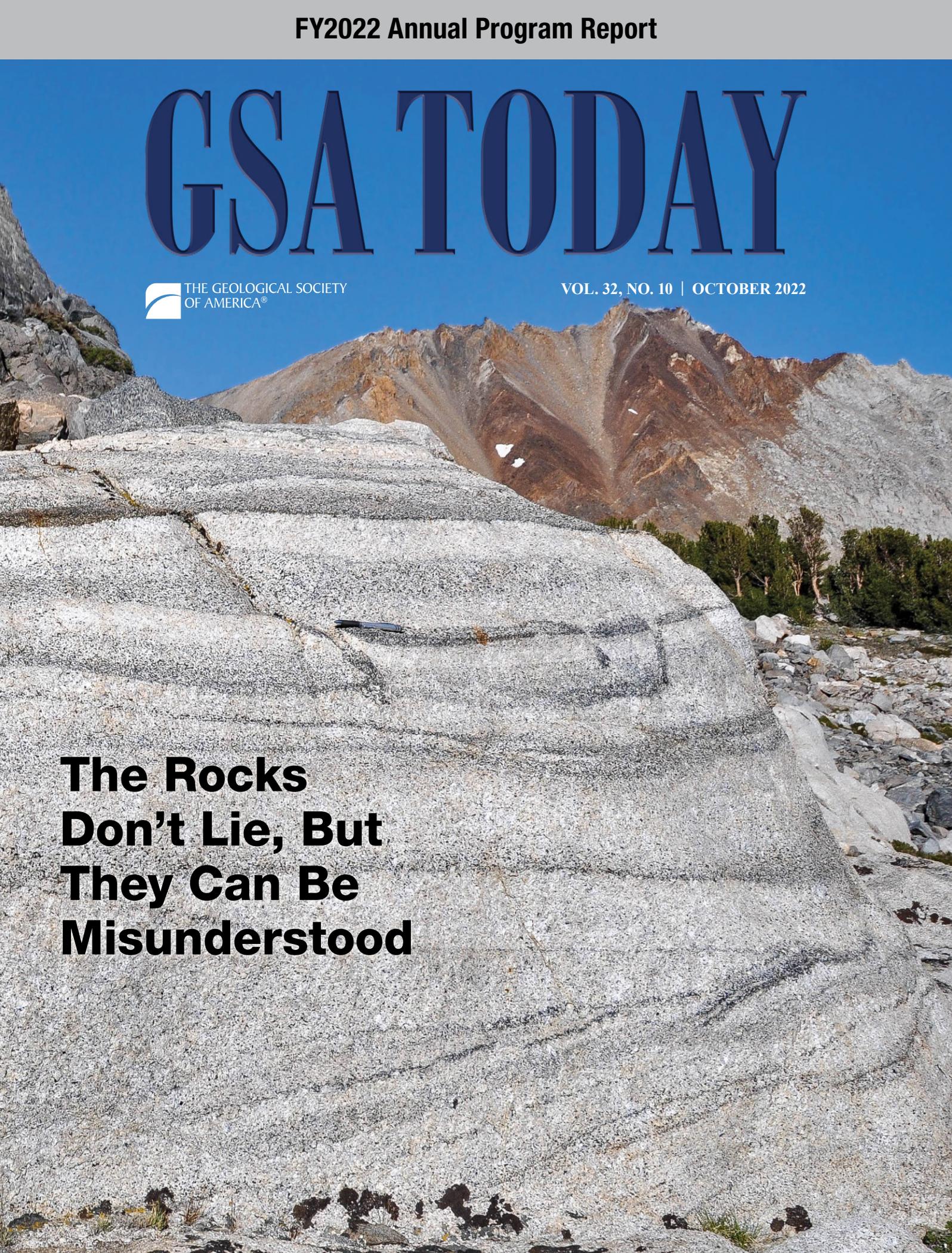


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**The Rocks  
Don't Lie, But  
They Can Be  
Misunderstood**

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## SCIENCE

### 4 The Rocks Don't Lie, But They Can Be Misunderstood

*Allen F. Glazner et al.*

**Cover:** Layering in granites resembles that in cross-bedded sedimentary rocks and is commonly interpreted to form from the same processes. Here, along the John Muir Trail near Pinchot Pass, Sierra Nevada, California, USA, layering is prominent near the roof of a Cretaceous granite; the same contact is visible on the western slope of Mount Perkins on the skyline, where dark red metamorphic rocks overlie the granite. Fluid dynamics analysis indicates that the parent magma was 6–10 orders of magnitude too viscous to permit the turbulence required to form cross-bedding. Width of foreground view ~2 m. This is an example of a conflict between field interpretation and physical analysis; dealing with such conflicts is discussed in the article on pages 4–10.



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# The Rocks Don't Lie, But They Can Be Misunderstood

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## ABSTRACT

Although the adage “the rocks don’t lie” is true—rocks are literal ground truth—their message can be misinterpreted. More generally, it is misguided to favor one form of inquiry, such as field observation, over others, including laboratory analyses, physical experiments, and mathematical or computational simulations. This was recognized more than a century ago by T.C. Chamberlin, who warned against premature adherence to a “ruling theory,” and by G.K. Gilbert, who emphasized the investigative nature of geological reasoning. Geologic research involves a search for fruitful, coherent, and causal hypotheses that are consistent with all the relevant evidence and tests provided by the natural world, and field observation is perhaps the most fertile source of new geologic hypotheses. Hypotheses that are consistent with other relevant evidence survive and are strengthened; those that conflict with relevant evidence must be either revised or discarded.

## INTRODUCTION

### The Critical Importance of Field Observations

Geology is largely a field-based science, and field evidence has long been given primacy in interpretation of the Earth. This is sometimes expressed as “the rocks don’t lie.” Rocks do indeed record Earth’s history and information about processes that link the lithosphere, hydrosphere, atmosphere, and biosphere. Understanding this record requires proper interpretation of field observations.

As field geologists, we have learned that the interpretation of field evidence is strongly shaped by what one has been taught as well as by prevailing theories and reigning paradigms. Moreover, one’s experience with

familiar materials and processes at the Earth’s surface influences the interpretation of features that formed at unfamiliar rates and/or physical conditions. The rocks don’t lie, but preconceptions and human experience can cause us to misinterpret what they reveal to us.

### A Warning from the Distant Past

In his classic, oft-discussed paper, “The Method of Multiple Working Hypotheses,” Chamberlin (1890) cautioned of the “blinding influence” of a “ruling” or “premature” theory. Because Chamberlin’s advocacy of keeping a nimble mind for one’s scientific work was written in the wordy, stilted, and androcentric prose of his time, we have rewritten and condensed a key portion in more modern language:

The moment that you come up with an explanation for a phenomenon, you develop affection for your intellectual child, and with time this grows ever stronger. You proceed rapidly to acceptance of the theory, followed by unconscious selection of data that fit and unconscious neglect of data that do not. Your mind lingers with pleasure on facts that confirm the theory and feels a natural coldness toward those that do not. You search instinctively for data that fit, for the mind is led by its desires. When these biases set in, collection of data and their interpretation are dominated by affection for the favored theory until you are convinced that it has been overwhelmingly confirmed. It then rises to a position of mind control, guiding observation and interpretation—from a favored child into your master.

When this last stage has been reached, unless the theory happens to be correct, all hope of progress is gone.

### The Nature of Geologic Investigations

Gilbert (1886, 1896) described the methods of geological research in a way that

nicely complements Chamberlin’s views. Gilbert distinguished between investigators and theorists and viewed geology as investigative. He argued that geologic hypotheses rarely arise from theory, but rather through analogical reasoning inspired by the direct study of nature (Gilbert, 1896). Gilbert’s emphasis on analogy and fruitfulness in the origin of geological hypotheses has been analyzed in detail by Baker (2014, 2017). Gilbert (1896, p. 12) stated an important caveat regarding field investigations: “However grand, however widely accepted, however useful its conclusion, [no hypothesis] is so sure that it cannot be called in question by a newly discovered fact. In the domain of the world’s knowledge there is no infallibility.”

The investigative nature of geological research has been emphasized recently by philosophers of science. Just as some crime scene evidence (e.g., fingerprints or DNA) can be highly conclusive for detective investigations, so geological questions may be most effectively resolved by what Cleland (2013) termed a “smoking gun.” Cleland cited as an example the bolide impact hypothesis for the end-Cretaceous extinctions (Alvarez et al., 1980), where excess iridium and shocked quartz provide two barrels. Cleland argued that the search for a smoking gun works especially well for distinguishing among the multiple hypotheses that commonly arise in historical natural sciences such as geology.

### Fieldwork is Challenging

The universe of observable features in geologic fieldwork is vast, so we must filter what we see to avoid paralysis. A soil scientist might pay little attention to granite bedrock, whereas a granite petrologist would likely do the opposite. This makes it difficult

to see things for which one is not looking. For example, quartz xenocrysts are common in andesites and are now recognized as clear evidence of magma mixing, but this was widely ignored for decades because fractional crystallization was the paradigm under which volcanic rocks were interpreted. The emergence of Sr-isotopic studies in the 1970s showed that this was incorrect. Similarly, for decades low-angle normal faults were mapped as thrust faults, unconformities, or gravity slides, because low-angle extensional faults were regarded as mechanically impossible. Although the mechanics of low-angle normal faults are still problematic, abundant and compelling geologic evidence has led to broad acceptance of their existence (e.g., Colletini, 2011).

Therefore, as also advocated by Chamberlin, keeping alternative hypotheses—that is, alternative explanations—in mind is important in fieldwork. A particular formation may be used as a benchmark to assign adjacent strata to other formations and work out the geologic structure. If evidence arises indicating that the rocks have been overturned, the stratigraphic assignments and structure must be revised. If one's mind is closed to this possibility, then “all hope of progress is gone.”

### Tests of Field-Based Hypotheses: Are the Rocks Lying?

Data for testing field-based hypotheses can come from multiple sources, including laboratory analyses, remote sensing, and geophysical imaging. This paper focuses on conflicts that can arise between field-based observations and information from these other sources. In cases of disagreement, a field-oriented geologist might insist that “the rocks don't lie” and, on that basis, dismiss inconsistencies with the field-based hypothesis (Fig. 1). Nevertheless, what the rocks indicate (what they “have to say to us”) may be misunderstood. Field-based interpretations that are inconsistent with results from other disciplines must be questioned, and inconsistencies should be used to drive the development of new hypotheses.

### FAILED HYPOTHESES ABOUT THE CONSTRUCTION OF PLUTONIC SYSTEMS

We begin by summarizing how new data collected during work on the Late Cretaceous Tuolumne Intrusive Suite (TIS; Fig. 2) in Yosemite National Park forced three of the authors to abandon much of what they had



**Figure 1.** In granites worldwide, accumulations of K-feldspar such as this have been interpreted variously as slurries deposited on a magma chamber floor, as concentrations produced by shear sorting during magma flow, and as masses that rose buoyantly within a magma chamber. These interpretations can be ruled out on the basis of phase equilibria, mineral chemistry, volcanic petrology, and basic physics. Are the rocks lying? Photo courtesy of Bryan Law.

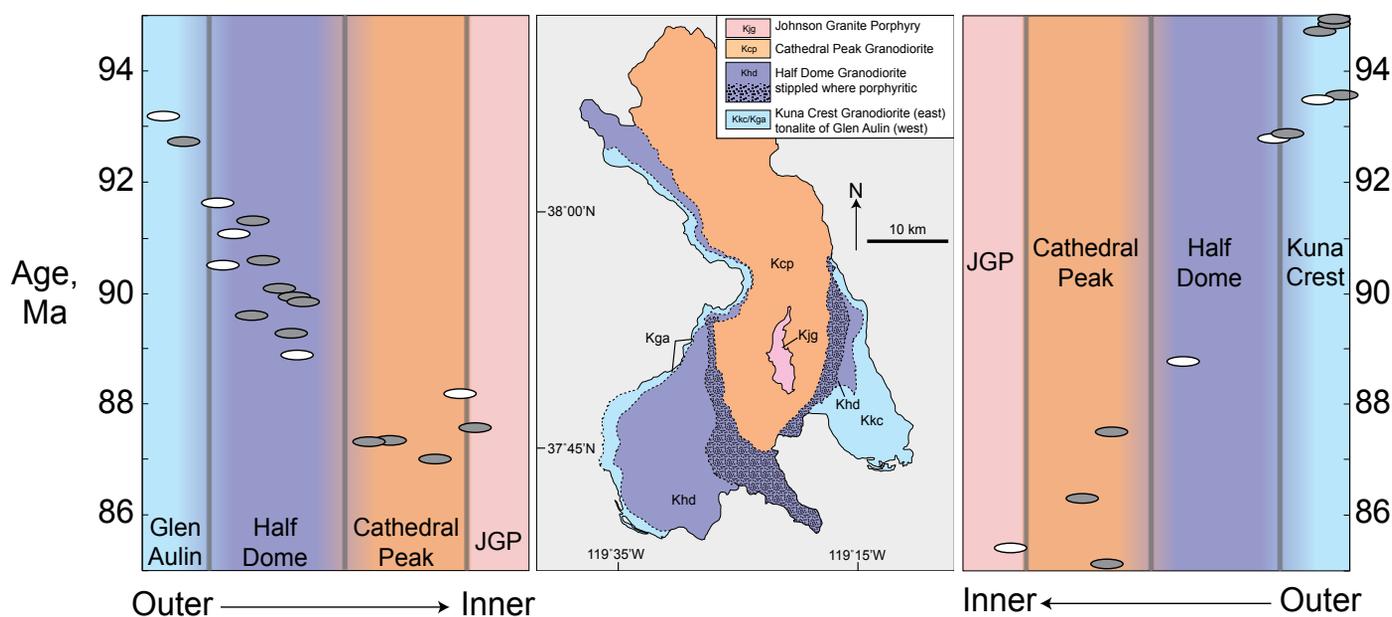
been taught about plutonic systems and to develop new explanations for how they work. Bateman and Chappell (1979) had proposed a model, widely reproduced in textbooks, in which the TIS was intruded in several distinct pulses, each of which shoved aside older, but still partially molten, material. This hypothesis makes several predictions, including that (1) construction should have taken  $\ll 1$  m.y.; (2) ages within a single pulse, and therefore a single map unit, should cluster even more tightly; and (3) such large magma chambers should show vertical gradients in composition. However, predictions 1 and 2 were contradicted by a spread of 10 m.y. in low-precision ages for the TIS (Kistler and Fleck, 1994, their fig. 14), far longer than predicted by the Bateman and Chappell model.

In 1994 we collected samples from the western side of the TIS for analysis using more advanced U-Pb techniques. In keeping with the nested-construction hypothesis, we predicted that the ages would reveal a duration of  $\sim 1$  m.y., but our results instead matched the eastward-younging 10-m.y. range of the earlier ages (Coleman and Glazner, 1997). We had been taught that science works by falsifying hypotheses, but rather than rejecting the standard model in light of these data, we sought other explanations. This is standard practice, although it conflicts with the scientific method as commonly understood;

Cleland (2001, p. 988) stated, “The famous Popperian directive to bite the bullet and reject the hypothesis in the face of a failed prediction has no logical force,” owing to auxiliary conditions on the test. In our case, we concluded that our data were not precise enough to show the true small age range that had been predicted.

Meanwhile, other conflicts with the standard model arose. We set out to measure vertical variations in the Half Dome Granodiorite of the TIS over its 1800 m of local relief, expecting to find gradients in geochemistry, mineralogy, and xenolith abundance consistent with processes in a magma chamber the size of the mapped pluton. This effort failed; we found none of the predicted vertical gradients (Gray et al., 2008), nor did Putnam et al. (2015) find them in the 1-km-tall southeast face of El Capitan. Mahan et al. (2003) concluded that the McDoole pluton south of Yosemite formed by amalgamation of vertical sheets, rather than having been intruded in one large pulse. Contacts between sheets are only noticeable where marked by screens of wall rock, and this observation planted a seed: Might there also be indistinct contacts in plutons that lacked wall-rock screens to mark them?

In 2000–2001, we used yet higher-precision analytical methods to date new samples from the western side of the TIS. These



**Figure 2.** Summary of precise U-Pb zircon ages for the Tuolumne Intrusive Suite divided between its western (left) and eastern (right) sides. Ages are plotted at their positions relative to the inner and outer contacts of a given unit. Our ages as of 2001 (white symbols) showed eastward/inward younging of the western side of the suite; we tested and confirmed this pattern in 2001 by dating samples from the eastern side. Ages determined in other labs since then (gray symbols) have also confirmed this pattern and the 10-m.y. age span. Symbol sizes roughly indicate precision of ages and placement within each unit. Ages in gray from summary in Paterson et al. (2016). JGP—Johnson granite porphyry.

results again spanned 10 m.y., and our minds started to open to the possibility that the standard model could not account for this anomaly. We hypothesized that if the TIS had been intruded over 10 m.y., then corresponding units on the eastern side (Fig. 2) should become younger westward over the same time span. New samples collected in 2001 to test this prediction confirmed the pattern, as did later U-Pb geochronology by a number of labs (Fig. 2).

The more-precise ages revealed another failed prediction of the nested-pulse hypothesis: Most age variation occurs *within* the plutons rather than *between* them; i.e., across mapped contacts. For example, dates from the Half Dome Granodiorite span ~4 m.y., but those from near its margins differ from adjacent TIS units by <1 m.y. These results led to a new hypothesis: Plutons in the TIS were amalgamated from small increments whose boundaries are difficult to see (Coleman et al., 2004; Glazner et al., 2004).

We thus began to explore the implications of incremental assembly of plutons rather than trying to fit our data into the standard model. This was challenging because many of the processes assumed to operate in plutonic magma chambers, such as convection, crystal settling, sidewall crystallization, and stoping, cannot occur at the pluton scale if only small parts of a pluton are substantially molten at any given time.

### CELEBRATED CASES WHERE GEOLOGY GOT THE BEST OF PHYSICS (APPARENTLY)

The history of geology involves well-known cases where field interpretations that were initially ruled out by physical analyses were later shown to be correct. An example is Kelvin's (1863) estimate that the Earth is <400 m.y. old, based on a thermal calculation that assumed conductive heat loss from an initially molten Earth. Compilation of an immense amount of field evidence and actualistic reasoning about process rates led geologists to insist that the Earth was much older, and that inference was ultimately vindicated by geochronology. England et al. (2007) demonstrated that the flaw in Kelvin's argument was the assumption of conductive heat transfer, and that recognition of mantle convection reconciled thermal calculations with geochronologic evidence that the Earth formed at ca. 4.5 Ga.

In another case, the continental-drift hypothesis neatly explained continuity of continental geology and paleofaunal provinces across the Atlantic Ocean and did away with the need for sunken land bridges and other speculative means of accounting for the evidence. However, physicists had correctly argued that continental drift, as originally proposed, was implausible because the mantle is far too viscous for continents to

plow through it. The problem lay not in the field observations but in the mechanism used to explain them. Development of the plate-tectonics hypothesis and the recognition that continents are carried by relatively strong lithospheric plates reconciled field geology with physics (the details of the continental drift controversy are much more complex; e.g., Oreskes, 1999).

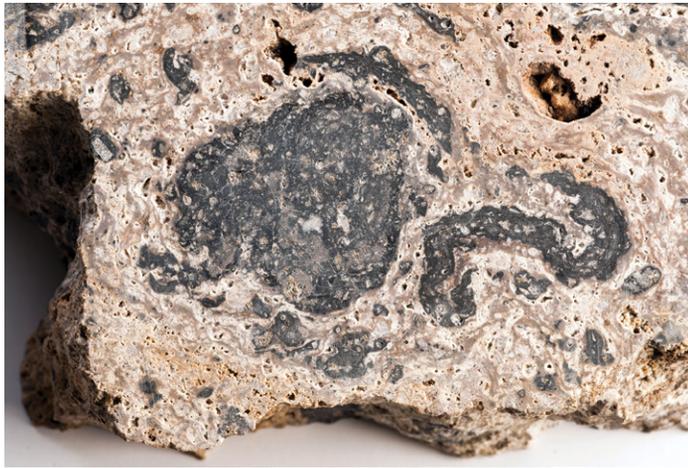
Field geology triumphed over physics in these cases not because the physics was wrong, but because incorrect physical models were used. Once a correct model was identified, the conflict evaporated.

### WHEN WHAT IS CLEAR TO THE EYE IS NEVERTHELESS UNLIKELY TO BE TRUE

In geology there are many examples where seemingly incontrovertible field interpretations turn out to be controvertible after all. A few examples follow.

#### Resolved Controversies

In Yellowstone National Park, Iddings (1899, p. 430) examined the complex contact relations of Pleistocene basalt and rhyolite lavas (Fig. 3) and stated, "It is evident... that the rhyolite fused the basalt." Fenner (1938, p. 1458) agreed and stated that "...relations that are so plainly revealed hardly permit doubt" of Iddings's interpretation. Fenner knew that this interpretation was



**Figure 3. Basalt swirls in a matrix of rhyolite from Yellowstone National Park.** Iddings (1899) interpreted relationships such as this as clear evidence that the basalt was melted by the rhyolite. Although experimental petrology in the early twentieth century showed that this is thermodynamically unlikely, Fenner (1938) concurred with Iddings's field interpretation and appealed to unknown sources of energy to explain the apparently backward melting relationships. Wilcox (1944) showed that these are simply mixed magmas, an interpretation that stands to this day (Pritchard et al., 2013). Width of view 14 cm; photo courtesy of Chad Pritchard.

directly contradicted by experimental petrology (Bowen, 1928, p. 175ff.), and appealed to unknown sources of energy to explain the conflict. There was no need; Wilcox (1944) showed that the two magmas were molten at the same time and mixed, an explanation that fits the field observations, physical chemistry, and geochemistry.

