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MEMBER RECOGNITION ISSUE

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Photo credit: Andrew Hoxey.

Undergraduate students from the University of Kansas take structural measurements at an outcrop of the Entrada Sandstone in Wayne County, Utah, USA. Structural measurements collected virtually using the Google Earth Engine Plane Orientation Calculator (POC) are compared to student measurements collected in the field to test the viability of using the POC for research or in a classroom.

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Several award deadlines have been adjusted from what was published in the *GSA Today* June issue. Richard Hay Award: 16 August; E-an Zen Fund: 10 July; History and Philosophy of Geology Student Award: 9 August.

SCIENCE

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Google Earth Engine Web Applications for Investigating and Teaching Fundamental Geoscience Concepts

Andrew K.R. Hoxey,*,[1] Michael H. Taylor,[1] J. Douglas Walker,[1] and Diane L. Kamola[1]

ABSTRACT

Cloud computing that queries public data enables rapid geographic information system analysis, reducing the processing time required for complex raster calculations on remote sensing data. When combined with cloud computing, web applications allow users with no experience in computing languages to access computing power as long as users have an internet connection, whether in the classroom, the field, or a research lab. We present two web applications developed on the Google Earth Engine platform that enable topographic and structural analyses on remote sensing data through a graphical user interface, expanding the accessibility of earth sciences.

The Google Earth Engine Plane Orientation Calculator web application calculates an orientation (strike and dip) of the plane defined by three user-selected points on a digital elevation model. The tool utilizes established methods of interpreting map patterns and elevations (i.e., the three-point problem) to understand the geometry of surface features, a fundamental interest to structural geologists and geologic studies. The Plane Orientation Calculator combines fundamental geologic mapping concepts and cloud computing web application to make it possible to measure structural features at any location on Earth within the coverage of public data. Users can make multiple measurements, catalog locations and orientations, and export data for use in other software. The simplicity of the tool means users at all experience levels can conduct remote geologic mapping.

Topographic swath profiles display elevation data, local relief, and regional trends in topography—an approach that is commonly used to identify areas of interest to geologists and geomorphologists. The Google Earth Engine Topographic Swath Profiler web application rapidly queries public digital elevation models selected by the user to produce topographic swath profiles. Users can customize the swath length, swath width, and sampling rate before displaying or exporting the sampled data as text or vector files. Topographic swath profiles are generated instantly via cloud computing, reducing the investment of time and computing budget typically required for such analysis.

INTRODUCTION

Physical and financial barriers to field investigations hinder retention in undergraduate programs (Hall et al., 2004; Giles et al., 2020) and have led to historical shortcomings in diversity, equity, and inclusion within the geoscience community (Núñez et al., 2020; Posselt and Nuñez, 2022). In response, several initiatives are focused on increasing accessibility and encouraging the development of virtual tools that supplement field experiences and expand accessibility (National Academies of Sciences, Engineering, and Medicine, 2020; Bursztyn et al., 2022; Pugsley et al., 2021). Similarly, cloud computing for GIS data processing has expanded the capabilities of researchers, industry professionals, and educators working with large data sets (Gorelick et al., 2017; Bhat et al., 2011; Krishnan et al., 2011).

Here we describe two Google Earth Engine (GEE) web applications (Gorelick et al., 2017)—the Plane Orientation Calculator (POC; andrewhoxey.com/online-tools/poc) and the Topographic Swath Profiler (TSP; andrewhoxey.com/online-tools/tsp)—designed for novice to expert users to interrogate global digital elevation models (DEMs). Web applications combine the speed and power of cloud computing with a graphical user interface (GUI) that can be operated with a mobile device from anywhere with internet access.

PLANE ORIENTATION CALCULATOR

Surface orientations are fundamental for geologic and structural maps and can inform interpretations of subsurface geometries, fault kinematics, and slope stability. The POC makes gathering surface geometry data possible anywhere within the coverage of the GEE DEM catalog (Fig. 1). Similar tools are commonly used for remote and reconnaissance mapping (Alberti, 2019; Allmendinger, 2020) but typically require expertise with GIS software to aggregate, process,

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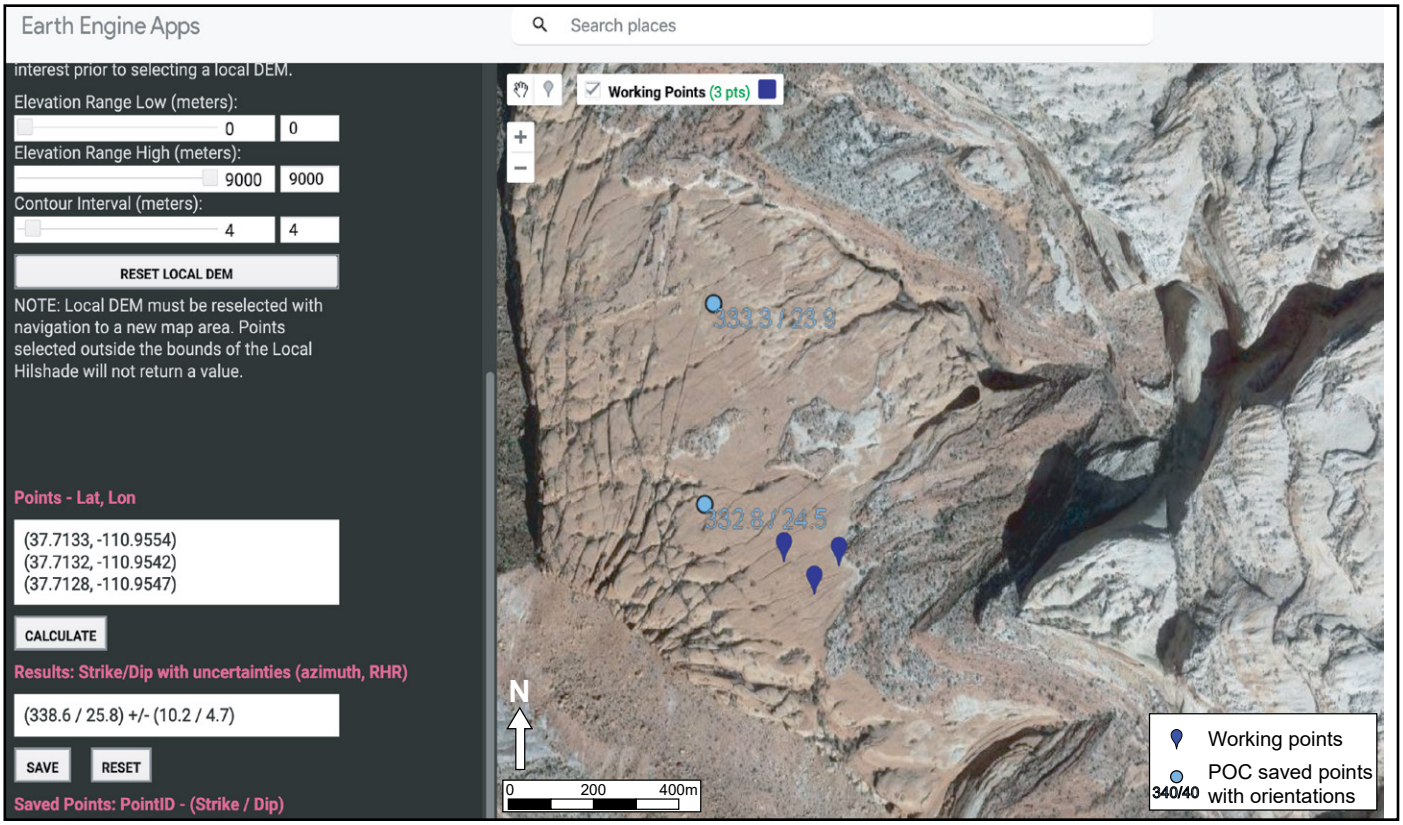

