The "front's" assumed location near southeast Michigan implies that the east arm of the MCR ended there (Cannon et al., 1989) so rift volcanism and extension did not continue to the east and south. If so, the rift would have been an isolated intraplate event, rather than part of a plate boundary reorganization as implied by paleomagnetic data and similar to those observed today in East Africa and in the geological record elsewhere (Stein et al., 2014).

More precise dating of MCR rocks near Lake Superior than available when the "front" was proposed (McLaughlin, 1954; Bass, 1960) shows that the rift-filling igneous rocks formed ca. 1109–1085 Ma, although rifting started perhaps ~10 m.y. earlier. Seismic reflection data suggest that the extension ended ca. 1096 Ma, ~10 m.y. before basaltic volcanism stopped (Stein et al., 2015). Even if compression occurred near the "front" during the Grenville orogeny, this deformation would be younger than the MCR's extension. Hence the "front" would not have been there and thus not prevented the rift's east arm continuing southward.

This timing is consistent with what is known about the initiation of the front in Canada and analogous fronts elsewhere. In a continental collision, deformation starts near the contact and then generally becomes progressively younger toward the interior final front site. Bethune (1997) dates the oldest known GF deformation in Canada at ca. 1035 Ma. Slightly to the east, Rivers (2012) dates the oldest deformation as Ottawan, whereas most metamorphic ages near the front in Canada are from the younger Rigolet phase (Rivers et al., 2012).

The "Grenville Front" issue illustrates the complexity of orogenic belts in space (~5000 km) and time (~300 m.y.). It seems likely that deformational phases varied along Laurentia's south and east margins. While matching long and fragmented orogenic zones allows reconstructions of the past configurations of continents, orogenic

belts with the same age need not be from the same event. A billion years from now, parts of the Andes and Cascadia volcanic arcs might look similar, and the Alpine and Himalayan collisions might appear to have been adjacent.

SUMMARY

New data and insights show that the linear gravity anomalies used to infer the position of the GF in the central U.S. are part of the MCR, and should not be mapped as a separate entity. There is little evidence that this lineation is associated with the western edge of a Grenville fold-and-thrust belt, and good reason to expect that Grenville deformation in the central U.S. would differ from that observed in Canada. It is time to erase the "Grenville Front" lineament in the central U.S. from maps.

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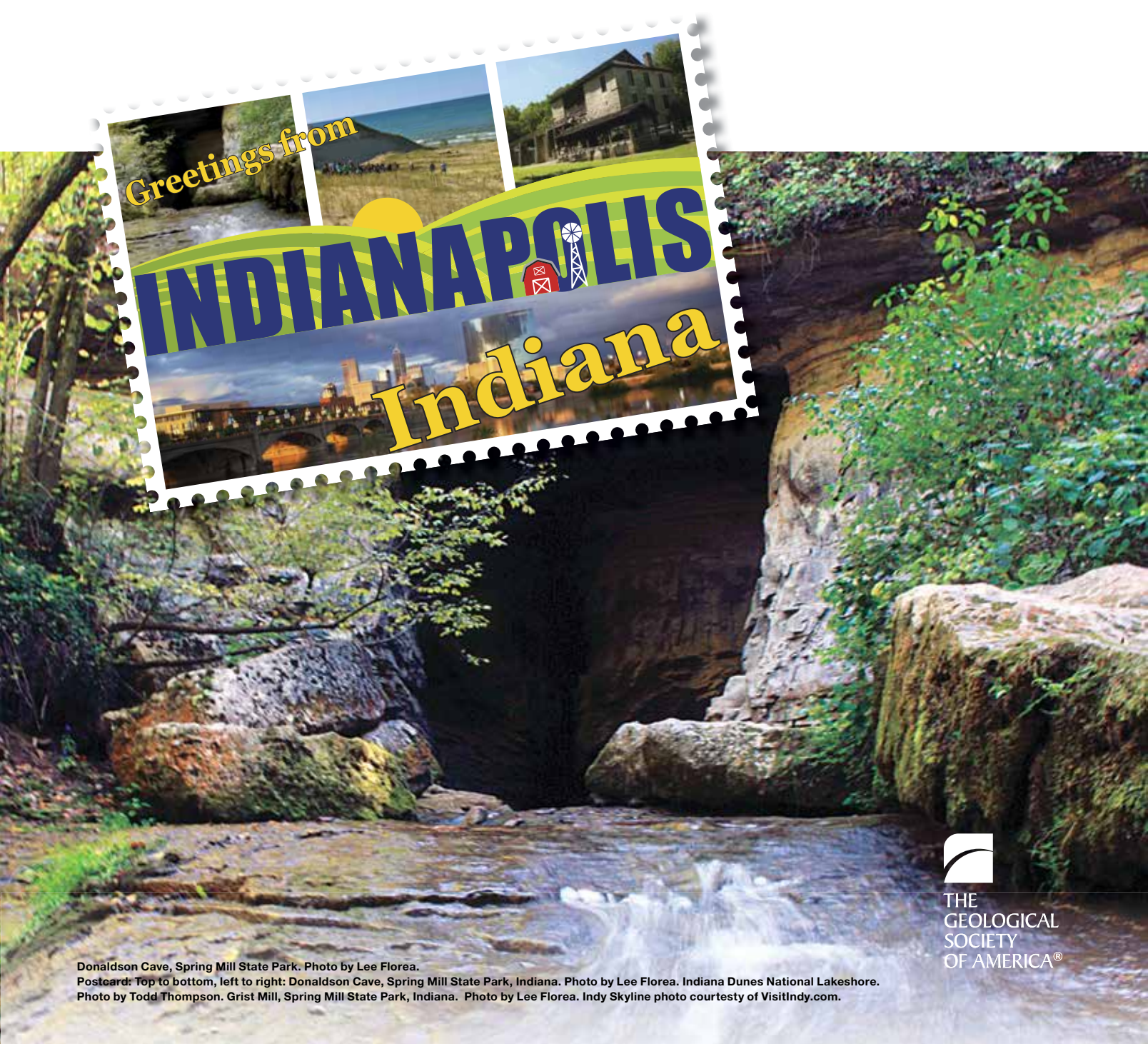
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You're Invited to Savor Some Hoosier Hospitality!

The 2018 GSA Annual Meeting & Exposition is returning to the Midwest in Indianapolis after a superb meeting in the Pacific Northwest in Seattle. Indianapolis provides a great location to host a geoscience meeting with a vibrant downtown and an outstanding convention center. The vast majority of the hotels are within easy walking distance to the Indiana Convention Center, with most connected to the center via skywalks. Additionally, the Indiana State Museum, the Eiteljorg Museum, and Children's Museum of Indianapolis are nearby, as are many excellent cafés, bistros, and restaurants. An added bonus on Saturday is the Indianapolis Monumental Marathon (also half-marathon and 5K), so if you are a runner this is an additional opportunity to enjoy the city.

The scientific meeting will be highlighted by 184 Technical Sessions and four Pardee Keynote Symposia and a comprehensive list of discipline sessions. The Technical Program Committee, GSA staff, and Division and Associated Society representatives have put together a program that will be of interest to everybody. The Technical Sessions highlight all aspects of earth sciences from geoarchaeology to volcanology with a touch of Midwest and Hoosier flair, with numerous sessions on paleontology, geomorphology, karst, hydrogeology, and sedimentology. The highlight of the meeting will be the Pardee Keynote Symposia on a variety of impressive topics:

- (1) Earth as a Big Data puzzle, which will have a similar format as the Speed Dating Pardee Symposium in Seattle with lightning talks and then booths demonstrating the various techniques in advancing data information;
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- (4) Human evolution and environmental history of Africa: 25 years of transformative research.

In addition, there will be lunchtime speakers on a variety of topics in the Feed Your Brain, Presidential Address, and Halbouty Lecture series.

Of course the GSA Annual Meeting is not all about the scientific sessions. There will be 26 one- to three-day field trips highlighting the geology of Indiana and the surrounding regions, including the investigation of sedimentary sequences, geomorphology, industrial minerals, karst systems, environmental aspects, and geologic history of the region. There will also be one- and two-day short courses on a variety of topics, including geoscience education, geochemistry, structural geology, energy, and geophysics. So, this year make a trip to Indianapolis to enjoy the Hoosier hospitality and discover the latest geoscience news. We look forward to seeing you in Indianapolis.

Kevin Mickus
2018 Technical Program Chair



Kevin Mickus

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Amy Brock-Hon

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TWO-ABSTRACTS RULE

- You may submit two volunteered abstracts, *as long as one of the abstracts is for a poster presentation*;
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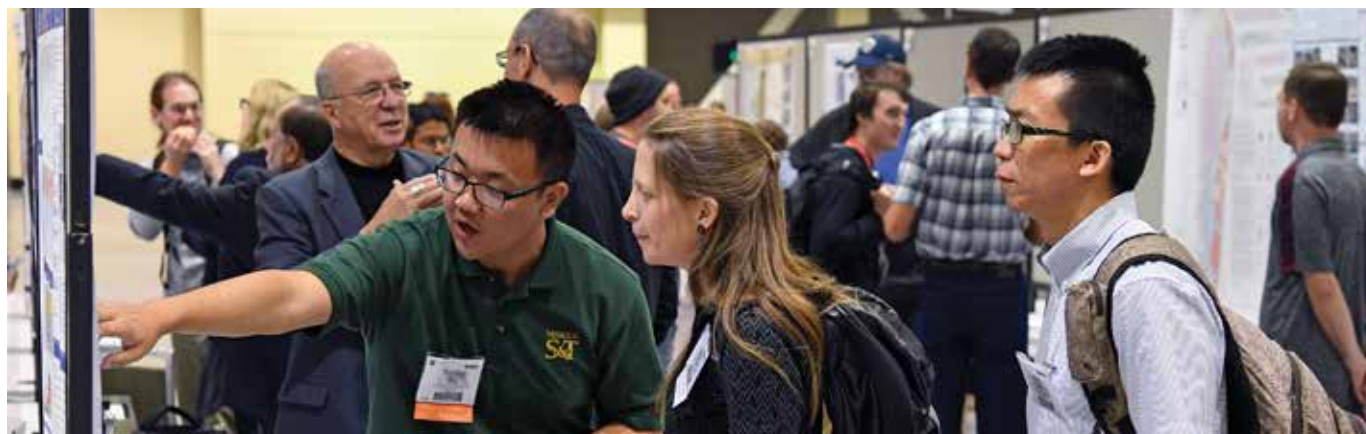
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ABSTRACTS PUBLICATION AND MEETING PRESENTATION

Working together as a community of geoscientists, we will continue to advance the finest science in a respectable, professional manner. Authors will display integrity in disseminating their research. Presentations will adhere to the content and conclusions of abstracts, as submitted and reviewed. Listed co-authors will have made a bona fide contribution to the project. Conversely, the presenter should remain gracious by offering collaborators the opportunity for recognition as a co-author. All co-authors must be aware of their inclusion and have accepted that recognition. Presenters must be diligent in preparing a polished product that conveys high-quality scholarship. Submission of an abstract implies a sincere intent to attend the meeting.

DISCIPLINE CATEGORIES

Can't find a topical session that fits your abstract?
No problem! In addition to topical sessions, we offer discipline categories (see p. 43–44). Discipline sessions are equally vital to our technical program and are an essential addition to the fulfillment of the overall meeting. Encourage your friends to submit a discipline abstract too.



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Pardee Keynote Symposia



Joseph Thomas Pardee (1871–1960)

Pardee Keynote Symposia are named in honor of GSA Fellow and benefactor Joseph Thomas Pardee (1871–1960) via a bequest from Mary Pardee Kelly. Pardee is perhaps best known for his work on Glacial Lake Missoula. These symposia consist of invited presentations covering a broad range of topics.

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

Cosponsor: *GSA Geoinformatics Division*

Disciplines: Geoinformatics, Geoscience Information/Communication, Geoscience Education

Advocates: Anders Noren; Leslie Hsu

What new discoveries would you make if you could easily access any geoscience data and vastly reduce time spent on data manipulations? This grand vision requires a diverse range of steps to build the software, practices, linkages, culture, and other resources that together form the ecosystem for data-driven geoscience. This session will be a forum for conversation on active projects addressing community data priorities. Learn about new tools, meet researchers and developers, forge new collaborations, and look toward the information frontier in geoscience.

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

Cosponsors: *GSA Geology and Society Division; GSA Geology and Public Policy Committee; Association for Women Geoscientists; Earth Science Women's Network*

Disciplines: Geoscience and Public Policy, Geoscience Education

Advocates: Susan Stover; Kelly Kryc

Efforts are underway to change conditions that have left women in the geosciences underrepresented, with disproportionately less advancement than male colleagues. Recognize barriers and get tools that can be implemented by individuals and institutions. Talks include the challenges of multiple barriers, actions GSA is taking, and programs shown to be effective in enacting change. Interactive exercises provide scenarios of implicit bias and

bystander intervention. Discuss work/life issues, negotiations, and confronting barriers. Dr. Jane Willenbring, Scripps Institute of Oceanography, provides "*Advice from a Woman Geopioneer.*" She broke open the discussion of harassment in the geosciences and brings a story of perseverance.

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

Cosponsors: *GSA Structural Geology and Tectonics Division; GSA History and Philosophy of Geology Division; GSA Geophysics and Geodynamics Division; American Geophysical Union*

Disciplines: Tectonics/Tectonophysics, History and Philosophy of Geology, Geophysics/Geodynamics

Advocates: Yildirim Dilek; Eldridge M. Moores

This Keynote Symposium marks the 50th anniversary of three landmark papers on the plate tectonics theory, published independently by J. Morgan, D. McKenzie, and X. Le Pichon in 1968, and is aimed at discussing the nature and significance of scientific developments in the earth sciences within the framework of the plate tectonics paradigm since then. It will also provide an interdisciplinary forum to examine the future directions of research and discovery in plate tectonics.

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

Cosponsors: *GSA Limnogeology Division; GSA Archaeological Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; GSA Continental Scientific Drilling Interdisciplinary Interest Group; EarthRates*

Disciplines: Limnogeology, Sediments, Clastic, Paleoclimatology/Paleoceanography

Advocates: Andrew S. Cohen; Gail M. Ashley

This session will highlight exciting new advances in our understanding of the connection between human evolution and environmental change, drawing from studies of key paleoanthropological sites, drill core investigations, and associated modeling experiments.

Topical Sessions

KARST

T1. Karst Hazards and Monitoring

Cosponsors: *GSA Karst Division; GSA Geophysics and Geodynamics Division*

Discipline: Karst

Advocates: Andrew J. Luhmann; Jonathan B. Sumrall; Jason Polk

Abstracts should be focused on hazards monitoring approaches found in karst landscapes. Topics include technical applications (e.g., LiDAR, 3D scanning, geodatabase development) and management implications (resource management, education, policy and regulation in karst areas).

T2. Cave and Karst Research in Indiana and Kentucky: A Tribute to Art Palmer, Peg Palmer, and Dick Powell

Cosponsors: *GSA Karst Division; GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division; National Cave and Karst Research Institute; Indiana Geological and Water Survey*

Disciplines: Karst, Hydrogeology, Geomorphology

Advocates: Lee J. Florea; Patricia N. Kambesis

This session seeks presentations and conversations from those whose lives and careers have been touched by friendships and collaborations with Art Palmer, Peg Palmer, and Dick Powell.

T3. Karst Hydrology and Hydrogeology

Cosponsors: *GSA Karst Division; GSA Geophysics and Geodynamics Division; GSA Hydrogeology Division*

Discipline: Karst

Advocates: Andrew J. Luhmann; Jonathan B. Sumrall; Jason Polk

This session calls for abstracts themed around the fundamental aspects of fluid-rock interactions within karst landscapes, including geologic, hydrogeologic, and hydrologic investigations. Topics include dye tracing, aquifer processes, surface-subsurface hydrology, and quantitative modeling.

T4. Karst Ecosystems and Biogeochemistry

Cosponsor: *GSA Karst Division*

Discipline: Karst

Advocates: Andrew J. Luhmann; Jonathan B. Sumrall; Jason Polk

Abstracts are sought 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.

T5. Karst Processes and Speleology

Cosponsor: *GSA Karst Division*

Discipline: Karst

Advocates: Andrew J. Luhmann; Jonathan B. Sumrall; Jason Polk

This session seeks abstracts involving cave and karst forming processes, geomorphic evolution of karst landscapes, and cave system development, including geochemical, morphological, and cave survey studies. Carbonate weathering, diagenesis, hypogene processes, carbonate mineralogy, and structural controls influencing cave development.

T6. Critical Zone Science in Karst and Carbonate Terrains

Cosponsors: *GSA Karst Division; GSA Hydrogeology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Geobiology & Geomicrobiology Division; GSA Quaternary Geology and Geomorphology Division; National Cave and Karst Research Institute*

Disciplines: Karst, Environmental Geoscience, Hydrogeology

Advocates: Chris Groves; Matthew D. Covington; Alan Fryar; C. Zhu

To advance understanding of relevant processes, we seek contributions that integrate geochemistry, biogeochemistry, hydrogeology, geophysics, and geomorphology, as well as those that employ isotope and modeling techniques, to examine karst critical zone processes.

T7. Karst Sedimentary, Paleoclimate, and Historical Records

Cosponsor: *GSA Karst Division*

Discipline: Karst

Advocates: Andrew J. Luhmann; Jonathan B. Sumrall; Jason Polk

Abstracts are sought that include the use of cave deposits, karst environmental records, and geoarchaeological and historical investigations to reconstruct or interpret past climates, landscapes, extreme events, and land use histories in karst areas.

INDUSTRY TRACKS

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



Economic Geology



Energy



Engineering



Hydrogeology and
Environmental Geology

💧 ❖ T8. Pseudo-Karst Processes and Features

Cosponsor: *GSA Karst Division*

Discipline: Karst

Advocates: Andrew J. Luhmann; Jonathan B. Sumrall; Jason Polk

This session seeks abstracts on topics focused on the origin, development, depositional processes, biogeology, and management of landscapes and features that morphologically or in other ways resemble karst.

ENGINEERING GEOLOGY

❖ \$ T9. Cultural Geology and Heritage Stone: Use, Petrology, Quarrying, Engineering Properties, and Other Aspects of Stone Used for Buildings, Monuments, Sculpture, or Otherwise Relating to the Interface of Stone with Human Culture Past and Present

Cosponsors: *GSA Environmental & Engineering Geology Division; GSA Archaeological Geology Division; Heritage Stone Subcommittee of the International Union of Geological Sciences; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division*

Disciplines: Engineering Geology, Archaeological Geology, Economic Geology

Advocates: Joseph T. Hannibal; Carol A. Grissom

This session will include talks related to building stone and other cultural uses of stone ranging from prehistory to the present.

❖ 💧 T10. Environmental & Engineering Geology Division

Cosponsor: *GSA Environmental & Engineering Geology Division*

Disciplines: Engineering Geology, Environmental Geoscience

Advocates: Jessica E. Witt; Stephen Slaughter; Anne C. Witt

The oral session for the Environmental & Engineering Geology Division gives an opportunity to the geoscience community to present their research, data, and work pertaining to environmental and engineering geology.

💧 ❖ T11. Environmental & Engineering Geology Division Student Posters

Cosponsors: *GSA Environmental & Engineering Geology Division; Association of Environmental & Engineering Geologists*

Disciplines: Engineering Geology, Environmental Geoscience, Soils

Advocates: Jessica E. Witt; Stephen Slaughter; Anne C. Witt

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

❖ T12. Communicating Geologic Hazard and Risk: Sharing Successes, Failures, and Lessons Learned

Cosponsors: *GSA Environmental & Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division; GSA Geophysics and Geodynamics Division; GSA Karst Division*

Disciplines: Engineering Geology, Geoscience Information/Communication, Geomorphology

Advocates: Stephen Slaughter; Matthew M. Crawford; William J. Burns

This session focuses on communication of geologic hazards and risk, evacuation, dissemination of technical information, and other topics—sharing successes, failures, and lessons learned.

ENVIRONMENTAL GEOSCIENCE

💧 ⚡ ❖ T13. Global Warning: Accelerating Rates of Change Forewarn of Catastrophic Impacts

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Energy Geology Division; GSA Environmental & Engineering Geology Division; GSA Geology and Health Division; GSA Geology and Society Division; GSA Geoscience Education Division; GSA Hydrogeology Division*

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

Advocates: George T. Stone

Fossil carbon is being transferred from natural subsurface sequestration to increasing accumulations in Earth's atmosphere and hydrosphere. The impacts of this unnaturally rapid chemical redistribution are increasingly problematic, stressing most of our planet's ecosystems.

💧 \$ T14. Mining Wastes in the Tri-State Mining District of Kansas, Missouri, and Oklahoma: Advances in Characterization and Remediation

Cosponsors: *GSA Environmental & Engineering Geology Division; GSA Karst Division; GSA Hydrogeology Division; GSA Limnogeology Division*

Disciplines: Environmental Geoscience, Geochemistry, Hydrogeology

Advocate: Melida Gutierrez

We are looking for papers about contamination characterization (e.g., volume of contaminated soils, toxicity), soil chemistry, remediation options, measuring effectiveness of remediation, contaminant (metal) transport in fractured media, etc., which applies to the Tri-State Mining District.