Salt domes are another case where an obvious and long-accepted interpretation turned out to be largely incorrect. It appears self-evident from field relations that the relative buoyancy of salt drives it upward through overlying rocks (Nettleton, 1943), and this origin of salt domes appeared in structural geology textbooks for decades. However, seismic imaging and borehole data led to recognition that the tops of many salt domes along the Gulf of Mexico remained at a fixed depth below the sea floor and that the domal shape results from the flanks being depressed by sediment deposited in adjacent “minibasins” (Worrall and Snelson, 1989). Subsidence of the minibasins is driven by the sediment load and accommodated by lateral extrusion of underlying weak, ductile salt into domes that grow downward from a fixed roof.

### **Cases Where Field Observations Lead to Reasonable Yet Questionable or Invalid Interpretations**

#### **Trying to Explain the Unimaginable**

Astronomy and geology require contemplation of time scales and length scales far

outside those of human experience. Granitic plutons are intruded and crystallized at depths ranging from a few kilometers to tens of kilometers, over durations of  $10^5$  to  $10^7$  years, at temperatures comparable to the melting temperature of gold, from magmas that last 10,000,000 times more viscous than water. Human experience is not relevant to these conditions and can be highly misleading.

#### **Bands in Granitic Rocks That Resemble Those Produced by Sedimentation**

Banding comparable in scale to bedding in sedimentary rocks but defined by differing mineral proportions is common in plutonic rocks. Such banding is generally assumed to result from crystals settling from a large, slowly crystallizing magma body (e.g., Wager and Brown, 1968, p. 208ff.). A common interpretation of intersecting mineral layers (Fig. 4C), by analogy with cross-bedded sediment, is scour-and-fill by currents in a magma chamber (Gilbert, 1906; Irvine, 1980). Magmatic liquids in granitic rocks, however, are so viscous that current velocities of tens of kilometers per second would be needed to produce the turbulence required for erosion to form cross-bedding (Glazner, 2014).

This physical argument makes the sedimentary analogy highly unlikely; cross-cutting layers in granitic rocks likely form by other processes, such as reactions that involve diffusion coupled with a super-

saturation nucleation threshold or autocatalysis (Fig. 4D; Fu et al., 1994; Ball, 2015). Crystal ripening and gradients in intensive parameters, such as temperature and chemical potential, can produce banding in igneous and metamorphic rocks (e.g., Thompson, 1959; Boudreau, 2011). Crystallizing granitic plutons are hydrous, high-temperature reaction vessels that stay hot and juicy over time scales of  $10^5$ – $10^6$  years. Whether such processes operate in these vessels is not known but is testable with experiments.

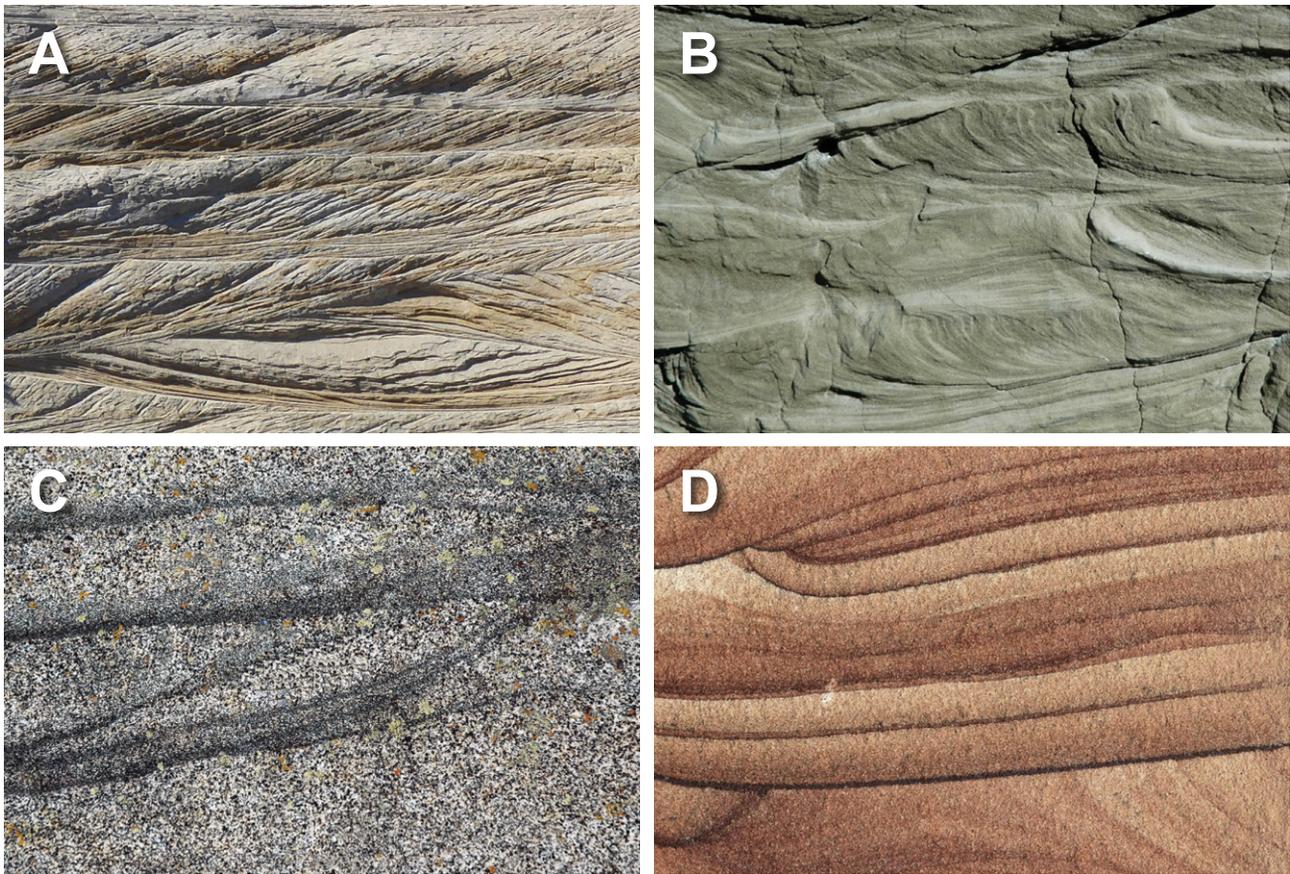
#### **K-Feldspar Megacrysts**

Large K-feldspar phenocrysts (megacrysts) in calc-alkaline granodiorites (Fig. 1) provide an example of a reasonable field interpretation that is contradicted by experimental and analytical data. A common field interpretation is that megacrysts were phenocrysts that grew to large size early enough to be swept around by magmatic currents, pile up in jams, and switch magmatic hosts (e.g., Vernon and Paterson, 2008).

This interpretation is firmly ruled out on several grounds (Glazner and Johnson, 2013), only one of which we discuss here. The phenocryst interpretation requires K-feldspar to be among the first phases to crystallize, but a large and consistent body of experimental data and petrographic observation of dacite lavas shows that K-feldspar is the last major phase to begin crystallization in a dacite (= granodiorite) magma, rarely even starting to grow before the magma is half crystallized. At half crystallization, the geometric state of the magma is akin to that of loosely packed fine gravel or coarse sand, a touching framework of crystals with ~50% pore space. Most K-feldspar crystals thus grow from the last ~50% of liquid, which is dispersed in a tortuous network of millimeter-scale pores. There is no space in which large crystals of K-feldspar can grow, and therefore they likely grow and recrystallize to highly potassic compositions by a displacive process akin to growth of garnets in schist or authigenic halite in evaporites (Glazner and Johnson, 2013).

#### **Deposition of Mudstones**

An example to which one's experience with Earth-surface conditions surely ought to apply is the accumulation of mudstone. These are assumed to be a continuous record of quiescent environmental conditions in the water column directly above (e.g., Gilbert, 1895; Herbert and D'Hondt, 1990). However, Schieber et al. (2007) showed that classroom



**Figure 4. Geometric similarity might, but need not, mean similarity of process. (A) Cross-bedded Jurassic aeolian sandstone near Boulder, Utah, USA. Width of view ~15 m. (B) Cross-beds in fluvial Pleistocene basaltic sands near Mono Lake, California, USA. Width of view 50 cm. Bedding in both A and B formed in turbulent, high-energy environments where the Reynolds number was likely  $>10^4$ , and thus grain inertia dominated. (C) Intersecting modal layering in Cretaceous granodiorite near Mack Lake, California, USA. Width of view 60 cm. How these features form is unknown, but the extremely high viscosity of silicate liquids means that Reynolds numbers were likely  $10^{-6}$  or less. Therefore, viscous forces were dominant, rendering impossible the sorts of grain interactions that produce crossbedding (Glazner, 2014). (D) Intersecting bands of diagenetic iron oxide in sandstone from the Triassic Chinle Formation, Utah, USA. Oxide layers do not correspond to depositional layering. Width of view 5 cm. Although these examples are geometrically similar, the erosive turbulence that truncated bedding in sedimentary rocks (A, B) cannot happen in highly viscous granitic magmas (C) and is irrelevant to the chemical processes that produce diagenetic banding in sandstones (D). The chemical processes that produced banding in the sandstone (D), however, may be relevant to banding in granodiorite (C).**

settling-tube experiments may be misleading. Their experimental design allowed aggregate grains composed of micron-sized particles to grow to sand size with each circuit of the flume. This more accurately replicated natural conditions and showed that thinly bedded mud can form under currents capable of transporting these aggregates in ripples. Their work implies that muddy sediment can be eroded and transported laterally without showing obvious signs of disturbance; thus, a series of layers may contain cryptic lacunae, and any particular layer may record environmental conditions from elsewhere in the basin (e.g., Meyers and Sageman, 2004; Lazar et al., 2015).

## SUMMARY

The statement “the rocks don’t lie” is true, but their messages may be misinterpreted. If a field interpretation (e.g., rhyolite

melting basalt, turbulence in granitic magmas) is inconsistent with results from another discipline (e.g., thermodynamics, fluid mechanics), then other explanations should be sought, regardless of the eyeball test. Just as physical and chemical reasoning applied to geologic examples must fit the geologic observations, field interpretations must satisfy fundamental physical and chemical principles. Field-based hypotheses that are consistent with other relevant information survive and are strengthened. Retaining an idea that fails valid tests simply because an alternative model has not yet been developed is unproductive. Rather, failed tests are opportunities to develop new hypotheses and to look at the rocks from different perspectives.

Consider the following quotes:

I see the granite problem as essentially one of field geology—it is not primarily one of

petrography, mineralogy, physical chemistry, or of any other ancillary discipline.

and

The second suggestion, of deposition from a liquid magma, is too little developed for critical consideration. To constitute a useful working hypothesis it should be supplemented by the suggestion of conditions determining deposition and erosion.

The first quote is a highly restrictive statement of “the rocks don’t lie” philosophy and comes from Read’s (1948, p. 170) defense of granitization, a long-discredited hypothesis for the origin of granites. The second, from Gilbert (1906, p. 324), refers to his own suggestion that banded granites result from erosion and deposition in a magma chamber. Gilbert knew that ascribing those features to a familiar process was not even “a useful working hypothesis” without more definition and information. In

1906, the physical properties of magma were mostly unknown, and work on turbulence by Stokes and Reynolds was new. If Gilbert had had this information at hand, he likely would have clearly formulated, and then rejected, his preliminary, tentative, field-based hypothesis in the manner that Chamberlin (1890) envisioned.

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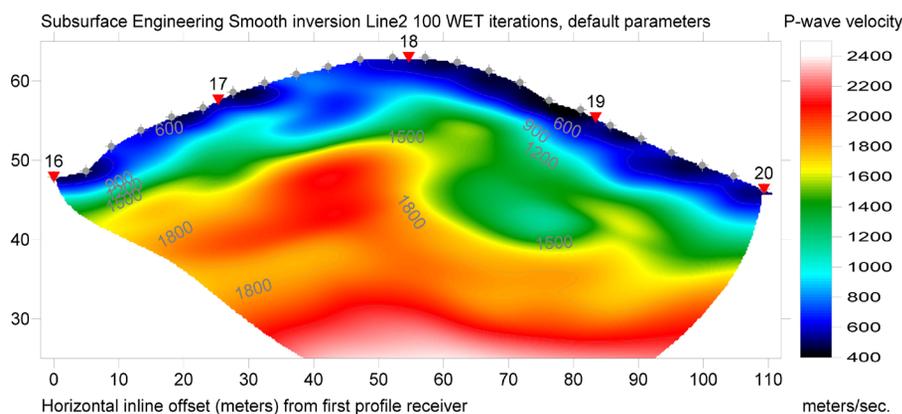
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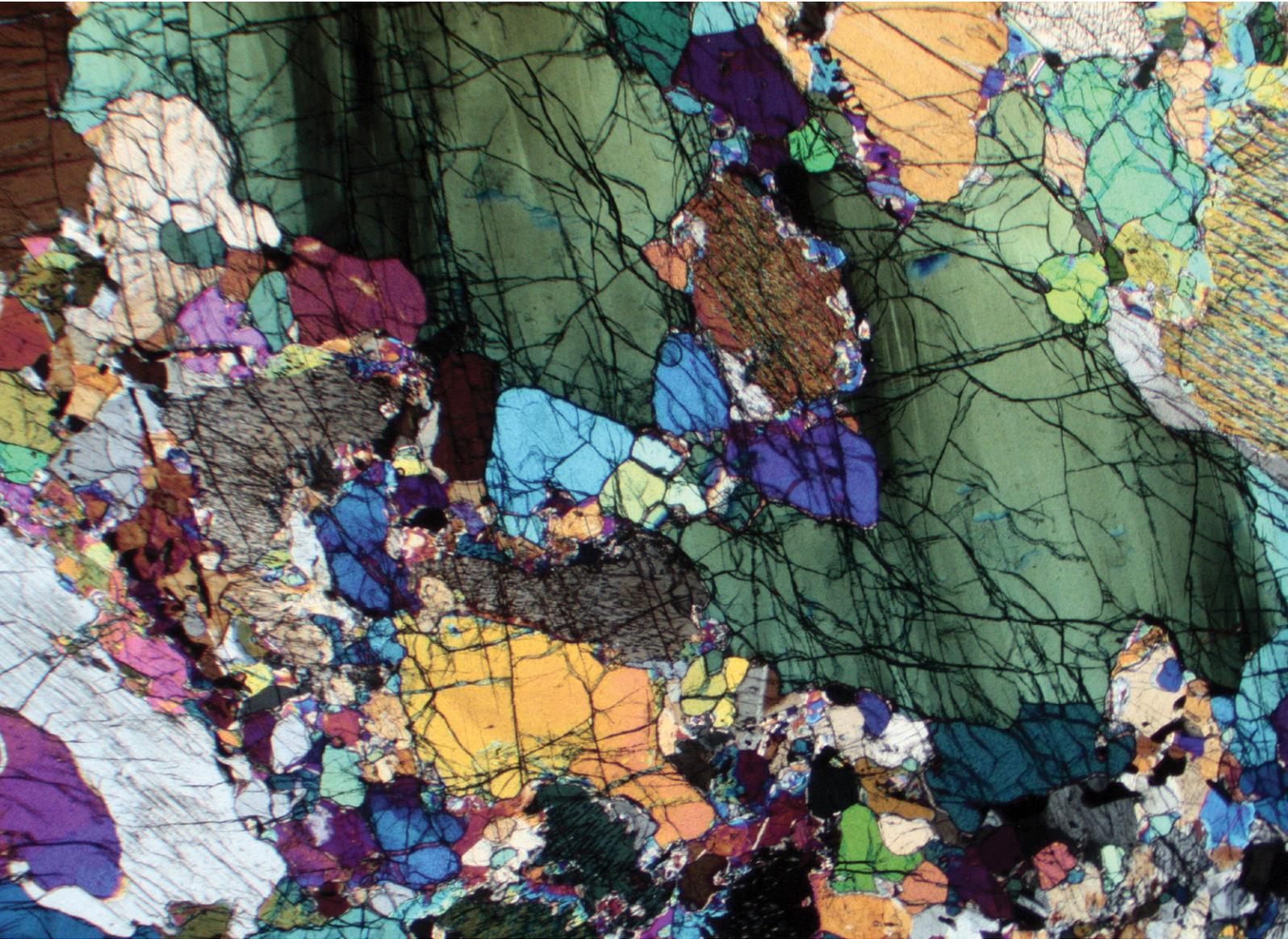
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# Annual Program Report

FY 2022



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Photo caption: A wehrlite is an ultrabasic igneous rock dominated by essential olivine and clinopyroxene with or without small amounts of orthopyroxene. Crossed nicols image, magnification 2x (field of view = 7mm). Image by Strekeisen via Wikimedia Commons. <https://creativecommons.org/licenses/by-sa/4.0/deed.en>

# A Year of Transitions

Change remains the constant and this past year at the Geological Society of America (GSA) saw many transitions begin and continue to unfold in GSA's evolution. The planning for the retirement of our terrific Executive Director, Dr. Vicki McConnell; the sale of our headquarters building; the continued commitment to DEI; and the implementation of a key feature of the Decadal Strategic plan—spinning up GSA's Center for Professional Excellence. Driven by members, leaders, and staff, the stage is set for strengthening GSA, reaching out into a larger geo-ecosystem, and highlighting the vitality of the geosciences as a critical component needed to solve some of society's thorniest issues.

## Beginning the Transition of the GSA Executive Director

My term began on 1 July 2021, the beginning of the FY2022 fiscal year, with a high priority task: initiating the search for the next GSA Executive Director (ED)/CEO. With the impending retirement of our current ED at the end of 2022, the multicomponent process of formulating transition plans and selecting a representative and high-quality search committee was a critical first step. While this change will be a challenge, it is an opportunity to explore a range of leadership models. With that as a backdrop, ED Vicki McConnell and I organized the annual leadership retreat in August 2021 with the expert facilitation by Seth Kahan of [visionaryleadership.com](http://visionaryleadership.com). Thirty-five GSA leaders, councilors, staff, and past presidents embraced Kahan's thought-provoking presentations focused on leadership models for the ED, as well as transformative and scalable models for the Society. Spirited discussions resulted in a consensus document outlining essential and desired attributes of our next ED/CEO. Commensurate with this is GSA's desire to reach out to a larger ecosystem of membership, becoming more sustainable, and move beyond our traditional sphere of influence. To maximize our ED/CEO search options, we employed the search firm, Storbeck, to guide us through the search and identify strong candidates. They have been superb at every step. The ED/CEO search is well underway, led by past president Doug Walker and past Councilor Wendy Bohrsen. More exciting news will certainly follow as this effort comes to fruition.

## Transition of Headquarters

Nearly two years ago, the Ad Hoc Campus Vision Committee outlined a plan for the GSA campus. The specifically designed and constructed headquarters (HQ) building, on a street—Penrose Place—named to honor an early GSA benefactor, is now 50 years old and is showing its age. Facing many facility issues, the 2020 Council voted unanimously to begin the sale of the building and campus. ED McConnell worked tirelessly to find a like-minded, mission-oriented, not-for-profit organization to purchase the building and surrounding land. Requiring mountains of paperwork, hours of legal consultation, and many negotiations, the sale of the building took place on 5 April 2022. A signing ceremony was held in Boulder followed by a reception at GSA headquarters for the new and old occupants, with online and in-person toasts. I had the pleasure of flying in for the event.



A generous leaseback allows GSA to occupy the building for two years, providing time to assess new workplace needs in an increasingly hybrid landscape. The pandemic brought a myriad of changes to the workplace environment, with GSA staff, Council, and leadership transitioning seamlessly to a remote work environment and now to a hybrid work environment. Assessing the new HQ needs will be in the hands of the incoming ED/CEO, with more transitions to occur.

As one final detail in the building sale, GSA Council had a special June meeting with the explicit task of investing the funds received. While exciting and daunting at the same time, Council met with our strategic investment advisors and, informed by our highly talented Investment Committee, made the decision for investing the funds to provide operating funds for the future HQ. These funds will be explicitly used for relocating into a new HQ space, buildout that may need to occur, upkeep, and other related expenses. With our stellar Investment Committee and advisors, GSA members can be assured that funds are secure, well invested, and will bring the needed resources to GSA for its continued success.

## Transitions at the GSA Connects Annual Meeting and Section Meetings

Excitement permeated the Portland Convention Center as GSA Connects 2021 reunited geoscientists in October for one of the first in-person professional meetings following the COVID-19 shutdown. With local, state, and national rules changing daily, GSA Council unanimously voted to move ahead with the in-person meeting, hoping for the best, while also having a hybrid component such that members could choose their comfort level. GSA meetings staff superbly navigated the technological challenges and seamlessly transitioned to the various oral delivery styles. With vaccinations required and safety protocols in place, the many social engagements brought time for the oh-so-missed networking events.

GSA is unsurpassed in its student events, mentoring opportunities, and interactions. One of our biggest successes to foster engagement and a sense of belonging in underrepresented groups is GSA's On To the Future program. Supported by generous donations, this year inaugurated the largest class and had standing-room-only events. To further inclusivity and the sense of belonging, LGBTQ+ events were included in the program and attended by many. As always, there was the celebration of sharing excellent

science and honoring the accomplishments of awardees. When combined with the renewal of in-person networking events, GSA Connects 2021 was a meeting to remember.

Sprinkled throughout the U.S., highly successful Section Meetings brought together members in person as well as in a hybrid environment, with one Section transitioning to fully remote. Each Section Meeting was attended by at least one member of the executive team. These meetings are a hallmark of GSA, in part because of student participation and programs. GSA members volunteer endless hours to shape, organize, and host such meetings, and GSA staff ensures they succeed.