Figure 1. The Plane Orientation Calculator (POC) calculates the orientation of a plane from user-selected points. Once users have identified three points (dark blue) that are representative of a plane, an orientation is calculated and displayed in the results panel. Saved points (light blue dots) are plotted and available to export as a .csv file.

and store data. The POC, by contrast, is optimized to make start-up simple and rapid.

Data Collection Workflow

The first step in using the POC is considering the scale of the feature being measured, the ability to accurately place points, and the resolution of the data being queried (Fig. 1). After navigating to an area of interest, users can select from various data catalogs, including high-resolution (e.g., USGS 3DEP 1 m) DEMs where available (U.S. Geological Survey, 2019). The "DEM in Use" drop-down menu includes eight options that will generate new layers of a local hillshade, contours, and an elevation color scale visible in the layers palette after clicking "RESET LOCAL DEM." Making the contour layer visible can be computationally intensive, but reducing the range of elevations covered by the contours and adjusting the contour interval can reduce computation time significantly. Once a local DEM is selected, the "Extent of Selected DEM" layer will also appear in the layer palette and show the spatial coverage of the catalog. The "RESET LOCAL DEM" button should be clicked after panning to a new region.

A crosshair cursor in the map viewer indicates when users can select a point. Points may be selected along geologic contacts, for example, a fault that Vs into a valley, or on a dip-slope. Users should consider all the data available, make an interpretation of the geology, and carefully place points to characterize the plane of interest. Closely spaced contours that overlay the imagery are particularly helpful for placing points accurately. After three points are created, the user can edit points by clicking and dragging their associated balloons. Once the user is satisfied with the point placement, clicking "CALCULATE" will yield an orientation of the plane defined by the three points.

After the calculation yields a result, users can elect to save the result, make edits to existing points, or discard the result. When a calculated orientation is saved, the result is recorded as a new feature at the location of the highest-elevation point. Multiple calculation results can be recorded in the saved points panel, will be added to the map as a new layer, and can be exported as a .csv file that includes location and orientation data.

Calculation

The orientation is calculated by (1) querying the DEM for values, (2) evaluating the relationship between the points as vectors, and (3) using the vectors to determine the orientation of the plane.

Querying the DEM employs the native GEE reducer function (ee.Image.reduceRegions()) and yields the elevation value of the nearest cell centroid. Changes in the zoom level will update the map display and resample the DEM, but data catalogs are queried at their native resolution, not the active pyramid level. Querying the DEM's native resolution may cause unexpected results relative to the map viewer but will reduce uncertainty when used properly.

The distances between user-selected points are calculated in the x, y, and z directions. Determining the x and y distances

independently using the native GEE function (ee.Feature.distance()) requires the formation of a third (*t*) point at the intersection of the two points' latitude and longitude, respectively. For example, the ee.Feature.distance() function for the high-elevation (*h*) and low-elevation (*l*) points returns the hypotenuse of a right triangle defined by the three points (*h, l, t*) in x–y space. Rather than applying trigonometry with a bearing between the two points (*h, l*), our approach of creating a third point and a right triangle minimizes the computational budget. All distances (x, y, z) are calculated relative to the highest-elevation (*h*) point such that the middle-elevation (*m*) and low-elevation (*l*) points can be characterized by vectors $[x_{h\text{-}m}, y_{h\text{-}m}, z_{h\text{-}m}]$ and $[x_{h\text{-}l}, y_{h\text{-}l}, z_{h\text{-}l}]$, where negative values in x and y correlate to west and south, respectively.

Vector multiplication is a simple computation in most software and is commonly employed for calculating plane orientations (Vacher, 2000). Following the procedures of Vacher (2000), the POC script uses the native GEE function (ee.Array.matrixSolve()) to determine the slope of the plane in the x and y directions, then convert the result to strike and dip using trigonometry.

Measurement Uncertainties

Data analysis using GEE has varying degrees of uncertainty that are dependent on the data set being queried, the zoom level, and the accuracy of the user selection. When selecting an area of interest, users should consider the measured feature's scale, the ability to accurately place points, the alignment of satellite imagery with elevation data, and the resolution of the DEM. Different data catalogs within GEE have varying measures of uncertainties by nature of the publisher's processing method and the reprojection in GEE. Rather than considering the precision of each catalog independently and propagating values through the calculation, we take a simplified approach by creating subparallel planes generated using the variance in the elevation within a nine-cell region around the queried points (Fig. 2A).

For example, the $\vec{l}_o[x, y, z]$ describes the position of the low-elevation point (*l*) relative to the high-elevation point (*h*). For elevation, the standard deviation of the nine-cell neighborhood determines z_{max} and z_{min} (Fig. 2A). For the x and y values, the native GEE function (ee.Feature.distance()) has some inherent uncertainty that is dependent on the