💧 ❖ T15. Urban Geochemistry

Cosponsors: *International Association of GeoChemistry; GSA Environmental & Engineering Geology Division; GSA Limnogeology Division; GSA International Interdisciplinary Interest Group*

Disciplines: Environmental Geoscience, Geochemistry, Geology and Health

Advocates: W. Berry Lyons; David T. Long

This session encourages presentations that qualify and quantify the geochemical and biogeochemical impacts (temporal and spatial) of urbanization and urban activities on soil, water, and air resources as well as on human and ecosystem health

💧 ⚡ T16. Advances in Agrohydrology: A Multidisciplinary Approach to Water Resources, Land Management, and Food Systems

Cosponsors: *GSA Geology and Society Division; GSA Hydrogeology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Limnogeology Division; GSA Environmental & Engineering Geology Division*

Disciplines: Environmental Geoscience, Hydrogeology, Geoscience and Public Policy

Advocates: Samuel J. Smidt; E.K. Haacker; Jillian M. Deines

Agriculture dominates global consumptive water use. Interactions between water resources and production of food, fuel, and fiber impact hydrology and food security. This session highlights research in water and food systems from multiple disciplines.

💰 ⚡ ⚡ T17. Sigma Gamma Epsilon Undergraduate Research (Posters)

Cosponsors: *Sigma Gamma Epsilon; GSA Environmental & Engineering Geology Division; GSA Limnogeology Division*

Disciplines: Environmental Geoscience, Sediments, Clastic, Structural Geology

Advocates: Diane M. Burns; James C. Walters

All Sigma Gamma Epsilon student members are invited to submit their research to this poster session to compete for awards. All geological investigations, from archaeological geology to volcanology, are encouraged to be entered.

💰 ⚡ T18. Generating Sustainable Urban Systems: A Convergence of Geology and Society

Cosponsors: *GSA Geology and Society Division; GSA Geology and Public Policy Committee; GSA Environmental & Engineering Geology Division; GSA International Interdisciplinary Interest Group*

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

Advocates: Richard Berg; Kathy Goetz Troost; Marilyn J. Suiter

Urban areas are critical convergence zones of high population density with land, air, mineral, and water resources. We will be discussing these relationships and interactions, which impact human health and infrastructure development and are central to ensuring sustainable outcomes.

GEOSCIENCE INFORMATION/COMMUNICATION

💰 ⚡ ⚡ T19. Geologic Maps and Their Derivatives (Posters)

Cosponsors: *Association of American State Geologists; GSA Geoinformatics Division; GSA Geophysics and Geodynamics Division*

Disciplines: Geoscience Information/Communication, Economic Geology, Engineering Geology

Advocates: Richard Berg; Harvey Thorleifson

This poster session will highlight new geologic maps, mapping programs, and innovations in geological mapping, including data management, Web accessibility, 3-D, and applications in water and land management.

⚡ ⚡ ⚡ T20. Rapid-Fire Research: Communicating the Connections between Geoscience and Society for the Modern Attention Span (or “In Five Minutes or Less”)

Cosponsors: *GSA Geology and Society Division; GSA Environmental & Engineering Geology Division; GSA Geology and Health Division; GSA International Interdisciplinary Interest Group*

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

Advocate: Erin E. Barry

This “lightning” session, composed of 5-minute talks followed by Q&A, encourages researchers and students from any branch of geoscience to speak on their work with a special focus on its relevance to society.

⚡ ⚡ T21. Geology and Hydrology of Your Public Lands: Understanding and Managing America’s Geologic Heritage, Active Processes, Geohazards, Energy Development, and Mineral Resources

Cosponsors: *National Park Service; U.S. Forest Service; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division; GSA Hydrogeology Division; GSA Energy Geology Division; GSA Geophysics and Geodynamics Division*

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

Advocates: Jason P. Kenworthy; Johanna Kovarik; F. Edwin Harvey

This is an interdisciplinary forum for earth scientists, land managers, and educators to present their work and describe its relevance to the public and land managers, particularly as it relates to decision making.

T22. Changing Information Needs in the Geosciences

Cosponsors: *Geoscience Information Society; GSA Geoinformatics Division*

Disciplines: Geoscience Information/Communication, Geoinformatics, Geoscience Education

Advocates: Cynthia L. Prosser; Chris A. Badurek

This session addresses the constantly changing information needs of researchers in the geosciences.

💰💧🔗 T23. Current Developments in Geological Mapping

Cosponsors: *Association of American State Geologists; GSA Geoinformatics Division; GSA Karst Division*

Disciplines: Geoscience Information/Communication, Hydrogeology, Economic Geology

Advocates: Richard Berg; Harvey Thorleifson

This session will highlight new mapping and innovations in geological mapping, including data management, web accessibility, 3D, and applications in water and land management.

💧 T24. Geoscience and Other STEM Internships on Public Lands: Providing Career Development Opportunities for Students and Recent Graduates

Cosponsors: *GSA Geology and Society Division; National Park Service; U.S. Forest Service*

Disciplines: Geoscience Information/Communication, Geoscience Education, Environmental Geoscience

Advocates: Lisa Norby; Johanna Kovarik; Matthew Dawson

The National Park Service Geoscientists-in-the-Parks and the GeoCorps™ America programs provide professional development and resource management opportunities on public lands for geoscience students and others pursuing careers in STEM fields. This session highlights the scientific accomplishments of these internship programs.

T25. Geoscience Information Needs in Education and Research (Posters)

Cosponsors: *Geoscience Information Society; GSA Geoinformatics Division*

Disciplines: Geoscience Information/Communication, Geoinformatics, Geoscience Education

Advocates: Chris A. Badurek; Cynthia L. Prosser

This poster session examines the information needs involved in successful teaching or research activities. Posters highlighting innovative methods of supplying geoscience information and data sources to users are welcome.

T26. Geoscience Apps on the Web and in Your Hand (Posters)

Cosponsor: *GSA Geoinformatics Division*

Disciplines: Geoscience Information/Communication, Geoscience Education, Geoinformatics

Advocate: Shane Loeffler

Mobile and web applications are increasingly being used to access and collect geoscience data. We encourage submission by the creators and users of these applications. Demonstrations are also encouraged.

ARCHAEOLOGICAL GEOLOGY

T27. The Application of Soil Science in Archaeological Research During the 21st Century

Cosponsors: *GSA Archaeological Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA International Interdisciplinary Interest Group*

Disciplines: Archaeological Geology, Geomorphology

Advocates: Rolfe Mandel; Vance T. Holliday

This session focuses on recent advancements in soil science that have shed light on what soils can reveal about archaeological landscapes and site formation processes, buried-site potential, paleoenvironments, and other aspects of the human past.

T28. Geoarchaeological Approaches to the Study of Human Dispersal in the Pleistocene

Cosponsors: *GSA Archaeological Geology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Quaternary Geology and Geomorphology Division; GSA Geophysics and Geodynamics Division; GSA Limnogeology Division; GSA International Interdisciplinary Interest Group*

Disciplines: Archaeological Geology, Soils, Geomorphology

Advocates: Justin A. Holcomb; Angela K. Gore

Geoarchaeological research is uniquely poised to contribute to archaeological narratives, such as the dispersal of *H. sapiens*. This session highlights methodological and theoretical papers seeking to contextualize human movement, migration, and mobility in the Pleistocene.

GEOMICROBIOLOGY

💧 T29. New Voices in Geobiology

Cosponsor: *GSA Geobiology & Geomicrobiology Division*

Disciplines: Geomicrobiology, Geochemistry, Paleoclimatology/Paleoceanography

Advocates: Victoria A. Petryshyn; Lydia S. Tackett; Rowan C. Martindale; Simon A.F. Darroch

The goal of this session is to bring together new research focusing on the interplay between geologic and biologic processes with a special emphasis on new field sites, novel materials/methods, and the development/refinement of proxies.

ECONOMIC GEOLOGY**\$ T30. Geology and Fluid Dynamics of Cr, Ni-Cu-PGE, and PGE Mineralized Magmatic Plumbing Systems**

Cosponsors: *GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Society of Economic Geologists*

Disciplines: Economic Geology, Petrology, Igneous, Geochemistry

Advocates: Edward M. Ripley; Chusi Li; C. Michael Lesher

This session will focus on the geology, geometry, morphology, fluid dynamics, and genesis of mineralized magmatic plumbing systems, with special emphasis on those in the Mid-Continent Rift and Circum-Superior Belt.

ENERGY GEOLOGY**🔌 T31. Environmental Impacts Studies for Energy Resources**

Cosponsors: *GSA Energy Geology Division; GSA Environmental & Engineering Geology Division*

Disciplines: Energy Geology, Environmental Geoscience, Hydrogeology

Advocates: Marc L. Buursink; Laura S. Ruhl; Travis L. McLing; J. Fred McLaughlin

This session will explore research relating to environmental issues associated with energy geology, including exploration practices, extraction of resources, and waste disposal.

🔌💰💧 T32. Energy and Mineral Resources of the Illinois Basin

Cosponsors: *GSA Energy Geology Division; GSA Environmental & Engineering Geology Division; GSA Geology and Society Division; GSA Continental Scientific Drilling Interdisciplinary Interest Group; Society of Economic Geologists*

Disciplines: Energy Geology, Economic Geology, Environmental Geoscience

Advocates: Maria D. Mastalerz; Liliana Lefticariu; Allan Kolker

In this session we consider energy and mineral resources of the Illinois Basin in the context of current societal needs for energy, carbon sequestration, industrial minerals, and potential new resources, such as rare earth elements.

🔌💰💧 T33. Geologic Energy Research

Cosponsor: *GSA Energy Geology Division*

Disciplines: Energy Geology, Geochemistry, Environmental Geoscience

Advocates: Laura S. Ruhl; Marc L. Buursink; Travis L. McLing; J. Fred McLaughlin

This is the general session of the GSA Energy Geology Division and highlights research into geologic-based energy resources. Topics include coal geology, petroleum geology, geothermal, uranium, and the environmental impacts from energy utilization.

🔌💰🔌 T34. Unconventional Energy Resources

Cosponsor: *GSA Energy Geology Division*

Disciplines: Energy Geology, Geochemistry

Advocates: Travis L. McLing; Marc L. Buursink; Laura S. Ruhl; J. Fred McLaughlin

This session will examine unconventional oil and natural gas plays in the United States. Topics include thermal maturity, organic geochemistry, organic petrology, mineralogy, and petroleum engineering.

GEOCHEMISTRY**T36. Analytical Advances in Non-Traditional Stable Isotope Geochemistry—Innovative Applications to Earth Science Systems**

Cosponsors: *GSA Hydrogeology Division; GSA Mineralogy, Geochemistry, Petrology and Volcanology Division; GSA Geobiology & Geomicrobiology Division*

Disciplines: Geochemistry, Marine/Coastal Science, Geomicrobiology

Advocates: Amy Wolfe; Claire McLeod

This session provides a platform to discuss recent advances in analytical techniques and applications of non-traditional stable isotope systems to address fundamental questions spanning a broad range of research areas and disciplines.

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



Economic Geology



Energy



Engineering



Hydrogeology and
Environmental Geology

T37. Global Change: Evolution and Extinctions in the Triassic

Cosponsors: *GSA Geobiology & Geomicrobiology Division; Paleontological Research Institution; Paleoclimatology/Paleoceanography; GSA Sedimentary Geology Division; Paleontological Society*

Disciplines: Geochemistry, Paleontology, Diversity, Extinction, Origination, Paleoclimatology/Paleoceanography

Advocates: Stephen E. Grasby; David P.G. Bond

This session examines geochemical, stratigraphic, and paleontological records of dynamic climate events through the Triassic period that was characterized by dramatic shifts in climate, extinction, and evolution.

\$ T38. Interdisciplinary Investigations of Mantle-Crustal Mass Transfer

Cosponsors: *GSA Geophysics and Geodynamics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division*

Disciplines: Geochemistry, Geophysics/Geodynamics, Petrology, Igneous

Advocates: Marek Locmelis; Steve Gao; Kelly H. Liu; Ricardo David Arevalo Jr.

Understanding how the mantle and crust evolve and interact is important for the modeling of Earth's past. We encourage papers on the processes leading to mass transfer between the two chemically and rheologically distinct layers.

GEOINFORMATICS**T39. Innovations in Web-Delivery and Discovery of Geoscience Data and Maps (Posters)**

Cosponsor: *GSA Geoinformatics Division*

Disciplines: Geoinformatics, Geoscience Information/Communication

Advocate: Douglas C. Curl

This session seeks contributions that showcase techniques for delivering geoscience data and maps to the public or user groups through web applications, mobile applications, or other Internet-connected services.

\$ T40. Machine-Learning and Artificial-Intelligence Applications in the Geosciences

Cosponsors: *GSA Geoinformatics Division; GSA Energy Geology Division; GSA Sedimentary Geology Division; GSA Hydrogeology Division; GSA Geophysics and Geodynamics Division*

Disciplines: Geoinformatics, Geoscience Information/Communication, Sediments, Clastic

Advocates: Joshua A. Cohan; Donald A. Keefer

This session encourages contributions demonstrating application of learning-based algorithms or artificial-intelligence technologies to geoscience problems. Projects demonstrating multidisciplinary contributions or multiple techniques within a single application are of particular interest.

T41. FAIR Data—What Can Geoinformatics Do?

Cosponsors: *GSA Geoinformatics Division; American Geosciences Institute; American Geophysical Union; Geoscience Information Society*

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

Advocates: Denise Hills; Christopher Keane; Shelley Stall

FAIR (Findable, Accessible, Interoperable, Reusable) data are essential for scientific integrity. Practicing geoscientists will demonstrate how they integrate geoinformatics into their research, emphasizing ways that they are able to make their data FAIR.

\$ T42. Data Science for Geosciences: Advancing Geoscience Research in the Cyberinfrastructure

Cosponsors: *GSA Geoinformatics Division; GSA Geophysics and Geodynamics Division*

Disciplines: Geoinformatics, Geoscience Information/Communication, Geoscience Education

Advocates: Xiaogang Ma; Anirudh Prabhu; Fang Huang; Peter Fox

Themed on data science for geosciences, this session welcomes submissions of both theoretical and practical topics in geoinformatics, and geoinformatics studies.

GEOLOGY AND HEALTH**T43. From Source to Stomach: Assessing Interactions between Earth Materials and Human Health**

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division; GSA Hydrogeology Division*

Disciplines: Geology and Health, Mineralogy/Crystallography, Hydrogeology

Advocates: Amy Wolfe; Mark P.S. Krekeler; Jonathan Levy

This session will explore the relationship between toxic element exposure through natural and anthropogenic activities and impacts to human health.

T44. Geology and Health Research, Outreach, and Education Activities

Cosponsors: *GSA Geology and Health Division; GSA Geology and Society Division*

Disciplines: Geology and Health, Geochemistry, Hydrogeology

Advocates: Saugata Datta; Franco Marcantonio; Robert B. Finkelman; Karina Galinskaya

This session will link geology and human health to society, and the implementation of policies and education.

💧 T45. Is There a Medical Geologist in the House? A Session Honoring the Contributions of Robert Finkelman to the Field of Medical Geology

Cosponsor: *GSA Geology and Health Division*

Disciplines: Geology and Health, Environmental Geoscience, Geoscience and Public Policy

Advocates: Malcolm Siegel; G. Nelson Eby; Saugata Datta; Jean M. Morrison

This session will honor Dr. Robert Finkelman, a leader in the field of medical geology for more than 20 years, through his work in government and academic institutions, in the United States and internationally.

💧 T46. From Local to Global—Why Geology Matters for Human Health

Cosponsors: *GSA Geology and Health Division*

Disciplines: Geology and Health, Environmental Geoscience, Hydrogeology

Advocates: Bethany Overfield; William C. Haneberg

This session emphasizes research at the intersection of health science and earth science. Encompassing everything from the origin, transport, and accumulation of geogenic carcinogens to properties of hot spring spas—geology and health are interconnected.

💧 T47. Global Drinking Water and Public Health: Conditions, Contaminants, Concerns, and Strategies

Cosponsors: *GSA Hydrogeology Division; GSA Karst Division; GSA Limnogeology Division; GSA International Interdisciplinary Interest Group*

Disciplines: Geology and Health, Environmental Geoscience, Hydrogeology

Advocates: Jonathan W. Peterson; Aaron A. Best

This session will focus on the conditions and contaminants in drinking water sources from many global locations. A theme will be identifying commonalities and strategies, including relatively short-term actions, to protect or improve human health.

GEOMORPHOLOGY

💧 T48. Fluvial Processes from Catchments to Coastlines

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

Disciplines: Geomorphology, Sediments, Clastic, Quaternary Geology

Advocates: Douglas A. Edmonds; Brian J. Yanites

Rivers connect mountainous catchments to coastlines by eroding, moving, and depositing sediment. We encourage abstracts that investigate sediment transport dynamics and river morphology within and across these scales.

❖ T49. Cascading Geohazards: Frequency, Impacts, and Topographic Signatures

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Geophysics and Geodynamics Division; GSA Environmental & Engineering Geology Division*

Disciplines: Geomorphology, Engineering Geology, Quaternary Geology

Advocates: Brian J. Yanites; Alison R. Duvall

We seek contributions from a broad spectrum of studies focused on understanding the frequency of cascading hazards and the signature they leave in the landscape.

💧 T50. Processes and Feedbacks in the Critical Zone

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division*

Disciplines: Geomorphology, Soils, Quaternary Geology

Advocates: Alison Anders; Martha C. Eppes

Processes and feedbacks occurring from the top of the canopy to the bottom of the bedrock weathering zone. Field, instrumentation, simulation, and/or modeling data for geosphere, pedosphere, hydrosphere, atmosphere, and/or biosphere processes are welcome.

T51. Planetary Aeolian Geology from Outcrop to Orbit: Nathan Bridges Memorial Session

Cosponsors: *GSA Planetary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division*

Disciplines: Geomorphology, Sediments, Clastic, Planetary Geology

Advocates: Kirby D. Runyon; Bradley J. Thomson

Honoring the life and legacy of Dr. Nathan Bridges, this session traces the theme of wind-blown sediment and its effects across the solar system from a processes perspective.

❖💧 T52. Techniques and Applications of Digital Elevation Models and Derivative Products to Understand Fluvial Systems

Cosponsors: *Kentucky Geological Survey; GSA Environmental & Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division; American Quaternary Association; GSA Geoinformatics Division*

Disciplines: Geomorphology, Engineering Geology, Quaternary Geology

Advocates: Matthew A. Massey; Jason M. Dortch

Digital elevation models and their derivative products are essential to understanding surface dynamics. This session will explore DEM-based techniques and applications to assess the processes and evolution of fluvial systems.

❖💧 T53. **High-Resolution Datasets for Fluvial and Hillslope Processes and Landforms: Frontiers of Remotely Sensed Data**

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Geoinformatics Division; GSA Sedimentary Geology Division; GSA Environmental & Engineering Geology Division*

Disciplines: Geomorphology, Environmental Geoscience, Stratigraphy

Advocates: Quinn W. Lewis; Christopher E. Sheehan; Jeffrey M. Valenza

This session focuses on the use of high spatial and/or temporal resolution datasets, or innovative use of remotely sensed data, for improving understanding of fluvial and hillslope processes and landforms.

💧 T54. **Quantifying Geomorphic Processes and Rates of Landscape Evolution**

Cosponsor: *GSA Quaternary Geology and Geomorphology Division*

Disciplines: Geomorphology, Quaternary Geology, Tectonics/Tectonophysics

Advocates: Lydia M. Staisch; Arjun M. Heimsath; Paul R. Bierman

This session focuses on quantifying the relationships between tectonics, climate, and erosional processes. Presentations on new approaches and applications of methods such as cosmogenic nuclides, thermochronology, chemical mass balance, detrital geochemistry, and luminescence are encouraged.

⚡❖💧💰 T55. **Tipping the Scales: Scaling Relationships in Modern and Ancient Sediment-Routing Systems**

Cosponsors: *SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Planetary Geology Division; American Association of Petroleum Geologists; GSA Structural Geology and Tectonics Division*

Disciplines: Geomorphology, Sediments, Clastic, Quaternary Geology

Advocates: Fabien J. Laugier; Zane Jobe; Sam Johnstone

We solicit contributions that investigate scaling relationships in sediment routing systems on Earth or other planetary surfaces. We seek broad representation in environments (eolian to deep-marine) and methods (field, remote-sensing, geochronology, modeling), and integration within a source-to-sink framework.

T56. **From Alpine Glaciers to Ice Sheets: Understanding Glacial Dynamics, Landscapes, and Environmental Change**

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; Paleoclimatology/Paleoceanography*

Disciplines: Geomorphology, Quaternary Geology

Advocates: Elizabeth Orr; Jason M. Cesta; Michelle Fame; Sarah Crump

This session focuses on the role of glacial systems within landscape development and discusses the framework glacial landforms provide for understanding glacial dynamics and reconstructing patterns of long-term environmental change.

T57. **Undergraduate Research Talks: The Next Step in Student Research Projects**

Cosponsors: *GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geoinformatics Division; GSA Limnogeology Division; GSA Structural Geology and Tectonics Division; GSA Geology and Health Division; GSA Hydrogeology Division; GSA Sedimentary Geology Division; GSA Karst Division; GSA Geobiology & Geomicrobiology Division; GSA Environmental & Engineering Geology Division; GSA Energy Geology Division; GSA Geophysics and Geodynamics Division; GSA Planetary Geology Division; GSA Archaeological Geology Division; GSA Geoscience Education Division; GSA History & Philosophy of Geology Division*

Disciplines: Geomorphology, Volcanology, Geochemistry

Advocates: Jacqueline A. Smith; Bradley G. Johnson

This oral session provides a venue for undergraduate students and recent graduates to present talks on completed research projects. Students may submit abstracts for research in any subdiscipline of geology, earth science, or environmental science.

💧 T58. **Advances in Understanding Pleistocene Landscape Evolution through the Window of Bedrock Topography (Posters)**

Cosponsor: *GSA Quaternary Geology and Geomorphology Division*

Disciplines: Geomorphology, Quaternary Geology, Hydrogeology

Advocates: Eric C. Carson; Shawn Naylor

This session highlights recent work toward understanding the causal mechanisms and geomorphological effects of Pleistocene bedrock erosion and drainage reorganizations by looking at glaciated regions around the world, with a focus on the North American mid-continent.