### Transitions in Organizational Structure

Council meetings bring together dedicated elected council members with GSA leadership. This year, GSA Council met in person and remotely to advance GSA's activities, programs, and partnerships, and to implement the many recommendations made by last year's ad hoc committees. Exhausting hours on Zoom are to be applauded. GSA's continued commitment to diversity, equity, and inclusion (DEI) was highlighted by the hiring of our new associate director for DEI, Dr. Elizabeth Long. She will begin implementing recommendations from our ad hoc DEI working group. Commensurate with our commitment, changes to the nominations portal to incorporate DEI activities into the nominations process will be forthcoming.

Transformations have occurred in both the Council and the monthly Executive Committee meetings to make for more engagement by explicitly focusing on strategy for the future and strategic discussions of programs. Additionally, conversation centers around how to best message our members to effectively communicate of all GSA's benefits, opportunities, and programs.

Annually, GSA and the GSA Foundation celebrate the service of dedicated staff who have been at the Society for a landmark number of years: 5, 10, 15 and 20! This year I had the pleasure of remote participation by reading citations for the nine staff being recognized. The incredible depth and commitment of GSA's staff underscores their passion for the organization. Three staff members were

highlighted for 20 years of GSA service! Thank you to all who ensure that GSA functions smoothly and fulfills all the necessary tasks, typically behind the scenes.

### Transitions of Essential Knowledge

GSA members and geoscientists are essential to providing solutions to many of society's most vexing problems. Critical is their role in climate-change solutions, water resources, energy development, and identification, exploration, and sourcing materials for the energy transition and for technological needs, yet geosciences are commonly underrepresented in these discussions and in research and policy decision making. To highlight our critical role in society, an additional consensus item from the leadership retreat was the need for refreshing of GSA's mission statement to provide a clear message that GSA members do science for humankind's best interest. This refresh is on deck for the coming year.

At the request of the National Science Foundation (NSF), GSA embarked on another successful crowd-sourcing event for transformative research in GeoHealth. Capitalizing on ideas and knowledge of constituents from across our membership and Associated Societies, GSA's Division of Geology and Health, and our D.C. Geoscience Policy Office, GSA's report was accepted with high marks by NSF leadership for its innovative ideas. The working group highlighted geomaterials for society's benefit as well as the challenges.

There are many more topics encompassing a myriad of other advances in GSA's highly successful publications, meetings, programs, awards, and committees. GSA is successful because of the amazing, hardworking staff and the many volunteers like yourselves who donate countless hours to advance the geosciences and the Society. Progress has occurred, and GSA is on the cusp of even greater impacts in the future. Watch for more transformations.

The synergy of leadership, membership, staff, and partners coupled with our passion for the geosciences will facilitate GSA's continued evolution and positive transitions into the future. All of these transitions affirm the leadership of GSA in the geoscience community.

It has been my pleasure and honor to work with all of you. The year has flown by.



Barb Dutrow,  
2021–2022 GSA President

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## LETTER FROM THE EXECUTIVE DIRECTOR

Dear GSA members, leaders, staff, and geoscience community,

First, please take a moment to read through the entire report to get the whole picture of GSA's contributions to our members and the geoscience community. We continue to lead under the direction of GSA's leadership and through volunteers, as well as the dedicated and professional support of GSA staff.

I would like to introduce you to GSA's Associate Director for Diversity, Equity, and Inclusion (DEI), Dr. Elizabeth Long. Elizabeth began her tenure at GSA in late January 2022 and rapidly became the lead on our DEI efforts. She is overseeing a variety of programs, including the On To the Future mentor program, and is working with all aspects of GSA programs and projects. Elizabeth represents GSA in all DEI activities involved in implementing the DEI recommendations, goals, and objectives of the Decadal Strategic Plan and the ad hoc DEI Working Group. She works closely with the newly formed Center for Professional Excellence, the GSA Unlearning Racism in Geoscience (URGE) pod, and the GSA Ethics and Compliance Office.

We are also very excited to be implementing one of the major goals of our Decadal Strategic Plan—the roll-out of one of the centers for excellence, our Center for Professional Excellence. Matt Dawson, formerly GSA education programs manager, has been appointed the interim assistant director of the Center and is working on the organization and coordinating activities. The overall objective is to centralize our professional development and career-support programs (for example, GeoCareers, research grants, scholarships, mentoring, awards, leadership training, etc.) and present them in such a way as to augment our member's usage and enhance their benefits. The Center is a virtual construct; thus, it fits nicely with the goal to reduce our physical footprint. We anticipate the roll out of the Center for Geoscience Discovery in 2023.

As President Barb Dutrow noted in her report, we have sold our Boulder headquarters and campus and are in the process of some serious downsizing and reformatting of our workplace and workforce policies, like so many other organizations. While the decision to occupy a smaller and more sustainable footprint was made before we had to adapt to a pandemic world that decision is now more relevant. The intent is to relocate somewhere in the Denver-Boulder corridor within the next year or so. The GSA workforce will be primarily remote-first, with a much smaller headquarters footprint. This will not affect our programs, services, or processes in the least. I am proud to report that the organization that purchased the property, Boulder Housing Partners, will be preserving the original wing of the GSA building and as much of the campus as possible while developing affordable housing for the Boulder community.

The other change will come soon after the GSA Connects 2022 meeting in October in Denver, when I retire as GSA's Executive Director. GSA leadership is actively recruiting for the new ED/CEO, and we hope to be introducing them to the geoscience community in Denver. It has been my honor and privilege to serve GSA these past seven years, and I hope to continue to contribute to its success and growth.

I thank all my geoscience colleagues and friends for your trust and support. I also humbly thank all the GSA staff I have worked with over the years. They are just the best.



Vicki McConnell,  
GSA Executive Director

## Thank You GSA Volunteers!

Looking back each year at all the work we have done together and the goals we have accomplished, we are reminded that the “secret ingredient” in the success of our Society is the wealth of dedicated and hardworking members who give generously of their time and talents. From planning meetings, to editing journals, to reviewing grants and awards applications, to serving on committees, running our scientific Divisions, serving students as mentors and campus reps... the list goes on. A huge “thank you” goes out to all of them.

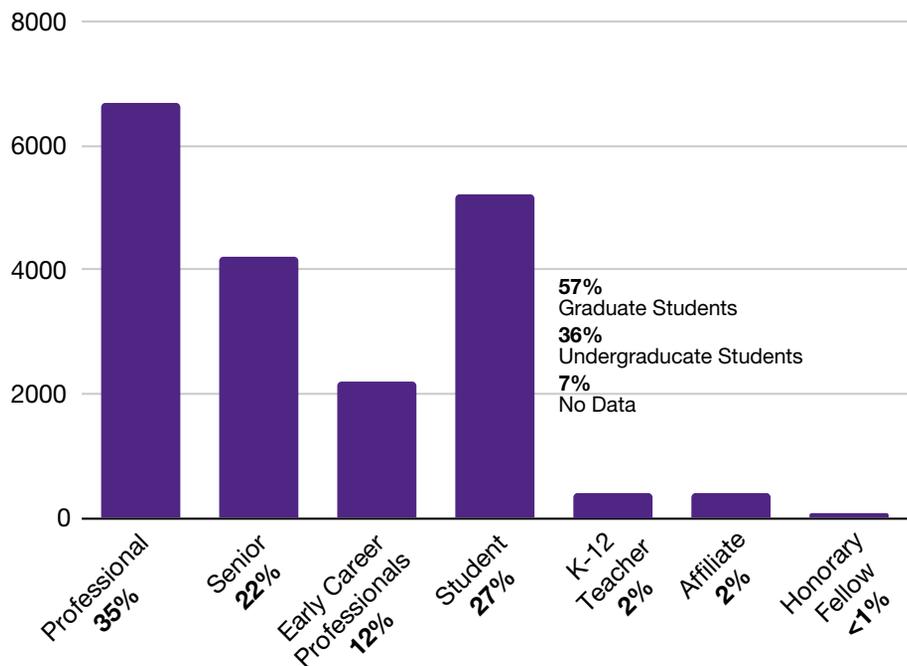
To members who are not currently active but who might like to engage more deeply with GSA, please know that there is a myriad of ways to further your personal goals as well as the aims of the Society through service. We invite you to join a scientific Division, self-nominate for a committee, or let us know how you'd like to get involved. Email [gsaservice@geosociety.org](mailto:gsaservice@geosociety.org) with questions.

### Stay Connected to GSA

-   Follow GSA @geosociety on **Twitter** and **Instagram**.
-  **Facebook**—Join GSA fans worldwide at [www.facebook.com/GSA.1888](https://www.facebook.com/GSA.1888).
-  **YouTube**—Learn more about GSA and careers in the geosciences at [www.youtube.com/user/geosociety](https://www.youtube.com/user/geosociety).
-  **LinkedIn**—Network and stay connected to your professional peers at <https://www.linkedin.com/company/geological-society-of-america>.

# Membership

**Member Type**  
Membership as of 31 December 2021 = 19,088



GSA members represent more than 27 scientific specialties and interests and have the option to belong to one or more of GSA's 22 scientific Divisions, six regional Sections, and GSA International.

## Did you know?

- GSA members save up to \$15\* off dues if they renew their 2023 membership by 1 November.  
\*Applies to those in high-income country/territories.
- Lifetime membership is now an option—Support GSA and receive membership benefits for life!
- Individuals in non-high-income countries/territories qualify for reduced GSA membership dues.
- **New this year:** Scientific Division dues are now standardized:
  - Student members: US\$2 each—and join one for free
  - Early-career professional & K–12 teacher members: US\$5 each
  - Professional, Senior\* & Affiliate members: US\$10 each
 \* Senior members may still opt for dues waiver(s) or choose to financially support their Division(s).
- The GSA/GSA Foundation Membership Assistance Program and Fund enables those who cannot afford the cost of membership—or who experience difficulty in transferring funds from their country to the USA—to become members.

## Member Benefits

- One complimentary Section affiliation is included with membership. Choose others when you renew to expand your geographic interests.
- Join one or more scientific Divisions when you renew your membership—Expand your network and collaborate with others who share your professional interests. Student members get one free Division of choice; additional Divisions are only US\$2 each.
- Student and early-career professional members qualify for reduced GSA membership dues and reduced scientific Division dues. Take advantage of webinars, mentor programs, research and travel grants, and more!
- Members enjoy reduced meeting registration rates and reduced abstracts fees.
- Special opportunities for student members at meetings—mentor luncheons, networking events, and volunteer opportunities to offset the cost of attending GSA meetings.
- Communicate and collaborate with fellow members in GSA's online member community and discussion forum.
- All members get free online access to *Geology*. Student and early-career professional members also get free online access to *GSA Bulletin*.
- Supercharge your research with GSA Millennium Edition of Geofacets—a web-based tool to access thousands of georeferenced maps—included with membership.
- Subscribe to premier publications at member-only rates when you renew your 2023 membership.
- Opportunities for leadership, mentoring, service, and awards.

# Diversity, Equity, and Inclusion

The Awards Committees submitted revised award rubrics to Council, following the guidelines of the ad hoc Nominations and Awards Committee. GSA staff worked to implement the recommendations to the nominations and awards process for incoming Committee members to utilize in the coming year.

Acting on recommendations from GSA Council and membership, including the ad hoc Diversity, Equity, and Inclusion (DEI) Committee, GSA initiated a hiring search for a full-time, director-level staff position to oversee DEI efforts.

In January, Dr. Elizabeth Long joined the GSA staff as the organization's first associate director of DEI. Priorities for this position include working with membership to improve DEI work at the annual meeting and Section Meetings; revising GSA's nominations and awards processes, in partnership with member-guided committees; and securing funding to increase and improve the sustainability of DEI efforts.

In the fall, GSA's ad hoc Committee on Nominations and Awards submitted its report to Council outlining proposed revisions designed to improve inclusivity and equity of GSA's awards as well as increase

diversity and inclusion on all committees. The report was approved by Council, and GSA staff began the implementation process.

GSA held its annual meeting in Portland, Oregon, USA, in October 2021, using both virtual and in-person formats. After receiving feedback from attendees, GSA members, and our larger community, GSA committed to a fully hybrid and accessible annual meeting in October 2022. In addition, GSA incorporated feedback from membership to improve inclusion at the annual meeting, highlighting events such as the LGBTQ+ reception, live-streaming talks for presenters who are unable to attend in person, and revising ethical guidelines and codes of conduct for programs such as poster sessions.

Members of our National Science Foundation-funded Geosciences ASCEND RCN (Geosciences Associated Societies Committed to Embracing and Normalizing Diversity Research Coordinated Network) project met for a virtual planning summit in early 2022. In June, Geo ASCENDS hosted its first Community Conversation, a virtual format open meeting designed to allow participants to workshop specific topics, challenges, and goals with peers from other RCN project team members. The monthly Community Conversations are facilitated by project personnel and largely driven by GSA members.

## Ethics

GSA updated and enhanced its Events Code of Conduct and related resources, including a new training guide for session chairs, to foster respectful, inclusive scientific events (RISE; [www.geosociety.org/rise](http://www.geosociety.org/rise)). More than 300 GSA members, ranging from Councilors to student volunteers, were trained on procedures to promote a welcoming culture where meeting and field-trip participants feel safe coming forward with concerns.

The 2021 Annual Ethics Report is online at [www.geosociety.org/documents/gsa/about/ethics/2021-annual-ethics-report.pdf](http://www.geosociety.org/documents/gsa/about/ethics/2021-annual-ethics-report.pdf). This report provides transparent information about GSA's ethics

policies, the types of concerns being raised, and how GSA has resolved them. Using fair, rigorous enforcement procedures, GSA continues to take all complaints seriously and to impose sanctions for proven violations, up to and including the revocation of membership and fellowship status.

GSA continues to serve on the Leadership Council of the Societies Consortium on Sexual Harassment in STEMM, a coalition of professional societies formed to share and promote leading practices to advance a culture of inclusion, excellence, and integrity across fields in science, technology, engineering, mathematics, and medicine.

### July

GSA connected 223 students and ECPs with enriching, interdisciplinary projects led by the USDA Forest Service, National Park Service, and Bureau of Land Management.



### August



Emily Zawacki (above) begins term as GSA's 2021–2022 Science Communication Fellow.

### September

GSA welcomes Morgan Disbrow-Monz (below) to begin a one-year term as GSA's Science Policy Fellow.



Scientific Division members and non-members were surveyed to gain insight as to why the membership of some Divisions have increased or decreased, why a portion of GSA members choose not to belong to any Divisions, and how membership in scientific Divisions can be more relevant and valuable.

# Meetings

GSA offers a variety of meetings to geoscientists—from small research forums, to moderate specialty conferences, to a large annual meeting. These forums, conferences, and meetings are held around the globe throughout the year. GSA provides a platform for scientists to share their latest research, build upon current knowledge, and network with peers. GSA strives to keep meetings cost effective while providing the latest technology platforms for scientific exchange.

GSA hosted its first hybrid meeting in October 2021 in Portland, Oregon, USA. All Pardee Keynote Symposia, Noontime Lectures, Halbouty Distinguished Lecture, and the GSA Presidential Address, along with 80+ selected topical sessions, were live-streamed and recorded for on-demand viewing by registered attendees. There were close to 3,000 attendees in Portland (1,000 online) for GSA’s first in-person meeting coming out of the pandemic. Twenty-two short courses were offered online and six in person. More than 108 companies, organizations, and universities exhibited during the meeting, up from 53 in 2020. GSA successfully implemented its Commitment to Care program to keep attendees in Portland healthy and safe, requiring all attendees to be vaccinated, test before arriving, wear a mask, and socially distance.

Hundreds of volunteers participate yearly in GSA Connects—from Local Organizing Committee members and the Joint Technical Program Committee to the hundreds of session conveners from every geoscience discipline. There is something for everyone at GSA Connects.

GSA Section Meetings are unique venues for interdisciplinary science and are important hubs for discussing and presenting current research. They provide an excellent opportunity for both professionals and students to attend and participate in technical sessions, field trips, and short courses close to home.

In 2022, GSA was able to host two in-person Section Meetings, one online Section Meeting, and one hybrid. The South-Central Section Meeting kicked things off with an online meeting on 14–15 March with 143 attendees. Right on South-Central’s heels was the Cordilleran & Rocky Mountain Section Joint Meeting in Las Vegas, Nevada, USA, on 15–17 March with close to 600

## GSA CONNECTS 2021 STATS

<b>2,864</b> In-Person Attendees	<b>61</b> OTF Mentors	<b>34</b> Short Courses
<b>1,109</b> Online Attendees	<b>50</b> GeoCareers Mentors	<b>12</b> Field Trips
<b>76</b> On To the Future (OTF) Scholars	<b>50</b> Countries Represented	<b>2,703</b> Abstracts Accepted

attendees. Next up was the Northeastern Section Meeting in Lancaster, Pennsylvania, USA, on 20–22 March; they had close to 680 attendees. The North-Central & Southeastern Joint Section Meeting closed things out on 7–8 April in Cincinnati, Ohio, USA, and online, with 845 attendees.

GSA Penrose Conferences and Thompson Field Forums are GSA’s premiere small-group meeting and field-trip venues for collaborative research around the world. GSA hosted a Penrose Conference titled “The Geological Fingerprints of Slow Earthquakes” on Santa Catalina Island, California, USA, on 1–5 April 2022, with 49 attendees, after having reschedule multiple times in 2021. A Thompson Field Forum titled “Old or Young? The Topographic Evolution of the Sierra Nevada” was held from 20–27 June going between Nevada and California, with 40 attendees. A second Penrose Conference titled “Progressive Failure of Brittle Rocks” was hosted at the Highland Lake Inn and Resort in Flat Rock, North Carolina, USA, from 20–24 June, with 85 attendees.

While the pandemic continues to cause havoc for many organizations and scientific societies, this past fiscal year has shown that folks are ready to meet back in person, especially when safety procedures are put into place and followed by fellow geoscientists.



Amanda Labrado began a one-year term in the office of Representative Ocasio-Cortez (D-NY) as the GSA-USGS Congressional Science Fellow in September 2021.

## October

GSA hosted its first hybrid meeting in October 2021 in Portland, Oregon, USA.



149 professionals, 108 early-career professionals, 544 students, 13 K–12 teachers, and 54 affiliates were elected to membership.

Eighteen scholars who were selected for the On To the Future Program (OTF) program in 2020 deferred their awards until 2021. They joined 58 diverse students who were selected to participate as the OTF cohort at GSA Connects 2021.

# Government Affairs

## Policy Webinars

With health and safety concerns limiting access to Capitol Hill, GSA joined with other geoscience societies to hold webinars to facilitate the ability of geoscientists to engage in policy remotely. These webinars are archived in GSA's members-only online toolkit.

- Connecting Close to Home: Engaging Federal Policymakers in Your Community
- Experiences of Being a Geoscience Congressional Fellow: A Primer for Applicants
- Geoscience Policy Update
- Engaging with Policymakers in and out of D.C.

Additionally, GSA and its partners held several virtual briefings for congressional staff about key geoscience issues, including:

- The Devastating Power of Tsunamis & What They Mean for the Coastal U.S.
- Unpredictable & Dangerous: Lessons from the 2022 Tonga Eruption
- Minerals for the 21st Century Economy

## GSA Letters and Testimony

GSA submitted testimony requesting increased funding for the U.S. Geological Survey (USGS), National Science Foundation (NSF), and National Aeronautics and Space Administration (NASA) for fiscal year 2023. GSA is an active member of coalitions that also submitted testimony and letters in support of geoscience agencies, including the Coalition for National Science Funding, the Coalition for Aerospace and Science, USGS Coalition, the Energy Sciences Coalition, and the Task Force on American Innovation.

Among the letters GSA sent to policymakers included the following statements:

- Supporting the “Reconciliation in Place Names Act,” which creates a process to review and revise offensive names of public lands
- Calling on Congress to lead with science to understand and address the effects of climate change

- Supporting open science and sustainable public access
- Advancing scientific research on the microbiome

## GSA Science Policy Fellow

GSA welcomed Morgan Disbrow-Monz to begin a one-year term as the “in-house” GSA Science Policy Fellow in August 2021. Disbrow-Monz earned her Ph.D. from the University of Minnesota, where her research focused on better understanding the microstructural processes in natural ice that play a major role in glacier and ice sheet movement. Morgan reflects, “As a lifelong scientist with a limited policy background, the fellowship is providing me with the essential skills, mentorship, and professional network to be an effective communicator in the policy arena. ... I rely on creative communication strategies to serve as a liaison between GSA members and policymakers, which includes writing about current legislation on GSA’s *Speaking of Geoscience* blog, expanding GSA’s public toolkits for effective meetings with policymakers, developing informational webinars, and interacting with members directly at GSA’s various meetings.”

*“This position fulfills my curiosity needs by allowing me to continue expanding my knowledge of scientific issues but with an emphasis on building human relationships to promulgate that knowledge.”* —Morgan Disbrow-Monz, 2021–2022 GSA Science Policy Fellow

## GSA-USGS Congressional Science Fellow

Amanda Labrado began a one-year term in the office of Representative Ocasio-Cortez (D-NY) as the GSA-USGS Congressional Science Fellow in September 2021. Labrado is a biogeochemist who received her Ph.D. from The University of Texas at El Paso (UTEP), where she studied how microbes facilitate the formation of minerals on the top of salt domes. She writes, “Engaging in the policy-making process has allowed me to utilize the skills geoscientists learn to sharpen in different ways. The ability to make observations, analyze data, apply knowledge, and

## November

Changes to the GSA Fellowship Program, as recommended by the Fellowship ad hoc Committee and approved by Council, were implemented. These changes included updated criteria for nominators, clarified eligibility requirements for nominees, and new nomination categories.