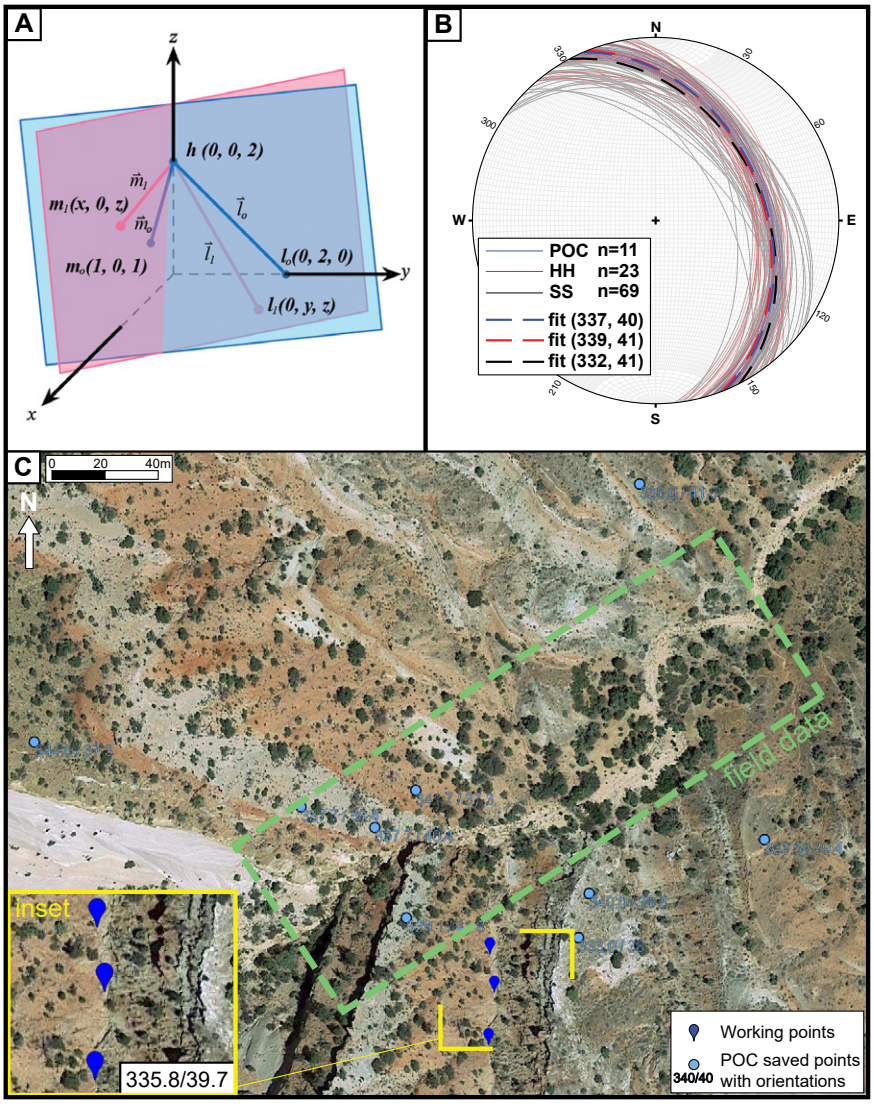

Figure 2. (A) Schematic diagram describing the framework for the uncertainty calculation. Translating the low-elevation point (*l*) and mid-elevation point (*m*) away from the original plane (blue) by a distance equal to the measured uncertainty yields a new plane (red) with an orientation that characterizes the precision. (B) Stereonet including all the data collected using the Plane Orientation Calculator (POC; blue planes), hand-held compass measurement (HH; red planes), and StraboSpot2 software (SS; black planes). Online data was collected using USGS 3DEP 1-m DEM (U.S. Geological Survey, 2019). (C) Screenshot from POC showing the area where data was collected in southwest Utah. Blue dots show the location of POC measurements. The green box shows the location of field measurements. The inset map shows the three points (blue) selected along a lithologic contact for measurement #11 and the yielded orientation (see Supplemental Material [see footnote 2]). POC-queried features include other lithologic boundaries, dip-slopes, and laterally continuous beds that V across the gulch.

projection of the DEM. Since all projections will have different results and we want the tool to remain as universal as possible, we impose a 5% uncertainty to all distance calculations. The six values ([x_{min}, y_{min}, z_{min}] and [x_{max}, y_{max}, z_{max}]) effectively buffer the point in 3-D space.

The geometry of a plane dictates that substituting the minimum x, y, and z values of the $\bar{l}_0$ vector results in a translation along the original plane. By contrast, the maximum x, y, and minimum z values result in a new point that is translated away from the original plane. For the uncertainty calculation, we consider the values that generate two new points (m_1, l_1) translated away from the original plane (Fig. 2A). Holding the high-elevation point (h) constant and calculating the orientation of the plane defined by (h, m_1, l_1) results in a new strike and dip. We calculate two different planes: (1) translating point m_0 up and away while translating point l_0 down and toward point h (h, m_1, l_1), and (2) translating point m_0 down and toward while translating point l_0 up and away from point h (h, m_2, l_2). The resulting planes represent the maximum rotation within the bounds of the queried values ([x_{min}, y_{min}, z_{min}] and [x_{max}, y_{max}, z_{max}]) and yield new $strike_{min,max}$ and $dip_{min,max}$ values displayed in the results panel.

In contrast to considering each DEM's projection and uncertainty independently, the method of deriving subparallel planes has the benefit of being simple and universal. While a more statistical approach that considers the quality of each DEM may result in greater confidence, the simplicity of the computation keeps the tool functional. The largest uncertainties in elevation are typically yielded when the neighborhood surrounding the selected points has a high variance (i.e., high local relief). For example, cliff faces generally yield elevation values with low precision relative to low-slope, laterally extensive surfaces, so users should consider the relief within the neighborhood of each selected point and avoid local topographic anomalies. Regardless of the DEM's resolution, large uncertainties are also yielded when the three points selected are separated by large distances in the x and y directions. The map distance is always assigned 5% uncertainty, even when selecting points that are separated by hundreds of kilometers, meaning closely spaced points yield more precise results.

Example Use Case

Reconnaissance mapping using remote sensing data is an important component of field research, particularly in remote and inaccessible areas where mapping is often supplemented by interpretations of imagery (e.g., DeCelles et al., 2020; Baltz et al., 2021). Similarly, accessibility problems with undergraduate field mapping courses or inclement weather can hinder data collection during student exercises. To test the viability of using the POC as a method of geologic mapping, here we compare data collected in the field using handheld compasses, a tablet equipped with the StraboSpot2 geologic data collections app (Walker et al., 2019), and the POC (Figs. 2B and 2C).

Outcrops of Jurassic sedimentary rocks in the southeast portion of Capitol Reef National Park provide an ideal laboratory because the rocks are well exposed, it is within the coverage of the USGS 1 m elevation data, and beds are consistently northeast-dipping (Figs. 2B and 2C; Hintze and Stokes, 1963; U.S. Geological Survey, 2019). Data were queried using the POC by placing points at 5–10 m spacing on continuous surfaces or along geologic contacts identified using the hillshade, contours, and satellite imagery (Fig. 2C inset; Supplemental Material[2]). In the field, data was collected using the StraboSpot2 app on an 11-inch iPad and by undergraduate students using standard Brunton compasses to simulate results of a student exercise (see Supplemental Material). Results are similar within typical variation, indicating the POC yields results that are a close approximation of the geology and a classroom setting. Our results indicate that the POC is a reliable virtual substitute for field measurements when bedrock orientations are well expressed in the DEM. Furthermore, the compatibility of the POC with mobile devices makes impromptu data collection possible, increasing the accessibility of geologic investigation.