💧 T59. **Human Alterations to Landscape Connectivity**

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Archaeological Geology Division; GSA International Interdisciplinary Interest Group*

Disciplines: Geomorphology, Soils, Environmental Geoscience

Advocates: Anne J. Jefferson; Stephanie S. Day; Robert B. Jacobson

Human activities affect geomorphic processes and landscape connectivity across scales, influencing fluxes of water, sediment, energy, and propagules. This session seeks innovative case studies and syntheses of human-altered geomorphic processes, landscape connections, and socio-ecological consequences.

💧 T60. Revolutions in Remote Sensing: Applications of UAVs to Field Mapping and Surface Analytics

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Structural Geology and Tectonics Division; GSA Environmental & Engineering Geology Division; GSA Archaeological Geology Division; GSA Geoinformatics Division; GSA Geophysics and Geodynamics Division*

Disciplines: Geomorphology, Environmental Geoscience, Archaeological Geology

Advocates: Dylan Blumentritt; Toby Dogwiler

Unmanned aerial vehicles (UAVs) are revolutionizing remote sensing and field mapping. Geoscientists can quickly and inexpensively acquire aerial photos, orthoimages, high-resolution DEMs, and other data sets. We encourage submissions that demonstrate innovative methodologies, applications, and analyses of UAV-acquired data.

T61. Fluvial Geomorphology of Post-Glacial Rivers

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

Disciplines: Geomorphology, Quaternary Geology, Environmental Geoscience

Advocates: Karen B. Gran; Amanda Henck Schmidt; Matthew Cross Jungers

This session will explore ongoing fluvial responses to glaciation and deglaciation. We welcome submissions focusing on field data, modeling results, and physical experiments on any kind of fluvial response to Pleistocene glaciation.

🌱💧 T62. Landscapes in the Anthropocene

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division; GSA International Interdisciplinary Interest Group; GSA Limnogeology Division*

Disciplines: Geomorphology, Geoscience and Public Policy, Environmental Geoscience

Advocates: José Antonio Constantine; Rónadh Cox

This session will bring together a trans-disciplinary group of innovative thinkers who are grappling with landscape disturbances that typify the Anthropocene, with the aim of facilitating societally relevant predictions of environmental change.

GEOPHYSICS/GEODYNAMICS

🌐 T63. Earthquakes and Deformation in Eastern North America and Other Continental Interiors: What We Know, What We Don't, What We Think, and Which Is Which?

Cosponsors: *GSA Geophysics and Geodynamics Division; GSA Structural Geology and Tectonics Division*

Disciplines: Geophysics/Geodynamics, Tectonics/Tectonophysics, Geoscience and Public Policy

Advocates: Leah Salditch; James S. Neely

We encourage papers especially from early career scientists exploring longstanding but unresolved questions about continental intraplate earthquakes, both induced and naturally occurring—why, where, and when they happen and the resulting hazards.

💰 T64. Beyond EarthScope in the Eastern U.S.—What We've Learned and What Needs Doing Next

Cosponsors: *GSA Geophysics and Geodynamics Division; GSA Structural Geology and Tectonics Division*

Disciplines: Geophysics/Geodynamics, Tectonics/Tectonophysics, Structural Geology

Advocates: Seth Stein; G. Randy Keller; Reece P. Elling; Stephen Marshak

The EarthScope program “to understand the growth and modification of North America” is ending. We encourage papers that assess what EarthScope has learned about eastern North America, and what major new scientific questions and research directions should be addressed next.

🌐🌱 T65. Recent Advances in Using Near-Surface Geophysics to Solve Geological Problems

Cosponsors: *GSA Geophysics and Geodynamics Division; GSA Quaternary Geology and Geomorphology Division; GSA Environmental & Engineering Geology Division; GSA Hydrogeology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Karst Division; GSA Archaeological Geology Division*

Disciplines: Geophysics/Geodynamics, Hydrogeology, Karst

Advocates: Kevin L. Mickus

We encourage novel studies that use near-surface geophysics (electrical, electromagnetic, seismic, gravity, magnetics) to investigate a variety of geological problems including groundwater, karst, geomorphology, archaeology, urban geology, and engineering geology.

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



Economic Geology



Energy



Engineering



Hydrogeology and
Environmental Geology

GEOSCIENCE AND PUBLIC POLICY**🕒💧💰 T66. The Twenty-First-Century Geoscience Workforce: What Is It? Who Is In It? Who is Missing?**

Cosponsors: *GSA Geology and Society Division; GSA Diversity in the Geosciences Committee; International Association for Geoscience Diversity; GSA Geoinformatics Division; GSA Environmental & Engineering Geology Division*

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

Advocates: Stephen K. Boss; Aisha R. Morris; Ivan G. Carabajal

This session is an exploration of class, gender, and race within the geoscience workforce. Session presentations will outline what the geoscience workforce is today and strategies to broaden it into the twenty-first century.

🕒💧💰 T67. Societal Benefits of Application-Specific Geologic Map Derivatives

Cosponsors: *Association of American State Geologists; GSA Geoinformatics Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division; GSA Environmental & Engineering Geology Division*

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

Advocates: William Andrews Jr.; John C. Brock; David R. Soller

Derivative maps provide a critical translation from traditional framework geologic maps to a wide variety of technical applications. Quality derivative maps can expand the audience and use of geologic information while generating significant societal benefit.

GEOSCIENCE EDUCATION**T68. Respecting, Developing, and Implementing Multiple Ways of Knowing within Geoscience Disciplines**

Cosponsors: *GSA Geoscience Education Division; GSA Geology and Society Division; GSA Diversity in the Geosciences Committee*

Disciplines: Geoscience Education, Hydrogeology, Energy Geology

Advocates: Angel A. Garcia; Darryl Reano

This session will focus on the formal and informal introduction of Traditional Ecological Knowledge (TEK) into classrooms to teach earth science, methods for organizing TEK, and the impacts of educational interventions implemented at the undergraduate level.

T69. Innovations in Using Fossil Collections for Deep Time Education and Outreach

Cosponsors: *GSA Geoscience Education Division; Paleontological Society; Paleontological Research Institution*

Disciplines: Geoscience Education, Paleontology, Diversity, Extinction, Origination, Paleoclimatology/Paleoceanography

Advocates: Amy Bolton; Bruce J. MacFadden

How do you engage students and families in learning from your fossil collections? This session addresses a variety of innovative ways fossil collections are used to teach about Earth's deep history.

T70. Geoscience Animations and Videos as Tools for Learning: Using Them in the Classroom, Making Them, and Assessing Their Impact

Cosponsors: *National Association of Geoscience Teachers*

Disciplines: Geoscience Education, Geoscience Information/Communication

Advocates: Robert J. Stern; Jeffrey Ryan

High-quality AND scientifically accurate animations of geologic phenomena are uncommon but potentially valuable in K–12 and college teaching. Contributions on innovative classroom uses of animations, their assessment, and how to make them are encouraged.

T71. Recruiting and Retaining K9–16 Students through Field- and Laboratory-Based Geoscience Experiences (Posters)

Cosponsors: *GSA Geology and Society Division; GSA Geoscience Education Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Health Division; GSA Environmental & Engineering Geology Division; GSA Sedimentary Geology Division; Council on Undergraduate Research Geosciences Division; GSA Energy Geology Division; National Association of Geoscience Teachers*

Disciplines: Geoscience Education, Environmental Geoscience, Geoscience Information/Communication

Advocates: Nazrul I. Khandaker; Stanley Schleifer; Arif M. Sikder

This session will enable faculty and K9–16 students to present their field- and laboratory-based research on a variety of geoscience-related aspects, including sedimentology, geomorphology, field geology, environmental geology, urban geology, geoscience education, and new pedagogical approaches.

T72. Integrating Active Learning Strategies into College-Level Geoscience Classrooms: Implementation, Effects, and “Lessons Learned”

Cosponsors: *GSA Geoscience Education Division; National Association of Geoscience Teachers; National Association of Geoscience Teachers Geoscience Education Research Division*

Discipline: Geoscience Education

Advocates: Jason P. Jones; Katherine Ryker; LeeAnna Young Chapman; C. Doug Czajka

The integration of active learning strategies into college-level STEM courses has been shown to improve student outcomes. This session will explore the evidence behind incorporating active learning into geoscience courses.

T73. Beyond Pretty Pictures: The Role of Photography in Promoting Understanding and Learning in the Geosciences

Cosponsors: *GSA Geoscience Education Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division*

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

Advocates: Jacquelyn E. Hams; Anita M. Marshall; Susan C. Eriksson

This session highlights the use of photographic mediums in learning, documenting, visualizing, and communicating geoscience.

T74. Declining Enrollments in U.S. Undergraduate Geoscience Programs: How Did We Get Here and How Do We Get Our Groove Back?

Cosponsors: *GSA Geoscience Education Division; National Association of Geoscience Teachers; GSA Energy Geology Division*

Disciplines: Geoscience Education, Geoscience Information/Communication

Advocates: Miriam Barquero-Molina; Angela Van Boening; Damon J. Bassett

Declining enrollments in geoscience means departments are feeling the pain, financial and otherwise. We discuss the reasons for the decline and strategies for better recruiting and serving of our graduates going into the professional workforce.

T75. Hidden in Plain Sight: Geology Where You Least Expect It

Cosponsors: *GSA Geoscience Education Division; National Association of Geoscience Teachers; National Earth Science Teachers Association*

Discipline: Geoscience Education

Advocates: LeAnne Teruya; Mark Boryta; Joseph Petsche

This session will highlight how theme parks, sports venues, buildings, malls, and film locations can offer engaging geological scenery and an interactive context for students learning geology.

T76. Beyond the Road-Cut: Virtual, Local, and Nontraditional Field Teaching and Learning Experiences

Cosponsors: *GSA Geoscience Education Division; National Association of Geoscience Teachers; National Association of Geoscience Teachers Geoscience Education Research Division*

Discipline: Geoscience Education

Advocates: Lauren Neitzke Adamo; Julia Criscione; Jacob Setera; Kelsey S. Bitting

Virtual exploration, museum-based assignments, and analysis of geoscience on campus can be more inclusive ways to enhance students' conceptual learning and motivation. This session welcomes presentations describing nontraditional field experiences and evidence of their effectiveness.

T77. Earth Science Literacy Principals: A Decade after Inception, Where Are We Now?

Cosponsor: *GSA Geology and Society Division*

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

Advocates: Hayley Joyell Smith; Michael E. Wysession

The focus is on the integration of the Earth Science Literacy Principles in public communication and educational frameworks. This is an opportunity to evaluate the usefulness of the concepts presented in the document. Presentations on failures, challenges, and successes are welcome.

T78. Barriers, Misconceptions, and Progress in Improving Climate Literacy and Strategies for Communicating about Climate Change

Cosponsors: *GSA Geoscience Education Division; National Association of Geoscience Teachers Geoscience Education Research Division; Climate Literacy and Energy Awareness Network (CLEAN); GSA Geology and Society Division; GSA Energy Geology Division; GSA Quaternary Geology and Geomorphology Division*

Discipline: Geoscience Education

Advocates: Don Duggan-Haas; Patrick Chandler; Anne U. Gold

This session will focus on research and evaluation of climate literacy efforts and effective ways of communicating about climate change in general but also in cultural relevant contexts.

T79. Showcase of Undergraduate Research Posters by 2YC and 4YCU Geoscience Students (Posters)

Cosponsors: *GSA Geoscience Education Division; National Association of Geoscience Teachers; National Association of Geoscience Teachers Geo2YC Division; International Association for Geoscience Diversity*

Disciplines: Geoscience Education, Environmental Geoscience, Sediments, Clastic

Advocates: Adrienne A. Leinbach; Gretchen L. Miller; Stephanie M. Rollins

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

T80. Exploring the ART in E(ART)h Science

Cosponsors: *National Earth Science Teachers Association; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division*

Disciplines: Geoscience Education, History and Philosophy of Geology

Advocates: Michael Passow; Belinda E. Jacobs; Carla McAuliffe

How important were contributions of artists traveling with scientists or recording landscapes far beyond the experience of the general public in establishing earth science? Perhaps without art, there might not have been earth science?

T81. Promoting Scientific CURE-iosity: Course-Based Undergraduate Research Experiences (CUREs) in Introductory Courses at 2YCs and 4YCs

Cosponsors: Council on Undergraduate Research Geosciences Division; National Association of Geoscience Teachers; GSA Geoscience Education Division

Discipline: Geoscience Education

Advocates: Virginia L. Peterson; Kenneth L. Brown; Sarah K. Fortner; Claire McLeod

This session provides a platform to discuss effective practices related to CUREs, especially in introductory geoscience courses. We encourage educators from 2YC and 4YC institutions to share approaches to integrating CUREs into their undergraduate curriculum.

T82. Hands-On Teaching Demonstrations that Combine Geoscience and Societal Issues: Audience Participation Requested!

Cosponsors: GSA Geoscience Education Division; National Association of Geoscience Teachers

Discipline: Geoscience Education

Advocates: Elizabeth A. Nagy-Shadman; Tiffany A. Rivera

This is a geoscience education session that practices what it preaches. Authors present micro-demonstrations of effective teaching activities that integrate geoscience content with societal concerns. Presentations include audience participation, assessment results, and reflections on effectiveness.

T83. Beyond the Numbers: Strategies for Inclusive Education Practices across the Geological Sciences

Cosponsors: American Geophysical Union; GSA Diversity in the Geosciences Committee; GSA Geoscience Education Division; National Association of Geoscience Teachers; National Earth Science Teachers Association; NTA (National Technical Association)

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

Advocates: M. Brandon Jones; Felicia Davis; Marilyn J. Suiter; Lina Patino; Lisa Rom; Amanda Adams

This session aims to highlight education and outreach concepts that move the diversity, equity, and inclusion (DEI) needle beyond numerical targets to achieve a culture of DEI at larger and systemic scales.

T84. Making Sense of Methodologies and Theoretical Frameworks in Geoscience Education Research

Cosponsors: GSA Geoscience Education Division; National Association of Geoscience Teachers; National Association of Geoscience Teachers Geoscience Education Research Division

Disciplines: Geoscience Education, Geoscience Information/Communication

Advocates: Anne Gold; Karen S. McNeal; Leilani Arthurs; Katherine Ryker

Methods and theoretical frameworks can come from multiple disciplines to shape the forefront of our field. Presenters are encouraged to highlight their decision-making process in research studies that advance the field. New approaches and applications of established methods/frameworks are welcome.

T85. Preparing Graduate Students and Post-Docs for the College Teaching Workforce

Cosponsors: GSA Geoscience Education Division; National Association of Geoscience Teachers

Discipline: Geoscience Education

Advocates: Anne E. Egger; Karen Viskupic

Strategies for preparing graduate students and post-docs for teaching at the college level go beyond supporting teaching assistants. We seek submissions that highlight successful models for developing evidence-based teaching skills in future faculty.

T86. Making the Case for Collections: How Institutions Are Using Real Objects to Engage the Public, Solve Problems, and Save the World

Cosponsor: GSA Geoscience Education Division

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

Advocates: Peggy Fisherkeller; Dallas Evans

As humans produce more of everything, competition for physical space becomes ever more intense. This session will highlight how institutions and individuals are ensuring that resource-consuming natural history collections continue to be viewed as relevant.

T87. Collaborative Partnerships between K–12 Teachers/ Informal Educators and Scientists

Cosponsors: National Earth Science Teachers Association; National Association of Geoscience Teachers Teacher Education Division

Disciplines: Geoscience Education, Geoscience Information/Communication

Advocates: Susan Meabh Kelly; Carla McAuliffe; Suzanne T. Metlay; Peggy M. McNeal; Michael J. Passow

This session is dedicated to sharing education/outreach efforts that are the product of scientists collaborating with K–12 teachers and/or informal educators.

HISTORY AND PHILOSOPHY OF GEOLOGY

T88. Women and Geology: Nevertheless, We Persist

Cosponsors: Association for Women Geoscientists; Earth Science Women's Network; GSA Geology and Society Division; GSA Quaternary Geology and Geomorphology Division; GSA Geophysics and Geodynamics Division; GSA Karst Division; GSA History and Philosophy of Geology Division

Disciplines: History and Philosophy of Geology, Geoscience Information/Communication, Geoscience Education

Advocate: Beth A. Johnson

This session addresses issues and barriers women in geology experience and provides possible solutions and support. Included are discussions on issues regarding recruitment and retention of women as well as efforts to increase diversity.

    **T89. Using Technology to Solve Geological Problems**

Cosponsors: *GSA History and Philosophy of Geology Division; Ann Johnson Institute for Science, Technology & Society; GSA Geoinformatics Division; GSA Environmental & Engineering Geology Division*

Disciplines: History and Philosophy of Geology, Economic Geology, Engineering Geology

Advocates: Katherine J. Lewandowski; Allison Marsh

Engineering and technology have often proven necessary to solve problems associated with extracting Earth resources of all kinds. This session seeks talks looking at the intersection of geology and technology from a historical perspective.

T91. Evolution of Paleontological Art

Cosponsors: *GSA History and Philosophy of Geology Division; History of Earth Sciences Society; Paleontological Society; Cushman Foundation; Paleontological Research Institution; National Earth Science Teachers Association*

Disciplines: History and Philosophy of Geology, Paleontology, Paleocology/Taphonomy

Advocates: Renee M. Clary; Dallas Evans; Gary D. Rosenberg

Papers explore the paleontological images and reconstructions of ancient life that document the progression of scientific thought, including paleo art that serves as the scientific cornerstone and the interesting but incorrect reconstructions that were ultimately revised.

T92. Great Expectations: The Promise and Wonder of Geology in the Heartland

Cosponsors: *GSA History and Philosophy of Geology Division; History of Earth Sciences Society; GSA Quaternary Geology and Geomorphology Division*


Disciplines: History and Philosophy of Geology, Quaternary Geology, Economic Geology

Advocates: Michael S. Smith; John A. Diemer

The westward expanse across the Appalachian Mountains opened new frontiers for the explorer, settler, and geologist. This

session explores how the personalities and changing ideas of geology addressed the challenges of geological investigation in these new territories.

HYDROGEOLOGY

 **T93. Measuring and Modeling Fluxes across the Surface Water/Groundwater Interface**

Cosponsors: *GSA Hydrogeology Division; GSA Karst Division*

Disciplines: Hydrogeology, Environmental Geoscience

Advocates: Andrea E. Brookfield; G.L. Macpherson; Adam S. Ward

This session encourages the submission of abstracts discussing the measurement and modeling of fluxes of gases, solutes, and fluids across groundwater/surface water interfaces, with an emphasis on innovative techniques and results of unique case studies.

 **T94. Water Temperatures in Surface and Subsurface Hydrologic Systems: Controls, Applications, and Implications**

Cosponsors: *GSA Continental Scientific Drilling Interdisciplinary Interest Group; GSA Karst Division; GSA Hydrogeology Division; GSA Energy Geology Division*

Discipline: Hydrogeology

Advocates: Tyler V. King; Barret L. Kurylyk; Dylan J. Irvine; Laura K. Lautz

Focus: Field-based, big-data-driven, or modeling studies that consider the temperature of surface and subsurface hydrologic systems. Potential topics: Groundwater–surface water interactions, novel field techniques, thermal projections, ecohydrology, heat as a tracer, and cold regions hydrogeology.

 **T95. Climate Variability, Change, and Water Resources**

Cosponsors: *GSA Hydrogeology Division; GSA Karst Division; GSA Limnogeology Division; GSA International Interdisciplinary Interest Group*

Disciplines: Hydrogeology, Environmental Geoscience, Geochemistry

Advocates: Randy L. Stotler; David L. Rudolph

Changes to the hydrologic cycle due to increasing climate variability are affecting water quantity and quality. Submissions describing and predicting the effects of climate change on water resources, and/or mitigation strategies, are encouraged.

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



Economic Geology



Energy



Engineering



Hydrogeology and Environmental Geology

💧 T96. Large Watershed to National Scale Data and Science for Water Management

Cosponsors: *GSA Hydrogeology Division; GSA Geoinformatics Division; GSA Karst Division; GSA International Interdisciplinary Interest Group*

Disciplines: Hydrogeology, Environmental Geoscience, Energy Geology

Advocate: E. Randall Bayless

The topical session will explore large watershed and national-scale water management models, creation of standardized input variables, and the applications as a way to improve coordination and collaboration among scientists and improve methods.

💧 \$ 🔄 🕒 T97. Advances in the Development and Application of Hydrogeological Models

Cosponsors: *GSA Hydrogeology Division; GSA Karst Division*

Discipline: Hydrogeology

Advocates: Rene Therrien; John W. Molson

This session focuses on advances in hydrogeological modeling and field-scale model applications. Investigations of model uncertainty and complexity, as well as simulation of existing and future pressures on groundwater systems (natural or human) are welcome.

🕒 🔄 💧 \$ T98. Satellite Remote Sensing Applications in Hydrology and Geology

Cosponsors: *GSA Hydrogeology Division; GSA Geoinformatics Division; GSA Geophysics and Geodynamics Division; GSA Environmental & Engineering Geology Division; GSA Geology and Society Division; GSA Limnogeology Division; GSA International Interdisciplinary Interest Group*

Disciplines: Hydrogeology, Geoinformatics, Geophysics/Geodynamics

Advocates: Richard H. Becker; Wondwosen Mekonnen Seyoum

Understanding hydrology and geology at varying scales depends upon consistent spatial observations. We seek presentations on applications integrating remote sensing observations from UAV- to satellite-scale with traditional methods in hydrology and geology.