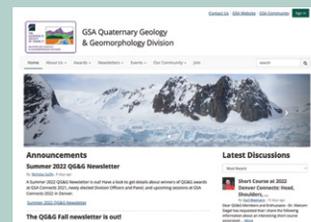


GSA’s ad hoc Committee on Nominations and Awards submitted its report to Council outlining proposed revisions designed to improve inclusivity and equity of GSA’s awards as well as increase diversity and inclusion on all committees.

## December

A working group of scientific Division leaders was formed to further analyze the Divisions members and non-members survey results, make recommendations to strengthen scientific Division memberships, and better serve their members.

All Division websites were updated to cleaner design.



effectively communicate have been crucial to me in learning how to present policies, work in a bipartisan manner, and remain calm and productive during tight turnarounds.”

### GSA Updates Seven Position Statements

Over the past year, GSA Council approved a major revision to the Water Resources position statement, now titled Water Resources: Quantity. Minor revisions to the following position statements were also approved: Supporting Planetary Exploration, Teaching Evolution, Rewarding Professional Contributions in Public Spheres, Geoheritage, The Value of Geologic Mapping, and Freedom of Scientific Expression. GSA members are encouraged to use the statements as geoscience communication tools when interacting with policymakers, students, colleagues, and the general public. These are online at [www.geosociety.org/positionstatements](http://www.geosociety.org/positionstatements).

### Geoscience and Human Health (GeoHealth): Impacts and Mitigation of Impacts on Human Health Due to a Changing Natural Environment

Under the overarching theme of GeoHealth, the National Science Foundation (NSF) requested GSA contribute innovative ideas that have the potential for solving societal problems and provide commercialization potential on a short time frame. GSA gathered feedback from its network, including members and Associated Societies, through a series of targeted brainstorming sessions, online questionnaires, Section Meeting events, and directed outreach to experts in the community of practice. GSA is grateful to its members and the broader community for their thoughtful input and to the NSF for the opportunity to participate.

The responses underscore the fundamental linkage that the health of Earth influences the health of humans. It is essential that geoscientists, who analyze all of Earth’s spheres, partner with those in the health, epidemiological, and toxicological fields to

maximize synergy in identifying, monitoring, communicating, and mitigating impacts on human health that occur through geologic processes. In concert, those same partners provide synergy to use geological materials to improve human health. The full report is online at [www.geosociety.org/geohealth-solutions](http://www.geosociety.org/geohealth-solutions).

### Policy Outreach

GSA’s policy office conducted an interactive, gallery-style, outreach activity at the Northeastern Section Meeting in Lancaster, Pennsylvania, USA, to gain a better understanding of what the GSA membership views as the most pressing geoscience policy issues and how the community recommends working toward solutions to these issues. Diversity, equity, and inclusion, education, and climate change were the top broad issues that emerged. GSA hopes to continue and expand on this activity at future meetings to track how priority issues change over time.

### Speaking of Geoscience Blog Policy Updates

Over the past year, the policy office contributed nine policy posts to GSA’s *Speaking of Geoscience* blog: Energizing the Future: House of Representatives passes the Department of Energy Science for the Future Act; Reconciling with our Past: The Reconciliation in Place Names Act; Budgeting for Science: What the White House’s Budget Request and Congress’ Appropriations Mean for Federal Science Agencies; Science Policy at the GSA Connects 2021 Annual Meeting in Portland, Oregon; Bipartisan Investment in The nation’s Infrastructure: H.R.3684 Signed into Law!; Revisiting the 1872 Mining Law; FY22: Less Than Expected Increases for Science; GSA Fellow, Dr. Asmeret Asefaw Berhe, Confirmed to Lead the Department of Energy Office of Science; and Dr. David Applegate’s Nomination to be the Director of the U.S. Geological Survey (USGS) Moves to the Senate Floor.

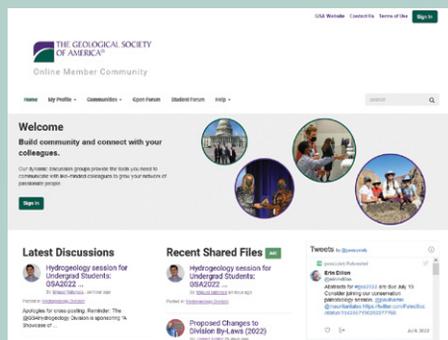
2022

## January



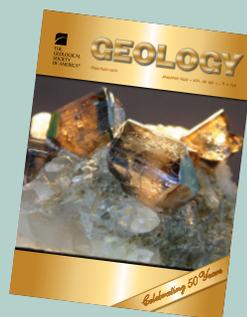
Dr. Elizabeth Long joined the GSA staff as the organization’s first associate director of DEI.

New user experience for the online member community was launched.



## February

Research grants and awards deadlines culminated this month, with hundreds of grant applications.



Geology reached a milestone, publishing volume 50 in 2022.

# Education & Outreach

## EXPLORE CAREERS

### GeoCareers & Mentoring

Throughout the year, GSA members had access to Mentoring365, a virtual three-month mentoring program. GSA's networking and mentor programs engaged 540 mentees and 141 mentors.

For GSA Connects 2021, our GeoCareers Corner was back in person. Drop-in and résumé/CV mentoring were available, and jobs were posted for attendees to view. The following programs remained online: Early Career Networking Event, Networking Event, Women in Geology Panel, GeoCareers Résumé Workshop, GeoCareers Company & Agency Information Session, and the GeoCareers Career Pathways Webinar.

Three of the four Section Meetings were in person in 2022. All four of them featured a Roy J. Shlemon Mentor Program in Applied Geoscience and a John Mann Mentors in Applied Hydrogeology Program. The three-part career series addressed topics from career development planning to information on best practices for crafting a résumé and cover letter. Finally, a geology club meet-up was offered so that club officers could network and exchange ideas.

## PROFESSIONAL DEVELOPMENT

### Webinars

Sixteen webinars were offered in collaboration with scientific Divisions, Associated Societies, government agencies, and other organizations. These webinars drew more than 700 attendees and covered topics related to geoscience careers, graduate school, science policy, research funding, and more.

### GeoScene

This is GSA's monthly digest for students and early-career professionals (ECPs) who are charting their education and career. Issues are emailed monthly to ~12,500 people and contain upcoming deadlines for awards and scholarships, professional

## GSA CONNECTS 2021 SHORT COURSE STATS

24 short courses (6 in person; 18 online)	47% of participants were students	22 participants per course, on average
531 short-course participants	13% of GSA Connects attendees participated in a short course	US\$27 average cost per course

development opportunities, science stories written by students and ECPs, career information, highlights on diversity, and available jobs and internships. Visit GSA's website ([www.geosociety.org](http://www.geosociety.org)) to subscribe and review previous content.

### Student and ECP articles in *GSA Today*

In FY22, seven articles were written by students and ECPs with content of interest to that audience. Topics included professional geologist licensure, museum careers, poster presentation tips, undergraduate research survey results, becoming a science policy fellow, and reports from both a field-camp scholarship recipient and an On To the Future (OTF) awardee. This initiative began as a way for students and ECPs to publish and provide information to one another.

### Short Courses

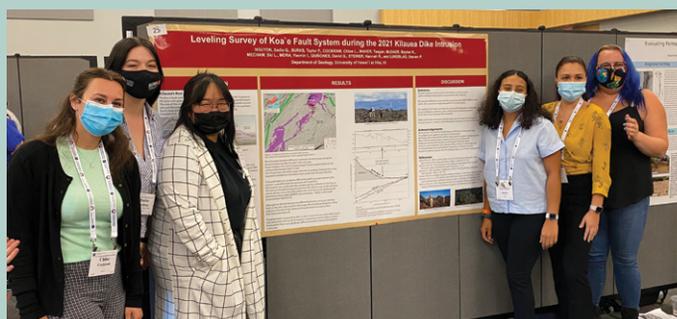
GSA Connects 2021 offered 24 short courses, which were taught by professional geoscientists and enabled attendees to learn new topics, build skills, and network.

### K–12 (Kindergarten through 12th grade) Education and 2YC (2-Year Colleges)

GSA staff worked with member volunteers and the Next Generation Science Standards–Earth and Space Science (NGSS-ESS) Working

## March

Six non-traditional students attending urban universities in GSA's Northeastern Section were provided financial assistance to attend the 2022 Northeastern Section Meeting.



The South-Central Section Meeting kicked things off with an online meeting on 14–15 March followed by the Joint Cordilleran & Rocky Mountain Section Meeting in Las Vegas, Nevada, USA, on 15–17 March. The Northeastern Section Meeting in Lancaster, Pennsylvania, USA, took place on 20–22 March.

In March, members of Student Advisory Committee successfully helped facilitate the GSA online GeoHealth Brainstorming Sessions in partnership with the National Science Foundation.

Group to offer an online workshop about “Virtual Contexts” for ~30 educators in conjunction with GSA Connects 2021.

## FIELD AND RESEARCH OPPORTUNITIES

### GeoCorps™ America and The National Park Service (NPS) Scientists in Parks (SIP) Program

GSA connected 223 students and ECPs with enriching, interdisciplinary projects led by the USDA Forest Service, National Park Service, and Bureau of Land Management. Program participants were placed at 132 federal public-land sites and offices and completed more than 116,000 hours of critical work related to the geosciences and other natural-resource fields.

GSA Connects 2021 featured 12 GeoCorps and SIP participants presenting their work.

*“The biggest take away from this experience for me was realizing how I can use my education background and skills and apply that in the real world to help make a positive difference. This has been the most meaningful work experience I’ve had the opportunity to participate in and it felt incredibly fulfilling.”* —Summer 2021 GeoCorps Participant, Superior National Forest

### GeoCorps Participant, Superior National Forest

### GSA Field Camp Excellence Award

This US\$10,000 award went to the University of Iowa Field Camp in recognition of its commitment to safety awareness, diversity, and technical excellence.

“We are so honored to be recognized for our excellent technical merit and dedication to field safety. We will continue to be dedicated to those aspects while also focusing on increasing the diversity and accessibility of our field camp. We would like to earnestly thank GSA for supporting us in pursuing these goals.” —Emily Finzel, The University of Iowa Field Camp

### Graduate Student Research Grants

GSA continued to support graduate-level research by using funds from GSA, the GSA Foundation, and a three-year (2020–2022) award from the National Science Foundation, which is aimed at supporting GSA’s efforts to increase the level of diversity among the students who apply for and receive grants. In 2022,

more than 330 students were funded, with over US\$750,000 provided in total. *This material is based upon work supported by the National Science Foundation under Grant No. 1949901.*

### Undergraduate Student Research Grants

Four GSA Sections awarded 17 undergraduate students with research grants, totaling over US\$17,000 in funding.

### AGeS-DiG

GSA facilitated applications for the AGeS-DiG (Awards for Geochronology Student Research, Diversity in Geochronology) program, which provided six research grants aimed at expanding access to geochronology for those underrepresented in the earth sciences. *This material is based upon work supported by the National Science Foundation under EAR-1759200, -1759353, -1759201 awards to R.M. Flowers (CU-Boulder), J.R. Arrowsmith (ASU), and V. McConnell (GSA).*

### GSA/ZEISS Research Grant

A US\$10,000 research grant was provided to Olivia Barbee, an early-career researcher at Michigan Technological University, for a research proposal titled: “Developing novel correlative 3D and 2D microscopy of quartz from volcanic supereruptions on Earth.”

## TRAVEL GRANTS & SCHOLARSHIPS

### On To the Future Program

Eighteen scholars who were selected for the OTF program in 2020 deferred their awards until 2021. They joined 58 diverse students who were selected to participate as the 2021 cohort at GSA Connects 2021 in Portland, Oregon, USA.

### Northeast Urban Travel Award

Six non-traditional students attending urban universities in GSA’s Northeastern Section were provided financial assistance to attend the 2022 Northeastern Section Meeting.

### J. David Lowell Field Camp Scholarships

Thirty undergraduate students were each provided US\$2,000 to attend the field camp of their choice. This year, Brunton gifted

## April



The GSA Foundation's Death Valley Rendezvous donor trip reconvened.

Penrose Conference titled “The Geological Fingerprints of Slow Earthquakes” on Santa Catalina Island, California, USA, occurred from 1–5 April.

The sale of the building took place on 5 April.



Launched full Connects 2022 website build.



The Joint North-Central & Southeastern Section Meeting, held 7–8 April in Cincinnati, Ohio, was a success.

each awardee with a Brunton Orange Standard Transit in a personalized leather case.

### Expanding Representation in the Geosciences Scholarships

Six diverse undergraduate students were each provided a US\$1,500 ERG scholarship, a GSA student membership, and full meeting registration for GSA Connects 2022.

### CENTER FOR PROFESSIONAL EXCELLENCE

To better serve our community and achieve our mission, GSA is launching two centers, the Center for Professional Excellence and the Center for Geoscience Discovery, Integrity, and Rigor. Each Center fosters collaboration across all of GSA and facilitates partnerships with our organization. In spring 2022, staff began to shape the Center for Professional Excellence, which supports the growth and excellence of geoscientists throughout their career trajectory. The goal is to begin widely publicizing this center at GSA Connects 2022.

# Student Advisory Council

Fiscal year (FY) 2022 Student Advisory Council (SAC) Chair Yueyi Che (Stanford University) has been leading a variety of efforts to improve student member engagement within GSA. During GSA Connects 2021, SAC held an in-person mixer for students to get to know each other and student representatives at the meeting. Shortly after GSA Connects 2021 and at the beginning of the spring of 2022, SAC held two meetings to discuss how GSA could make its student resources more accessible and student leadership opportunities more equitable. Led by Che, SAC is proposing structural changes to GSA Council related to students and student leadership in GSA. SAC is also reconnecting with the campus reps. In March, members of SAC

successfully helped facilitate the GSA online GeoHealth Brainstorming Sessions in partnership with the National Science Foundation. FY22 SAC Chair-Elect Miguel Valencia (Florida International University) created an SAC webinar handbook to guide the student representatives in hosting their own webinars. Student representatives have been actively hosting webinars and creating a mentorship program within their Sections/Divisions. Finally, SAC is busy preparing for the upcoming GSA Connects 2022. We hope to provide more support for first-time attendees and create physical space at the meeting for students to meet peers and have a sense of belonging at the meeting. We look forward to the rest of the year and wish to see you in Denver.

## GSA 2023 Membership

**Being an engaged member will help you advance your career.  
Renew by 1 November—Save up to \$15 off dues\***

\* applies to those in high income country/territories

[www.geosociety.org/members](http://www.geosociety.org/members)

### May



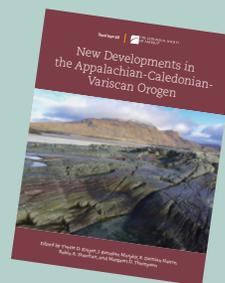
Thirty undergraduate students were each provided US\$2,000 via the J. David Lowell Field Camp Scholarship Fund to attend the field camp of their choice.

### June

38 members were granted Fellowship; two others were granted Honorary Fellowship.

141 professionals, 91 early-career professionals, 821 students, 23 K–12 teachers, and 66 affiliates were elected to membership.

Council approved the standardizing of scientific Division dues as recommended by the Division Leaders Working Group that derived from suggestions from the Division members survey.



In FY22, GSA published 12,439 pages written by 3,352 authors from 53 countries representing 119 disciplines and subdisciplines.

# Publications

*Geology* has reached a milestone, publishing volume 50 in 2022. In 1970, GSA leaders looking for new ways to disseminate scientific information assigned the task to an ad hoc study group, which proposed a “short-note, rapid publication journal.” GSA Council gave the go-ahead in 1972 (the same year that the Society’s headquarters building was completed at 3300 Penrose Place in Boulder, Colorado, USA), and the first issue of *Geology* was published in September 1973. Along with short, peer-reviewed articles, early issues included book reviews, letters, and summaries of *GSA Bulletin* papers. Today, the journal is at the top of its game and has been the leading geoscience journal for many years.

Published by GSA since 1890, *Geological Society of America Bulletin* has fulfilled many roles, recording GSA’s activities, meeting abstracts, proceedings, and memorials to members, finally settling into the sole purpose of publishing peer-reviewed research. In the early 2000s, when GSA digitized and posted all issues back to volume 1, usage soared, and the journal’s impact factor climbed. But one nagging problem has followed *Bulletin* off and on for decades: a backlog of accepted papers waiting to be published. A victim of its own popularity, *Bulletin* has always had long papers and lots of them. (Some readers may recall the most [in]famous solution to the problem: microfiche.) Today, papers are published online as soon as they are ready, but there is still a long wait for papers to be assigned to a print issue, even after the number of papers in each issue was doubled. In April 2022, GSA Council approved a Publications Committee proposal to cease the print version of *GSA Bulletin* after 2023, and the journal will carry on as an online publication.

Born online-only in 2005 and made fully open access in 2017 is *Geosphere*, which continues to enjoy a climbing impact factor. A few libraries still request print copies of *Environmental & Engineering Geoscience*, published jointly by the Association of Environmental and Engineering Geologists and GSA, but its online presence at GeoScienceWorld brings its content of new theory, applications, and case histories to a wider audience.

## 2022 JOURNAL IMPACT FACTORS™ (FROM CLARIVATE, 2022)

*Geology*:  
6.324; five-year: 6.456

*Geosphere*:  
3.944; five-year: 4.284

*GSA Bulletin*:  
5.410; five-year: 5.250

*Environmental  
& Engineering  
Geoscience*:  
0.779; five-year: 0.860

GSA books are produced in print but are also online at GeoScienceWorld, and print and ebook versions are sold in the GSA Store. GSA published nine Special Papers, three Memoirs, and three Field Guides in fiscal year 2022. Legacy series, available online or in the GSA Store, include Reviews in Engineering Geology and Maps and Charts. Additional ebooks available at GeoScienceWorld include Engineering Geology Case Histories, Penrose Field Guides, and numerous non-series books. At the GSA Store and online is the complete suite of Decade of North American Geology volumes and maps.

***GSA’s peer-reviewed journals and books are made possible by 18 science editors, 127 associate editors and editorial board members, and 1,831 reviewers!***

A top member benefit is *GSA Today*, GSA’s open-access science and news magazine, featuring peer-reviewed science articles, hot-topic and issue-driven articles, member news, and announcements.

All members get free online access to *Geology* and free access to the GSA Millennium Edition of Geofacets, a web-based tool to access thousands of georeferenced maps. Student and early-career professional members also get free online access to *GSA Bulletin*.



Thompson Field Forum titled “Old or Young? The Topographic Evolution of the Sierra Nevada” was held from 20–27 June going between Nevada and California with 40 attendees. A Penrose Conference titled “Progressive Failure of Brittle Rocks” was hosted at the Highland Lake Inn and Resort in Flat Rock, North Carolina, USA, from 20–24 June with 85 attendees.

Six diverse undergraduate students were each provided a US\$1,500 for the Expanding Representation in the Geosciences Scholarship Program (ERG), a GSA student membership, and full meeting registration for GSA Connects 2022.



Justin Samuel began his role as GSA’s Marketing and Communication Director.

SIP 2022 winter application closed with 1,274 applicants.

# Marketing & Communications

## Press Releases

Supporting its strategic aspiration to link geoscience to society, GSA engages in media relations activities to enlarge the footprint of member research and publications. GSA issued 70 press releases in FY22, highlighting peer-reviewed research published in the Society's top-rated geoscience journals, presenting new findings from GSA meetings, and providing Society news. These are distributed to an extensive list of science journalists and posted on the American Association for the Advancement of Science (AAAS) online science news service, EurekAlert!. In addition, GSA encourages and assists public information officers at universities and government agencies to write their own releases about their GSA published research or presenting authors and then augments distribution of those releases for wider reach. GSA invites journalists to attend annual and Section Meetings with complimentary registration and hosted a newsroom. Go to [www.geosociety.org](http://www.geosociety.org), click on the "News" tab, and select "GSA in the News" to read some of the latest coverage.

## Science Communication Fellowship

Emily Zawacki served as GSA's 2021–2022 Science Communication Fellow. Accomplishments from her term include crafting press releases on a variety of topics from signs of water on Mars to environmental justice issues around dam removals to volcanic hazards. Emily helped advance GSA's social-media goals by piloting TikTok videos to accompany several of her deliverables.

*"The GSA Science Communication Fellowship has afforded me the opportunity to hone my skills as a professional science communicator, mixing traditional writing with multimedia products."* — Emily Zawacki, GSA's 2021–2022 Science Communication Fellow

## GSA Website

In fiscal year 2022, we improved the design and technology supporting GSA's web properties with an eye to the future. We overhauled the user experience of the online Member Community, giving it a clean and modern feel with strong ties to GSA branding. We continued to support our Divisions and volunteers with training, resources, and direct access to GSA staff, and we transitioned all Division sites to a new theme developed last year.

Behind the scenes, we are refactoring some of the technology that supports GSA's websites to make them resilient for the future. We analyzed GSA's performance on search platforms like Google and identified ways to continually improve our visibility.

## TOP WEBSITE PAGEVIEWS IN FY2022:

154,000	64,000
GSA Homepage	GSA Job Board
139,000	50,000
Geologic Time Scale	Field Experiences
125,000	
Scientists in Parks	

Throughout the year, we supported GSA through its regular cycle of meetings and programs with custom web properties, always designed with intentionality and an aspiration toward improvements in process and performance.

GSA hosted over 2.9 million pageviews over the last year. Visit us at [www.geosociety.org](http://www.geosociety.org).

## Speaking of Geoscience™

GSA posted 17 blogs on this channel, sharing ideas and dissecting issues ranging from geoscience policy to an interview with Black in Geoscience Week organizers to profiles of GSA's On To the Future Program participants. In FY22, *Speaking of Geoscience* had a readership of more than 1,200 visitors per month, with a total of nearly 20,000 blog views.