TOPOGRAPHIC SWATH PROFILER

Topographic swath profiles can be broadly described as a series of parallel cross-sectional topographic profiles sampled within a region and projected onto a single plane. They are commonly used by geoscientists to describe the first-order topographic expression of geologic phenomena, such as mountain belts (Burbank et al., 2003; Bookhagen and Burbank, 2006). The Topographic Swath Profiler (TSP) is a web application that allows users to conduct rapid topographic analysis with little time investment or coding expertise (Fig. 3).

Data Collection Workflow

The TSP allows users to select from multiple DEMs of varying resolutions. Choosing an ideal DEM resolution is an important step in topographic analysis regardless of the processing interface. Users should consider the scale of the features being investigated and the importance of resolving any detail within the feature. By default, the TSP is designed to sample the selected DEM at its native resolution, regardless of the pyramid level displayed in the map viewer, which may include cell resampling. As a result, anomalies in high-resolution data that may not be visible in the map viewer will be included in the output profile, and attention should be paid to the selection of the DEM and how it is displayed. On selecting a DEM, the user must click "RESET LOCAL DEM" to generate new layers in the layer palette.

Once the appropriate data set is selected, clicking the map area will create start and end points for the desired swath. A polygon outlining the sampling region will automatically generate and refresh with changes to the dimensions. The start and end points can be edited by clicking on the balloons and moving them as needed, and two sliders control the swath width and sampling rate. Swath width is measured as a fraction of the length and can be adjusted to as large as 50% (1:2 aspect ratio), while sample density is

[2]Supplemental Material. Table of measurements used in Plane Orientation Calculator example. Please visit https://doi.org/10.1130/GSAT.S.25878097 to access the supplemental material, and contact editing@geosociety.org with any questions. All scripts are available at https://github.com/andrewkrh/GEE_GeologyTools.

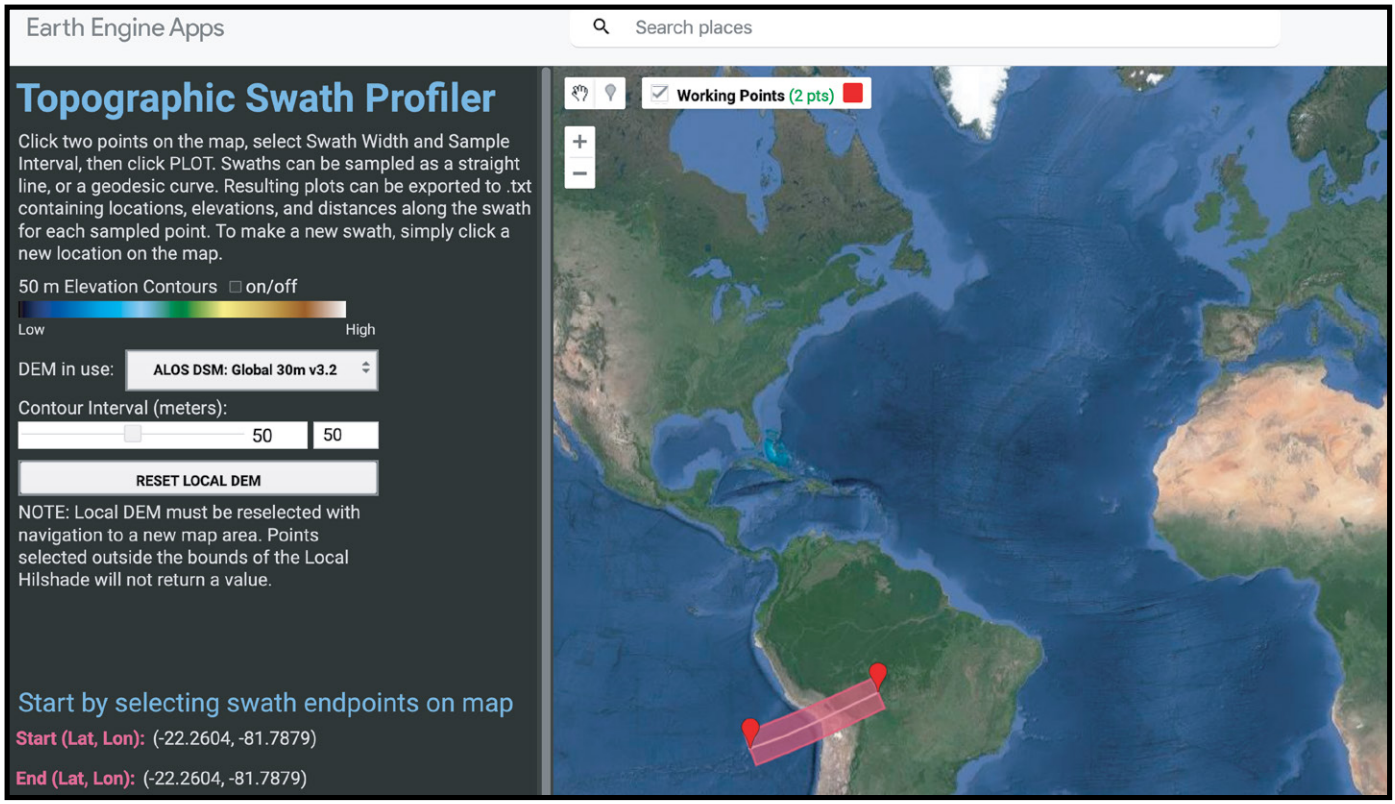

Figure 3. A screenshot from the Topographic Swath Profiler (TSP) shows an example swath location. The TSP allows users to generate continental-scale topographic swath profiles instantly.

measured as a percent of the selected DEM's native resolution. As discussed in a later section, the TSP is limited to processing no more than 20,000 data points, so larger swaths may require a reduction in the sample density.

Once the swath profile dimensions are set, clicking "PLOT" generates two distance-versus-elevation plots visible in the results panel. The top panel includes all the points sampled, and the bottom panel is a line plot showing minimum, maximum, and mean elevations with distance along the swath. The plots can be exported from GEE as .svg files, or users can export the results as a .csv file. Note that the charts displayed do not feature consistent aspect ratios, meaning the vertical exaggeration will vary, and advanced users may prefer to export data for use in other plotting software. Exported KML files will include the line between the selected points and a polygon of the swath bounds.

Tool Limitations

The primary advantage of the TSP is the speed and accessibility of GEE web applications that make it possible to rapidly investigate areas of interest globally. However, limitations of processing capacity and data reprojections may make the TSP undesirable for research applications in comparison to other methods of generating topographic swath profiles (Schwanghart and Scherler, 2014; Forte and Whipple, 2019).