💧 T99. Five Decades of Impactful Ideas in Hydrogeology: Recognizing the Contributions of Frank Schwartz

Cosponsors: *GSA Hydrogeology Division; National Ground Water Association*

Disciplines: Hydrogeology, Geochemistry, Environmental Geoscience

Advocates: Alan E. Fryar; Chen Zhu

Since the early 1970s, multiple research strands in hydrogeology have emerged and matured. This session will provide an overview of past, present, and future research directions in hydrogeology in the context of Frank Schwartz's contributions.

💧 T100. Applications and Advances in Groundwater Flow Modeling

Cosponsors: *GSA Hydrogeology Division; GSA Karst Division*

Disciplines: Hydrogeology, Environmental Geoscience, Geochemistry

Advocates: Daniel B. Abrams; Daniel R. Hadley

This session will focus on a range of groundwater flow modeling topics, including investigations of water quantity and quality, advances in modeling technology and visualization, and integration of groundwater flow models with other scientific disciplines.

💧 T101. Advances in Data Discovery and Analysis for Hydrogeology

Cosponsors: *GSA Hydrogeology Division; GSA Geoinformatics Division; GSA Karst Division*

Disciplines: Hydrogeology, Environmental Geoscience, Geoinformatics

Advocates: Junfeng Zhu; Ming Ye; Velimir Vesselinovic

This session seeks presentations on applying recent advances in mathematics, statistics, and computer sciences to solve hydrogeological problems. We welcome topics on applications of innovative data analysis methods, data collection techniques, and field studies.

🔄 💧 T102. Dye Tracing and Emerging Environmental Tracers in Hydrogeology

Cosponsors: *GSA Hydrogeology Division; GSA Karst Division*

Disciplines: Hydrogeology, Karst, Geochemistry

Advocates: Douglas Gouzie; Dorothy J. Vesper

We seek a broad variety of tracer applications—from dye-tracing studies in karst and surface water hydrology to isotopic, microelectronic, nanoparticle, and other innovative tracers used in the range of hydrogeologic and hydrologic studies.

💧 T103. Springs: Groundwater-Influenced Ecosystems, Gaining Streams, and Wetlands

Cosponsors: *GSA Hydrogeology Division; GSA Karst Division; GSA Geobiology & Geomicrobiology Division; GSA Limnogeology Division*

Disciplines: Hydrogeology, Karst, Geomicrobiology

Advocates: Abraham E. Springer; Sue Swanson; Brad David Wolaver

Springs maintain aquatic and terrestrial ecosystems, streams, wetlands, and water sources globally. Presentations are encouraged from multidisciplinary, collaborative studies of the characterization, monitoring, modeling, and education of stakeholders to improve the understanding of springs, associated ecosystems, and anthropogenic users.

T104. Environmental Geophysics: Tools and Applications

Cosponsors: *GSA Hydrogeology Division; GSA Geoinformatics Division; GSA Geophysics and Geodynamics Division; GSA Karst Division*

Disciplines: Hydrogeology, Geophysics/Geodynamics

Advocate: David Lampe

This topical session will highlight new aerial, surface, and borehole geophysical methods and applications of traditional tools to laboratory and field investigations.

T105. A Showcase of Undergraduate Research in Hydrogeology (Posters)

Cosponsors: *GSA Hydrogeology Division; Council on Undergraduate Research Geosciences Division; GSA Karst Division*

Discipline: Hydrogeology

Advocates: Samuel J. Smidt; Susan Swanson; Laura K. Rademacher; Molly Cain

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.

T106. The Axial Role of Water in Being Prepared for Environmental Change

Cosponsors: *GSA Hydrogeology Division; National Ground Water Association; Geochemical Society; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division; GSA Karst Division; GSA Energy Geology Division*

Disciplines: Hydrogeology, Geochemistry, Environmental Geoscience

Advocates: Chen Zhu; P. David Polly; Yanguo Teng

In the complex web of water-food-energy, water plays an axial role.

T107. Arsenic, Manganese, Chromium, and Other Geogenic Contaminants, Including Radionuclides in Hydrological Systems—Source, Biogeochemical Cycling, Toxicity, and Removal

Cosponsors: *GSA Hydrogeology Division; GSA Geology and Health Division; GSA International Interdisciplinary Interest Group; International Society of Groundwater for Sustainable Development (ISGSD); International Water Association (IWA); Specialist Group Metals and Related Substances in Drinking Water (METRELS)*

Disciplines: Hydrogeology, Environmental Geoscience, Geology and Health

Advocates: Prosun Bhattacharya; Saugata Datta; Madeline Schreiber; Manish Kumar; Arslan Ahmad; Abhijit Mukherjee; David Lampe

The cycling of arsenic, manganese, radium, and other geogenic contaminants in hydrogeological systems from regional to local scales will be discussed. This encompasses occurrence, mobility,

biogeochemical cycling, health impacts, and removal technologies.

T108. Polar and Alpine Change

Cosponsors: *GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Sedimentary Geology Division; GSA Limnogeology Division; GSA International Interdisciplinary Interest Group*

Disciplines: Hydrogeology, Soils, Environmental Geoscience

Advocate: W. Berry Lyons

Polar and alpine areas are undergoing some of the most rapid change on our planet. This session encourages presentations on geomorphological, hydrological, biogeochemical, and ecological changes occurring in these environments. Presentations related to cryospheric loss and its consequences are encouraged.

T109. Hydrogeology and Energy

Cosponsor: *GSA Hydrogeology Division*

Disciplines: Hydrogeology, Energy Geology

Advocates: Erick Burns; Mark A. Engle

This session seeks a broad array of hydrogeology-energy topics including geothermal, hydrocarbon-water, and other water-energy issues. Preference is given to work on causative interrelationships or complex interactions that govern occurrence and evolution of subsurface energy resources.

LIMNOGEOLOGY

T110. Lakes through Space and Time

Cosponsors: *GSA Limnogeology Division; GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; AASP - The Palynological Society; American Quaternary Association; Association for the Sciences of Limnology and Oceanography; International Association of Limnogeology; SEPM (Society for Sedimentary Geology); GSA Continental Scientific Drilling Interdisciplinary Interest Group*

Disciplines: Limnogeology, Paleoclimatology/Paleoceanography, Stratigraphy

Advocates: Scott W. Starratt; Michelle F. Goman

This session celebrates lacustrine research around the world. Lakes are important fresh water reservoirs, and their sediments serve as archives of global change, local human impact, and ecological succession.

T111. Human Evolution and Environmental History in Africa: 25 Years of Transformative Research (Posters)

Cosponsors: *GSA Limnogeology Division; GSA Archaeological Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; GSA Continental Scientific Drilling Interdisciplinary Interest Group; EarthRates*

Disciplines: Limnogeology, Sediments, Clastic, Paleoclimatology/Paleoceanography

Advocates: Gail M. Ashley; Andrew S. Cohen

This session will highlight exciting new advances in our understanding of the connection between human evolution and environmental change, drawing from studies of key paleoanthropological sites, drill core investigations, and associated modeling experiments.

MARINE/COASTAL SCIENCE

T112. Coastal Wetland Feedbacks: Interconnecting Processes That Lead to Wetland Building and Sustainment

Cosponsors: *GSA Quaternary Geology and Geomorphology Division*

Disciplines: Marine/Coastal Science, Geomorphology, Quaternary Geology

Advocates: Elizabeth Ann Olliver; Alejandra Ortiz

We seek abstracts aimed at understanding the feedbacks between physical, biological, and chemical processes that build and maintain coastal wetlands across spatial and temporal scales, and how these feedbacks are impacted by environmental variability.

MINERALOGY/CRYSTALLOGRAPHY

T113. Gemological Research in the Twenty-First Century—Characterization, Exploration, and Geological Significance of Diamonds and Other Gem Minerals

Cosponsors: *Mineralogical Society of America; Gemological Institute of America; Society of Economic Geologists; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division*

Disciplines: Mineralogy/Crystallography, Economic Geology, Geoscience Information/Communication

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

Gemstones are among the most recognized of all minerals. This session focuses on diverse aspects of gems, including exploration, formation conditions, properties, compositions, treatment, identification, diamond and its mineral inclusions, and their geological implications.

T114. Apatite, from Magma to Medicine: In Honor of John M. Hughes

Cosponsors: *GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Mineralogical Society of America; GSA Geobiology & Geomicrobiology Division*

Disciplines: Mineralogy/Crystallography, Petrology, Igneous, Economic Geology

Advocates: John Rakovan; Jessica J. Barnes

This session aims to present cutting-edge research on apatite with regard to its utilization in understanding crustal and mantle processes, biological processes, practical applications in industry, as well as processes in extraterrestrial environments.

T115. Mineral Evolution and Ecology: Potential Directions for the Next 100 Years with the Mineralogical Society of America

Cosponsors: *Mineralogical Society of America; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Geochemical Society; Deep Carbon Observatory; Russian Mineralogical Society; International Mineralogical Association*

Disciplines: Mineralogy/Crystallography, Geochemistry

Advocates: Edward S. Grew; Robert M. Hazen

Documenting and explaining the diversity and distribution of mineral species through space and time will remain major challenges for the next century. Mineral evolution and ecology are emerging as powerful approaches to data-driven discovery.

PALEOCLIMATOLOGY/PALEOCEANOGRAPHY

T116. New Developments in Geochemical Proxies for Paleoclimatographic Research

Cosponsors: *GSA Sedimentary Geology Division; Geochemical Society; International Association of Sedimentologists; Cushman Foundation*

Disciplines: Paleoclimatology/Paleoceanography, Geochemistry, Sediments, Clastic

Advocates: Thomas J. Algeo; Jeremy D. Owens; Jennifer Morford

Geochemical proxies are essential for investigation of paleoceanographic, paleoclimatic, and paleoenvironmental conditions. This session will examine the development of new elemental, isotopic, and biomarker proxies to track surficial processes in deep-time research.

T117. Greenhouse to Icehouse Transition: Global Events of the Devonian, Carboniferous, and Early Permian

Cosponsors: *GSA Sedimentary Geology Division; International Association of Sedimentologists; Geochemical Society; GSA International Interdisciplinary Interest Group; Paleontological Society*

Disciplines: Paleoclimatology/Paleoceanography, Stratigraphy, Geochemistry

Advocates: Thomas J. Algeo; Isabel P. Montañez

This session will feature new research on global tectonic, climatic, oceanic, and biotic events encompassing the mid-Paleozoic transition from a greenhouse to an icehouse world as well as the Late Paleozoic Ice Age.

T118. Paleoenvironmental Reconstructions from Biogenic Carbonates

Cosponsors: *SEPM (Society for Sedimentary Geology); Paleontological Society; Paleontological Research Institution; GSA Sedimentary Geology Division; GSA Karst Division*

Disciplines: Paleoclimatology/Paleoceanography, Geochemistry, Paleontology, Paleoecology/Taphonomy

Advocates: Yurena Yanes; Wesley G. Parker; Donna Surge

This session encourages studies of the physical and/or chemical properties of biogenic carbonate skeletons for paleoenvironmental reconstruction. Contributions include, but are not limited to, paleoclimate inferences, proxy calibration, model development, and novel methods.

T119. Extinction and Survival across the Triassic-Jurassic Boundary

Cosponsors: *GSA Sedimentary Geology Division; Paleontological Research Institution; Paleontological Society*

Disciplines: Paleoclimatology/Paleoceanography, Paleontology, Diversity, Extinction, Origination, Stratigraphy

Advocates: Shane Schoepfer; Thomas J. Algeo

The Triassic-Jurassic boundary represents the first mass extinction experienced by the modern evolutionary fauna. This session will bring together paleontologists, geochemists, and other researchers who are interested in this important period of transition.

T120. Cushman Foundation Symposium: Hothouse to Coldhouse Transitions at Southern High Paleolatitudes during the Cretaceous and Cenozoic

Cosponsors: *Cushman Foundation; Geochemical Society; Paleontological Society; GSA Sedimentary Geology Division; GSA International Interdisciplinary Interest Group*

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

Advocates: Brian T. Huber; Sietske J. Batenburg; Kenneth G. MacLeod; Gabriel Tagliaro

This session will focus on the evolution of climate and ocean circulation as temperatures at southern high paleolatitudes underwent two warming and cooling cycles during the Cretaceous and Cenozoic.

T121. Insights from Microfossils, Palynology, and Their Modern Analogs: From Traditional to Emerging Techniques

Cosponsors: *Cushman Foundation; AASP - The Palynological Society; Geochemical Society; Paleontological Society; Paleontological Research Institution; GSA Limnogeology Division; GSA Sedimentary Geology Division*

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

Advocates: Miriam E. Katz; Peter P. McLaughlin Jr.; Caitlin Keating-Bitonti; Ingrid Romero; David K. Watkins

Traditional applications of microfossils/palynology are central to many studies, while novel approaches (especially geochemistry) utilizing microfossils have expanded recently. This session highlights traditional and innovative microfossil/palynology applications in terrestrial and marine environments, including modern analogs.

T122. Oceans and Climates through Earth History: From Proxy Reconstructions to Model Assessments (Posters)

Cosponsors: *Cushman Foundation; Paleontological Research Institution; Geochemical Society; Paleontological Society; GSA Limnogeology Division; GSA Sedimentary Geology Division; GSA International Interdisciplinary Interest Group*

Disciplines: Paleoclimatology/Paleoceanography, Geochemistry, Paleontology, Diversity, Extinction, Origination

Advocates: Miriam E. Katz; Dorothy K. Pak

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

PALEONTOLOGY

T123. Cephalopods through Time

Cosponsors: *Paleontological Society; EarthRates; Paleontological Research Institution*

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

Advocates: Christina Ifrim; Margaret M. Yacobucci; Neil H. Landman

This session will integrate the latest breakthroughs of research on recent and fossil cephalopods, and on the connection between their evolution, paleoclimate, and marine biogeochemical cycles.

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



Economic Geology



Energy



Engineering



Hydrogeology and Environmental Geology

T124. Integrated Biostratigraphy (Posters)

Cosponsors: *North American Commission on Stratigraphic Nomenclature (NACSN); SEPM (Society for Sedimentary Geology); Paleontological Society; Cushman Foundation; International Subcommission on Stratigraphic Classification (ISSC); GSA Sedimentary Geology Division*

Disciplines: Paleontology, Biogeography/Biostratigraphy, Stratigraphy, Paleontology, Paleoecology/Taphonomy

Advocates: Richard H. Fluegeman; Carlton E. Brett; Lucy E. Edwards; Brian R. Pratt

This session will focus on the integration of biostratigraphy with other types of stratigraphic records toward the solution of geoscience problems. The conveners are interested in applications of biostratigraphy from a variety of chronostratigraphic, environmental, and geographic settings.

T125. EARTHTIMES and EarthRates: Exploring the Tempo and Mode of Earth-System Processes and Evolution

Cosponsors: *EARTHTIME; EarthRates; GSA Continental Scientific Drilling Interdisciplinary Interest Group; GSA Sedimentary Geology Division; Paleontological Society*

Disciplines: Paleontology, Diversity, Extinction, Origination, Stratigraphy, Geochemistry

Advocates: Daniel Condon; Leah Morgan; Shanan E. Peters

This session will explore the development of established, novel, varied, and integrated approaches for establishing geological “timescales” and “frameworks” to advance our understanding of earth system processes and evolution, from solid Earth to evolution of life.

T126. Earth and Life Co-Evolution in the Early to Middle Neoproterozoic (1000 to ca. 635 Ma)

Cosponsors: *GSA Geobiology & Geomicrobiology Division; AASP - The Palynological Society; Paleontological Society; Paleontological Research Institution; GSA Sedimentary Geology Division*

Disciplines: Paleontology, Diversity, Extinction, Origination, Geochemistry, Precambrian Geology

Advocates: Qing Tang; Heda Agic; Leigh Anne Riedman

This session is focused on gaining a better understanding of the coevolution of Earth and life in the early to middle Neoproterozoic. We welcome inputs from paleontologists, geochemists, sedimentologists, earth system modelers, and more.

T127. Earth-Life Transitions: Critical Information from Deep Time to Manage Future Environmental Change

Cosponsors: *Paleontological Society; SEPM (Society for Sedimentary Geology); GSA Limnogeology Division; EarthRates; GSA Sedimentary Geology Division*

Disciplines: Paleontology, Diversity, Extinction, Origination, Paleoclimatology/Paleoceanography, Geophysics/Geodynamics

Advocates: David J. Bottjer; Lisa E. Park Boush

This session will provide a platform for the latest results from Earth-Life Transitions and related investigations that highlight the many advances made under this novel National Science Foundation program.

T128. Recent Advances in Ichnology: Traces of Modern and Ancient Behavior

Cosponsors: *Paleontological Society; GSA Limnogeology Division; GSA Sedimentary Geology Division*

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

Advocates: Daniel I. Hembree; Jon J. Smith; Brian F. Platt

Trace fossils provide critical paleoecological and paleoenvironmental information. We encourage research on new ichnological discoveries at all scales in marine and continental settings, novel techniques of trace fossil analysis, and neoichnological experiments.

T129. Evolution of Terrestrial Ecosystems: Community Assembly through Time

Cosponsors: *Paleontological Society; Paleontological Research Institution*

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

Advocates: Laura C. Soul; Danielle Fraser; Joshua H. Miller

In this session we will evaluate mechanisms driving changes in terrestrial community ecology through time. We will present perspectives from studies in deep time and the recent, across a wide variety of taxa.

T130. Phylogenetic Paleobiology: Exploring Macroevolutionary Trends with Evolutionary Trees

Cosponsors: *Paleontological Society; Paleontological Research Institution; GSA Geobiology and Geomicrobiology Division*

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

Advocates: Selina R. Cole; David F. Wright; Laura C. Soul; William Gearty

This session will highlight recent advances integrating phylogenetic comparative methods with fossil data to address evolutionary and ecological questions through deep time. Topics include macroevolutionary trends, rates of change, diversification dynamics, trait evolution, and paleobiogeography.

T131. Phylogenetic Paleoecology; Macroecology within an Evolutionary Framework

Cosponsors: *Paleontological Society; Paleontological Research Institution*

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

Advocates: Curtis R. Congreve; James C. Lamsdell

This session will focus on the integration of phylogenetic datasets with paleoecology to understand broad topics in the history of life, including the relationship between ecology/biogeography and evolutionary rates, community assembly, and extinction/radiation selectivity.

T132. Applications of 3D Printing and Other 3D Methods to Experimental Paleontology

Cosponsors: Paleontological Research Institution; Cushman Foundation; Paleontological Society

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

Advocates: Erynn H. Johnson; Aja M. Carter; Lauren Sallan

Novel 3D technologies have enabled paleontologists to directly address questions that would otherwise be untestable. This session showcases experimental work that has given new life to fossils using a variety of materials, computerized and printed.

T133. Molecular, Developmental, and Genomic Approaches to Understanding the Fossil Record

Cosponsors: Paleontological Society; GSA Geobiology and Geomicrobiology Division

Disciplines: Paleontology, Phylogenetic/Morphological Patterns, Paleontology, Diversity, Extinction, Origination, Geomicrobiology

Advocates: Jeffrey R. Thompson; Eric M. Erkenbrack

This session aims to foster enhanced collaboration between paleobiologists and molecular biologists, genomicists, and developmental biologists. Presentations will ideally address questions in evolutionary biology through interdisciplinary approaches utilizing developmental biology, genomics, and the fossil record.

T134. Echinoderm Paleobiology: In Honor of the Career of James Sprinkle

Cosponsors: Paleontological Society

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

Advocates: Chris L. Schneider; Colin D. Sumrall

This session will explore current and novel research regarding fossil echinoderms and will honor the career of a major contributor to echinoderm research, Dr. James Sprinkle.

T135. Paleopathology: Incidences of Disease, Trauma, and Infection from Arthropods to Anthropology

Cosponsors: Paleontological Society

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

Advocates: Jennifer E. Anne; Allison R. Tumarkin-Deratzian

Advances in identification and diagnosis of pathologies in ancient life, from the Cambrian to the Holocene.

PETROLOGY

\$ T136. Tick Tock in the Rock: Elucidating the Time Scales of Geologic Processes and Honoring the Contributions of Bruce Watson, 2018 Roebling Medalist

Cosponsors: Mineralogical Society of America; Geochemical Society; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Volcanic and Magmatic Studies Group; American Geophysical Union

Disciplines: Petrology, Igneous, Petrology, Metamorphic, Geochemistry

Advocates: Frederick J. Ryerson; Mark Harrison; Julia E. Hammer; Sumit Chakraborty; Calvin F. Miller

This session spotlights the contributions of Bruce Watson, who has advanced understanding of chemical diffusion, textural evolution of partially molten and fluid-bearing rocks, crystal and bubble growth, and other topics relating to kinetics in aqueous, magmatic, and metamorphic systems.

T137. Cold Magma Storage: A Hot Topic

Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geophysics and Geodynamics Division; Geochemical Society

Disciplines: Petrology, Igneous, Geophysics/Geodynamics, Geochemistry

Advocates: Michael R Ackerson; Craig C. Lundstrom

Recent work suggests that silicic magmas are stored or even form at 1 °C–200 °C below the wet haplogranite solidus. This represents a fundamental contradiction to the view that igneous processes end at 650 °C. Does cold storage occur? If so, how?

\$ T138. Magmas Assemble! Petrologic, Geochemical, Chronologic, and Geophysical Insights into the Architecture and Timescales of Magmatic Systems

Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geophysics and Geodynamics Division

Disciplines: Petrology, Igneous, Geochemistry, Volcanology

Advocates: Ken Brown; Claire McLeod

This session focuses on new and innovative research aimed at understanding the evolution and assembly of magmatic systems. We encourage contributions that address all aspects of these systems, including petrology, geochemistry, chronology, and geophysical perspectives.