## GSA Today

GSA's member communications magazine offers a monthly science article as well as program updates and news about meetings. In FY22, *GSA Today* shipped out an average of 10,217 copies to GSA members, plus had a following of more than 11,300 readers who requested email alerts for when a new issue became available online.

## GSA Connection

GSA Connection is GSA's monthly electronic magazine, which is sent out to more than 30,000 readers. User opens average 57.4%, which is well above the industry standard of 24%. The highest clicks are on the *GSA Today* science article and on the trivia answers link.

## Department Director Transition

GSA's Director of Communications and Marketing, Christa Stratton, retired in June 2022 after 23 years of dedicated service. Justin Samuel, a long-time GSA employee, was selected to take over this role. We are pleased to have Justin as our new director and wish Christa all the best.

# Thank You FY2022 Sponsors

## Corporate and Organizational Relationships

GSA and the GSA Foundation collaborate on a range of sponsorships supporting the GSA Connects and more: field camp excellence recognition, geoscience students' field camp attendance, diversity programs, and a number of in-kind services and member benefits are all made possible thanks to partners and sponsors. We are pleased to include companies in a more integrated way: technical sessions, short courses, and field camps are searchable by four different industry tracks, and applied geoscience sessions occur at GSA Connects. Additionally, representatives from our corporate

partners have served on proposal teams, strategic planning task forces, and our careers program committee.

The combined efforts of business and science can make a greater difference than any organization alone. As GSA continues to convey its relevance to the private sector, we look forward to expanding corporate relationships in a variety of industries. Together, we can foster the growth of current and future leaders in the geoscience community, engaging business and industry as a positive force to advance science, stewardship, and service.

We thank the companies and organizations that join us in the meaningful impacts of partnership.

### Organizational Partner



Brunton

### Platinum



Image Audiovisuals\*



Zeiss

### Gold



Chevron



ExxonMobil



Paleontological Society



Lithium Americas

### Silver

Grindstone Labs

### Bronze

Anonymous

Elsevier

\*denotes in-kind sponsorship

### Member Benefit Partner



Brunton

### DOVETAIL WORKWEAR

Dovetail Workwear



Enterprise Rent-a-Car/National Car Rental



Geofacets



Interior Federal Credit Union



Journal of Geoscience Education



# Geological Society of America Foundation

The mission of the Geological Society of America Foundation is to develop and provide funds to support the goals and programs of the Geological Society of America. These funds are distributed according to the needs of the Society and in a manner consistent with the desire of the donors.

The responsibilities of the Foundation are twofold: (1) to support GSA programs, and (2) to preserve the Foundation's assets for the future.

## 2021–2022 Highlights

In a second consecutive year of challenging, uncertain circumstances across the globe, donors to GSA through the Foundation continued a robust showing of support: In FY2022, the GSA Foundation received Annual Campaign contributions of more than US\$1.25M from individual GSA members and corporations. There were 7,040 separate gifts at all levels from over 5,700 donors (almost 30% of members), a testament to the dedication of steadfast supporters.

While it has been a fruitful last year, we are looking ahead eagerly: We can make a still greater impact. With graphics like the one below, we aim to build awareness across all of GSA's membership, beyond our current donors, about the value of giving back to the Society. Our loyal base of donors gives year after year. We hope to reach the remaining 70% of GSA's membership with the message that small gifts from many members make a big difference in what GSA can offer. You will see more of these facts and figures in the year ahead, as we encourage every member to find their own fit in service to GSA and support of the Foundation as we work together to ensure the strength and presence of the geosciences.



We are deeply appreciative of those who include the Foundation in their estate plans; Legacy Circle gifts are vital to

unrestricted funding. In Fiscal Year 2022, we received nearly US\$175,000 from bequests. While many annual contributions meet an immediate need, these usually unrestricted legacy gifts can ensure support far beyond current needs and, often, on a larger scale. They allow GSA leadership to plan for important priorities of the Society or new initiatives that would not otherwise be possible. Over the past year, we learned of eight additional donors who are including GSA, through the Foundation, in their planned giving.

The GSA Foundation's student giving circle, Tektonikos – Building the Future, had another strong showing, with 1,350 donors from our student membership. We are eager to engage and encourage this group to remain involved as the future of the Society's membership and leadership.

Our spring mini-campaign supported On To the Future, bringing students from underrepresented groups to their first GSA meeting by covering registration, a year's membership, a travel stipend, and pairing with a one-to-one mentor. A longtime donor once again matched your contributions up to US\$10,000, a challenge this member has offered for a number of years to bolster this important initiative.

The GSA Foundation was able to provide funding for a record 30 J. David Lowell Field Camp Scholarships—10 more than when the program was solely funded by a corporate sponsor. This year-end campaign kicked off on Giving Tuesday, including a donor's US\$10,000 matching challenge to fellow supporters. Helping students obtain vital field experience remains a passion of our GSA members. Organizational partner Brunton upped their contribution to match this increase in scholarships by providing thirty engraved Transit compasses to recipients.

## Support by the Numbers

Of GSA members **6,128** donate to GSAF to support programs that benefit **30.5%** 20,075 members and beyond

*If every member gave simply the price of a coffee from a cafe, it would fund the cost of our Science Policy Fellow or it could provide...*

**50** On To the Future grants to serve those from groups under-represented in the geosciences

If the members who have yet to contribute gave just \$5 each, **35** GSA student members could receive scholarships toward a field camp of their choice—a hallmark of many geoscientists' training

**Did you know...**

**Just 313** members gave **\$60,000** as part of GSA CARES during the COVID pandemic, and that all but **8** were regular donors?

**836** student members to help provide assistance to

You get the point. Join your peers in helping your organization provide the very best. It doesn't take a lot of \$. **It just takes a lot of us.**

<https://gsa-foundation.org>

### Alexandra Banks: My Field Camp Experience (18 Nov. 2021)

*As a non-traditional student, receiving the J. David Lowell Field Camp Scholarship allowed Alexandra Banks to participate in field camp, which helped her find her place in geoscience.*

**Where did you attend field camp?**  
I attended the Southern Illinois University Geology field camp. We spent a majority of the time learning field mapping in Montana. We also visited various locations throughout Wyoming and Idaho to learn about the geologic processes that formed some of this country's most beloved parks.

**What did receiving the J. David Lowell Field Camp Scholarship mean to you?**  
A field course is commonly required to complete a degree in geology, and it is a really important experience for students. Receiving this scholarship alleviated the financial strain due to not only the cost of the course, but taking six weeks away from work. As a non-traditional student, I am primarily responsible for all of my school and living expenses. This scholarship allowed me to focus on all that I had to gain, rather than how I was going to make it through the summer.

**What did that experience teach you about the geosciences, yourself, and your future career?**  
I learned that the field of geoscience is very diverse. There are many different applications, and I found myself interested in facets that I had never thought much about before. I also learned that I really enjoy working outside. Fieldwork is very challenging, and the hard work makes me feel strong and confident. The physical aspect of many geology jobs is not something that intimidates me. Rather, I look forward to it.

**What opportunities did attending field camp provide that you wouldn't have had otherwise and in your opinion, how important is field camp for geoscience students?**  
Attending field camp allowed me to be able to apply fundamental geologic concepts to real landscapes and features. Field camp is integral to the success of a geology student, because reading about something and recognizing it in the field are two different things. Field camp provides the opportunity for students to visit very diverse landscapes and learn in 3D. It also helps students orient themselves in the world of geosciences and really find out what interests them the most.

**Why should individuals support field camp opportunities for students?**  
Support is so important because field camp is such a valuable and important part of our education, and is required for most geology degrees. However, it is quite costly and requires time away from work. The scholarship program that I participate in for fall and spring semesters does not extend financial support for the summer. Students should not have to decline opportunities, or avoid programs that require a field course due to financial strain.

Stories like this and of many other GSA program recipients can be found on the Foundation's News & Events page of our website (<https://gsa-foundation.org/news-events/>).

Each year, we work with donors to create a number of new funds that often support research grants or awards. An example of a less-common fund in the past year is the Christopher I. and Irene N. Chalokwu Travel Grant for Students in Africa. GSA International oversees selection of the grant, which aims to support high-quality research by students on the African continent, bring African geology into focus for U.S. professionals and institutions, shine a light on studies that are underreported, and broaden participation at GSA Connects and beyond. With the introduction of this fund, Dr. Chalokwu and his wife, Dr. Irene N. Chalokwu, provide an outstanding example of how individuals can create opportunity across geopolitical borders and realize impacts far beyond a single place or time. We hope that this vision and generosity inspires others who also support international scientific exchange.

After two years of postponement due to the pandemic, the second *Death Valley Rendezvous* took place in the spring of 2022. Participants included geologists and their guests. Darrel Cowan led us throughout the region, looking at the Kingston Peak Formation, stromatolites as an early record of microbial life on earth at different times in the Proterozoic, Tecopa lake beds, pup fish, and more, including a day with Nature Conservancy naturalist Len Warren talking about birds of the area. Since the trip was once again in high demand, it will also run in Spring of 2023.

The Foundation is pleased to help donors support GSA programs and priorities important to them. Looking forward, we are eager to maintain the increased annual funding level achieved in the last several years and to work with GSA in identifying engaging and effective resource-building strategies. With your help, we will continue to shape a strong future for GSA.

### **How Members Can Get Involved:**

Support students, research, and education through a voluntary contribution to the GSA Foundation when you renew your 2023 membership.

Help others be part of our GSA member community. The Membership Assistance Program and Fund enables those who cannot afford the cost of membership, or who experience difficulty in transferring funds from their country to the USA, to become members. Support and spread the word.

We encourage every member to avail themselves of the opportunity to serve GSA and to support the Foundation in our combined efforts to ensure the dynamism and strength of the geosciences. Please visit the Foundation's website ([www.gsa-foundation.org](http://www.gsa-foundation.org)) for information regarding ways you can make a philanthropic impact for GSA and the geosciences.

#### **Debora B. Marcinkowski**

Executive Director  
GSA Foundation

#### **Jeffrey Oslund**

Chair  
Foundation Board of Trustees

# Renew Your 2023 GSA Membership by 1 Nov. Save up to \$15 on Dues\*

## LEARN

- Enjoy free online access to *Geology* and *Geofacets*\*, subscribe to additional peer-reviewed journals, and receive *GSA Today*
- Purchase special papers, memoirs, field guides, and more at member-only rates
- Apply for research grants and short-term field experiences
- Take advantage of mentoring and career guidance

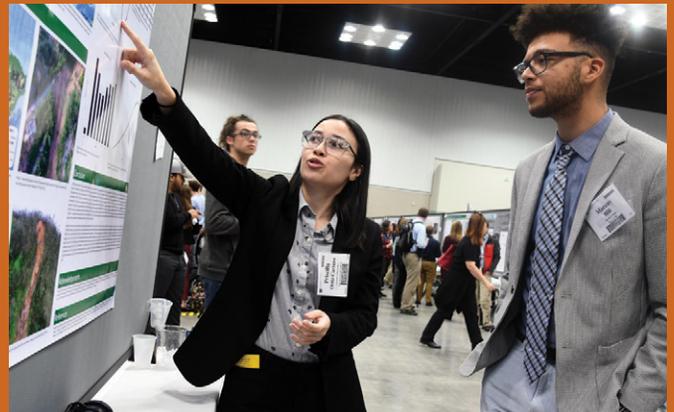
\* student, early career professional, and K-12 teacher members also receive online access to *GSA Bulletin*



**\$800,000+**  
Research Funding/year

## GROW

- Publish in premier scientific journals
- Present your research at scientific meetings
- Attend technical sessions, short courses, field trips, career workshops
- Lead a field trip or short course



**13,000+**  
*Geology* Articles  
Free to Members Online

Invest in Yourself by Renewing Your 2023 GSA Membership Today

GSA is dedicated to advancing your geoscience career and keeping you connected with your scientific community.

\*applies to those in high income countries/territories

## CONNECT

Collaborate, exchange ideas, and network:

- 19,000+ members worldwide
- Online communities, forums, and member directory
- Scientific meetings and events
- 22 scientific Divisions
- 6 geographic Sections



**8,000+**  
Attend Meetings/year

## GIVE BACK

- Serve on a Committee or in a leadership role
- Nominate a deserving colleague for an honor or award
- Be a mentor or advocate
- Support diversity in and awareness of the geosciences
- Support our programs by contributing to the GSA Foundation



**700+**  
Volunteers/year

[www.geosociety.org/members](http://www.geosociety.org/members)

## Registration

*You still have time to register for GSA Connects 2022!*

Register at [community.geosociety.org/gsa2022/registration](https://community.geosociety.org/gsa2022/registration) throughout the meeting.

Badges will be available at the “On-Demand Registration Desk” in Lobby F of the Colorado Convention Center (CCC) starting at 7 a.m. on Saturday, 8 October.

Sat., 7 a.m.–7 p.m.

Sun., 6:30 a.m.–6:30 p.m.

Mon.–Wed., 7 a.m.–4:30 p.m.

Ribbons are available near the GSA Information Desk during onsite registration hours in the CCC.



We support Respectful, Inclusive Scientific Events (RISE) and are committed to ensuring a safe and welcoming environment for all participants.

By registering for this meeting, you agree to abide by the GSA Events Code of Conduct Policy in all venues at our meetings, including ancillary events, field trips, and official and unofficial social gatherings.



### Enroll in a Short Course Today!

Take advantage of cutting-edge courses as part of your GSA Connects 2022 experience. This is a great opportunity to earn continuing education credits.

- ADD a new skill to your résumé or CV;
- ENRICH your meeting experience;
- IMPROVE your ability to reach professional goals;
- CONNECT with colleagues who share your research interests and passions;
- NETWORK with potential employers, mentors, and collaborators; and
- KEEP your skills relevant in a rapidly changing world.

[community.geosociety.org/gsa2022/program/short](https://community.geosociety.org/gsa2022/program/short)



### Share Your Story and Make a Difference

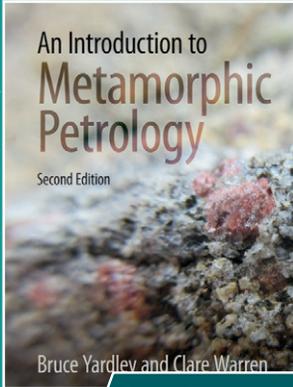
Sign up to mentor students at GSA Connects 2022.

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

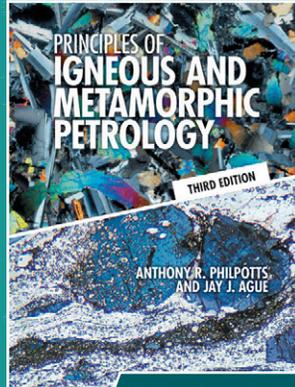
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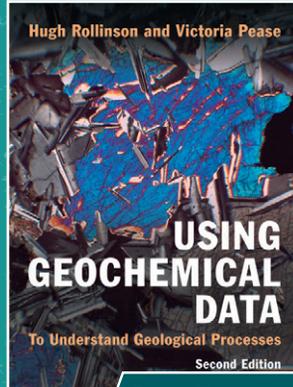
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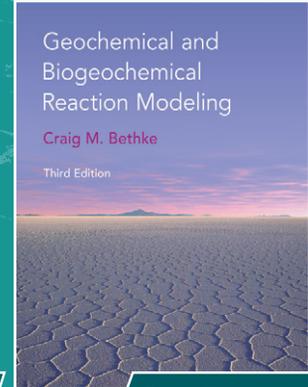
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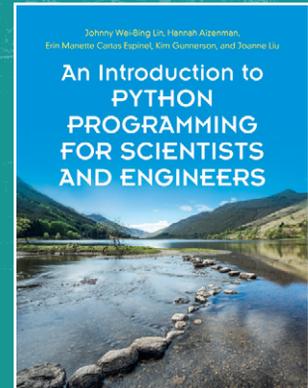
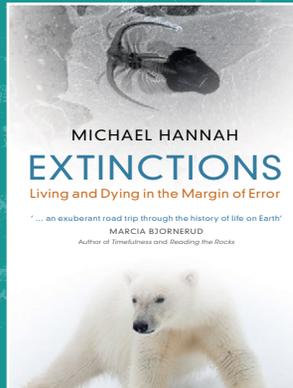
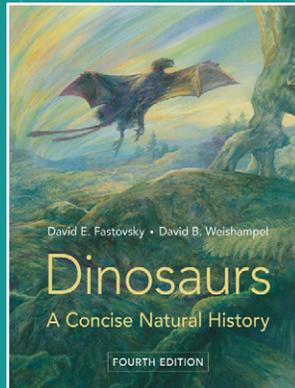
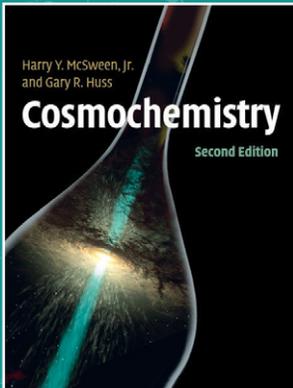
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2nd Edition

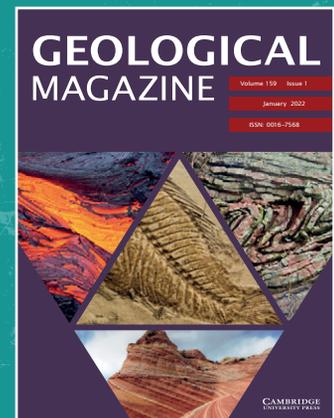
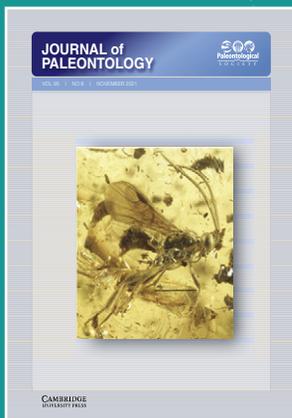


3rd Edition



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## Your Guide to Career Success

Envision your future career in the geosciences and learn about how to make it a reality by attending these events.  
[community.geosociety.org/gsa2022/geocareers](http://community.geosociety.org/gsa2022/geocareers)

### GEOCAREERS DAY

(Mon., 10 Oct.)

*Direct Access to Company and Agency Representatives.*

To register, add this event to your meeting registration.

Cost: US\$25; includes lunch.

- Career Workshop (10–11 a.m.)
- Company Information Booths (11 a.m.–12:30 p.m.)
- Mentoring Roundtables (11 a.m.–12:30 p.m.)
- Panel Luncheon (12:30–2 p.m.)

### GEOCAREERS CORNER

(Sun.–Tues., 9–11 Oct.)

*Career Guidance and Information.*

No registration is required; all are welcome.

- Early Career Professional Coffee (Sun., 9–10 a.m.)
- Networking Event (Sun., 3:30–5 p.m.)
- Women in Geology Program (Sun., 5:30–7 p.m.)
- Résumé/CV Review Clinic (Sun.–Tues., 10 a.m.–3 p.m.)
- Drop-in Mentoring (Sun.–Tues., 10 a.m.–3 p.m.)
- Geology Club Meet Up (Mon., 2–3 p.m.)
- Career Presentations
- Post or View Jobs



## Success in Publishing: Navigating the Process

Led by experienced GSA science editors (and GSA Distinguished Service Awardees) Rónadh Cox and Nancy Riggs, this workshop focuses on the bigger creative picture. Learn how to:

- frame and structure your work for publication,
- create well-thought-out figures and tables that communicate your ideas,
- write an attention-getting cover letter,
- choose the right journal for your work,
- and more!

Plus, hear from the experts on what constitutes a good review, how you would benefit from being a reviewer, and how it can advance your career toward an editorship.

This highly successful, free workshop for early career geoscientists on the process of preparing and publishing papers will be held in person for its tenth year during GSA Connects 2022. For more information and to receive email updates, go to [www.geosociety.org/GSA/Publications/GSA/Pubs/WritersResource.aspx](http://www.geosociety.org/GSA/Publications/GSA/Pubs/WritersResource.aspx).



# Richard Gilder Graduate School

## Master of Arts in Teaching



### Change lives. Teach science.

Join a **fully paid** graduate teacher education program in Earth and space science that prepares you to teach in high-need middle and high schools, including a monthly stipend towards living expenses in the New York City area.

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



## Apply Today!

Complete details are available at [amnh.org/mat](http://amnh.org/mat)

With deepest appreciation, the Museum acknowledges Kathryn W. Davis for her generous founding support of the Master of Arts in Teaching (MAT) Program. Leadership support for the MAT program is provided by The Shelby Cullom Davis Charitable Fund.

Generous support has been provided by the Bezos Family Foundation.

The MAT program is supported in part by the U.S. Department of Education under Grant Numbers U3365140026 and U3365190042 and the National Science Foundation under Grant Number DUE-1852787.

Additional support has been provided by The Rice Family Foundation and Nancy B. and Hart Fessenden.

[amnh.org/mat](http://amnh.org/mat)

[mat@amnh.org](mailto:mat@amnh.org) | 212-313-7464

# 2023 GSA Awards & Medals

GSA selects individuals based on track record and commitment to integrity and promise to continue living up to the ethical standards embodied in GSA's Code of Ethics and Professional Conduct, in addition to their many accomplishments. The deadline for receipt of all medal, award, and recognition nominations is **1 February 2023**.