In contrast to other topographic analysis tools that are limited only by the user's local processing capacity, GEE limits the processing quota to 10 MB per query, which equates to ~20,000 data points in a swath, meaning resampling is often necessary. Resampling is executed via raster scaling, meaning rasters are resampled to a user-defined scale prior to being queried. The resampling slider is designed to be intuitive for beginners and is measured as a percent of the DEM's original resolution, where a lower percent equates to a lower sampling rate. For example, using a 30-m-resolution DEM and a 50% sample density will result in a 60-m-resolution DEM where all the 60 m cells are included in the swath profile. Advanced users should consider the GEE scaling limitations and the resampling method when selecting from the available DEMs, as resampling high-resolution DEMs may introduce large uncertainty.

Global projections can also lead to unexpected results when data are projected to the swath. Reprojecting images in the GEE interface is discouraged even when working with varying data sets. As a result, calculating a cell's along-swath distance (distX) is simplified by calculating the length of the center line with ee.Geometry.length() and dividing by the sample density. A series of swath-perpendicular lines yields columns of values queried from cells that intersect a given line. All values in a column are assigned the same along-swath distance (distX) regardless of the queried cell's centroid location or the distance from the swath's center line (distY). The global projection and distance calculation ignores differences in lengths between the upper and lower bounds of a swath, potentially yielding inconsistencies in regional-scale (>1000 km length) or cross-polar swaths.

The limitations of processing capacity and reprojections are a necessary trade-off for global usability and accessibility.

The benefits outweigh the negatives for most instances of reconnaissance investigation or student engagement.

Example Use Case

Using the TSP in undergraduate courses allows students to engage with fundamental relationships between geologic processes and topography by querying research-grade data. For example, users can describe the geometric variations in subduction zones by generating topographic swath profiles across convergent margins (Figs. 4A–4C). Three swaths generated with the TSP across the Altiplano, Cascadia, and Japan clearly illustrate how subduction interfaces with differing ages and compositions of the crust result in different topographic and bathymetric signatures. Similar results can be generated with an elevation profile in Google Earth Pro, which samples elevations along a single line of low-resolution data. Generating a topographic swath smooths anomalous noise and facilitates greater discussion on local relief or the potential for along-strike variation. In any classroom where students have access to the internet, high-resolution DEMs can be used for introducing students to concepts like the angle of repose on sand dunes or the formation of marine terraces.

The TSP is also a powerful reconnaissance and hypothesis-building tool for researchers investigating new regions. Available tools for generating topographic swath profiles often require reprojecting and resampling DEMs (Schwanghart and Scherler, 2014), which can be nontrivial depending on the user's experience level and the data availability, implying a time investment. Cloud computing eliminates the preparation process and makes analysis possible with a mobile device, supplementing investigations and inspiring new questions in the office or in the field.

CONCLUSION

The availability of cloud computing and public data catalogs is increasing the accessibility of analysis, allowing for creative and innovative ways to engage with earth sciences. We present two web applications developed on the GEE online interface that can be used by workers with no computational background to query DEMs. The Plane Orientation Calculator (POC) and Topographic Swath Profiler (TSP) query global data sets, are accessible to anyone with an internet connection, and are designed to be user-friendly and rapid.

The POC uses fundamental geometric principles to calculate the orientations of planes defined by user-selected points on the surface of the Earth. The web application combines the accessibility of data in GEE with a proven method for calculating structural orientations into a tool for reconnaissance mapping, remote data collection, and student engagement. The TSP is similarly designed for rapid computing and ease

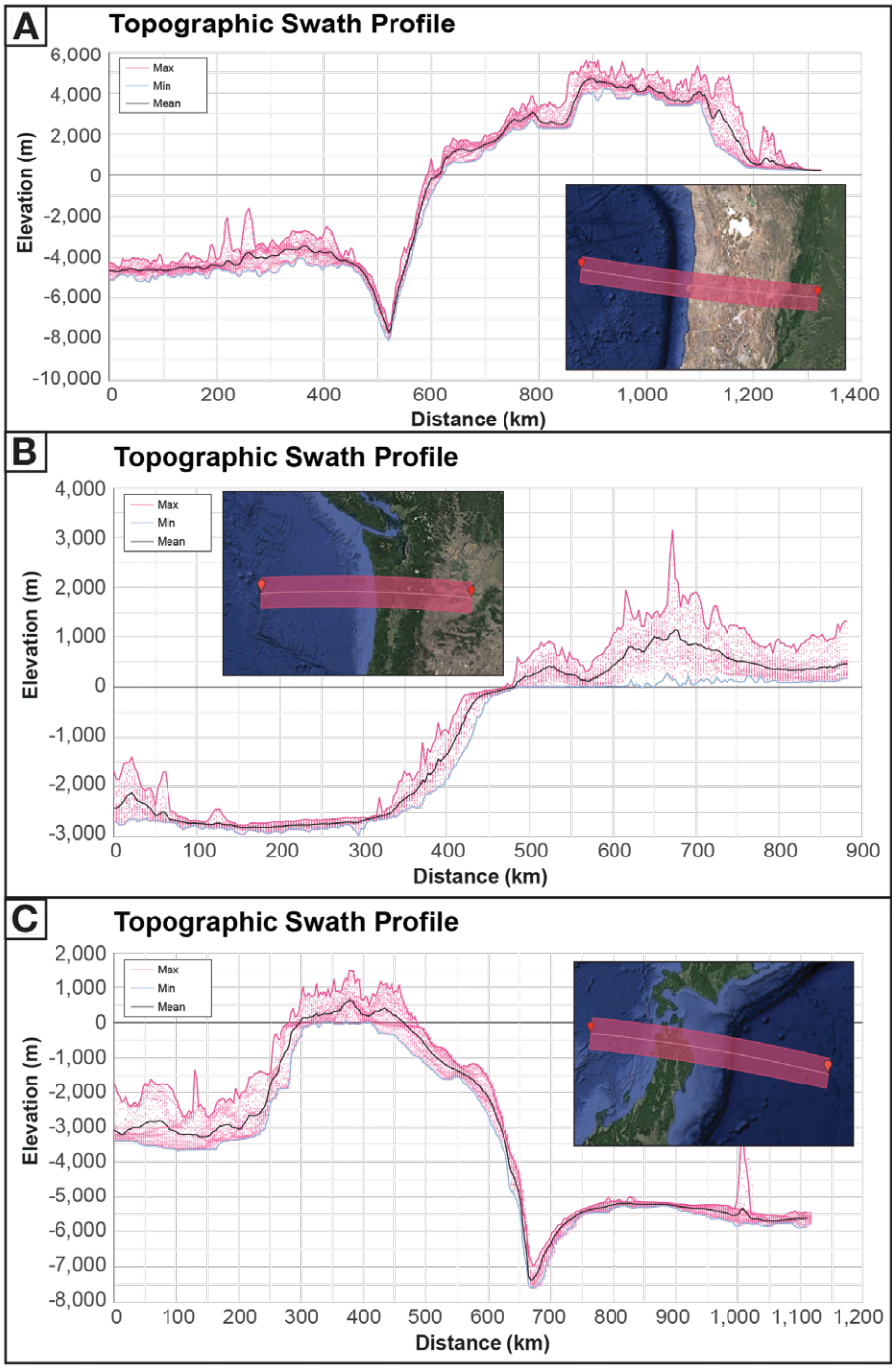

Figure 4. Example of classroom use for the Topographic Swath Profiler (TSP). Data were sampled across three sites: Altiplano, Cascadia, and Japan (A–C, respectively). Because the TSP is simple and fast, novice users can compare features in minutes. Elevation data from ALOS 30 m global (Takaku et al., 2020).