4-7 November
Indianapolis, Indiana, USA

§ T139. Work on the Zircon, Highlight the Apatite: Wielding the Power of Accessory Minerals and Honoring the Contributions of Bruce Watson, 2018 Roebling Medalist

Cosponsors: *Mineralogical Society of America; Geochemical Society; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Volcanic and Magmatic Studies Group; American Geophysical Union*

Disciplines: Petrology, Igneous, Petrology, Metamorphic, Geochemistry

Advocates: Calvin F. Miller; Mark Harrison; Sumit Chakraborty; Frederick J. Ryerson; Julia E. Hammer

Accessory minerals have become major contributors to our understanding of petrogenesis. We seek contributions on accessory minerals (apatite, rutile, monazite, etc.) from experimental, theoretical, and field-based studies that carry forward the legacy of innovation of Bruce Watson, 2018 Roebling Medalist.

§ T140. Frontiers in Mineralogy, Petrology, and Geochronology: A Session in Honor of Dana Medalist Jörg Hermann

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

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

Advocates: Bradley Hacker; Marc M. Hirschmann; Hugh St.C. O'Neill

Recent decades have witnessed considerable advances in mineralogy, petrology, and geochronology, underpinned largely by new micro-analytical methods, computational power, and cross-fertilization from other fields. This session is devoted to highlighting recent achievements and promising novel approaches.

T141. Different Personalities of Granites and Rhyolites: Silicic Magmas from the Lower Crust to the Surface—A Session in Honor of Calvin Miller, Recipient of the MGPV Distinguished Geological Career Award

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

Disciplines: Petrology, Igneous, Geochemistry, Volcanology

Advocates: Guilherme A.R. Gualda; Lily L. Claiborne; Jonathan S. Miller; Delores Robinson

Calvin Miller investigates silicic magmatism, from deep crustal granites to erupted rhyolites, using techniques including field relationships, petrography, geochemistry, geochronology, and accessory mineralogy. Contributions in these topics are welcome to celebrate his career and legacy.

T142. Metamorphic Petrology Past, Present, and Future: Preparing for the Next 100 Years with the Mineralogical Society of America

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

Disciplines: Petrology, Metamorphic, Mineralogy/Crystallography, Tectonics/Tectonophysics

Advocates: John M. Cottle; Sarah Penniston-Dorland; Mark J. Caddick

Metamorphic petrology, a cornerstone of solid earth research, provides constraints on geodynamic processes. On the eve of the Mineralogical Society of America centenary, this session will highlight past, recent, and future developments in metamorphic petrology.

PLANETARY GEOLOGY

T143. The Age of Small World Exploration: Major Results from Minor Planets and Other Small Solar System Bodies

Cosponsors: *GSA Planetary Geology Division; GSA Geophysics and Geodynamics Division*

Disciplines: Planetary Geology, Geophysics/Geodynamics, Structural Geology

Advocates: Kynan H.G. Hughson; David A. Williams

Understanding “small worlds” like asteroids, comets, and the comparatively large dwarf planets is key to understanding the nature of our solar system. We welcome abstracts related to geologic, geophysical, and compositional analyses of “small worlds.”

T144. Friends of Hoth: Episode III—Bodies of the Outer Solar System

Cosponsor: *GSA Planetary Geology Division*

Discipline: Planetary Geology

Advocates: Emily S. Martin; D. Alex Patthoff

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

T145. Apollo 17 Forty-Five Years on: Reanalysis of the Geochemistry, Geophysics, and Field Geology in Light of Data from the Lunar Reconnaissance Orbiter and Other Recent Missions

Cosponsors: *GSA Planetary Geology Division; GSA Geophysics and Geodynamics Division; GSA Geoinformatics Division*

Disciplines: Planetary Geology, Geochemistry, Geophysics/Geodynamics

Advocates: Noah E. Petro; Jacob E. Bleacher; C.R. Neal; H.H. Schmitt

Forty-five years since the Apollo 17 mission to the Taurus-Littrow Valley, the analysis of the samples, interpretation of surface measurements, and field observations are being revisited in the context of newly acquired remote sensing data.

T146. Geomorphology and Landscape Evolution of Mars

Cosponsors: *GSA Planetary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division*

Disciplines: Planetary Geology, Geomorphology

Advocates: Sharon Wilson Purdy; James J. Wray; Elena Favaro

We welcome abstracts focusing on fluvial, alluvial, and lacustrine landforms using orbital and (or) rover data to investigate the geomorphology and geology of Mars, as well as related Earth analog studies.

T147. Planetary Mantles: Using Samples to Explore Earth, the Moon, and Mars

Cosponsors: *GSA Planetary Geology Division; GSA Geophysics and Geodynamics Division*

Disciplines: Planetary Geology, Petrology, Igneous

Advocates: Clive R. Neal; Molly C. McCanta; Amy L. Fagan; Bradley J. Thomson

Comparative planetology through the study of terrestrial, lunar, and martian mantles.

 **T148. Radar & Microwave Remote Sensing of Desertic and Planetary Environments**

Cosponsors: *GSA Geoinformatics Division; GSA Geophysics and Geodynamics Division*

Disciplines: Planetary Geology, Geophysics/Geodynamics, Hydrogeology

Advocates: Essam Heggy; Bradley J. Thomson; G. Wesley Patterson

This session will discuss advances on the geomorphic and geophysical properties of desertic and planetary environments as revealed from radar and microwave remote sensing techniques, addressing questions on volatiles occurrence, surface dynamics, subsurface characterization, and paleoclimatic changes.

T149. Volcanism and Tectonism on Planetary Bodies

Cosponsors: *GSA Planetary Geology Division; GSA Geophysics and Geodynamics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division*

Disciplines: Planetary Geology, Volcanology, Tectonics/Tectonophysics

Advocates: Paul K. Byrne; Christian Klimczak

This session solicits abstracts on volcanic and tectonic landforms and processes on solar system bodies and extrasolar worlds, encompassing surface geology, interior and thermal evolution, and comparative planetary studies with observational, experimental, or theoretical approaches.

T150. Impact Cratering: Geologic, Geochemical, and Geophysical Signatures on the Terrestrial Planets

Cosponsors: *GSA Planetary Geology Division; GSA Structural Geology and Tectonics Division; GSA Geophysics and Geodynamics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division*

Disciplines: Planetary Geology, Structural Geology, Geochemistry

Advocates: Jeffrey B. Plescia; Christian Koeberl

Impact cratering is a dominant process across the solar system influencing a planet's geology and evolution. The session focuses on impact flux, geologic and geophysical implications of impacts, and geochemistry recorded in ejecta and insight provided for the bolide.

T151. The G.K. Gilbert Award Session

Cosponsor: *GSA Planetary Geology Division*

Discipline: Planetary Geology

Advocates: James J. Wray; Sharon A. Wilson; Bradley Thomson

This session will honor the 2018 winner of the Planetary Geology Division's G.K. Gilbert Award, highlighting recent contributions in the awardee's field of research.

T152. Grain to Global Perspectives of Mars: Evolving Views of the Martian Sedimentary Rock Record

Cosponsors: *GSA Planetary Geology Division; SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division; GSA Limnogeology Division*

Disciplines: Planetary Geology, Stratigraphy, Geochemistry

Advocates: Briony Horgan; Samantha Gwizd; Rachel E. Kronyak; Vivian Sun

This session synthesizes recent research on the origin, deposition, and alteration of sediments on Mars. We seek contributions investigating the stratigraphy, chemistry, and mineralogy of Mars' sedimentary record using rover, orbital, and terrestrial analog data.

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



Economic Geology



Energy



Engineering



Hydrogeology and Environmental Geology

T153. Voyages to Ocean Worlds throughout the Solar System

Cosponsors: *GSA Planetary Geology Division; GSA Geophysics and Geodynamics Division*

Disciplines: Planetary Geology, Structural Geology, Geophysics/Geodynamics

Advocates: Jennifer E.C. Scully; Debra L. Buczkowski

Ocean worlds are intriguing planetary bodies. We welcome abstracts related to geologic, geophysical, and/or compositional analyses of ocean worlds, through the use of spacecraft data, telescopic observations, modeling studies, laboratory investigations, and/or comparative studies.

T154. Coordinated Microanalysis as a Tool for Increasing the Scientific Yield of Returned Planetary Materials

Cosponsors: *GSA Planetary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Microanalysis Society*

Disciplines: Planetary Geology, Mineralogy/Crystallography, Geochemistry

Advocates: Jessica J. Barnes; Michelle Thompson

Maximizing the scientific yield from samples returned by space missions is essential. This session will showcase how coordinated microanalysis of planetary materials is currently done, what the current state-of-the-art is, and future avenues for improvement.

T155. Big Data in Planetary Geology

Cosponsors: *GSA Planetary Geology Division; GSA Geoinformatics Division*

Disciplines: Planetary Geology, Geoinformatics

Advocates: Kelsey T. Crane; Xiaogang Ma; Bradley J. Thomson

We seek abstracts that investigate planetary bodies and processes using Big Data. This includes innovative processing techniques, application of multiple datasets to address multifaceted problems, and establishing best practices for preserving and working with large volumes of data.

T156. Geology and Geophysics of the Eratosthenian and Copernican Moon

Cosponsors: *GSA Planetary Geology Division; GSA Geophysics and Geodynamics Division*

Disciplines: Planetary Geology, Geophysics/Geodynamics, Tectonics/Tectonophysics

Advocates: Debra H. Needham; Caleb I. Fassett; Renee C. Weber

This session will cover a wide range of investigations of the recent and current Moon, including current lunar seismicity, possible recent volcanic activity, recent tectonism, impacts and impact processes, and development of the lunar regolith.

PRECAMBRIAN GEOLOGY**\$ T157. Evolving Perspectives of the Precambrian World: Using Combined Theoretical and Applied Approaches to Tackle Problems at the Intersection of Geology, Geobiology, and Geochemistry**

Cosponsors: *Paleontological Society; GSA Geobiology & Geomicrobiology Division*

Disciplines: Precambrian Geology, Geochemistry, Geomicrobiology

Advocates: Latisha Ashley Brengman; Geoffrey J. Gilleaudeau

Tracking early Earth's dynamic surface evolution invites an integrated and cross-disciplinary multi-scale approach. We seek contributions from experimental, theoretical, field-, and/or laboratory-based studies that focus on deciphering key events in Precambrian earth system evolution.

🕒 T158. Evolution of the Midcontinent Rift: A Window into Proterozoic Environments, a Repository of Minerals, and a Lesson in Rifting

Cosponsors: *GSA Geophysics and Geodynamics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division; Society of Economic Geologists; GSA Geobiology & Geomicrobiology Division*

Disciplines: Precambrian Geology, Tectonics/Tectonophysics, Economic Geology

Advocates: Nicholas L. Swanson-Hysell; Seth Stein; Tyrone O. Rooney

The Midcontinent Rift hosts a remarkable record of tectonic, magmatic, and sedimentary processes. Geological, geochemical, geophysical, and geobiological research into the rift is expanding understanding of rift formation, Proterozoic earth history, and its economic deposits.

T159. Different Roads to Rodinia: Re-Analysis of the Geochronology and Tectonic Evolution of Precambrian Sedimentary and Crystalline Basement Terranes in Southeastern Laurentia

Cosponsors: *GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geophysics and Geodynamics Division; GSA Sedimentary Geology Division*

Disciplines: Precambrian Geology, Tectonics/Tectonophysics, Geophysics/Geodynamics

Advocates: John B. Hickman; J. Richard Bowersox

This session focuses on new interpretations of Precambrian geology and tectonic events in southeastern Laurentia, including Grenville and Granite-Rhyolite terranes, Midcontinent Rift System, Middle Run and Jacobsville sandstones, and the Illinois Basin "pre-Mt. Simon" units.

QUATERNARY GEOLOGY

💧 T160. Advances in Understanding the Laurentide Ice Sheet

Cosponsors: *GSA Quaternary Geology and Geomorphology Division*

Disciplines: Quaternary Geology, Geomorphology, Sediments, Clastic

Advocates: Kathy Licht; Henry Loope; Timothy G. Fisher

This session brings together observational and modeling studies that improve all aspects of our understanding of the Laurentide Ice Sheet, including terrestrial to oceanographic records and reconstructions of glacial environmental change.

T161. Examining Big Questions or Paradigms with Geochronology

Cosponsor: *GSA Quaternary Geology and Geomorphology Division*

Disciplines: Quaternary Geology, Geomorphology, Geochemistry

Advocates: B. Brandon Curry; Kenneth Lepper

The robustness of most geologic paradigms rests upon chronology. We encourage presentations that (1) explore the notion that Quaternary dating techniques have evolved to the point of testing causal relationships, and (2) deal with the advances that make this ponderable.

💧 T162. Shoreline Behavior, Paralic Architecture, and Lake-Level Change in the Great Lakes

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; GSA Limnogeology Division*

Disciplines: Quaternary Geology, Limnogeology, Sediments, Clastic

Advocates: John W. Johnston; Erin P. Argyilan; Steve J. Baedke; Kenneth Lepper; Todd A. Thompson

All aspects of modern and ancient Great Lakes coastlines are encouraged that examine the composition, stratigraphy, architecture, and age of nearshore and onshore systems to improve interpretations of processes, shoreline behavior, and lake-level change.

T163. Dust and Loess: Records of Climate and Geomorphic Change

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Continental Scientific Drilling Interdisciplinary Interest Group; GSA Sedimentary Geology Division*

Disciplines: Quaternary Geology, Geomorphology, Paleoclimatology/Paleoceanography

Advocates: Jessica L. Conroy; Dave A. Grimley

This session aims to bring together researchers investigating the dust-climate-geomorphology nexus. We encourage submissions presenting dust, loess, or other eolian-influenced

paleorecords (lakes, soils, ice cores) that represent variability in past climates, landscapes, or surface processes.

💧 T164. Quaternary History of the Ohio River Basin and Other Fluvial Systems Influenced by the Laurentide Ice Sheet

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Archaeological Geology Division; GSA Sedimentary Geology Division*

Disciplines: Quaternary Geology, Geomorphology, Archaeological Geology

Advocates: Todd Grote; J. Steven Kite; G. William Monaghan

This session encourages presentations on any aspect of the Quaternary history of watersheds influenced by the Laurentide Ice Sheet. Topics may include, but are not limited to, stratigraphy/chronology, geomorphology, glacial history, paleoecology, geoaerology, and hydrology.

💧 T165. Where Does the Wind Blow? Aeolian Systems in Time and Space

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; International Society of Aeolian Research; GSA Sedimentary Geology Division*

Disciplines: Quaternary Geology, Geomorphology, Archaeological Geology

Advocates: Nicholas Lancaster; Mark R. Sweeney

This session will feature research focused on the rich record of the effects of Quaternary climate change on aeolian processes and landforms and their often-complex response to changes in sediment supply, mobility, and availability.

💧 T166. The Happy Convergence of Chronologic Applications to Archaeologic, Geologic, and Pedologic Questions within the Interior Plains: From Texas to the Arctic

Cosponsors: *GSA Quaternary Geology and Geomorphology Division; GSA Archaeological Geology Division; GSA Limnogeology Division*

Disciplines: Quaternary Geology, Archaeological Geology, Limnogeology

Advocates: Shannon A. Mahan; Tammy M. Rittenour; Sebastien Huot; Joel Q.G. Spencer; Carlie J. Ideker; Michelle S. Nelson; Christina M. Neudorf; Kathleen Rodrigues

This session aims to explore the intersection of geochronologic methods with archaeological, geologic, large lakes, and soils research to understand landscape response to climate, tectonics, and human modification.



4-7 November
Indianapolis, Indiana, USA

SEDIMENTS

🇺🇸 T167. **Mixed Siliciclastic-Carbonate Depositional Systems**

Cosponsors: *SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division; GSA Energy Geology Division*

Disciplines: Sediments, Carbonates, Sediments, Clastic

Advocates: John-Paul Zonneveld; Murray K. Gingras

Sedimentary systems are commonly categorized as either carbonate or siliciclastic. Mixed sedimentary systems are common. This session is to highlight the causes influencing the occurrence, architecture, and preservation of mixed siliciclastic-carbonate depositional systems.

🇺🇸 T168. **Sedimentary Geology Division/SEPM Student Research Competition: Dynamics of Stratigraphy and Sedimentation (Posters)**

Cosponsors: *GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)*

Disciplines: Sediments, Carbonates, Sediments, Clastic, Stratigraphy

Advocate: Amy L. Weislogel

This poster session is intended for students presenting research on topics related to sedimentary geology, which could range from studies of carbonates, clastic and chemical sediments, to sedimentary processes from ancient and/or modern systems.

🇺🇸 T169. **The Evolution of Continental Weathering through Geologic Time: Paleoclimate, Biogeochemistry, Diagenesis, and Clay Minerals**

Cosponsors: *GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Energy Geology Division; GSA Geoinformatics Division*

Disciplines: Sediments, Clastic, Quaternary Geology, Energy Geology

Advocates: Gregor Austermann; Anne Hildenbrand; Dario Harazim; Neil Fishman

This session will integrate breakthroughs in clay mineral production in surface environments and its connection to marine biogeochemical cycles, paleoclimates, and burial diagenesis. Research on mechanical/chemical weathering, clay chemistry, paleoclimates, and modeling are highly welcome.

💧 T170. **Floodplains as Repositories of Information on Climate, Hydrology, Ecology, and Human Activities**

Cosponsors: *GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Limnogeology Division*

Disciplines: Sediments, Clastic, Soils, Paleoclimatology/Paleoceanography

Advocates: Larry D. McKay; Steven L. Forman; Gary E. Stinchcomb

This session examines the utility of floodplains as repositories of diverse types of information that can be applied to answering important questions concerning our environment and society.

🇺🇸 T171. **Late Paleozoic Tectonics and Sedimentation along the Allegheny-Ouachita-Marathon Orogenic Belt**

Cosponsors: *GSA Sedimentary Geology Division; GSA Geophysics and Geodynamics Division; GSA Structural Geology and Tectonics Division*

Disciplines: Sediments, Clastic, Tectonics/Tectonophysics, Stratigraphy

Advocates: Xiangyang Xie; Majie Fan; Robert J. Stern

This session seeks contributions addressing the late Paleozoic suturing between Gondwana and Laurentia, and associated changes in sedimentary processes along the Allegheny-Marathon-Ouachita orogenic belt in the eastern and southern United States. Perspectives from other continents are also welcome.

SOILS

T172. **Critical Zone Science—Bio-Geo Interactions across Environmental Gradients and Time**

Cosponsors: *GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Geobiology & Geomicrobiology Division; GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division*

Disciplines: Soils, Geochemistry, Geomicrobiology

Advocates: Bryan G. Moravec; Zsuzsanna Balogh-Brunstad

Critical Zone Science is a complex and interdisciplinary field. We solicit contributions that address the complex relationships among biota and minerals/rocks/soils on various spatial and temporal scales, including the heterogeneity of the studied systems.

STRATIGRAPHY

🇺🇸 T173. **Deep-Water Sedimentation Patterns in Clastics and Carbonates**

Cosponsor: *GSA Sedimentary Geology Division*

Disciplines: Stratigraphy, Sediments, Clastic, Sediments, Carbonates

Advocate: Afsoon Kazerouni

This session aims to bring together researchers from different disciplines to share the latest advances in our fields.

🇺🇸 T174. **Permian-Triassic Biotic Crisis: New Insights through Integrative Studies of Earth, Ocean, and Atmosphere**

Cosponsors: *GSA Sedimentary Geology Division; GSA Geobiology & Geomicrobiology Division; International Association of Sedimentologists; SEPM (Society for Sedimentary Geology); Paleontological Research Institution; GSA International Interdisciplinary Interest Group; Paleontological Society*

Disciplines: Stratigraphy, Paleontology, Diversity, Extinction, Origination, Paleoclimatology/Paleoceanography

Advocates: Christopher R. Fielding; Tracy D. Frank; Steve McLoughlin; Vivi Vajda; Arne M.E. Winguth

This session will feature new research on causes and consequences of the Permian-Triassic mass-extinction event, emphasizing work that integrates sedimentological, geochemical, paleontological, and modeling datasets from regions across the globe.

⏻ T175. Late Jurassic through Early Cretaceous Geologic Time Scale

Cosponsors: *Cushman Foundation; Paleontological Research Institution; Paleontological Society*

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

Advocates: Selen Esmeray-Senlet; Felix M. Gradstein; James G. Ogg

This session will bring researchers together to discuss the status of the geologic time scale between M26 and M0 magnetochrons for the purpose of a revision of this time interval with geochronologic and chemo-bio-chronostratigraphic information.

⏻ \$ T176. Evolution of Rocky Mountain Basins—Ancestral Rocky Mountains through the Laramide

Cosponsors: *GSA Sedimentary Geology Division; GSA Structural Geology and Tectonics Division; GSA Geophysics and Geodynamics Division*

Disciplines: Stratigraphy, Tectonics/Tectonophysics, Structural Geology

Advocates: Jessica A. Thompson Jobe; Theresa M. Schwartz

This session seeks multidisciplinary studies addressing the Paleozoic-Cenozoic evolution of Rocky Mountain basins using the sedimentary record. We seek a range of outcrop and subsurface to modeling studies that focus on lithospheric to surface processes.

T186. Celebrating the Sedimentary Legacy of Dr. Robert H. Dott Jr.

Cosponsors: *GSA Sedimentary Geology Division; GSA History and Philosophy of Geology Division*

Disciplines: Stratigraphy, Sediments, Clastic, History and Philosophy of Geology

Advocates: Marjorie A. Chan; Joanne Bourgeois; Steven G. Driese

We seek contributions honoring the wide-ranging influence of the late Dr. Robert H. Dott, Jr., humanitarian, teacher, scholar, and author. Topics include the history of science, historical geology, sedimentary processes, petrology, geoheritage, and others.