[www.geosociety.org/awards](http://www.geosociety.org/awards)

## Penrose Medal

The Penrose Medal was established in 1927 by R.A.F. Penrose Jr. to be awarded in recognition of eminent research in pure geology, for outstanding original contributions, or for achievements that mark a major advance in the science of geology. This award is made only at the discretion of the GSA Council, and nominees may or may not be members of the Society. Penrose's sole objective was to encourage original work in purely scientific geology, which is interpreted as applying to all scientific disciplines represented by GSA. Scientific achievements should be considered rather than contributions in teaching, administration, or service. Mid-career scientists who have already made exceptional contributions should be given full consideration for the award.

## Day Medal

The Arthur L. Day Medal was established in 1948 through a donation by Arthur L. Day, founding director of the Geophysical Laboratory of the Carnegie Institution of Washington. It is awarded annually, or less frequently at the discretion of the Council, to recognize outstanding distinction in the application of physics and chemistry to the solution of geologic problems, with no restriction to the particular field of geologic research. It was Dr. Day's wish to provide an award to recognize outstanding achievement in research and to inspire further effort, rather than to reward a distinguished career, and so it has been the longstanding practice of the Society to award this medal to geoscientists actively pursuing a research career.

## Young Scientist Award (Donath Medal)

The Young Scientist Award was established in 1988 to be awarded to a young scientist (35 years or younger throughout the year in which the award is to be presented—*for 2022, only those candidates born on or after 1 Jan. 1987 are eligible*) for outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the earth sciences. The award consists of a gold medal (the Donath Medal) and an honorarium.

## How to Nominate

To ensure thorough consideration by the respective committees, please follow these nomination instructions carefully; additional information supplied will not enhance the nomination. For each candidate, please submit the following:

1. **Nomination form:** Please go to <https://rock.geosociety.org/forms/Awardform.asp> to submit the form online.
2. **Supporting documents,** to be submitted as e-mail attachments or via post; for Penrose, Day, and Donath, the following supporting documents are required:

- Curriculum vitae.
- Summary (300 words or less) of the scientific contributions to geology that qualify the candidate for the award.
- Selected bibliography of no more than 20 titles (for the Donath medal, only 10 titles are required).
- Letters of support from each of five GSA Fellows or members in addition to the person making the nomination. **For the Day Medal only:** letters from five scientists with at least three of those being from GSA Fellows or members and up to two from fellows or members of the Mineralogical Society of America, Geochemical Society, or American Geophysical Union. Nominations for the Day Medal will be reviewed using this rubric: <https://www.geosociety.org/documents/gsa/awards/day-medal-rubric.pdf>. For the Donath Medal only: Nominations for the Donath Medal will be reviewed using this rubric: <https://www.geosociety.org/documents/gsa/awards/donath-medal-rubric.pdf>. Nominators are encouraged to ask nominees to provide information for the DEI specific rubric.

## Florence Bascom Geologic Mapping Award

The Florence Bascom Geologic Mapping Award was approved by GSA Council in October 2013, and the first award was presented in 2015. This award acknowledges contributions in published high-quality geologic mapping that led the recipient to publish significant new scientific discoveries, to bring about greater understanding of fundamental geologic processes and concepts, and to contribute to the application of new knowledge to societal needs and opportunities in such areas as mineral resources, water resources, and the environment.

The recipient will have authored high-quality geologic maps, cross sections, and summary reports that have received scientific acclaim and are available to both peers and the public, through federal or state agencies or major scientific societies. In evaluating the merits of nominees for this award, scientific achievements should be considered rather than contributions in teaching, administration, or service. Nominees may or may not be members of the Society, and they may be from any nation.

The selection criteria employed by the Geologic Mapping Award Committee are as follows: (A) excellence of the nominee's published geologic maps; (B) clear record of greater understanding of fundamental geologic processes and/or concepts, and high-quality publication of same, emerging directly from the meritorious quality of the geologic mapping; and (C) peer acclaim of the practical usefulness of the geologic mapping and the new discoveries that emerged from the mapping.

## How to Nominate

1. **Nomination form:** Please go to <https://rock.geosociety.org/forms/Awardform.asp> to submit the form online.
2. **Supporting documents,** to be submitted as e-mail attachments or via post:
  - **Curriculum vitae.**
  - Letter of nomination (300 words or less) addressing the evaluation criteria.
  - Selected bibliography of geologic maps (20 titles or less).

- Selected bibliography of peer-reviewed publications (20 titles or less).
- PDFs or website links to several key geologic maps authored by the nominee.
- Letters of support from three scientists with at least two from GSA Fellows or members and one from a member of another professional geoscience organization. Diverse supporters (i.e., including individuals who are not currently/recently associated with the nominee's institution) are strongly encouraged.

### **Randolph W. "Bill" and Cecile T. Bromery Award**

The Bromery Award for Minorities should be given to any minority, preferably African Americans, who qualify under at least one of these two categories:

1. Nominee has made significant contributions to research in the geological sciences, as exemplified by one or more of the following:
  - Publications that have had a measurable impact on the geosciences.
  - Outstanding original contributions or achievements that mark a major advance in the geosciences.
  - Outstanding lifetime career that demonstrates leadership in geoscience research.
2. Nominee has been instrumental in opening the geoscience field to other minorities, as exemplified by one or more of the following:
  - Demonstrable contributions in teaching or mentoring which have enhanced the professional growth of minority geoscientists.
  - Outstanding lifetime career service in a role which has highlighted the contributions of minorities in advancing the geosciences.
  - Authorship of educational materials of high scientific quality that have enjoyed widespread use and acclaim among educators or the general public.

#### **How to Nominate**

1. **Nomination form:** Please go to <https://rock.geosociety.org/forms/Awardform.asp> to submit the form online.
2. **Supporting documents,** to be submitted as e-mail attachments or via post:
  - Curriculum vitae.
  - Letter of nomination (300 words or less).
  - Letters of support from three scientists with at least two from GSA Fellows or members and one from a member of another professional geoscience organization.
  - Optional selected bibliography of no more than 10 titles.

### **Doris M. Curtis Outstanding Woman in Science Award**

The Doris M. Curtis Outstanding Woman in Science Award recognizes a woman who has had a major impact on the field of the geosciences based on her Ph.D. research. The generous support of the Doris M. Curtis Memorial Fund makes this award possible. GSA's 103rd president, Doris Curtis, pioneered many new directions for geology, not the least of which was her tenure as GSA president after an unbroken chain of 102 men. Causes dear to her were women, public awareness, minorities, and education. Women are eligible for this award the first five years following their Ph.D. degree.

#### **How to Nominate**

1. **Nomination form:** Please go to <https://rock.geosociety.org/forms/Awardform.asp> to submit the form online.
2. **Supporting documents,** to be submitted as e-mail attachments or via post:
  - Curriculum vitae including dissertation title and abstract.
  - Selected bibliography of no more than 10 titles.
  - Letter of nomination that clearly states how the Ph.D. research has impacted the geosciences in a major way. Diversity, equity, and inclusion (DEI) promotion activities are to be included in the submitted letter of nomination.
  - Letters of support from three scientists with at least two from GSA Fellows or members and one from a member of another professional geoscience organization. DEI promotion activities are to be included in the submitted letters of support.
3. Additionally, nominators and support letter-writers are requested to address the continued impact of the nominee and their Ph.D. research to the scientific community by including the following:
  - Relevance of the work to the specialty field and more broadly to the geosciences and society.
  - Discussion of the impact of the Ph.D. work via altered ways of thinking, new techniques, new citation data of resulting publications, etc.
  - Efforts by the nominee to impact the geosciences through activities such as mentoring, teaching, and initiatives promoting diversity in the field.

### **GSA Distinguished Service Award**

GSA Council established the GSA Distinguished Service Award in 1988 to recognize individuals for their exceptional service to the Society. GSA members, Fellows, associates, and employees may be nominated for consideration, and any GSA member or employee may submit a nomination for the award. GSA's Executive Committee will select awardees, and GSA Council must ratify all selections. Awards may be made annually, or less frequently, at the discretion of Council.

#### **How to Nominate**

1. **Nomination form:** Please go to <https://rock.geosociety.org/forms/Awardform.asp> to submit the form online.
2. **Supporting documents,** to be submitted as e-mail attachments or via post:
  - Curriculum vitae.
  - Letter of nomination (300 words or less).
  - Brief biographical sketch that clearly demonstrates the applicability of the selection criteria.
  - Optional selected bibliography of no more than 10 titles.

### **GSA Public Service Award**

GSA Council established the GSA Public Service Award in 1998 in honor of Eugene and Carolyn Shoemaker. This annual award recognizes contributions that have materially enhanced the public's understanding of the earth sciences or have significantly served decision makers in the application of scientific and technical information to public affairs and earth science-related public policy. This may be accomplished by individual achievement in:
 

- Authorship of education materials of high scientific quality that have enjoyed widespread use and acclaim among educators or the general public.

- Acclaimed presentations (books and other publications, mass and electronic media, or public presentations, including lectures) that have expanded public awareness of the earth sciences.
- Authorship of technical publications that have significantly advanced scientific concepts or techniques applicable to the resolution of earth-resource or environmental issues of public concern.
- Other individual accomplishments that have advanced the earth sciences in the public interest.

The award will normally go to a GSA member of any nation, with exceptions approved by Council, and may be presented posthumously to a descendant of the awardee.

#### How to Nominate

1. **Nomination form:** Please go to <https://rock.geosociety.org/forms/Awardform.asp> to submit the form online.
2. **Supporting documents,** to be submitted as e-mail attachments or via post:
  - Curriculum vitae.
  - Letter of nomination (300 words or less).
  - Brief biographical sketch that clearly demonstrates the applicability of the selection criteria.
  - Selected bibliography of no more than 10 titles.

#### GSA Honorary Fellow

Established by the GSA Council in 1909, Honorary Fellowship may be bestowed on individuals who have made outstanding and internationally recognized contributions to geoscience, or in rare circumstances, provided notable service to the Society. In practice, nearly all candidates are non-North Americans who live and work outside of North America. The most noteworthy exceptions were astronauts. The awardee does not have to be a member of the Society to receive the award. No more than two Honorary Fellows will be awarded annually. Honorary Fellows receive complimentary lifetime membership to the Society.

#### How to Nominate

1. **Nomination form:** Please go to <https://rock.geosociety.org/forms/Awardform.asp> to submit the form online.
2. **Supporting documents,** to be submitted as e-mail attachments or via post:
  - Curriculum vitae.
  - Letter of nomination (300 words or less) that clearly demonstrates the applicability of the selection criteria.
  - Letters of support from three scientists with at least two from GSA Fellows and one from a GSA Fellow or a person of equivalent international stature.
  - Selected bibliography of no more than 20 titles.

#### Award Notes

Candidates whose names are submitted by the respective award committees to GSA Council but who do not receive an award will remain under consideration by those committees for three years. For those still under consideration, it is recommended that an updated nomination package be sent to GSA (required for the Donath Medal).

All nomination forms and submission instructions can be found online at [www.geosociety.org/awards](http://www.geosociety.org/awards). Nomination forms and instructions may also be obtained from GSA Grants and Awards, P.O. Box 9140, 3300 Penrose Place, Boulder, CO 80301-9140, USA, +1-303-357-1028, [awards@geosociety.org](mailto:awards@geosociety.org).

#### OTHER AWARDS

##### John C. Frye Environmental Geology Award

**Deadline:** 31 March 2023

In cooperation with the Association of American State Geologists (AASG), GSA makes an annual award for the best paper on environmental geology published either by GSA or by one of the state geological surveys.

Anyone can nominate a paper as long as it is selected from a GSA or state geological survey publication and published during the preceding three full calendar years. The nomination letter must include a paragraph stating the importance of the paper. Up to three letters from users of the publication can be included to support the nomination.

Each nominated paper will be judged on its uniqueness or significance as a model of its type of work and its overall worthiness for the award. The paper must (1) establish an environmental problem or need; (2) provide substantive information on the basic geology or geologic process pertinent to the problem; (3) relate the geology to the problem or need; (4) suggest solutions or provide appropriate land-use recommendations based on the geology; (5) present the information in a manner that is understandable and directly usable by geologists; and (6) address the environmental need or resolve the problem. It is preferred that the paper be directly applicable to informed laypersons (e.g., planners, engineers).

Please send your nominations to GSA Grants and Awards, P.O. Box 9140, Boulder, CO 80301-9140, USA. For more information, go to [www.geosociety.org/GSA/About/awards/GSA/Awards/Frye.aspx](http://www.geosociety.org/GSA/About/awards/GSA/Awards/Frye.aspx).

##### AGI Medal in Memory of Ian Campbell

The AGI Medal in Memory of Ian Campbell recognizes singular performance in and contribution to the profession of geology. Candidates are measured against the distinguished career of Ian Campbell, whose service to the profession touched virtually every facet of the geosciences. Campbell was a most uncommon man of remarkable accomplishment and widespread influence, and in his career as a geologist, educator, administrator, and public servant, he was noted for his candor and integrity. To submit a nomination, go to [www.americangeosciences.org/awards/iancampbell](http://www.americangeosciences.org/awards/iancampbell).

##### AGI Marcus Milling Legendary Geoscientist Medal

The Marcus Milling Legendary Geoscientist Medal is given to a recipient with consistent contributions of high-quality scientific achievements and service to the earth sciences having lasting historic value; who has been recognized for accomplishments in field(s) of expertise by professional societies, universities, or other organizations; and is a senior scientist nearing completion or has completed full-time regular employment. Prior to 2007 it had been called the AGI Legendary Geoscientist Award. To submit a nomination, go to [www.americangeosciences.org/awards/legendarygeoscientist](http://www.americangeosciences.org/awards/legendarygeoscientist).

# Mark Your Calendar for Meetings Closer to Home



## South-Central Section

13–14 March  
Stillwater, Oklahoma, USA  
*Todd Halihan, todd.halihan@okstate.edu*  
[www.geosociety.org/sc-mtg](http://www.geosociety.org/sc-mtg)

Edmon Low Library, Oklahoma State University.  
Photo credit: rseigler0 from Pixabay.

## Joint Southeastern & Northeastern Sections

17–19 March  
Reston, Virginia, USA  
*Arthur Merschat, amerschat@usgs.gov; Patrick Burkhardt, patrick.burkhardt@sru.edu*  
[www.geosociety.org/se-mtg](http://www.geosociety.org/se-mtg)

Reston Town Center water fountain.  
Photo credit: J. Rodysill.



## North-Central Section

4–5 May  
Grand Rapids, Michigan, USA  
*Tara Kneeshaw, kneeshta@gvsu.edu; Ginny Peterson, petersvi@gvsu.edu*  
[www.geosociety.org/nc-mtg](http://www.geosociety.org/nc-mtg)

L.V. Eberhard Center at GVSU. Photo credit:  
Amanda Pitts, University Communications,  
Grand Valley State University.



## Cordilleran Section

17–19 May  
Reno, Nevada, USA  
*Stacia Gordon, staciag@unr.edu*  
[www.geosociety.org/cd-mtg](http://www.geosociety.org/cd-mtg)

Panorama from the Mono Lake South Tufa Area.  
Photo credit: Dr. Philipp Ruprecht.



## Rocky Mountain Section

23–25 May  
Fort Collins, Colorado, USA  
*Rick Aster, rick.aster@colorado.edu*  
[www.geosociety.org/rm-mtg](http://www.geosociety.org/rm-mtg)

Pineridge Natural Area.  
Photo credit: Jan Alexander from Pixabay.

# Geological Fingerprints of Slow Earthquakes

Santa Catalina Island, California, USA  
1–5 April 2022

## CONVENERS

**James Kirkpatrick**, McGill University, Dept. of Earth and Planetary Sciences, Montréal, Québec, Canada, james.kirkpatrick@mcgill.ca

**John Platt**, University of Southern California, Dept. of Earth Sciences, Los Angeles, California, USA

**David Schmidt**, University of Washington, Dept. of Earth and Space Sciences, Seattle, Washington, USA

**Melodie French**, Rice University, Dept. of Earth, Environmental and Planetary Sciences, Houston, Texas, USA

**Christie Rowe**, McGill University, Dept. of Earth and Planetary Sciences, Montréal, Québec, Canada

## INTRODUCTION

This Penrose Conference assembled a multidisciplinary group of scientists to debate how geological evidence can contribute toward understanding why slow earthquakes occur and to explain their characteristics. Slow earthquakes are a family of fault and shear zone slip events that include slow slip events (SSEs), tectonic tremor, and low frequency earthquakes (LFEs). In some systems these different events occur together, and they are known as episodic tremor and slip, or “ETS.” Compared to earthquakes, the slip across a fault during a slow earthquake occurs slowly, but significantly faster than plate-rate creep. Slow earthquakes are widely observed where geophysical networks are robust, contribute significantly to the overall slip budget in portions of some plate boundary faults, and may elucidate stress transfer between portions of plate boundaries with different modes of fault slip. Understanding slow earthquakes is therefore critical to better constrain regional seismic hazards and may also constrain the physical conditions and fault-loading rates at depth.

The conference was held on 1–5 April 2022 at the University of Southern California Wrigley Institute for Environmental Studies on Pimu (Santa Catalina Island), California, USA, where the exceptional exposures and structural complexity of the Catalina Schist provided inspiration for the discussions. Forty-seven attendees, including ~45% early-career scientists, traveled from eight different countries, including Canada, Germany, Japan, Italy, the Netherlands, New Zealand, and the UK. The meeting launched with a series of keynote talks presenting cutting-edge perspectives on slow earthquakes from seismological, geodetic, experimental, modeling, and geological communities. The subsequent breakout discussion sessions and poster sessions were devoted to research presentations from the participants, framing relevant hypotheses that explain slow earthquakes and debating how geological evidence can be leveraged to test those hypotheses.

A day-long field trip informed much of the meeting discussions, with participants taking in exposures of the Catalina Schist that were metamorphosed and deformed under conditions similar to where some slow earthquakes occur today. Exposures included a mélange and a sheeted vein complex in the Catalina Blueschist Unit, which focused attention on pore pressure constraints,

coupling between metamorphic and structural processes, the importance of mechanical heterogeneity during deformation, and the rates at which veining/fracture and distributed deformation occur. In the Catalina Amphibolite Unit, blocks of mafic and ultramafic rocks in a metasomatized matrix attested to fluid-rock interaction and the accompanying progressive changes in rock rheology leading to mechanical heterogeneity.

The keynote presentations emphasized that the well-resolved source parameters of slow earthquakes (e.g.,  $\sim 10^{-7}$  m/s slip rate, km/day rupture propagation rate, and  $\sim 10$  kPa stress drop for SSEs) are distinct from regular earthquakes. Furthermore, to first order the geodetic and seismic records of slow earthquakes appear to be similar, regardless of tectonic setting or depth of the slip event. A broadly held view was that because the SSEs accommodate substantially more of the plate motion budget and exhibit much larger seismic moments than LFEs, SSEs are the dominant member of the slow earthquake family and should be the focus of future efforts to understand the physics of slow slip. However, some participants argued that the LFE components of SSE were the best-resolved geophysically and should be instrumental in driving more specific comparisons to geologic features. The breakout discussions therefore explored the significance of existing geological observations and the future research needs from geological work in two themes:

### 1. Is there any process, condition, or structure common to slow earthquakes that could explain their characteristics?

The consistent geodetic and seismological characteristics of slow slip suggest there may be a common process or set of conditions at the sources of SSEs and possibly another for tectonic tremor and LFEs. Attendees debated if and how grain-scale deformation mechanisms, deformation structure geometry, and deformation conditions (e.g., effective pressure, temperature, etc.) could be different across the range of slow earthquake occurrences but combine to yield similar slip phenomena. A combination of deformation mechanisms involving frictional sliding plus some viscous-type mechanism likely promotes slow earthquakes. Further work is needed to determine how the two mechanisms interact and are preserved in the rock record, recognizing that both the interactions and the preservation may vary between different SSE settings. Attendees agreed that geological field observations from slow earthquake source depths indicate the deformation associated with these events likely affects a volume rather than a planar or quasi-planar surface, which is also allowed by the geophysical constraints. Heterogeneity is ubiquitous, but further work is needed to determine what structures or rheological contrasts are relevant to slow slip, and how slow slip can propagate over long distances despite the heterogeneity. Although slow slip phenomena occur over a broad range of metamorphic conditions, attendees noted that low effective stresses promote slow slip by driving slip toward frictionally neutral stability, though low effective stresses alone cannot explain why slow slip occurs rather than regular earthquakes. More detailed analyses of

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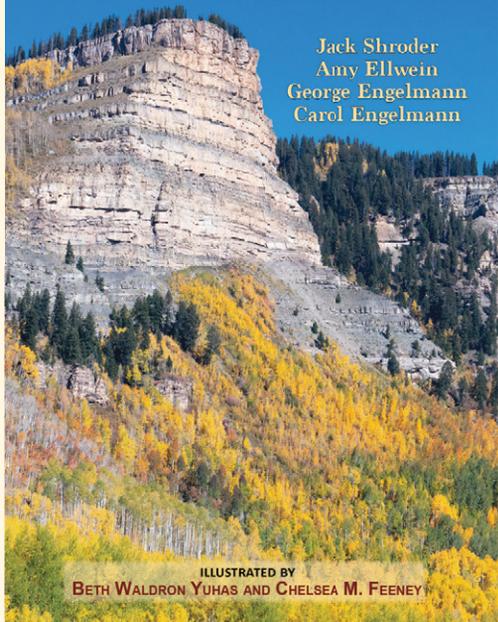
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Jack Shroder  
Amy Ellwein  
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### GEOLGY UNDERFOOT ON COLORADO'S WESTERN SLOPE

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## PENROSE REPORT

slow earthquake sources in places with well-constrained thermal structures should be undertaken to connect the deformation conditions with slow earthquake characteristics.