of use in querying DEMs to produce topographic swath profiles. Topographic swath profiles are a commonly employed representation of the topographic expression of geologic phenomena. However, constructing topographic swath profiles typically requires nontrivial background knowledge and GIS software that creates an obstacle for users with limited time or experience. With the TSP, novice users can interrogate global data sets and produce topographic swath profiles. The tools described above increase the accessibility of data collection and topographic analysis to any user with a mobile device connected to the internet, making them useful tools for research, virtual field trips, and introducing geologic concepts in classroom settings.

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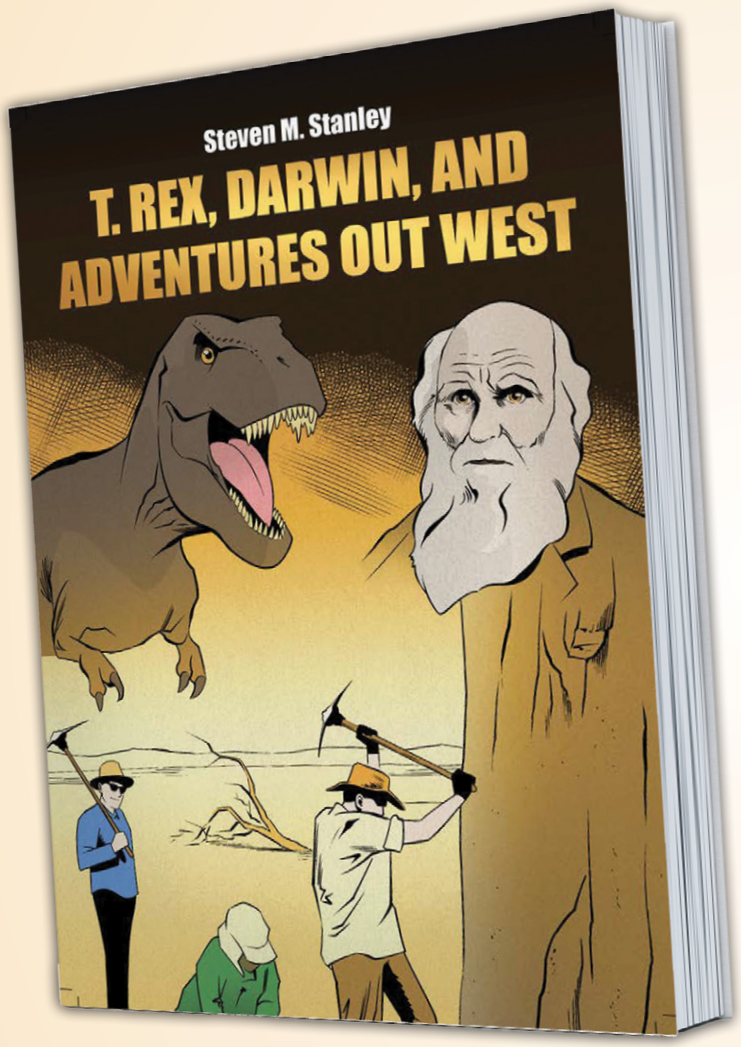
MANUSCRIPT ACCEPTED 30 APRIL 2024

T. REX, DARWIN, AND ADVENTURES OUT WEST



Get ready for a wild ride through the untamed landscapes of the American West!

A group of bright college students who call themselves "The Melange" are ready for adventure. Led by their inspirational professor, they embark on a journey Out West. From a close encounter with *T. rex* that leads to a mystery, the novel is a whirlwind of drama, elation, tragedy, and humor. You'll be left pondering whether dinosaurs were really warm-blooded, the origins of storytelling, and the curious conundrum of why dogs come in so many varieties while cats all look alike.

About the Author:
Steve Stanley has authored many scientific journal articles and has written several books. He's the only paleontologist to have received GSA's Penrose Medal in the past 30 years.

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Early Registration Deadline: 31 July
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REQUEST AN EVENT SPACE
Host a meeting or social event with your alumni organization or professional association.
Deadline: 9 August
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BOOK YOUR HOTEL
Make your hotel plans for September now! Reserve your room before 21 August to ensure you get the best rates at GSA hotels steps away from the Anaheim Convention Center.
https://bit.ly/4bsRy4u

LET'S MAKE THIS A RESPECTFUL INCLUSIVE SCIENTIFIC EVENT (RISE)
Help keep GSA meetings safe, respectful, and inclusive by becoming a RISE liaison. RISE liaisons play an important role in addressing misconduct concerns.
https://bit.ly/3wOjgtI

GeoCareers: Your Guide to Career Success

Envision your future career in the geosciences and learn how to make it a reality by attending these events.

GEOCAREERS DAY
Sun., 22 Sept.
Career insights from industry and government representatives.
- Résumé and USAJobs Workshop
- Company Connection
- Mentor Roundtables
- GeoCareers Panel Luncheon

GEOCAREERS CORNER
Sun.–Tues., 22–24 Sept.
Learn valuable information that will help you guide your career to the next level.
- Career Presentations
- Résumé Review Clinic
- Drop-in Mentoring
- Early Career Professional Coffee
- Geology Club Meet-Up
- Networking Reception
- Women in Geology Program
- Post or View Jobs

GSA Student Members: Attend Connects for Free!

Help us out by volunteering to work at least ten hours at the meeting, and we'll cover the cost of your registration! The Student Volunteer Program is now open for GSA student members in good standing to sign up. When you sign up early, you get the best selection of jobs and can make sure you find ones that will fit best with your schedule. Not only do you get to see how the meeting works from the inside, you'll also be playing a vital role that helps make the meeting a success for everyone! Sign up at **https://bit.ly/44WQ8NK.**

Ignite Your Curiosity with Noontime Lectures

Grab your lunch and listen to engaging talks on hot geoscience topics.

Assessing Landscape Response to Modern Climate Change: How Much Do We Know?
Monday, 22 September, 12:15–1:15 p.m.