STRUCTURAL GEOLOGY

T177. Folding: Processes, Observations, and Consequences (Posters)

Cosponsor: *GSA Structural Geology and Tectonics Division*

Disciplines: Structural Geology, Tectonics/Tectonophysics

Advocates: Andreas Eckert; Amanda Hughes

We seek contributions investigating the processes and consequences of folding from field, analytical, and modeling studies in the contexts of tectonic history, crustal deformation, rheology, landscape evolution, or fluid migration.

⏻ \$ T178. Geologic Mapping in the Twenty-First Century: Innovative Applications of Technology and Strategies to Aid Field-Based Studies

Cosponsors: *GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division; GSA Geoinformatics Division; GSA Geophysics and Geodynamics Division*

Disciplines: Structural Geology, Stratigraphy, Tectonics/Tectonophysics

Advocates: Sourav Krishna Nandi; Matthew P. McKay

Geologic mapping is an integral part of earth science investigations. We seek contributions that integrate geophysics, remote sensing, geochemistry, geochronology, stratigraphy, and other analytical techniques to aid geologic mapping.

⏻ \$ T179. Best Student Geologic Mapping Competition (Posters)

Cosponsors: *U.S. Geological Survey National Cooperative Geologic Mapping Program; Geological Society of America; Association of American State Geologists; GSA Foundation; American Geosciences Institute; American Institute of Professional Geologists; Journal of Maps; GSA Structural Geology and Tectonics Division; GSA Quaternary Geology and Geomorphology Division*

Disciplines: Structural Geology, Stratigraphy, Geomorphology

Advocates: Michael Marketti; Darcy K. McPhee

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.

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



Economic Geology



Energy



Engineering



Hydrogeology and
Environmental Geology

TECTONICS/TECTONOPHYSICS**\$ ☰ T180. Plate Tectonics Paradigm and Future Directions of Research—Discovery in Light of Its 50-Year History**

Cosponsors: *GSA Structural Geology and Tectonics Division; GSA History and Philosophy of Geology Division; GSA Geophysics and Geodynamics Division; American Geophysical Union*

Disciplines: Tectonics/Tectonophysics, Geophysics/Geodynamics, History and Philosophy of Geology

Advocates: Yildirim Dilek; Eldridge M. Moores

This session is aimed at discussing the nature and significance of scientific developments in earth sciences within the framework of the plate tectonics paradigm since 1968, and marks the 50th anniversary of its inception.

T181. Recent Advances and Future Directions in Palealtimetry and Paleoclimate

Cosponsors: *GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA International Interdisciplinary Interest Group*

Disciplines: Tectonics/Tectonophysics, Geochemistry, Paleoclimatology/Paleoceanography

Advocates: Lily J. Jackson; Kurt E. Sundell; Miquela Ingalls

This session will focus on recent and future advances in proxy- and model-based paleoaltimetry and paleoclimatology with a primary goal of forging multidisciplinary collaboration.

T182. The Cenozoic Evolution of Tibet—How Do We Unify Seemingly Contradictory Evidence?

Cosponsors: *GSA International Interdisciplinary Interest Group; GSA Quaternary Geology and Geomorphology Division; GSA Geophysics and Geodynamics Division; GSA Sedimentary Geology Division*

Disciplines: Tectonics/Tectonophysics, Geomorphology, Paleoclimatology/Paleoceanography

Advocates: Nadine McQuarrie; Gregory D. Hoke; Eric Kirby

This session welcomes diverse contributions from geodynamic and atmospheric numerical modeling, proxy-based observations

of Earth surface conditions, thermochronology, and geomorphic evolution, all centered on the Cenozoic evolution of Tibet.

☰ \$ T183. The Geology of Colombia

Cosponsors: *GSA International Interdisciplinary Interest Group; GSA Sedimentary Geology Division*

Disciplines: Tectonics/Tectonophysics, Geoscience Information/Communication, Petrology, Igneous

Advocates: Jorge Gomez Tapias; Maria Fernanda Almanza Melendez Jr.

We encourage an exchange of multidisciplinary research on the up-to-date geological knowledge of Colombian geology, in order to provide new perspectives of research that will offer future research opportunities.

T184. Geodynamic, Orogenic, and Surface Processes of Flat-Slab Subduction

Cosponsors: *GSA Structural Geology and Tectonics Division; GSA Geophysics and Geodynamics Division; GSA Sedimentary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Quaternary Geology and Geomorphology Division; GSA International Interdisciplinary Interest Group*

Disciplines: Tectonics/Tectonophysics, Geophysics/Geodynamics, Stratigraphy

Advocates: Tomas N. Capaldi; Emily S. Finzel; Majie Fan

This session seeks contributions that connect surface, crustal, and mantle processes associated with flat-slab subduction, specifically addressing geodynamics, kinematics, magmatism, uplift, erosion, basin subsidence, and sediment dispersal in ancient and modern systems.

VOLCANOLOGY**\$ T185. Features, Processes, and Emplacement of Melted Rock on the Earth and Planets**

Cosponsors: *GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Planetary Geology Division; Mineralogical Society of America; GSA Geophysics and Geodynamics Division; GSA Quaternary Geology and Geomorphology Division*

Disciplines: Volcanology, Planetary Geology, Geomorphology

Advocates: Jacob E. Bleacher; Andrew P. de Wet; Sarah A. Fagents

The emplacement of silicate melts can create a diverse set of features, which provides insights into past eruption and impact conditions as well as paleo-environments on the Earth and the planets.



4-7 November
Indianapolis, Indiana, USA

Discipline Categories

Can't find a topical session that fits your abstract? No problem! In addition to topical sessions, we offer the following discipline categories. Discipline sessions are equally vital to our technical program and are an essential addition to the fulfillment of the overall meeting. Encourage your friends to submit a discipline abstract too.

2018 Joint Technical Program Committee (JTPC)

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Discipline Categories *(continued)*

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Andrew P. Barth, absz100@iupui.edu Paul Kapp, pkapp@email.arizona.edu	structural geology; tectonics	Structural Geology and Tectonics Division

GSA's Associated Societies Program

GSA has a long tradition of collaborating with like-minded organizations in pursuit of mutual goals to advance the geosciences. As the Society 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.

GSA currently works with its 73 Associated Societies and 18 specialty science Divisions to build a dynamic annual meeting

technical program and exciting events during the meeting. We invite our Associated Societies to present their representative science and hold customized events during the GSA 2018 Indianapolis, Indiana, USA, meeting on 4–7 November 2018. GSA is looking forward to hosting our valued partners and organizations to present their science, hold meetings, and to exhibit at a booth during the meeting. Members of Associated Society organizations also receive the GSA member registration rate to the annual meeting. For more information about the GSA Associated Society program and a full list of current Associated Societies, go to <https://goo.gl/7WYVru>.

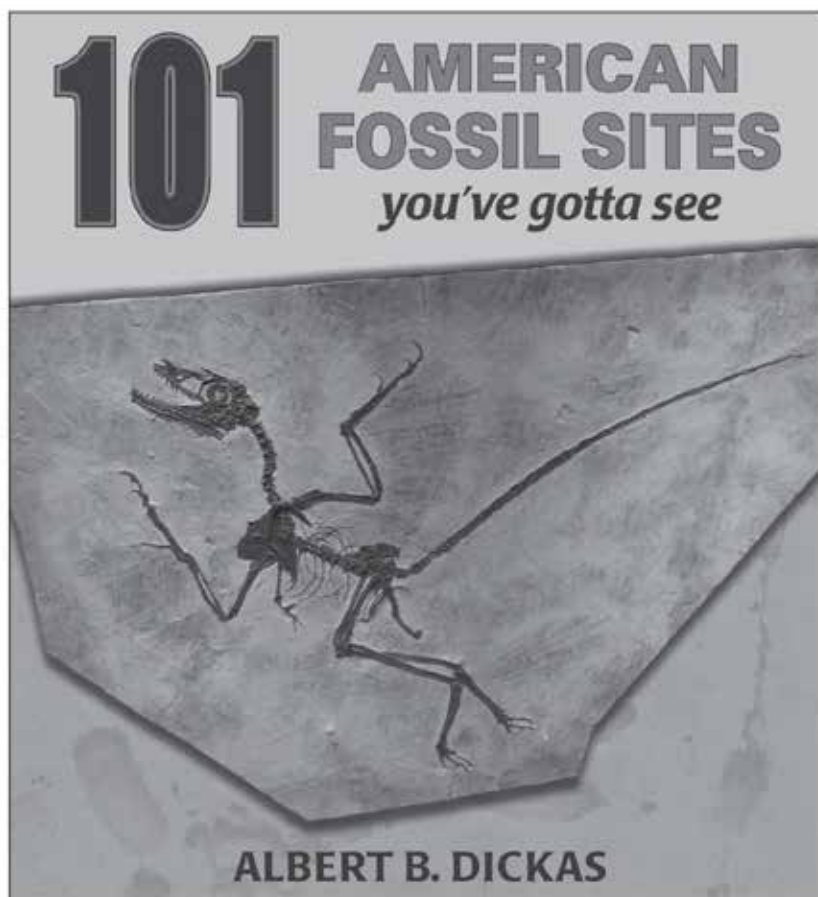
TAKE A TRIP OF DISCOVERY LOOKING FOR FOSSILS ACROSS THE COUNTRY

Examining in detail at least one amazing fossil site in every state, the author clearly explains the critters preserved in the rocks, from sharks and rhinoceroses to trilobites and horn corals. At some sites you can even sift through the shale to find fossils that you can keep. Amply illustrated with photographs and written in a clear yet playful prose, *101 American Fossil Sites You've Gotta See* will entertain and inform amateur and seasoned fossil buffs, whether from an armchair or in the field.

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Registration

- ▶ **Registration will open in early June**
- ▶ **Early registration deadline:** 1 October
- ▶ **Cancellation deadline:** 8 October

GSA strives to create a pleasant and rewarding experience for every attendee. Let us know in advance of the meeting if you have needs that require further attention. Most dietary considerations can be met without any extra charge. Be sure to check the box when registering online and describe your need in the space provided.

REGISTRATION FEES

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

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

Don't forget to...

- Register for tours, special events, field trips, and short courses
- Bring a copy of your meeting confirmation with you
- **STUDENTS:** Be sure to apply for the travel grant program by 1 October
- Make your hotel reservation
- Book your travel

**Check the meeting website
for more information.**

▶ **Travel Grants**

Need assistance getting to the Annual Meeting?

GSA Sections, Divisions, and Associated Societies are ready to help!

Various groups are offering grants to help defray your costs for registration, field trips, travel, etc., at the GSA Annual Meeting & Exposition. Check out the meeting website for application and deadline information.

Note—Eligibility criteria and deadline dates may vary by grant.

For meeting attendees who reside outside of North America, check the International Travel Grant webpage at [www.geosociety.org/ Intl_TravelGrant](http://www.geosociety.org/Intl_TravelGrant). The deadline to apply is **5 July**.

Help a member participate in the GSA Annual Meeting by donating to the Student Travel Fund on your registration.

Interested in helping students participate in the meeting? Every year, a large percentage of students apply for travel grants for the meeting but do not receive an award due to a limited number of funds. You can help reduce this number by donating as little as US\$10 via your registration form. **100% of funds collected go to students.**

Travel & Transportation



Indianapolis International Airport.



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

By Air

Indianapolis International Airport (IND)

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

By Bus

Megabus

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

Greyhound

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

By Train

Amtrak

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

By Car

Driving

Known as the Crossroads of America, Indy is within a day's drive of more than half of the country's population. Traffic congestion is a rarity in Indianapolis, and visitors find the city's street layout straightforward and easy to navigate. Downtown features more than 70,000 parking spots. (Reserve your spot now with Spot Hero—more information is on GSA's meeting webpage.)



4-7 November
Indianapolis, Indiana, USA

International Attendees: If you are visiting the United States from outside of the country and do not have United States citizenship, you may require a visa. For more information, go to <https://travel.state.gov/content/visas/en.html>. You can obtain and print out the GSA Invitation Letter to the 2018 Annual Meeting via a link at community.geosociety.org/gsa2018/visaletter.

Hotels

GSA has selected a range of hotels in terms of proximity to the Indiana Convention Center (ICC) at rates and styles to meet your needs and preferences. Below is the list of hotels and group rates for our block. Rates are in U.S. dollars and do not include the current applicable tax of 17% per room, per night. Complimentary basic Internet will be provided in all guest rooms booked through GSA/VisitIndy Housing Bureau.

When making your hotel reservation, please check the type of room you are reserving. Some hotels will only offer “run of house” inventory. Run of house means you can request the type of room you want (room with one bed or room with two beds) but ultimately the hotel will determine which room you receive based on their availability at the time of check-in. Other hotels will offer a specific bed type when reserving a room (room with one bed or room with two beds). If you want to make sure you have a specific

number of beds in your room, make your reservation at a hotel that offers room inventory with a specific number of beds and not just “run of house.” Please check the GSA website for details.



ALERT: The official GSA housing bureau is VisitIndy. To receive the GSA group rate at each hotel, reservations must be made through VisitIndy and not directly with the hotels. GSA and VisitIndy will NOT contact attendees directly to solicit new reservations. If you are contacted by a vendor who claims to represent GSA, please notify the GSA Meetings Department at meetings@geosociety.org or +1-303-357-1041. Please do not make hotel arrangements or share any personal information through any means other than a trusted, reliable source.

Hotel	Rate (tax not included)	Each Additional Adult (3rd & 4th person)	Distance to ICC	Parking Daily/ 24 hr**
JW Marriott (HQ)	US\$199	US\$25	Skywalk	US\$48 Valet / US\$43 Self
Courtyard by Marriott Indianapolis Downtown	US\$179	US\$25	Skywalk	US\$35 Valet / US\$32 Self
Crowne Plaza Indianapolis Downtown	US\$184	US\$25	Skywalk	US\$38 Valet / US\$28 Self
Embassy Suites Indianapolis–Downtown*	US\$180	US\$25	Skywalk	US\$22 Self
Fairfield Inn & Suites by Marriott Downtown*	US\$169	US\$25	Skywalk	US\$35 Valet / US\$32 Self
Hampton Inn Downtown*	US\$150	US\$20	2 blocks	US\$28 Valet
Hilton Indianapolis Hotel & Suites	US\$165	US\$25	3 blocks	US\$44 Valet / US\$38 Self
Hilton Garden Inn Downtown	US\$141	US\$10	5 blocks	US\$29 Valet / US\$26 Self
Holiday Inn Downtown	US\$142	US\$10	6 blocks	US\$20 Self
Holiday Inn Express & Suites Downtown–Convention Center*	US\$142	US\$10	1 block	US\$18 Self
Indianapolis Marriott Downtown	US\$189	US\$25	Skywalk	US\$48 Valet / US\$43 Self
Omni Severin Hotel	US\$170	US\$20	Skywalk	US\$40 Valet
Springhill Suites by Marriott Indianapolis Downtown*	US\$179	US\$20	Skywalk	US\$35 Valet / US\$32 Self
Staybridge Suites Indianapolis Downtown–Convention Center*	US\$153	US\$10	2 blocks	US\$18 Self

*Breakfast included in rate (check hotel website for specifics regarding breakfast menu)

**Parking rates subject to change; additional fees for oversized vehicles

[Of Note]

In 2010, the Geological Society of America's Council voted to bring the 2018 GSA Annual Meeting & Exposition to Indianapolis, Indiana, 4–7 November. Much has happened in the interim that affects the geoscience research community, and we acknowledge that the long-range nature of planning scientific conferences sometimes conflicts with the ability to nimbly navigate a changing political, social, and economic landscape. We understand that geoscientists have a choice in where they choose to present research and network with colleagues, and that members represent a diverse range of legitimate concerns and priorities. We want to make sure that you have the best information available to make an informed decision.



Indiana's Religious Freedom Restoration Act (RFRA)

"Indy welcomes all" is a reflection of the city's ethos and their well-earned, decades-long reputation of providing exceptional hospitality to all visitors. The state's amended RFRA now aligns with Indianapolis' longstanding Human Rights Ordinance protections and the community looks forward to welcoming and serving all visitors, just as they always have.



2018 United States Elections

The 2018 United States elections will mostly be held on Tuesday, 6 Nov. 2018, which falls this year over the GSA Annual Meeting. If you are a citizen of the United States, we encourage you to register and vote. While many states have early voting, mail-in voting, or absentee voting available, we recognize that each state has its own rules. For your convenience, here are two links that may help you to determine whether you are able to vote early and attend GSA, or whether you will need to be in your state in order to vote on Tuesday, 6 Nov. We hope you will be able to vote early and join us in Indianapolis.

<https://www.usa.gov/midterm-state-and-local-elections>

<http://www.ncsl.org/research/elections-and-campaigns/absentee-and-early-voting.aspx>



Indianapolis Monumental Marathon

A unique opportunity awaits us in the running of the Indianapolis Monumental Marathon on Saturday, 3 Nov. The starting line will be one block from the Indiana Convention Center where the GSA Annual Meeting & Exposition will take place.

The Indianapolis Monumental Marathon is one of the 20 largest marathons in the U.S. and is an ideal fall marathon for everyone from the first-time marathon runner to elite athletes. Starting and finishing at the Indiana State Capitol, the course highlights landmarks and historical neighborhoods throughout Indianapolis. Not a full marathon runner? A half-marathon, 5K, and kids fun run are also planned.

We hope to capitalize on this opportunity to build community and add another fun dimension to the meeting for athletic-minded geoscientists. If you are interested in joining one of the races, you can find out more at www.monumentalmarathon.com.

While the race should not impede the majority of our activities on Saturday, it might take you a little more time to get to the convention center if you are attending a field trip, short course, or have other business that morning.



GSA Meetings RISE to the Top

We support **Respectful Inclusive Scientific Events** and are committed to ensuring a safe and welcoming environment for all participants. We expect all meeting participants to abide by the GSA Events Code of Conduct Policy (<https://goo.gl/WGAhGC>) in all venues at our meetings, including ancillary events, field trips, and official and unofficial social gatherings.

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

Downtown Indy has six thriving cultural districts, each offering a distinct mix of shopping, dining, and entertainment. Hop on one of the 250 bikes from the Pacers Bikeshare to explore the city, and dock the bike at one of the 26 stations once you are done.

Mass Ave: 45 Degrees from Ordinary

Known for its art galleries and theaters, this free-spirited, five-block avenue is lined with boutique shopping, independent restaurants, traditional pubs, and public art. An array of theaters offers visitors their pick of traditional plays and musicals, off-beat productions, edgy and adult-oriented drama, improv, and stand-up. Before the show, visit the Kurt Vonnegut Museum + Library or grab your locally handcrafted Indy souvenir from one of the boutiques.

Fountain Square: Funky. Artsy. Retro. Anything but Square

Experience vintage charm, shop galleries of talented local artists, take swing dancing lessons, and try your hand at duckpin bowling, all in this funky neighborhood. Visitors can also dine at an assortment of locally owned restaurants, enjoy a honey wine flight at Indiana's only meadery, and tour a microbrewery where scientists create the recipes.

Wholesale District: Welcome to the Main Event

Entertainment is front and center in the Wholesale District, set in the heart of the central business district. Here you will find your favorite hotel brands surrounded by the retro-style Bankers Life Fieldhouse—home of the NBA Pacers and concerts by big-name acts; Lucas Oil Stadium—home of the NFL Colts and Super Bowl 2012; and the versatile Indiana Convention Center. Circle Center Mall, a four-story shopping hub, and Georgia Street, a

unique outdoor event promenade, connect these major event venues. Just steps away are attractions such as Monument Circle, the Indianapolis Symphony Orchestra, Indiana Repertory Theatre, comedy clubs, steakhouses, sports bars, and more.

Market East: An Emerging District

This up-and-coming district has grown into a popular location with many new developments and accommodations. Located in the heart of the district is City Market, a historic market with 36 artisan food vendors and a farmer's market every Wednesday. More than US\$225 million in investment is bringing retail, residential, and new office towers online. Access to the district has become easier than ever with the recent opening of the state-of-the-art Julia M. Carson Transit Center, home of the city's public transit.

Indiana Avenue: Rhythm. Reborn

Indiana Avenue celebrates the rich cultural heritage of the African-American community in Indianapolis. The cornerstone of this neighborhood is Madame Walker Theater Center, a great place to hear jazz on an historic stage that has seen the likes of Wes Montgomery and Louis Armstrong. The theater stands in honor of America's first self-made female millionaire and hosts an eclectic line-up of performances.

Broad Ripple Village: We're Open if You Are

Just north of downtown is a lively neighborhood with a mix of one-of-a-kind shops, art galleries, innovative chefs, and popular nightlife spots. This trendy village is also highlighted by the popular Monon greenway and is known as where "Mr. Top 10," David Letterman, grew up.

GSA 2018

4-7 November
Indianapolis, Indiana, USA

Pedal boats and gondolas offer different ways to explore the Central Canal. Photo courtesy of VisitIndy.

Event Space & Event Listing Requests



► **Deadline for first consideration:** 6 June

Please let us know about your non-technical events via our online event space & event-listing database. Space is reserved on a first-come, first-served basis; in order to avoid increased fees, you must submit your request for meeting rooms by 6 June. The event space & event listing submission should be used for meeting rooms to hold events (i.e., business meetings, luncheons, receptions, etc.):

- At the Indiana Convention Center (ICC) or JW Marriott Indianapolis—with no food/beverage minimum or room rental fee from the facility/hotel; and/or
- For off-site events (events that are not being held at the ICC or JW Marriott Indianapolis). Ensure that your event is listed in the meeting program book, in the personal scheduler, and the mobile app, as well as on the GSA website.