### 2. How can geological observations test the slow earthquake hypotheses?

Multiple hypotheses have been proposed that can explain how slip velocities during slow earthquakes are limited, thereby differentiating them from regular earthquakes. Many of the hypotheses are developed from the rate and state friction framework and are supported by laboratory rock friction experiments. Others call for coupled frictional-viscous deformation. The relevance to natural systems is largely untested. Attendees examined the hypotheses and asked what geological structures might serve as records that the hypothesized mechanisms were active in ancient slow earthquakes, what geological features would lead the hypothesis to be rejected, and whether there are new geological observations that should be collected to test the hypotheses. For most hypotheses there are both deformation structures that are predicted to be consistent with the hypothesis and characteristics of deformed rocks that would reject the hypothesis. Some, such as a specific velocity-neutral condition and a dislocation creep-based mechanism might be indistinguishable from perceived “steady-state” structures. Work is needed from both the observational and geological communities to reconcile the relevant scales of deformation process and structures so that future field and microscale observations can contribute positively toward understanding slow slip.

### CONSENSUS

Ultimately, the breakout discussions concluded that no signature has been identified in the rock record that uniquely identifies slow slip phenomena as observed with contemporary geophysical sensors but that does not radiate seismic waves. Overcoming this barrier may depend on a combination and linkage of deformation-related features, rather than a “smoking gun” (in contrast to frictional heat anomalies that record seismic slip). Defining the mechanisms accommodating slow slip is important for informing the physics of slow slip, but will likely require definition of different geological signatures in different settings. Future cross-disciplinary studies are needed to reconcile the observations of active slow slip with the rock record. This type of work will benefit from a clarification of terminology so that aspects of the deformation associated with slow slip can be compared across fields. The

Penrose attendees are developing a set of papers to address these next steps and will invite community participation.

### ACKNOWLEDGMENTS

The 2022 Penrose Conference met on Pimu (Catalina Island), ancestral home of the Gabrielino/Tongva Nation, the Juaneño Band of Mission Indians Acjachemen Nation, and the Payómkawichum (Luiseño) nations. This conference was made possible thanks to financial support from the Geological Society of America, the National Science Foundation GeoPRISMS program (2025105), and the Southern California Earthquake Center (SCEC-19133). We thank GSA meeting manager Becky Sundeen for organizational and administrative support during the challenging planning process and the staff at the Wrigley Center for their huge efforts.



Photo credit: Daniel Ortega-Arroyo.

### PARTICIPANTS

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# At the Nexus of Earth Science and Civilization: GSA's Geology and Society Division

**Jim Heller, Chair**

“We’ve learned ...that over the history of our planet, Earth and life have co-evolved. Changes in the environment affect life, and changes in life can transform the environment. This is a lesson to ponder as we think about our future as well as our past.” —Andrew H. Knoll, Ph.D., 2014, *Cambrian Ocean World: Ancient Sea Life of North America (Life of the Past)*

To summarize the focus of a membership comprised of geoscientists of broad interdisciplinary interests—such as GSA’s Geology and Society Division—is challenging. The above quote, possibly, touches on its essence. Recent history, illuminated through science, has demonstrated mankind’s remarkable capacity to alter global conditions. Humanity, even in its infancy, has depended on geologic resources to maintain its presence on Earth. The archaeological and historical records, for example, demonstrate profound change in the acquisition of natural resources—beginning with the origins of the earliest hominids and their manufacture of stone tools to our present-day industrial economies and their comparatively enormous demand for minerals, energy, land, and water. Moreover, sustaining human existence (i.e., societies) necessitates engineering the natural habitat. This entails integrating the built environment onto, and within, Earth—and to do so in a way that maximizes efficiency of resources, promotes security, and maintains stability. This becomes more challenging when communities attempt to adapt (not necessarily by choice) to marginal circumstances—an increasingly common problem in our modern age of anthropogenic climate change, diminished environmental quality, and competition for the necessary tangible assets of even basic living.

Earth scientists belong, arguably, to a small number of professions that can truly appreciate and understand this critical nexus between societal interests and geology. The Geology and Society scientific Division (G&SD), established in 2003, is a home for GSA members who are interested in this nexus. At its core, the Division promotes the interests of its diverse membership on a broad number of topics where geology intersects with social, economic, and science-policy matters. This is accomplished through several avenues: partnership with the GSA’s Geology and Public Policy Committee (GPPC), student engagement, outreach grants, technical sessions, and a popular and festive GSA Connects social known as “New Terranes.”

As with all Divisions, G&SD may support other GSA committees; however, the Division has a standing obligation to partner with the GPPC. As the Society’s principal editorial “voice,” the GPPC produces important position statements and white papers on a number of pertinent science policy issues. G&SD augments the GPPC’s mission by cosponsoring special policy forums, promoting its publications to the membership, and, beginning in 2022, sponsoring a GPPC student representative to GSA’s Congressional Science Visit Days on the Hill.

G&SD promotes student engagement by sponsoring a best student paper competition at GSA Connects. A diverse panel of judges, recruited from the GSA membership, reviews student presentations germane to areas of geoscience and societal matters. One winner (and on occasion, two) is selected for a cash prize and recognition by the Division.

G&SD, as of 2017, is the principal administrator of the GSA E-an Zen Fund Supporting Geoscience Communication. This important grant supports outreach projects designed to convey geoscience to the lay public. Two grants in the amount of US\$1,500 are awarded annually to GSA member applicants who offer the most relevant and innovative strategies.

The Division sponsors a number of technical platforms at GSA’s annual and Section meetings—often partnering with other GSA Divisions when we share similar interests. In addition to important topical sessions, G&SD organizes or endorses Pardee Symposia, Noontime Lecture sessions, short courses, workshops, and field trips. In 2021, the Division management board began to promote a solely Division-sponsored session at GSA Connects, organized by the G&SD officers.

Want to learn more about becoming a Congressional Science Fellow or a Science Policy Fellow? Interested in Scientists in Parks or GeoCorps™ America? Want to engage with representatives of GPPC or G&SD members? Then the “New Terranes” social may be just the ticket. This evening event offers the opportunity to network and find out more about GSA’s amazing programs and science policy groups (first round compliments of the host!)

G&SD will celebrate its twentieth anniversary next year. Please join us for GSA Connects 2023 in Pittsburgh, Pennsylvania, USA, to commemorate this occasion.



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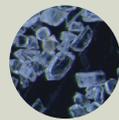
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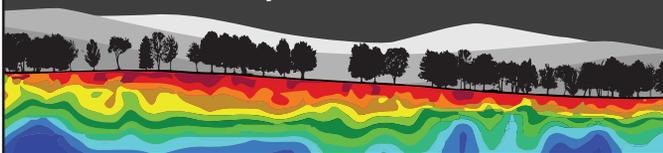
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# Why GSA is Important to Me

The Geological Society of America has consistently supported me throughout my career as a geoscientist and has been my “home” Society since 2015. During the most formative years of my career, GSA provided me with invaluable experiences that no doubt shaped me into the geoscientist I am today. Some of these include a GeoCorps America™ and Geoscientists-in-the-Parks internship in Rock Creek Park, Washington, D.C., and my first conference experience. It was these opportunities that helped me uncover my love for geoscience and passion for research.

More recently, GSA has supported my graduate career with graduate student research grants, both of which funded fieldwork in the Sierra Nevada and Santa Catalina Island, California. My first grant also provided me with hands-on experience working with MicroCT during my M.S., a mode of analysis that I’ve continued to use during my Ph.D.

Annual GSA conferences, many of which I have been fortunate enough to attend, allow me to catch up with old friends and network with new colleagues. By serving as a member of the Membership and Fellowship Committee, I am able to support fellow members and give back to the Society that has helped and continues to help strengthen my career. GSA is special to me



because it hosts a unique geoscience community, works hard to improve membership experiences, and supports a diverse group of backgrounds and career levels.

Justine Grabiec  
GSA Member since 2015



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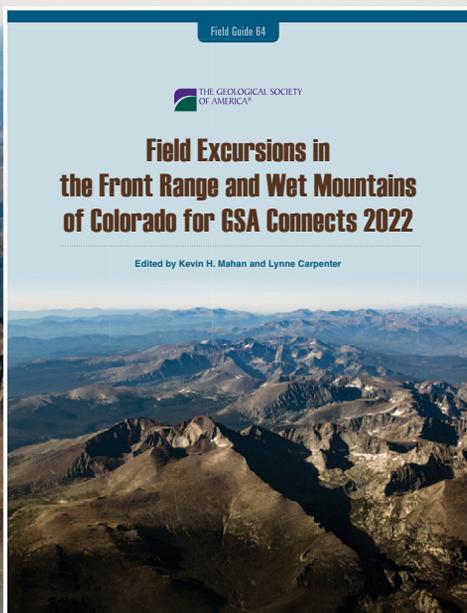


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## Field Excursions in the Front Range and Wet Mountains of Colorado for GSA Connects 2022

*Edited by Kevin H. Mahan and Lynne Carpenter*

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

FLD064, 66 p., ISBN 9780813700649  
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## A Walk in the Park...

... Wild, vast Denali National Park, to be exact. We stood at the abrupt end of a gravel road, a chilling wind rolling up over its brink, staring across a tumbling mountainside a hundred yards to another precipitous edge where the road re-started. My mind needed time to make sense of the visual chaos in front of us before recognizing that the crumbled earth some forty feet below was, indeed, the missing stretch of roadway.

Park geologist Denny Capps and three of Denali National Park and Preserve’s interns were explaining the Pretty Rocks Landslide, its long history, and substantially increasing movement over the past eight years. In fact, the recent displacement has been severe enough to close the park road at its midpoint while extensive two-year plans are implemented to reestablish a safe road across the slide area.



Nicole Benshoff explaining the geology of this kind of slide.

Nicole Benshoff is focused on this and other landslides throughout the park during her internship, and Samantha Hilburn is working in science communications. Both are part of the Scientists in Parks (SIP) program—a partnership between the National Park Service (NPS), the Geological Society of America, the Stewards Individual Placement Program, and the Ecological Society of America.

The program offers unique opportunities to work on current scientific needs in national parks, build professional experience, and foster the next generation of diverse natural resource stewards. Angela Fiorito is an intern in the NPS’s Mosaics in Science Diversity Program, a GIS assistant documenting historical aerial photos. With first-hand experience that positions are highly sought after and competitive, all three value the exceptional opportunities to apply their geology backgrounds to real-world, science-based work in Denali.

Nicole said, “So far my time at Denali National Park and Preserve has served as a foundational experience for government work and how geology would be incorporated. The hands-on experience with geohazards, monitoring, and communication is invaluable and will

bolster my graduate student skillset. I look forward to every new day as it always brings something exciting.”

GSA and the NPS have partnered on work-experience programs since 1997, and Nicole’s geology assistant position is fully funded by donors who have been supporting these efforts through the GSA Foundation for sixteen years. Sally and Bob Newcomb are committed to facilitating important scientific work on challenging, current issues, noting, “The most fun Bob and I have all year is reading the letters from the interns about their experiences, the reports of their activities, and sometimes their publications. A few of the areas addressed by interns in Denali include glaciation, hazard mitigation, river morphology, novel fossils, monitoring fossil access, and visitor education,” and now, the tremendously important work on increasing landslide implications in the park. The Newcombs enjoy keeping up with the interns by attending talks and posters at GSA and reading their reports, and after ten years of consistent funding, they visited Denali to interact with the interns and park staff, explore deep into the park, and learn about the science being done.

Among hundreds of annual participants in SIP and GeoCorps™ America—a similar program partnering with the Bureau of Land Management and the U.S. Forest Service—dozens have gone on to full-time federal employment over the years. If you are passionate about encouraging aspiring geoscientists to conduct important scientific work on America’s public lands, please contact Debbie Marcinkowski at [dmarcinkowski@geosociety.org](mailto:dmarcinkowski@geosociety.org) or +1-303-357-1047. General contributions of all sizes make a difference.

Standing at the dramatic edge of the Pretty Rocks Landslide, I watched Nicole’s eyes light up as she described for me in layman’s terms how the rhyolite in the Teklanika Formation contributes to the problematic instability throughout the park, as weathering results in the clay that slides. It was strikingly clear as we stood in this majestic expanse, what compels the Newcombs’ continued commitment, the immense need for scientific work in public lands, and just how much is supported through GSA’s work-experience partnerships.

**Debbie Marcinkowski**, GSA Foundation Executive Director



From left: Park geologist and 2022 science interns at the edge of the Pretty Rocks Landslide and the temporary end of the park road. Braided rivers characterize the landscape of Denali National Park and Preserve. Hiking up a drainage to a new landslide representative of many appearing along the park road.



## Be a Part of GSA Connects 2023

Submit a field trip, short course, and/or technical session proposal.

15–18 October | Pittsburgh, Pennsylvania, USA

GSA Connects 2023 will bring together the geological community to enable you to share your scientific research, network with leaders in the field, and keep your skills relevant in a rapidly changing world. Plan now to be part of this gathering by submitting a proposal for a short course, field trip, and/or a technical session considering the themes “Diverse Science for a Sustainable Future” or “Climate Crisis and Energy Transition.”



**Connect and network with colleagues who share your research interests and passions by leading a field trip.**

Field trips can be anywhere from a half day to five days long, and proposals may be submitted by anyone. We are encouraging proposals for online field trips. The selection can be made within the proposal submission form.

**Deadline:** 1 Dec. 2022  
<https://gsa.confex.com/gsa/2023AM/fieldtrip/cfs.cgi>



**Present your evidence-based knowledge to a large international audience by organizing and chairing a technical session.**

Proposals are being taken for Pardee Keynote Symposia and topical sessions. Please make your selection on the proposal submission form.

**Deadline:** 1 Feb. 2023  
<https://gsa.confex.com/gsa/2023AM/cfs.cgi>



**Gain recognition as an expert in your topic of research as an instructor of a short course.**

Courses run the Friday and Saturday before the meeting and are typically a half day to two full days. Both online and in-person proposals are sought.

**Deadline:** 1 Feb. 2023  
<https://gsa.confex.com/gsa/2023AM/shortcourse/cfs.cgi>

Bookmark the Geoscience Job Board at [www.geosociety.org/jobs](http://www.geosociety.org/jobs) for up-to-the-minute job postings. Job Board ads may also appear in a corresponding monthly print issue of *GSA Today*. Send inquiries to [advertising@geosociety.org](mailto:advertising@geosociety.org), or call +1-800-427-1988 ext. 1053 or +1-303-357-1053.

### POSITIONS OPEN

#### **Two Assistant Professors: Hydrosphere and Structural Geology, Occidental College**

For a full description of these positions, please visit <https://www.oxy.edu/working-oxy/faculty-positions>

The Department of Geology at Occidental College invites applications for two tenure-track faculty positions at the rank of Assistant Professor beginning August 2023. We seek colleagues with expertise in 1) the hydrosphere, including but not limited to the interaction of water (including snow, ice, and oceans) with climate, critical zone and atmospheric, lithospheric and surface process, or 2) structural geology and tectonics, especially the deformation of continental crust. Preference will be given to candidates that apply innovative and quantitative approaches to investigating water and structural/tectonic systems across temporal and spatial scales, through some combination of fieldwork, computational modeling, remote sensing, analysis of large datasets, and laboratory analysis. The expertise of a successful candidate will complement departmental strengths and have potential to enhance departmental connections with other science programs on campus and across the greater Los Angeles region.

Review of applications will begin October 14th, 2022. Department members will meet interested candidates at the GSA meeting or virtually; please email the Search Committee Chair to make arrangements.

#### **Required Qualifications**

- Ph.D. in Geology with an emphasis in the Hydrosphere or Structural Geology and Tectonics
- demonstrated commitment to excellence in undergraduate teaching
- a strong record of scholarly accomplishments appropriate to the level of appointment
- experience in working collaboratively with colleagues
- demonstrated potential for effective integration of technology into instruction
- demonstrated commitment to working effectively with students from minoritized and marginalized social groups
- demonstrated commitment to the four cornerstones of the mission of the College: excellence, equity, community, and service

**Application Submission Materials.** You must submit a complete application package electronically to be considered. To apply,

please send the following required materials to [geosearch2022@oxy.edu](mailto:geosearch2022@oxy.edu):

- Cover Letter in which you respond to the required qualifications
- Curriculum Vitae
- Research Statement (include research interests in the context of a liberal arts college)
- Teaching Statement (specifically address your ability to 1) teach in a socioeconomically, ethnically and culturally diverse environment, and 2) engage students in an innovative and externally funded research program)
- 1–3 representative publications
- Candidate Statement on Commitment to Inclusive Excellence

This statement provides your unique perspective on your past and present contributions to and future aspirations for promoting diversity, inclusion, equity, and justice in your professional career. This should include your demonstrated commitment to, past evidence of, and future plans for creating equitable opportunities for learning and mentoring especially for students from marginalized and minoritized groups. The purpose of this statement is to help the department identify candidates who have professional experience, intellectual commitments, and/or willingness to engage in activities that could help the College contribute to its mission in these areas.

- List of three references with relevant contact information.

If you advance to the finalist phase, we will ask each of your three references to submit a letter of recommendation. Do not submit these letters with your initial application.

Please direct all questions about the position to: Darren Larsen at [geosearch2022@oxy.edu](mailto:geosearch2022@oxy.edu) or call (323) 341-4041.

To be assured full consideration, application materials must be received by October 14th, 2022.

Upon receipt of a complete application package, you will receive a preliminary questionnaire. You must complete this questionnaire to move forward in the search process.

**The Department and College.** Occidental is a nationally ranked liberal arts college recognized for its diverse student body and outstanding undergraduate research program. The mission of Occidental College and that of the Geology Department is to provide a gifted and diverse group of students with a total educational experience of the highest quality—one that prepares them for leadership in an increasingly complex, interdependent and pluralistic world.

Occidental is an EEO employer and does not unlawfully discriminate against employees or applicants on the basis of any characteristic protected by state or federal law. Individuals whose work can advance the College's strategic goals in these areas and those from groups whose underrepresentation in the American professoriate has been severe and longstanding are particularly encouraged to apply. All qualified applicants will be considered for employment, including those with

criminal histories, in a manner consistent with the requirements of applicable state and local laws, including the City of Los Angeles' Fair Chance Initiative for Hiring Ordinance. Occidental College is committed to working with and providing reasonable accommodations to applicants with qualifying disabilities. If you need a reasonable accommodation because of a disability for any part of the application or employment process, please contact Human Resources ([hr@oxy.edu](mailto:hr@oxy.edu)).

#### **Assistant Professor of the Practice in Environmental Geology, University of Kansas**

The University of Kansas Department of Geology seeks an Assistant Professor of the Practice in the field of Environmental Geology in support our growing environmental geology master's programs, to begin January 1, 2023. The position is a non-tenure track, full-time, academic-year appointment with a 3-year, renewable contract. Given the primarily online/hybrid nature of our programs, a commitment to excellence in online/on-campus hybrid teaching is essential. We seek an instructor with the ability to teach six courses per year from the following courses or subjects: Introductory, physical, and chemical hydrogeology, environmental site assessment, soil and water remediation, hydrogeophysics, environmental microbial geochemistry, or other relevant topics. For complete information and to apply go to <https://employment.ku.edu/academic/23308BR> or visit us at GSA at booth #2918.

#### **Assistant Professor of Geosciences (Hydrogeology), Hamilton College**

The Geosciences Department at Hamilton College invites applications for a tenure-track position at the rank of Assistant Professor, beginning July 1, 2023. We are seeking a broadly trained hydrogeologist who can effectively teach the fundamental concepts of hydrogeology in the classroom, lab, and field and who can contribute to our college's interdisciplinary program in Environmental Studies by teaching courses and mentoring ES students on issues related to water resources. We are especially interested in candidates who can demonstrate their experience in working with or teaching diverse student populations. Annual teaching responsibilities will include a topical introductory geology course and a core course in hydrogeology, both with labs and field trips, plus an elective course of the candidate's choosing. The candidate will regularly help lead department field trips and will have an opportunity to teach during the summer in the College's Higher Educational Opportunity Program. The position also requires institu-

"... the GSA job board is THE job board for geologists." –Mount Holyoke College

tional service, including academic advising of undergraduate students, after the first year.

Research is a cornerstone of undergraduate education at Hamilton. The candidate will be expected to maintain a robust scholarly research program in hydrogeology. Strong candidates will be able to demonstrate their ability to effectively mentor undergraduate students as part of their research. All Hamilton students complete a Senior Project and commonly participate in research during the academic year and over the summer.

Candidates with a Ph.D. are preferred, although ABD applicants will also be considered. Candidates must submit the following at <http://apply.interfolio.com/111914>: 1) a cover letter, 2) a teaching statement that describes your teaching philosophy, 3) a research statement that describes your research plans in the context of Hamilton's undergraduate setting, 4) a diversity, equity, and inclusion statement that addresses how you would further the College's goal of building a diverse educational environment through your teaching, scholarship, and/or service, 5) a complete curriculum vitae, and 6) names and addresses of three professional referees. Questions regarding the search may be directed to Dr. Catherine Beck, Search Committee Chair, at [ccbeck@hamilton.edu](mailto:ccbeck@hamilton.edu). Our review of applications will begin on October 17, 2022.

Hamilton ([www.hamilton.edu](http://www.hamilton.edu)) is a residential liberal arts college located in upstate New York. Applicants with dual-career considerations can find other Hamilton and nearby academic job listings at <https://www.hercjobs.org/regions/higher-ed-careers-upstate-new-york/>, as well as additional information at <https://www.hamilton.edu/dof/faculty-development/resources-for-prospective-or-new-faculty/opportunities-for-spouses-or-partners> (Opportunities for Spouses or Partners). Hamilton College is an affirmative action, equal opportunity employer, and is committed to diversity in all areas of the campus community. Candidates from underrepresented groups in higher education are especially encouraged to apply.