Amy E. East, Jonathan A. Warrick, Amy E. Gibbs, and **Patrick L. Barnard,** U.S. Geological Survey Pacific Coastal and Marine Science Center, Santa Cruz, California
Dongfeng Li, National University of Singapore and Peking University, Beijing, China
Joel B. Sankey, U.S. Geological Survey Southwest Biological Science Center, Flagstaff, Arizona
Margaret H. Redsteer, University of Washington Bothell, Bothell, Washington
Jeffrey A. Coe, U.S. Geological Survey Landslide Hazards Program, Golden, Colorado

Climate change impacts nearly all land and nearshore areas. This lecture addresses the complexities of identifying and measuring climate-induced landscape changes and hydrological shifts. Challenges include limited data, obscured effects from land use and seismic activity, data biases, and signal attenuation in sedimentary systems. Despite obstacles, leveraging historical and paleo data and prioritizing sensitive study sites offer crucial insights. Accurately attributing landscape changes to climate change enhances predictive abilities. By evaluating and quantifying these changes, societies can better mitigate their impact on health, safety, infrastructure, water–food–energy security, economies, and ecosystems.

Risky Business: Life Along an Active Margin
Wednesday, 25 September, 12:15–1:15 p.m.

Wendy Bohon, California Geological Survey

California is known worldwide for its lofty mountains, cliff-lined beaches, and sweeping vistas, but the geologic processes that created this spectacular scenery can also threaten the lives and livelihoods of the nearly 40 million people that reside within the state. In this session, we'll explore the faults of California and the hazards that they pose, as well as the efforts of the California Geological Survey to help mitigate the risk from these hazards through mapping, instrumentation, and collaboration.

Travel Grants

Apply for a travel grant for GSA Connects 2024 and get ready to make unforgettable memories!

Seize the opportunity to attend GSA Connects 2024 with travel grants generously provided by GSA Sections, Divisions, and Associated Societies. Whether it's assistance with registration, field trips, or travel expenses, there's financial support available just for you.

Every group has its own set of grants with varying eligibility criteria and deadlines, so be sure to explore the options that fit your needs. Don't miss out!

Register for the meeting before applying for a grant. Rest assured, if you're not selected for a grant and unable to attend, your registration fee will be refunded by GSA.

Learn more about travel grants and Division awards: **https://bit.ly/3yuX3BH**

Catapult Your Career to New Heights!

Sign Up for Short Courses

Learn a new topic and build your skills by attending a short course! Taught by industry professionals, these enlightening courses will help you to gain new knowledge, network with peers, and earn continuing education units (CEUs). You can even sign up for a short course if you're not attending the meeting! Early registration is highly recommended to secure your spot.

https://tinyurl.com/2unm738b

Fuel Your Geological Adventure With Chevron!

Explore the geological wonders of California with your peers this September! The GSA/Chevron Field Trip Grant empowers student and early career professionals by providing financial support for educational adventures.

FT405: Warren Hamilton Field Trip: Cretaceous through Neogene Tectonostratigraphic Evolution of the Southern California Margin. Uncover how the paleotectonics of the area can be discerned through examining key outcrops from Late Cretaceous through Paleogene and Neogene evolution. *The first nine students who apply can attend this two-day field trip at no cost (a value of $265).*

FT414: Geology, Coastal Geomorphology, and Soils of Eastern Santa Cruz Island: Tectonics and Sea-Level History. Learn about unique geologic features such as 2-million-year-old fossiliferous marine terraces, carbonate-rich sand dunes, and "self-swallowing" soils known as Vertisols. *The first two students who apply can attend this one-day field trip at no cost (a value of $150).*

FT410: Kirk Bryan Field Trip: The Holocene Trace of the San Andreas Fault through San Gorgonio Pass. Explore San Gorgonio Pass as the San Andreas Fault weaves through Mission Creek Preserve near Desert Hot Springs, California. Field trip leaders guide captivating exploration of fault slip history and geological phenomena. *The first ten students who apply can attend this one-day field trip at no cost (a value of $55).*

Scan the QR code to apply and indicate which trip you want to attend. Those who apply early get priority. Applications will be accepted on a rolling basis until 1 August.

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Save Big on GSA Connects 2024

There are lots of ways to make the meeting more affordable. Here are six easy ways to defray costs and make the most of the meeting.

1. **Become a Member:** It only costs $25 for an annual student membership, and you'll save up to $125 on registration!
2. **Use the Roommates & Rides Community:** Share housing, coordinate carpools, and make plans to meet up with colleagues.
3. **Register Early:** Register for Connects by 31 July to save money and avoid fee increases.
4. **Volunteer Your Time:** Work at least ten hours at the meeting and you'll get free registration.
5. **Apply for Travel Grants:** Students and early career professionals can offset the combined cost of registration, housing, and travel.
6. **Apply for Division Grants:** Many divisions offer funding to help defray the costs of travel, field trips, and short courses.

https://bit.ly/3x6QKDU

Write a justification letter to persuade your employer to help cover the costs of attending: https://bit.ly/4b3e3w8

Be a Mentor!

Meet with students and share your story! There are many opportunities, including:

- Résumé/CV Mentor
- Drop-In Mentor
- GeoCareers Day Table Mentor
- Women in Geology Mentor
- Networking Event Mentor

Sign up at **https://bit.ly/3USbUNI.**

Creating Change through Informed Policy

Joshua Martin, GSA Science Policy Fellow

Geoscience plays a crucial role in our society. It underpins solutions to many of the pressing issues we face, including climate change, water and resource management, clean energy, and resilience to natural hazards. This understanding may have even sparked your own interest in geoscience. While geoscience drives the solutions to these challenges, their implementation relies on effective policy. To ensure that policies are informed by geoscience, it is essential for scientists to engage in policy discussions at all levels. It is within this intersection of science and policy, and with the help of GSA, that I have discovered an unexpected and fulfilling career path.

Growing up in Columbus, Ohio, visits to the Orton Geological Museum and the Center of Science and Industry sparked an early love for geology and led me to major in geological sciences at Ohio University, where I also earned minors in math and physics. During my time there, I worked as a research assistant in the Planetary Geology group, and I relished the late nights I would spend in the lab, always eager to learn more; to solve the next problem; to answer the next question. I would carry that passion for knowledge forward into my Ph.D. program at Ohio State University.

Throughout graduate school, my life was almost singularly devoted to precision. The goal I worked toward for six years of my life through my dissertation was increasing the precision in measurements and models of the different materials that form our planet and many others. If I was being precise, I'd say I am a mineral physicist. My friends and family, on the other hand, would say I "study rocks." To some degree that is true, and it's certainly easier to understand for a quick introduction, but it doesn't tell the whole story. And yet, while saying "I used Monte Carlo statistical analysis to develop high-precision equations of state for planetary materials" is a much more *precise* description of what I did, that really doesn't tell the story either. This struggle I have faced—finding the balance between precision and clarity when communicating my research—is what drove me toward science communication, outreach, and eventually science policy.