If your event is private or by “invitation only,” please indicate that and limit who has access to the information. For example, for private events, you simply check the “private” box and the information won’t be included in any of our listings. If your event is by invitation only, please indicate that in the notes to GSA section.



GSA is dedicated to attracting the best and brightest minds to our science. Since 2013, more than 500 students from diverse backgrounds have been funded to attend their first GSA Annual Meeting. Students can apply before 25 May 2018 for a travel award to the Annual Meeting in Indianapolis, Indiana, 4–7 November 2018. At the meeting, students will have special opportunities to be paired with a mentor, attend special morning sessions, and network with GSA leadership.




community.geosociety.org/otf


Scientific Field Trips


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

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

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

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

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


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

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


407. Kirk Bryan Field Trip: At the Edge of the Laurentide Ice Sheet: Stratigraphy and Chronology of Glacial Deposits in Central Indiana. Sat., 3 Nov. **Cosponsor:** *GSA Quaternary*


Geology & Geomorphology Division. **Leaders:** Henry Loope, Indiana University; José Luis Antinao; G. William Monaghan.

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

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

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

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

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

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

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

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



Economic Geology



Energy



Engineering



Hydrogeology and
Environmental Geology

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

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

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

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

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

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

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

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

423. **A Day at the Museum: Behind-the-Scenes Tour of Collections, Exhibits, and Programming at Indianapolis Museums.** Thurs., 8 Nov. **Leaders:** Polly Sturgeon, Indiana University; Peggy Fisher-Keller; Eloise Batic; Dallas Evans.

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

425. **Devonian Black Shales of the Appalachian and Illinois Basin.** Thurs.–Fri., 8–9 Nov. **Cosponsors:** *Juergen Schieber; Zalmay Yawar; Zhiyang Li.* **Leaders:** Juergen Schieber.

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



Assorted fossils.



Granary. Photo by William Elliot.



Short Courses

Learn and explore a new topic. Build your skills.



Learn

- Digital Geoscience Education
- Open Educational Resource Modules
- Curriculum-Based Undergraduate Research Experiences
- Unconscious Bias and Active Bystander Intervention Training

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- Micropaleontology and Biostratigraphy
- Detrital Zircon Geochronology
- Geological Mapping
- Ground Penetrating Radar
- High Resolution Topography and 3D Imaging
- Limnogeology
- Dynamic Content
- Drones in the Geosciences
- Brittle and Ductile Deformation
- Petroleum Systems Fundamentals

Strengthen

- Data Science
- Earth History Visualization
- Mobile Mapping on Android Devices
- Building Mobile Apps
- Taking Students into the Field on Their Own Time
- Field Safety Leadership

Gain Tips

- Strengthening Students' Spatial Thinking Skills
- Diversity in Two-Year College Geoscience Programs
- Using Sketch Comedy and Stand-up in Geoscience Teaching
- Writing for Geologists whose Native Language is not English

Students, Early Career Professionals, and K-12 Teachers

- Sequence Stratigraphy
- Structure and Stratigraphy Used for Basin Exploration
- Selling Yourself at GSA
- Creating Meaningful Experiences in School Settings



4-7 November

Indianapolis, Indiana, USA

This is a great opportunity to earn continuing education credits!

community.geosociety.org/gsa2018/science-careers/courses



SPECIAL PAPER 523:

**The Web of Geological Sciences:
Advances, Impacts, and Interactions II**

Edited by Marion E. Bickford

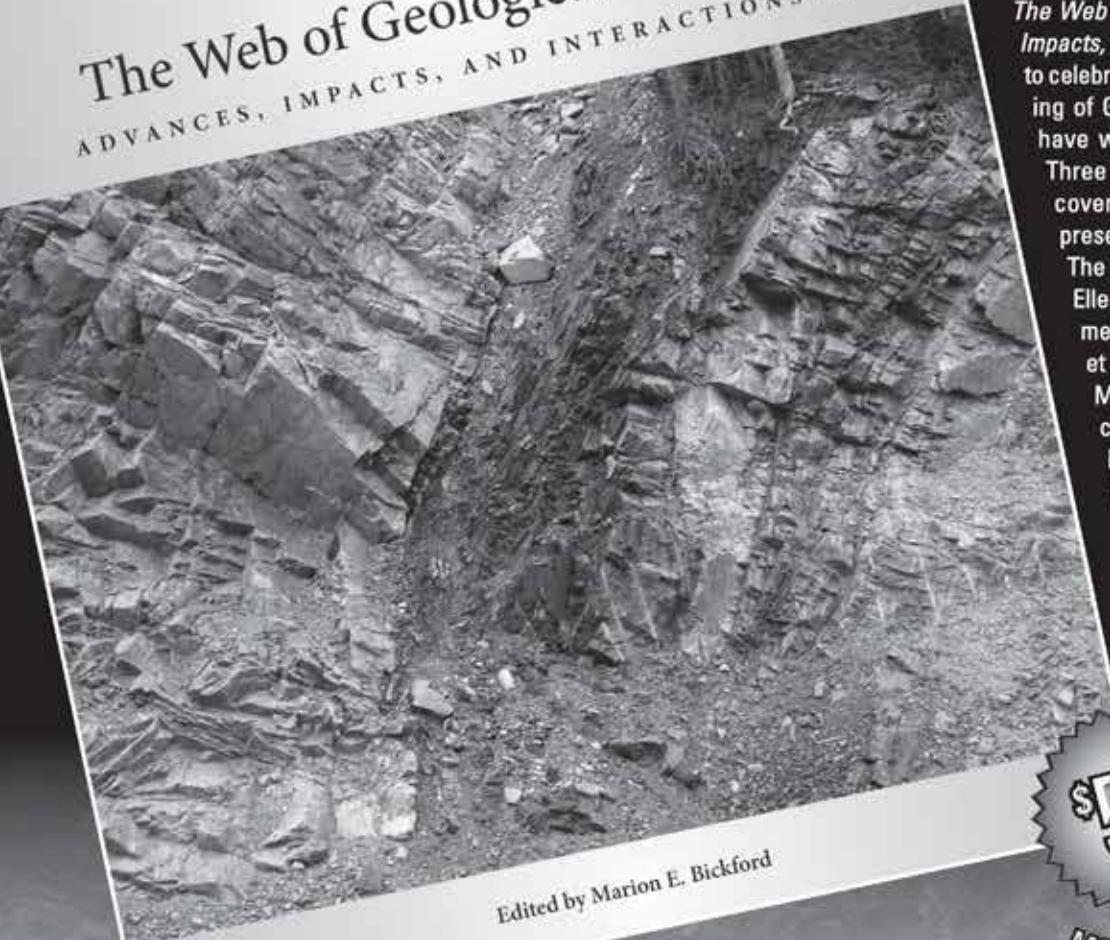
This book is a follow-up to Special Paper 500: *The Web of Geological Sciences: Advances, Impacts, and Interactions*, which was prepared to celebrate the 125th anniversary of the founding of GSA, and whose theme was "What have we learned in the last fifty years?"

Three important disciplines that were not covered in the first book are engagingly presented here: "Earth's dynamic surface: The past 50 years in geomorphology" by Ellen Wohl et al.; "The metamorphosis of metamorphic petrology" by Frank Spear et al.; and "The Archean-Hadean Earth: Modern paradigms and ancient processes" by Paul Mueller and Allen Nutman. Readers will find these chapters comprehensive and readable. They will appeal to professional scientists and especially to teachers.

SPE523, 237 p., ISBN 9780813725239
list price \$80.00



The Web of Geological Sciences
ADVANCES, IMPACTS, AND INTERACTIONS II



Edited by Marion E. Bickford

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THE
GEOLOGICAL
SOCIETY
OF AMERICA®

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

Deadline: 15 June 2018

Terms begin 1 July 2019 (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.

Use the online form at www.geosociety.org/nominate to make a nomination or self-nomination. Committee open positions and qualifications are also listed there. GSA headquarters contact: Dominique Olvera, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA; fax: +1-303-357-1060; dolvera@geosociety.org.

B—Meets in Boulder or elsewhere; **E**—Communicates by phone or electronically; **M**—Meets at the Annual Meeting; **T**—Extensive time commitment required during application review period.

ANNUAL PROGRAM COMMITTEE

Two Member-at-Large vacancies (4-year term; B, E, M); one Student Member-at-Large (2-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 the 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. One member-at-large should have previous meeting experience.

ARTHUR L. DAY MEDAL AWARD

Two Member-at-Large vacancies (3-year term; 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 of 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

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

This committee provides advice and support to GSA Council and initiates activities and programs that will increase opportunities for people of ethnic minority, women, and persons with disabilities and raise awareness in the geosciences community of the positive role these groups play within the geosciences. The committee is also charged with stimulating recruitment and promoting positive career development for these groups.

Qualifications: Members of this committee must be familiar with

the employment issues these groups face; expertise and leadership experience in such areas as human resources and education is also desired.

EDUCATION COMMITTEE

Three vacancies: 4-Year College Faculty Representative (4-year term; B, E, M), Member-at-Large (4-year term; B, E, M), Graduate 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.

GEOLOGIC MAPPING AWARD COMMITTEE

Two vacancies: Member-at-Large (3-year term; E), Student Member-at-Large (3-year term; E)

The purpose of this committee is to generate, receive, and evaluate candidates for the Geologic Mapping Award. This award acknowledges contributions in published high-quality geologic mapping that led the recipient to publish significant new scientific or economic-resource discoveries and to contribute greater understanding of fundamental geologic processes and concepts. The objective is to encourage training and support toward the production of excellent, accurate, detailed, purposeful geologic maps and cross sections. With respect to size or scale, there are no restrictions on map products. GSA's Geological Mapping Award will be made on an annual basis, leaving the option open for multiple awards to be given under unusual circumstance in any given year or to make no award in any given year.

GEOLOGY AND PUBLIC POLICY COMMITTEE

One vacancy: Member-at-Large (3-year term; B, 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 general public and for GSA members; and familiarity with appropriate techniques for the dissemination of information.

GSA INTERNATIONAL

Four vacancies: Member-at-Large, Secretary, IIG Chair, and Chair (4-year terms; 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.

JOINT TECHNICAL PROGRAM COMMITTEE

Two vacancies: Member-at-Large, Member-at-Large Marine/Coastal Geology (2-year term, 1 Dec. 2018–30 Nov. 2020; B, E).

Members of this committee help finalize the technical program for GSA's annual meetings by participating in the web-based selection and scheduling of abstracts, as well as topical session proposal review. **Qualifications:** Members must be familiar with computers and the Internet, be a specialist in one of the specified fields, and be available in late July–mid-August for the organization of the annual meeting technical program.

MEMBERSHIP AND FELLOWSHIP COMMITTEE

Two vacancies: Members-at-Large Academia (3-year term; B, T)

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. **Qualifications:** 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. **Extensive time commitment February–March.**

NOMINATIONS COMMITTEE

Two Members-at-Large vacancies (3-year term; 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.

PENROSE CONFERENCES AND FIELD FORUMS COMMITTEE

Two Members-at-Large vacancies (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 past conveners of a Penrose Conference or Thompson Field Forum.

PENROSE MEDAL AWARD COMMITTEE

Two Member-at-Large vacancies (3-year term; 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

Two vacancies: Student Member-at-Large (3-year term; E), Former Councilor (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.

PUBLICATIONS COMMITTEE

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

The primary responsibilities of the committee are nomination of candidates for editors when positions become vacant; reviewing the quality and health of each Society publication and reporting with an annual report to Council that includes recommendations for changes in page charges, subsidies, or any other publishing matter on which Council must make a decision. To carry out this charge, headquarters will provide the committee with all necessary financial information.

RESEARCH GRANTS COMMITTEE

Nine Members-at-Large vacancies with various specialties (3-year term; B, T)

The primary function of this committee is to evaluate the research grant applications received, by delegation of the Council's authority and within the limits of the research grants budget, to award specific grants to chosen recipients. The committee will also act on the distribution of funds derived from any other gifts or memorial or award funds that are to be administered by it. **Qualifications:** Members should have experience in directing research projects and in evaluating research grant applications. **Extensive time commitment required 15 Feb.–15 April.**

YOUNG SCIENTIST AWARD (DONATH MEDAL) COMMITTEE

Two vacancies: Member-at-Large, Councilor/Former Councilor (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 of the committee's work will be accomplished during the months of February and March. All committee decisions must be made by 1 April.

Committee, Section, and Division Volunteers: Council Thanks You!

GSA Council acknowledges the many member-volunteers who, over the years, have contributed to the Society and to our science through involvement in the affairs of the GSA. Your time, talent, and expertise help build a solid and lasting Society.

In Memoriam



The Society notes with regret the deaths of the following members (notifications received between 1 November 2017 and 28 February 2018).

Hans G. Ave Lallemand
Houston, Texas, USA
Date of death: 14 Nov. 2016

Irene B. Boland
Rock Hill, South Carolina, USA
Notified: 23 Jan. 2018

David A. Brew
Los Altos, California, USA
Date of death: 7 Nov. 2017

Don F. Carlos
Glendale, California, USA
Date of death: 14 Oct. 2017

Xunhong Chen
Lincoln, Nebraska, USA
Date of death: 22 Oct. 2015

Joe S. Creager
Kenmore, Washington, USA
Date of death: 1 Nov. 2015

Rodger E. Denison
Dallas, Texas, USA
Date of death: 8 July 2016

Joseph N. DiBenedetto
Helper, Utah, USA
Date of death: 27 Apr. 2015

John R. Dyni
Boulder, Colorado, USA
Date of death: 24 Sept. 2017

Edwin H. East
Bothell, Washington, USA
Date of death: 18 Aug. 2017

Jacob Eisel
Boulder, Colorado, USA
Date of death: 23 Feb. 2018

Wolfgang E. Elston
Albuquerque, New Mexico, USA
Date of death: 29 Feb. 2016

Noah Fishman
Midland, Texas, USA
Date of death: 4 Nov. 2015

G. Sidney Fox
Campo, California, USA
Date of death: 12 Nov. 2017

Keith H. Gerlach
Petersburg, Alaska, USA
Date Notified: 25 January 2018

Robert N. Ginsburg
Miami, Florida, USA
Date of death: 1 July 2017

William C. Goth
Camarillo, California, USA
Date of death: 8 Sept. 2017

David W. Greenlee
Buda, Texas, USA
Date of death: 1 Jan. 2018

Russell G. Harter
Los Angeles, California, USA
Notified: 11 Jan. 2018

Paul L. Heller
Laramie, Wyoming, USA
Date of death: 6 July 2016

Arthur H. Johnson
Kenner, Louisiana, USA
Notified: 20 Dec. 2017

Alan V. Jopling Fairlight
New South Wales, Australia
Date of death: 1 Aug. 2017

Robert O. Karsian
Englewood, New Jersey, USA
Date of death: 1 Nov. 2017

David Henry Krinsley
Eugene, Oregon, USA
Date of death: 5 Nov. 2017

Karla E. Kuebler
Webster Groves, Missouri, USA
Date of death: 8 Jan. 2018

Helen M. Lang
Morgantown, West Virginia, USA
Date of death: 17 Dec. 2017

James A. Lawrence
Truth or Consequences, New Mexico, USA
Date of death: 7 May 2017

Nancy Lindsley-Griffin
Jacksonville, Oregon, USA
Date of death: 20 Nov. 2017

Christopher J. Lombardi
Piscataway, New Jersey, USA
Notified: 29 Jan. 2018

Ursula Bailey Marvin
Cambridge, Massachusetts, USA
Date of death: 12 Feb. 2018

Mark McDonald
Bismarck, North Dakota, USA
Date of death: 19 Sept. 2016

John Ezra Moore
Denver, Colorado, USA
Notified: 12 Jan. 2018

Mona L. Nemecek
Indianapolis, Indiana, USA
Notified: 28 Feb. 2018

Emil Fred Pashley Jr.
Ogden, Utah, USA
Date of death: 24 Oct. 2017

Richard Howard Pearl
Portland, Oregon, USA
Date of death: 30 Apr. 2017

Dale Pendell
Penn Valley, California, USA
Date of death: 13 Jan. 2018

William J. Perry Jr.
Boulder, Colorado, USA
Date of death: 1 Feb. 2018

Christopher A. Rautman
Albuquerque, New Mexico, USA
Date of death: 12 May 2017

Charles M. Riley
Houston, Texas, USA
Date of death: 1 Apr. 2017

William D. Rose Jr.
Brookeville, Maryland, USA
Date of death: 23 Dec. 2017

William D. Sevon
Grafton, Massachusetts, USA
Date of death: 8 Oct. 2017

John H. Spang
League City, Texas, USA
Notified: 12 Dec. 2017

Neil L. Turner
Fulshear, Texas, USA
Date of death: 17 Sept. 2017

Jim VanKirk
Frisco, Texas, USA
Date of death: 31 Oct. 2017

Thomas E. Ward
Seattle, Washington, USA
Date of death: 1 Jan. 2015

Richard E. Wise
Bakersfield, California, USA
Notified: 6 Nov. 2017



GSA Division Awards



■ GEOLOGY AND SOCIETY

The E-an Zen Fund Geoscience Outreach Grant

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The Geological Society of America and the Geology & Society Division are pleased to announce a new grant opportunity for GSA members interested in developing innovative methods to bring geoscience knowledge to public audiences. Application materials should be submitted by 1 June in a single PDF to Dave Szymanski, Geology & Society Division past-chair, at dszymanski@bentley.edu; community.geosociety.org/gsocdivision/new/zenfund.

■ HISTORY & PHILOSOPHY OF GEOLOGY

History & Philosophy of Geology Student Award

Nomination deadline: June 15

The History and Philosophy of Geology Division of the Geological Society of America sponsors an Award for the best paper in history and philosophy of geology to be submitted for presentation by the student at the annual GSA meeting. The proposed paper may be: (1) a paper in the history and philosophy of geology; (2) a literature review of ideas for a technical work or thesis/dissertation; or (3) some imaginative aspect of the history and philosophy of geology we have not thought of before.

The paper may be in either oral or poster form, and presented at the History & Philosophy of Geology disciplinary session. For more information, please contact Kathleen Lohff, secretary/treasurer, History & Philosophy of Geology Division, at kathylohff@msn.com; community.geosociety.org/histphildiv/awards#student.

■ LIMNOGEOLOGY

Kerry Kelts Student Research Award:

Application deadline: 30 June

This award for undergraduate or graduate student research is named in honor of Kerry Kelts, a visionary limnogeologist and inspiring teacher. This year, one award of US\$1,000 for research related to limnogeology, limnology, or paleolimnology is available. For more information, go to rock.geosociety.org/limno/Kelts_Award_2017_announcement.html.

■ PLANETARY GEOLOGY

Ronald Greeley Award for Distinguished Service

Nomination deadline: 30 June

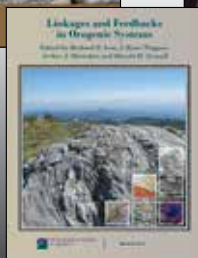
This award may be given to those members of the Planetary Geology Division (PGD), and those outside of the Division and GSA, who have rendered exceptional service to the PGD for a multi-year period. For more information, go to rock.geosociety.org/pgd/distinguished-service.html.

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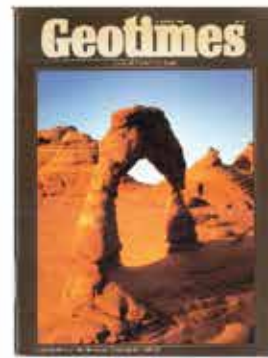
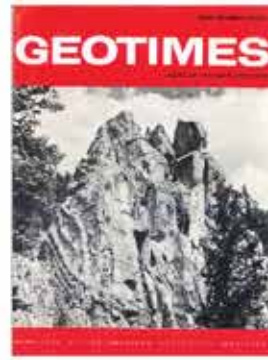
Notice of 2018 Spring Council & Corporate Meetings

All GSA members are invited to attend the open portions of Council Meetings and the Annual Corporate Meeting. To attend, contact Susan Lofton in advance for building access information and latest meeting times: slofton@geosociety.org.

- ▶ **Day 1:** Saturday, 5 May 2018
9 a.m.–4:30 p.m.
4:30–5:30 p.m.* (GSA Annual Corporate Meeting)
- ▶ **Day 2:** Sunday, 6 May 2018
7:30 a.m.–3 p.m.*

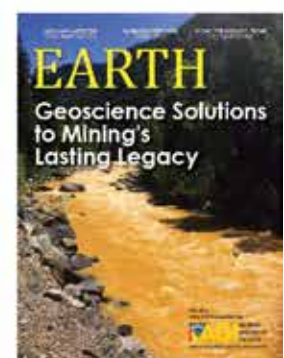
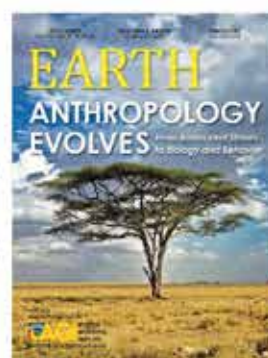
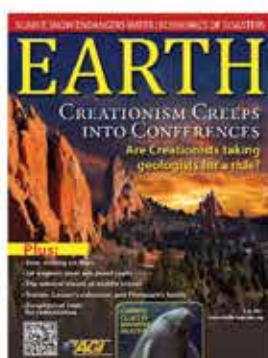
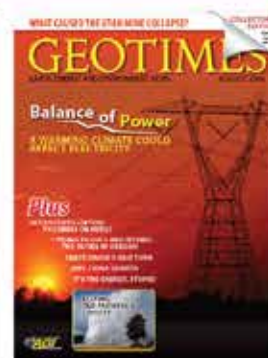


*Actual meeting times may vary. Meetings will be held at the GSA Headquarters in Boulder, Colorado, USA.