### **Mendenhall Postdoctoral Research Fellowships, Various Locations, U.S. Geological Survey**

The U.S. Geological Survey (USGS) is seeking candidates for Mendenhall Research Fellowships. The Mendenhall Research Fellowship Program provides an opportunity for postdoctoral fellows to conduct concentrated research in association with USGS scientists. Current postdoctoral opportunities span topics ranging from advanced computing, programming, and modeling, to ecology, water resources, energy and minerals, and natural hazards.

Check out the available Research Opportunities [ [https://www.usgs.gov/centers/mendenhall-research-fellowship-program/research-opportunities?utm\\_source=gsa-ad&utm\\_medium=external&utm\\_campaign=ss-mendenhall-2022](https://www.usgs.gov/centers/mendenhall-research-fellowship-program/research-opportunities?utm_source=gsa-ad&utm_medium=external&utm_campaign=ss-mendenhall-2022) ] for more information.

The postdoctoral fellows are appointed to the USGS for two years and receive full salary and benefits at the GS-12 level, step 1. Mendenhall Fellow appointments are time limited, not to exceed two years, and are full-time. Under certain circumstances, the appointment may be extended up to an additional two years.

Applicants are encouraged to contact the Research Advisor(s) for the Research Opportunity of interest to coordinate the development of a research proposal.

Open – Thursday 9/1/2022, Close – Tuesday 11/1/2022

Specific application requirements can be found on the Mendenhall Program website [ <https://www.usgs.gov/centers/mendenhall-research-fellowship-program> ].

For more information, contact the Mendenhall mailbox at [mendenhall@usgs.gov](mailto:mendenhall@usgs.gov).

The U.S. Geological Survey is an Equal Opportunity Employer.

### **OPPORTUNITIES FOR STUDENTS**

**M.S. and Ph.D. Opportunities in Economic Geology, Colorado School of Mines.** The Department of Geology and Geological Engineering at the Colorado School of Mines seeks students interested in pursuing graduate degrees (M.S. and Ph.D.) focused on mineral exploration, economic geology, and the geochemistry and petrology of ore deposits. Motivated applicants could enter our graduate program in January or August 2023. Successful students will be embedded into the NSF-supported Center for Advanced Subsurface Earth Resource Models (CASERM) with funding provided by industry partners. Successful students will gain significant experience and preparation for a booming mineral industry sector over the course of their study. Opportunities are also available through the parallel Professional Master's degree in Mineral Exploration, a one-year non-thesis study program. For more information, please contact [mineralexploration@mines.edu](mailto:mineralexploration@mines.edu).

### **Hiring?**

Find those qualified geoscientists to fill vacancies. Use GSA's Geoscience Job Board ([geosociety.org/jobs](https://geosociety.org/jobs)) and print issues of *GSA Today*. Bundle and save for best pricing options. That unique candidate is waiting to be found.

### **HAVE YOU SEEN THE GEOLOGY IN THE RED MOUNTAIN CUT IN BIRMINGHAM, ALABAMA?**

If so, we want to hear from you. The cut through Red Mountain, opened in 1969, exposed a complete stratigraphic succession from Upper Cambrian to Middle Mississippian, including many scientifically interesting details, such as marine invertebrate fossils of several ages, volcanic ash beds, and the famous Birmingham hematitic iron ores. The beds dip southeastward from the late Paleozoic Birmingham frontal ramp anticline, and two steep normal faults break through the stratigraphy. One of the faults has abundant evidence of fault movement during deposition of the Upper Silurian beds, including soft-sediment slumps and flows, followed by later displacement. Initially, a scientific walkway was constructed on one bench of the deep cut and displayed these geologic features for geologists, students, and the general public. Unfortunately, over time, the walkway has deteriorated and is now inaccessible. Plans are under way to clear the cut and build a new walkway entirely through the cut, along with geologic displays and explanations. The work has already begun with clearing dense vegetation, which grows rapidly in Alabama. Planning and design are under way for construction of the walkway and for geologic displays, and the new plan includes funds for maintenance to ensure the future of this geologic educational resource. A foundation is being established to manage the project and to seek grant funds. You can help by sending letters of endorsement that we can use in support of our grant proposals. In return, we offer you an opportunity to visit a unique geologic resource in the near future. We would like to have testimonials from as many states and nations as possible. Please write to:

By mail:

Red Mountain Cut Foundation  
5724 Highway 280 East  
Birmingham, AL 35242  
Attn: Mary Jane Webb

By email:

TO: Mary Jane Webb, [mjwebb@ebsco.com](mailto:mjwebb@ebsco.com)  
CC: Carla Burnham, [cburnham@ebsco.com](mailto:cburnham@ebsco.com)  
Bryson Stephens, [bstephens@ebsco.com](mailto:bstephens@ebsco.com)

All letters of support are welcome.

We suggest:

- Content speaks to the educational value the Red Mountain Cut and the importance of long-term access.
- Expresses support for the efforts of the "Red Mountain Cut Foundation."
- Be in color on letterhead and be signed.



## Assistant/Associate Professor of Watershed Hydrogeochemistry

The Department of Environmental Sciences at the University of California Riverside invites applicants for a full-time Assistant/Associate Professor of Watershed Hydrogeochemistry. Exceptional candidates in all areas of specialization in watershed-scale Hydrogeochemistry will be considered, with preferences given to qualifications in one or more of the following areas: tracer hydrology, stream and lake biogeochemistry, isotope hydrology, reactive transport processes and modeling, contaminant fate and transport, and water quality. The appointment will consist of a split 0.5 FTE I&R (Instruction and Research) and 0.5 FTE OR (Organized Research) appointment in the Agricultural Experiment Station (<https://cnas.ucr.edu/resources/agricultural-experiment-station>).

The successful candidate will support the Department's excellence in hydrology and water resources both at the undergraduate- and graduate-level. This hire will complement existing departmental and campus-wide faculty working on areas related to water resources and hydrogeochemistry (watershed processes, water movement and transport in soils, surface water and groundwater quality, urban/agricultural irrigation, and water management), water policy, climate change, and aquatic ecology. The successful candidate will have a strong track-record of peer-reviewed publications, proven record of, or exceptional promise for, developing a vibrant externally funded research program, and a portfolio of high-quality teaching at the undergraduate and graduate levels.

The successful candidate is expected to integrate field-based research with laboratory analyses and/or numerical modeling, and work at broad spatial scales. Examples of research foci include but are not limited to:

- 1) understanding catchment residence time and timescales of water flow to predict catchment response to climate change and management,
- 2) understanding and simulating multicomponent reactive transport processes,
- 3) contaminant fate and transport in the surface and subsurface hydrologic systems,
- 4) developing and advancing water quality models, and/or
- 5) improving estuarine and river water quality.

It is desirable that the candidate's research generate results that can be used by policy makers to enhance the sustainability of water resources within California. The successful candidate is encouraged to contribute and/or provide leadership to the campus-wide multidisciplinary initiative in water research (R'Water) through research and outreach activities. The faculty member may assume responsibility for teaching ENSC 140 (Limnology); and contribute to teaching ENSC 101 (Water Resources), and/or graduate-level courses on advanced topics in hydrogeochemistry and water quality.

### Required qualifications for this position include:

A Ph.D. in Hydrologic Sciences, Water Resources, Water Resources Engineering, Hydrogeochemistry, Environmental Science, Environmental Engineering, or a related field is required.

### Preferred qualifications for this position include:

Assistant level only: Demonstration of potential for securing competitive funding at the federal level. Strong track record of high-quality publications.

Associate/Full level only: Evidence of securing competitive extramural funding at the federal level. Evidence of leading large research teams. Excellent teaching records.

**To apply:** For consideration at an Assistant level, submit a cover letter, a curriculum vitae, three letters of references, a Statement of Research, a Statement of Teaching, and a Contribution to Diversity Statement to <https://apptrkr.com/3291744>.

For consideration at an Associate level, submit a cover letter, a curriculum vitae, teaching evaluations, contact information for three references, a Statement of Research, a Statement of Teaching, and a Contribution to Diversity Statement to <https://apptrkr.com/3291744>.

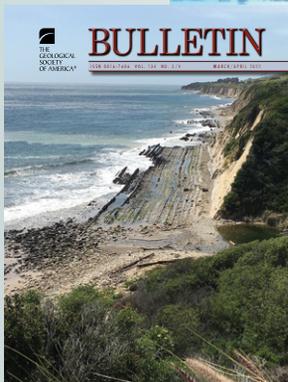
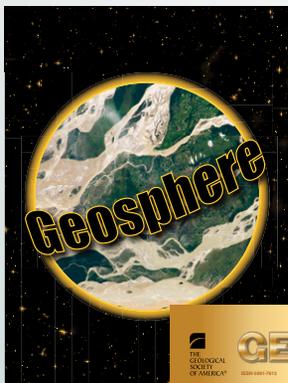
Review of applications will commence on November 15, 2022 and proceed until the position is filled. For full consideration, applicants should submit their complete applications prior to the above date.

Advancement through the Professor ranks at the University of California is through a series of structured, merit-based evaluations, occurring every 2-3 years, each of which includes substantial peer input.

For more information about this position, please contact Dr. Hoori Ajami, Chair of the Search Committee, Department of Environmental Sciences, at [hooria@ucr.edu](mailto:hooria@ucr.edu). For questions on application procedures and requirements, please contact Ms. Guadalupe Figueroa Academic Personnel, at [guadalupe.figueroa@ucr.edu](mailto:guadalupe.figueroa@ucr.edu).

UCR is a world-class research university with an exceptionally diverse undergraduate student body. Its mission is explicitly linked to providing routes to educational success for underrepresented and first-generation college students. A commitment to this mission is a preferred qualification.

*The University of California is an Equal Opportunity/Affirmative Action Employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age, disability, protected veteran status, or any other characteristic protected by law. University of California COVID-19 Vaccination Program Policy: As a condition of employment, you will be required to comply with the University of California SARS-CoV-2 (COVID-19) Vaccination Program Policy. All Covered Individuals under the policy must provide proof of Full Vaccination or, if applicable, submit a request for Exception (based on Medical Exemption, Disability, and/or Religious Objection) or Deferral (based on pregnancy) no later than the applicable deadline. Please refer to Appendix F, Section II.C. of the policy for the deadlines applicable to new University of California employees. (Capitalized terms in this paragraph are defined in the policy.) Federal, state, or local public health directives may impose additional requirements.*



# GSA Publications Milestones

*Geology* continues its reign as the #1 ranked geology journal for the sixteenth year in a row. According to Journal Citation Reports\*, it had a 2021 Journal Impact Factor of 6.324 and a five-year impact factor of 6.456.

The *Geological Society of America Bulletin's* impact factor jumped to 5.41, with a five-year impact factor of 5.25.

Both the impact factor and five-year impact factor soared for *Geosphere*, reaching 3.944 and 4.284 respectively.

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

\*Journal Citation Reports™, Journal Impact Factor™, and Web of Science™, from Clarivate, 2022.

Explore GSA's journals and books at [www.gsapubs.org](http://www.gsapubs.org).

## Statement of Ownership, Management, and Circulation

(Required by Title 39 U.S.C. 4369)

*GSA Today* (Publication No. 1052-5173) is published monthly by The Geological Society of America, Inc., (GSA) with headquarters and offices at 3300 Penrose Place, Boulder, Colorado 80301 U.S.A.; and mailing address of Post Office Box 9140, Boulder, Colorado 80301-9140 U.S.A. The Publisher is Vicki S. McConnell; the Managing Editor is Kristen E.A. Giles; their office and mailing addresses are the same as above. The annual subscription prices are: for Members and Student Associates, \$15; for non-members \$111. The publication is wholly owned by The Geological Society of America, Inc., a not-for-profit, charitable corporation. No known stockholder holds 1 percent or more of the total stock. The purpose, function, and nonprofit status of The Geological Society of America, Inc., have not changed during the preceding twelve months. The average number of copies of each issue during the preceding twelve months and the actual number of copies published nearest to the filing date (September 2022 issue) are noted at right.

This information taken from PS Form 3526, signed 30 August 2022 by the Publisher, Vicki S. McConnell, and filed with the United States Postal Service in Boulder, Colorado.

Item No. from PS Form 3526	Avg. No. Copies Each Issue in Past 12 Months	Actual No. Copies of Single Issue Published Nearest to Filing Date
<b>15. Extent and Nature of Circulation</b>		
a. Total number of copies ( <i>net press run</i> )	9,909	9,850
b. Legitimate paid and/or requested distribution ( <i>by mail and outside the mail</i> )	9,752	9,751
c. Total paid and/or requested circulation	9,752	9,751
d. Nonrequested distribution ( <i>by mail and outside the mail</i> )	0	0
e. Total nonrequested distribution	0	0
f. Total distribution ( <i>sum of c and e</i> )	9,752	9,751
g. Copies not distributed ( <i>office use, leftovers, spoiled</i> )	157	99
h. Total ( <i>sum of f and g</i> )	9,909	9,850
i. Percent paid and/or requested circulation ( <i>c/f × 100</i> )	100%	100%

# Science Editor Openings for 2024

GSA seeks applications for science co-editors for GSA Books (two positions), *GSA Bulletin* (one position), and *Geology* (two positions). The four-year terms begin 1 January 2024. Duties include: ensuring stringent peer review and expeditious processing of manuscripts; making final acceptance or rejection decisions after considering reviewer recommendations; and, along with your co-editors, setting the editorial tone of the publication and maintaining excellent content through publication of a diverse range of papers.

## POSITION DETAILS

Research interests that complement those of the continuing *GSA Bulletin* editors include but are not limited to: tectonics; tectonophysics; structural geology; low-T thermochronology; deformation; archaeological geology; economic geology; geochronology; geodynamics; paleomagnetism; petrology; Precambrian geology; sedimentary geology.

*GSA Books* editor duties include soliciting high-quality book proposals and ensuring that proper peer-review procedures are followed by volume editors. Editors handle the entire peer-review process for authored volumes. The successful candidate will have a wide range of interests and expertise, prior editing experience, and a strong publication record.

Research interests that complement those of the continuing *Geology* editors include, but are not limited to: paleontology; paleomagnetism; paleoceanography; marine geology; economic geology; stratigraphy; subsurface geophysics.

Note: Because of the volume of papers received by *Geology* and the breadth of the topics covered, editors must be willing to handle papers outside of their main disciplines.

Editors work out of their current locations at work or at home. The positions are considered voluntary, but GSA provides an annual stipend and funds for office expenses.

**Evaluation Process:** The GSA Publications Committee will evaluate applications and make its recommendations to GSA Council based on the combination of how a candidate's disciplinary expertise fits with the needs of the publication and on the candidate's application, which should provide documentation of the required and preferred qualifications listed here.

GSA affirms the value of diverse scientific ideas and the connection between diverse scientific ideas and a diverse group of contributors of those ideas. Accordingly, GSA welcomes applications from all qualified persons and encourages applications that highlight diversity.

**To Apply:** In a single PDF, submit your curriculum vitae and a letter of application that demonstrates how your interests and experience fulfill the required and preferred qualifications listed below to Bridgette Moore, bmoore@geosociety.org. **Deadline: 1 March 2023.**

## REQUIRED QUALIFICATIONS

- Experience as an editor or associate editor for a geoscience journal. Include details of the duties and duration of the position(s) held.
- Demonstrated expertise in two or more fields in the geosciences or in interdisciplinary fields broadly related to the geosciences.
- Demonstrated experience handling a significant editorial workload and ability to make timely decisions.
- Because of the breadth of topics covered in GSA publications, the applicant must clearly express willingness to handle papers outside of their main disciplines.
- Demonstrated ability to communicate clearly and be responsive to author needs.

## PREFERRED QUALIFICATIONS

- Experience with a GSA journal as a reviewer, associate editor, or editor.
- Breadth of interdisciplinary experience to complement that of existing editors; demonstrated interest in interdisciplinary research.
- International reputation and connections with the geoscience communities.
- Interest in encouraging innovation; willingness to take risks.
- Ability to support a positive team dynamic; ability to work with GSA staff and other editors to enhance the reputation of the publication.



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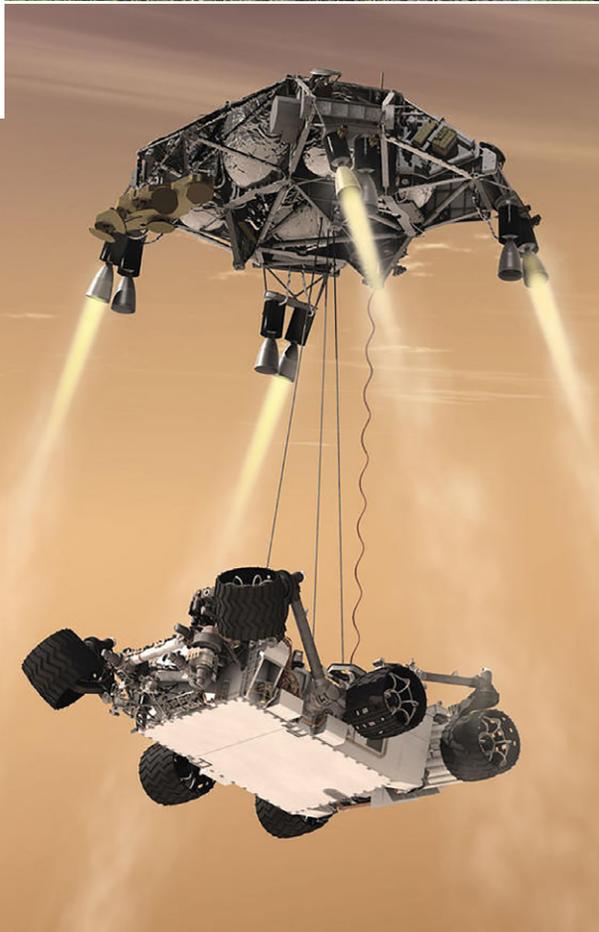
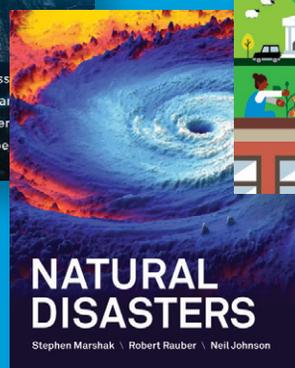
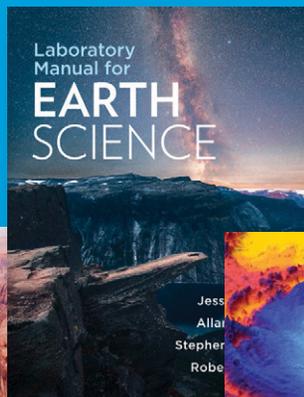
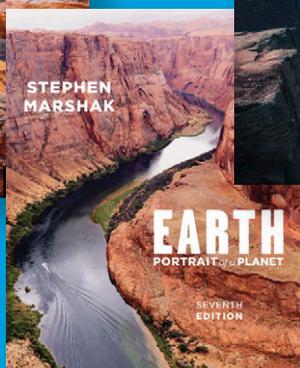
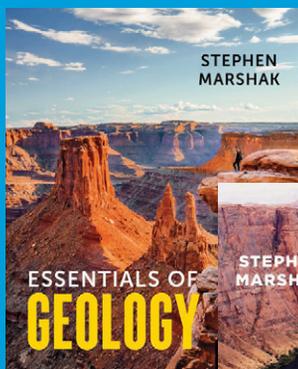


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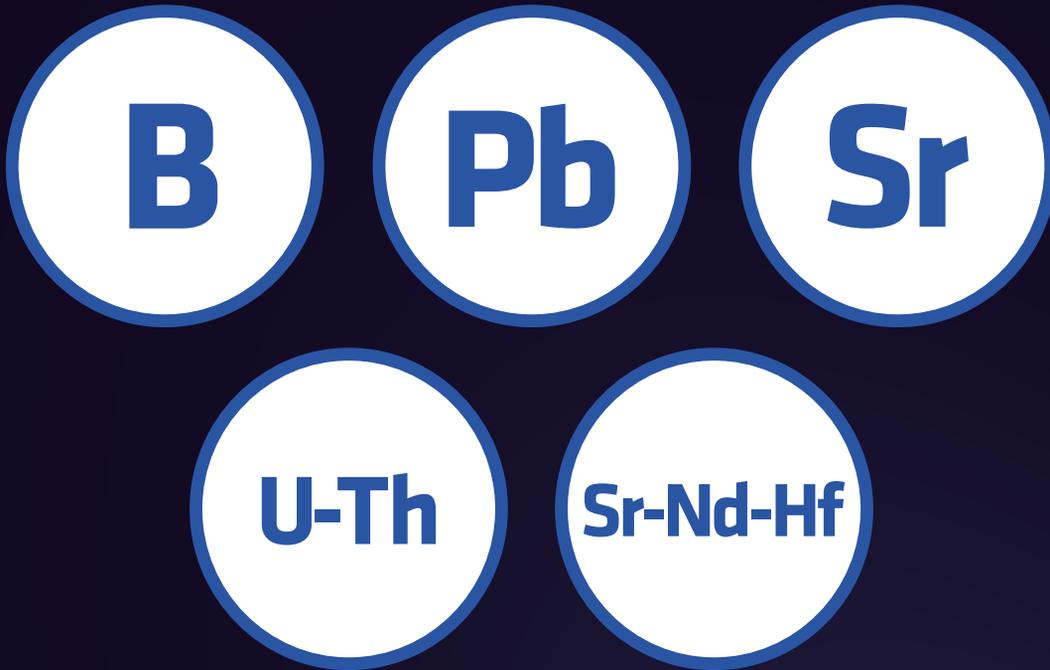


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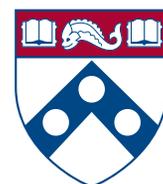
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