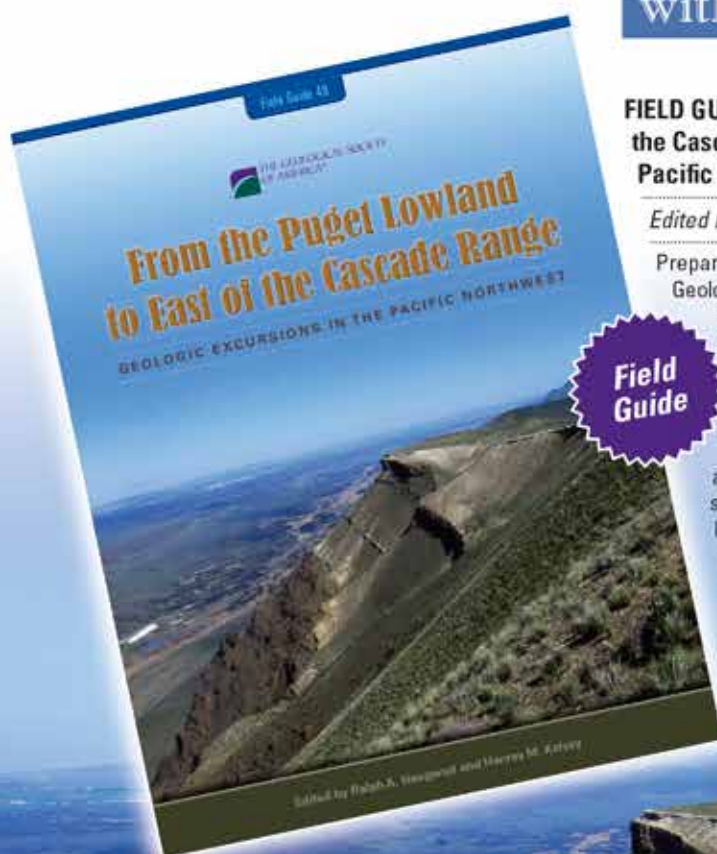
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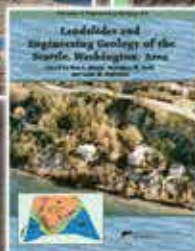
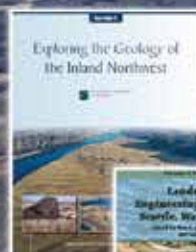
Field
Guide

FIELD GUIDE 49 ▶ From the Puget Lowland to East of the Cascade Range: Geologic Excursions in the Pacific Northwest

Edited by Ralph A. Haugerud and Harvey M. Kelsey

Prepared in conjunction with the 129th annual meeting of the Geological Society of America, this compelling volume contains guides that geographically focus on the Seattle, Washington, area within the Puget lowland, and also includes descriptions of trips in the Cascade Range and the region east of the Cascades. Highlights of the guides include a journey through the region that was affected by an earthquake on the Seattle fault 1100 years ago, a trip to the coast to look at tsunami deposits, trips that show evidence of past glaciations that inundated the Puget lowland, and trips that highlight catastrophic flooding and blankets of wind-blown silt, both of which covered the area east of the Cascades due to continental glaciations. Multiple trips help unravel the complex but fascinating geological history of the Cascade Range.

FLD049, 254 p., ISBN 9780813700496
| \$60.00 | member price \$42.00 |



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GeoTeachers K-12 Teacher Professional Development Workshops for 2018

Garden of the Gods, Colorado Springs, Colorado, USA. Photo by Dean Moosavi.

Workshop Registration

Status

Flagstaff, Arizona, USA, 23-27 July	OPEN
Colorado Springs, Colorado, USA, 30 July-3 Aug.	OPEN
Indianapolis, Indiana, USA, Annual Meeting Mini-Workshop, 2-4 Nov.	OPENS 1 JULY



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Applicants should send by US mail a curriculum vitae, graduate transcripts, a statement of experience managing analytical facilities, and the names and contact information for three references to: Chair, Search Committee, Dept. of Geological Sciences, PO Box 24606, S-389 ESC, Brigham Young University, Provo, UT, 84602. Applications will be considered until May 31, 2018.

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- **Rock Stars:** Into science bios? Each Rock Stars article, managed by GSA's History and Philosophy of Geology Division (www.geosociety.org/RockStarGuide), provides a two-page profile of a notable geoscientist whose contributions have impacted geoscience in a significant way.



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Charting the Geosciences with Google Ngram Viewer

Danita S. Brandt, Department of Earth and Environmental Geosciences, Michigan State University, East Lansing, Michigan 48824, USA, brandt@msu.edu

INTRODUCTION

Frequency of mention in books can be used to trace the evolution of a discipline, from the first recorded use of the word or phrase to its current standing, as measured by the number of books that include the phrase. Ngram Viewer, the tool developed by a team at Google Books (Michel et al., 2011) places a database (“corpus”) of >500 billion words at the disposal of its users (<http://books.google.com/ngrams>). Here I describe how this tool can be used to examine patterns suggested by qualitative ideas about the intellectual development of the geosciences. An example of the Ngram Viewer output is given in Figure 1.

N-GRAMS

An N-gram is a contiguous string of n items from a given sequence of text or speech. A 1 gram (also known as a unigram) is a string of characters uninterrupted by a space, e.g., “trilobite” or “3.14159.” An N-gram is a sequence of 1 gram, e.g., “trilobite extinction” (2 gram or bigram), and “Michigan State University” (3 gram or trigram). N-grams are used by computer scientists and computational linguists for text mining and natural language processing (Jurafsky and Martin, 2014). Google Books, a service of search-engine giant Google Inc., has amassed a database of more than 25 million scanned books. From this resource, a subset of over five million books, chosen for the quality of their optical scan and metadata (e.g., date of publication), comprises the corpus of Google Ngram Viewer. Currently, Ngram Viewer is restricted to a maximum word string length of $n = 5$ (five-grams), and counts only N-grams that occur at least 40 times in the corpus. The data consist of books published from the 1500s to 2000, and includes children’s literature, trade, and other books but no journal articles. The full data set is

available at www.culturomics.org and www.ngrams.googlelabs.com.

CAVEATS TO USING THE CORPUS

Problems with the unfiltered use of the Google Books corpus are well-documented, including errors introduced during optical scanning and entering metadata (Nunberg, 2009). Pechenick et al. (2015) described limits to inferring cultural and linguistic evolution from the Google N-gram corpus, including the problem of the burgeoning number of scientific texts since 1990, which skews the results toward academic usage of N-grams and is therefore less reflective of cultural context. However, if the user’s purpose is to trace the history of a scientific discipline rather than a cultural phenomenon, as the purpose is here, the bias Pechenick et al. (2015) described skews in a constructive direction. Because the database consists of books only, rather than journal articles, N-gram results might lag the intellectual development of a discipline.

APPLICATION TO THE GEOLOGICAL SCIENCES

Ngram Viewer is useful for suggesting testable hypotheses by identifying correlations. Two important caveats to keep in mind when using Ngram Viewer are, as in any analysis, correlation does not necessarily indicate causation, and, as with any online resource (Wikipedia, for example), Ngram Viewer provides a starting point to stimulate further investigation, not an end in itself. Here, in approximate chronological order, are three examples of Ngram Viewer searches drawn from geological topics chosen to illustrate the potential and the limitations of these data. Search terms and phrases (the N-grams) are enclosed in quotes.

The frequency of the unigram “geology” shows an increase at 1830, coincident with publication of the first volume of Charles Lyell’s *Principles of Geology*. Volume one

was followed by volumes two and three in 1832 and 1833, respectively. The N-gram frequency chart supports the hypothesis that Lyell’s books contributed to an increase in the frequency of the unigram “geology”; the conclusion that Lyell’s work had a major impact on the growth of geology is supported independently by historians of our discipline (Rudwick, 2010).

N-gram frequency of “micropaleontology” reached a maximum in the early 1950s, coincident with that decade’s “petroleum” boom, and reflects the well-documented connection between microbiostratigraphy and petroleum exploration (Haq and Boersma, 1998). However, not all possible correlations are easily tested using Ngram Viewer; an attempt to chart the N-grams “micropaleontology” and “petroleum” on the same graph returned a display in which the line tracing the frequency of “micropaleontology” was indistinguishable from the x -axis; the frequency of the N-gram “petroleum” swamped “micropaleontology.” The corpus is also sensitive to N-gram size and word order; the trigram “extinction of trilobites” successfully returned results; a query for “trilobite extinction” returned no N-grams. Although Ngram Viewer does not allow for easy comparison of N-grams with wildly different occurrence rates, this obstacle can be overcome by downloading and replotting the Ngram Viewer data using programs such as *R*.

Cause-and-effect is suggested by the graph of “geosynclines” and “plate tectonics” (Fig. 1). The graph traces the displacement of the older “geosynclines” paradigm for explaining crustal tectonics by the emergence of “plate tectonics.” The dramatic shift from “geosynclines” to “plate tectonics” occurred in the mid-1970s, as plate tectonic theory supplanted the pre-tectonic explanation of crustal dynamics and made its way into textbooks. The apparent causal connection between the



Figure 1. Screenshot of Ngram Viewer chart showing the frequency in the Google Books corpus of the N-grams “geosyncline” and “plate tectonics,” from 1900 to 2000. Y-axis is frequency of the N-gram in the corpus.

rise of plate tectonics and the fall of geosynclines can be examined more closely by accessing the corpus on which the search is based. In addition to the chart (Fig. 1), Ngram Viewer searches return links to the corpus on which the search is based, binned by year of publication. Clicking on these bins opens a Google search page with links to each publication included in the corpus. The diligent researcher can then sort through the titles and assess the quality of the data on which the Ngram Viewer chart is based.

OTHER USES FOR N-GRAMS IN THE GEOSCIENCES

Charting word frequency trends can contribute to identifying directions for research or investment of resources. In the U.S., a number of Departments of “Geology” became Departments of “Geological Sciences” in the late 1970s and early 1980s (including the department at Michigan State University), mirroring the increase in frequency of the bigram “geological sciences.” In 2016, MSU’s department changed its name, again, to “Earth and Environmental Sciences,” reflecting the increase in frequency of the “Environmental Sciences” bigram, which started in 1990. The N-gram frequency of other geologic disciplines also chart what might be interpreted as evolving priorities, especially in the textbook-rich academic environment: References to “evolutionary biology” now approach those of “paleontology.” As frequency of the bigram “evolutionary biology” increased, through the mid-1970s, the Paleontological Society debuted its new journal, *Paleobiology*.

The decisions to change department names, revise course descriptions, and initiate new journals described here were made before there was a Google Books corpus, but these decisions were undoubtedly affected by trends in metrics, like student enrollment and funding priorities, which are now indirectly reflected in that database.

SUMMARY

The output of Google’s “shiny new toy for nerds” (Zhang, 2015), Ngram Viewer, is not sufficient to support hypotheses of causality suggested by the correlations it generates, but its accessibility and ease of use can serve an important function in introducing scholars to the possibilities of digital research (Cohen, 2010). The frequency of N-grams through time maps where we have been, and, mindful of the adage, “those who cannot remember the past are condemned to repeat it,” history ought not be ignored in identifying trends in support of education, policy, planning, and funding objectives of our discipline.

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A.M. Velbel introduced me to Ngram Viewer and was instrumental in the evolution of this manuscript. Three reviewers contributed to a more focused and improved final version.

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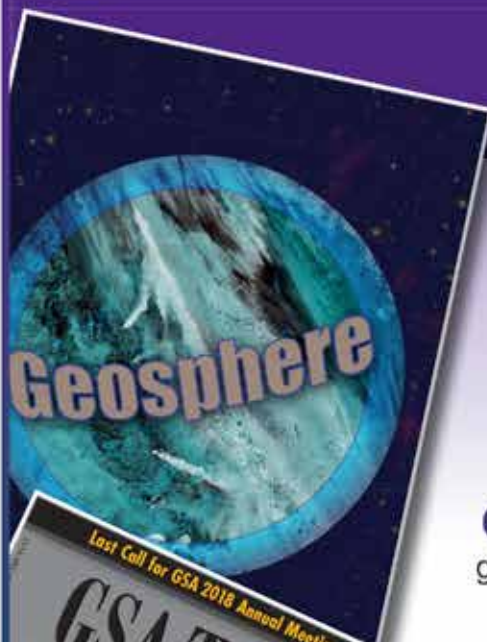
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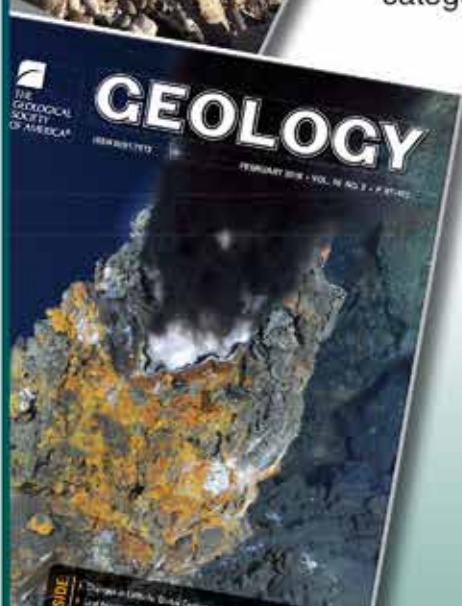
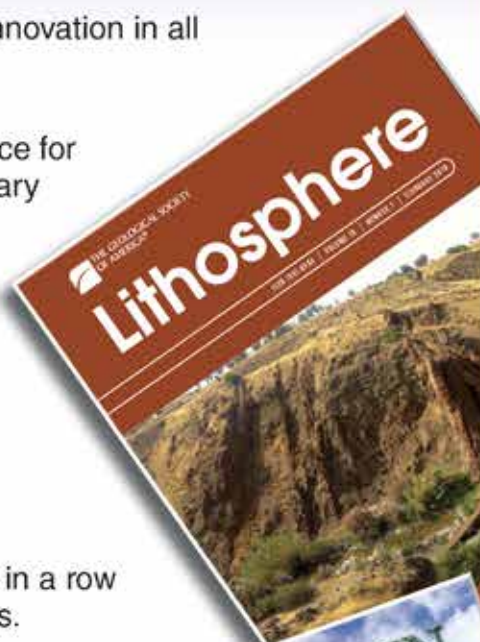
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Creating a Diverse, Welcoming Geoscience Community—An Interview with Tahlia Bear, GSA’s Diversity and Career Officer

Can you tell us about your career path that led you to GSA, including what attracted you to work for diversity and inclusivity in STEM fields?

I was the first in my family to go to college and I knew early on that I wanted to major in science. My classes were really tough my first semester and I didn’t feel prepared or supported and ended up doing poorly. Once I graduated, I was still attracted to jobs related to the environment, and since I had done summer teaching for the Upward Bound program, I wanted to work with students from underrepresented communities. Being American Indian, I have first-hand experience in knowing what challenges students face in pursuing science degrees. Throughout my career I have worked with educators, universities, and high school students who are vested in building interest in, as well as encouraging and supporting, students pursuing a degree in the sciences. This is my way of giving back.

An important aspect of your position is managing On To the Future (OTF). Since you have individual interactions with the students, can you describe the impact this program has in the lives of its participants?

I love the stories of student success! I enjoy hearing about a connection they made at the meeting that led to a graduate degree program or job interview, or has opened their horizon in some way. One of the most important elements is mentorship—each OTF student is paired with a mentor and together they navigate the annual meeting. For most participants, this is their first big scientific meeting—it can be overwhelming. The mentors and the other OTF participants help ease this stress while showing that you have a community to support you.

In what ways would you like to see OTF grow and expand?

I have enjoyed seeing past OTF students volunteer to be mentors to incoming OTF students, while others have been nominated to GSA committees or involved in the student advisory committee. The idea of giving back not only to students but to GSA is very positive. This is their organization and it’s great they want to help shape it. As far as program expansion—OTF students have an incredible sense of community, giving back, and sharing their passion for their science. I’d love to explore ways GSA can help support them in pursuing opportunities to give back to their communities.

In addition to OTF, what other ways are you working to help GSA become a more diverse and inclusive organization?

This past year I worked closely with the diversity committee to make diversity and inclusivity more visible at the annual meeting, including the Respectful Inclusive Scientific Events (RISE) initiative that is now a part of all GSA events. I’ve also ensured that GSA has a presence at minority-serving conferences. A few years ago we were able to partner with the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) to fund students to attend the SACNAS and GSA annual meetings, and I hope to do more cross-collaborative partnerships with other societies.

Join Tahlia in creating a diverse, welcoming geoscience community! Your support can ensure more student success stories in years to come. Learn how you can help at gsafweb.org/fund/on-to-the-future-fund.



Tahlia (right) addressing OTF participants and mentors during the 2017 Annual Meeting in Seattle, Washington, USA.



Tahlia enjoying a hike to Blue Lake in the Indian Peaks Wilderness, Colorado, USA.

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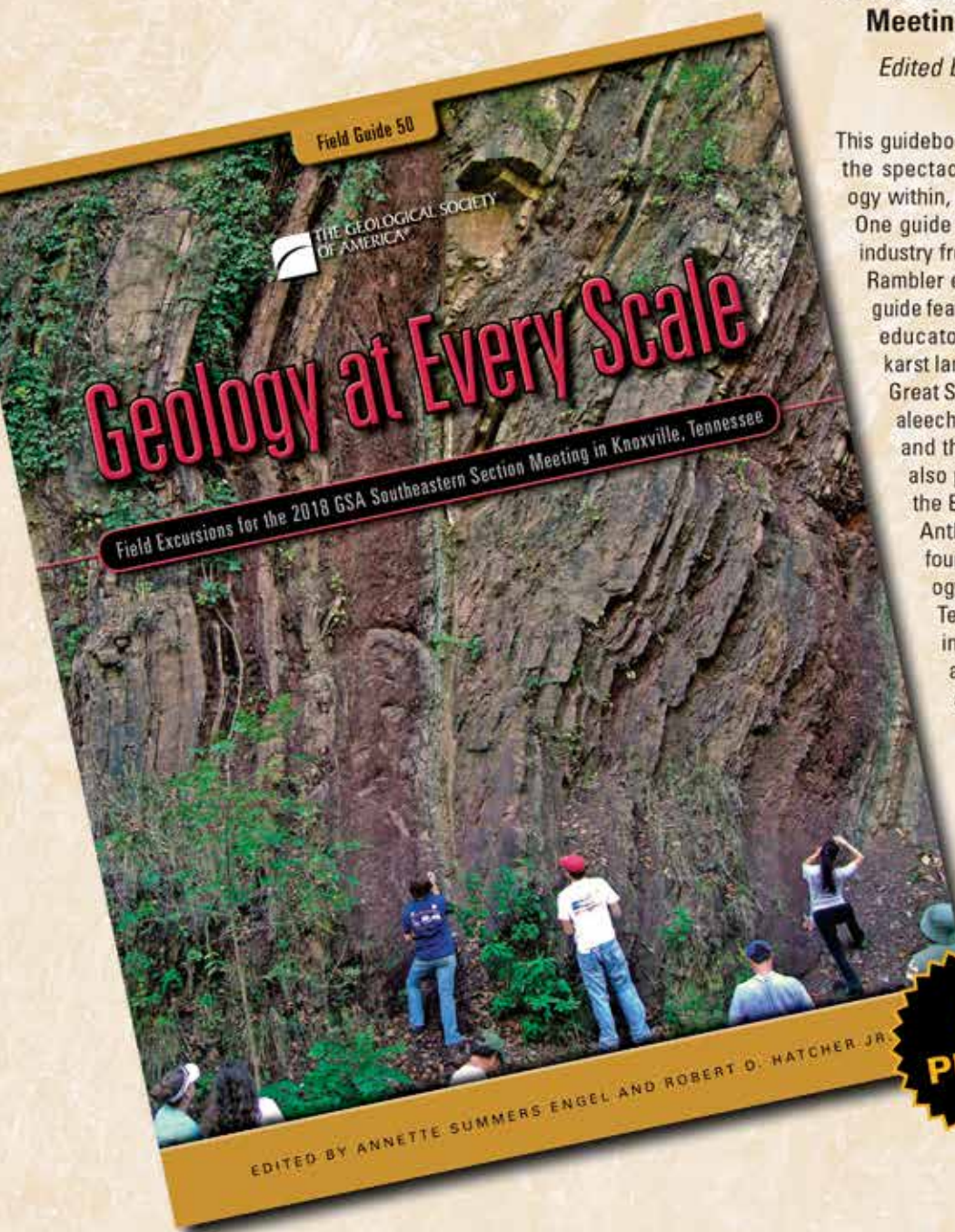


Geology at Every Scale: Field Excursions for the 2018 GSA Southeastern Section Meeting in Knoxville, Tennessee

*Edited by Annette Summers Engel and
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This guidebook contains nine field trips that highlight the spectacular sedimentary and structural geology within, and surrounding, Knoxville, Tennessee. One guide focuses on the East Tennessee marble industry from the vantage point of the Three Rivers Rambler excursion train in Knoxville, and another guide features limestone-centric lessons for STEM educators. Three guides explore the region's karst landscape and geological curiosities in the Great Smoky Mountains National Park and Tuckaleechee Cove, the Flynn Creek impact structure, and the Gray Fossil Site, for which that guide also provides training in nutrient hotspots at the Body Farm—the University of Tennessee Anthropological Research Facility. The last four guides examine regional structural geology and tectonics, including of the Eastern Tennessee seismic zone, the Nashville dome in central Tennessee, and the Blue Ridge and Inner Piedmont belts of the Carolinas and Georgia.

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