My interest in policy took off during the spring of 2020, when aspects of the COVID-19 pandemic highlighted the importance of clear communication between scientists, policymakers, and the public. Feeling burnt out on my research and looking for a way to help advocate for and communicate the importance of science during this time, I began to consider career opportunities beyond academic research. Engaging in online science policy workshops and, in particular, GSA's 2022 Geosciences Congressional Visits Day (GEO-CVD) opened my eyes to the realm of advocacy and science policy. During GEO-CVD, I traveled to Capitol Hill and met with members of the staff of four senators to advocate for increased funding for agencies relevant to the geosciences during the appropriations process. That experience, however simple it seemed on the surface, was a major turning point that left me feeling fulfilled in a way I hadn't in years. The experience I had and the people I met that weekend directly led me to my current position as GSA's Science Policy Fellow. In this position, I've found a place in science policy where I finally feel as though I am using my experience in geoscience, education, and communication to benefit the people around me.

I'VE FOUND A PLACE IN SCIENCE POLICY WHERE I FINALLY FEEL AS THOUGH I AM USING MY EXPERIENCE IN GEOSCIENCE, EDUCATION, AND COMMUNICATION TO BENEFIT THE PEOPLE AROUND ME.

As GSA's Science Policy Fellow, I serve as a liaison between scientists and policymakers, advocating for and communicating the importance of geoscience in a number of different ways. My days involve tracking legislation relevant to geoscientists, communicating with policymakers on Capitol Hill by contributing to letters of support and testimony on legislation, attending congressional hearings and agency briefings, and writing GSA's Public Policy Newsletter, where you can find information on the most recent activity out of GSA's Washington, D.C., office. I also now help organize GEO-CVD, which allows GSA members to meet with their representatives here in Washington, D.C., and advocate for the geosciences. Through these efforts, I regularly collaborate with other societies and stakeholders through coalitions that work together to send a unified message to Congress on the importance of agencies like the U.S. Geological Survey (USGS) and the National Science Foundation.

GSA has plenty of resources available to help you use your research to inform policy, including toolkits, position statements, and webinars. Recent graduates with an interest in science policy are encouraged to consider the Science Policy Fellowship, which provides a unique opportunity to advocate for science while learning about the policy world and developing the tools necessary to affect policy in a sustainable way, all while supported by GSA's remarkable staff. GSA also offers a Congressional Science Fellowship, jointly sponsored by the USGS, which places a Ph.D. scientist in a congressional office or on a congressional committee as a staff member for a year, and has an annual application deadline of 15 January. If you are interested in any of these opportunities, or have any questions on how to start engaging with science policy, please contact me at sciencepolicy@geosociety.org or visit the website at www.geosociety.org/policy!

Apply for 2024 Geosciences Congressional Visits Days, which will be held 9–10 September. **https://bit.ly/4ddIjqE**

2024 GSA Medal & Award Recipients

The Geological Society of America bestows medals and awards to recognize individuals who have through their outstanding achievements made significant contributions to the geosciences. GSA globally upholds excellence and innovation by annually paying tribute to those who are making remarkable impacts.

PENROSE MEDAL
Andrew H. Knoll
Harvard University

ARTHUR L. DAY MEDAL
Janice L. Bishop
SETI Institute; NASA Ames Research Center

YOUNG SCIENTIST (DONATH) MEDAL AWARD
Brenhin Keller
Dartmouth College

GSA DISTINGUISHED SERVICE AWARD
Carl A.P. Fricke
SafeTraces, LLC; SumGrowth LLC; Transit Control Solutions, Inc.

GSA PUBLIC SERVICE AWARD
Frederick D. Day-Lewis
Pacific Northwest National Laboratory

RANDOLPH W. "BILL" AND CECILE T. BROMERY AWARD
Aditya Kar
Fort Valley State University

GSA is honored to celebrate these extraordinary geoscientists at the 2024 Presidential Address and Awards Ceremony at GSA Connects 2024 in Anaheim, California on Sunday, 22 September.

DORIS M. CURTIS OUTSTANDING WOMAN IN SCIENCE AWARD
Gabriela A. Farfan
Smithsonian Institute

Oana Dumitru
University of Florida

GSA FLORENCE BASCOM GEOLOGIC MAPPING AWARD
Christopher D. Henry
Nevada Bureau of Mines and Geology

MICHAEL T. HALBOUTY DISTINGUISHED LECTURER AWARD
Lawrence D. Meinert
Meinert Consulting LLC

GSA INTERNATIONAL HONORARY FELLOW AWARDS
Tea Kolar-Jurkovšek
Geological Survey of Slovenia

Valentina Yanko
Odessa I. I. Mechnikov National University

Yehouda Enzel
Hebrew University of Jeresulum

Nico Goldscheider
Karlsruhe Institue of Technology

2024 GSA Division Primary and International Awards

MID-CAREER AWARD
Continental Scientific Drilling Division
Jeffery Robert Stone, Indiana State University

GILBERT H. CADY AWARD
Energy Geology Division
Anne Raymond, Texas A&M University

EDWARD B. BURWELL, JR. AWARD
Environmental and Engineering Geology Division
Stephen G. Evans, University of Waterloo
Negar Ghahramani, WSP
Scott McDougall, University of British Columbia
Nahyan M. Rana, Klohn Crippen Berger (KCB)
Andy Small, Klohn Crippen Berger (KCB)
W. Andy Take, Queen's University, Canada

RIP RAPP ARCHAEOLOGICAL GEOLOGY AWARD
Geoarchaeology Division
Paula J. Reimer, Queen's University Belfast

DISTINGUISHED CAREER AWARD
Geobiology and Geomicrobiology Division
Alan Jay Kaufman, University of Maryland

M. LEE ALLISON AWARD FOR GEOINFORMATICS
Geoinformatics and Data Science Division
Marshall (Xiaogang) Ma, University of Idaho

GEORGE P. WOOLLARD AWARD
Geophysics and Geodynamics Division
Larry Douglas Brown, Cornell University

MARY C. RABBITT HISTORY AND PHILOSOPHY OF GEOLOGY AWARD
History and Philosophy of Geology Division
Silvia Fernanda de Mendonça Figueirôa, University of Campinas–UNICAMP, Brazil

O.E. MEINZER AWARD
Hydrogeology Division
Douglas Kip Solomon, University of Utah

DISTINGUISHED GEOLOGIC CAREER AWARD
Mineralogy, Geochemistry, Petrology, Volcanology Division
John Michael Rhodes, University of Massachusetts

G.K. GILBERT AWARD
Planetary Geology Division
Charles (Chip) Shearer, University of New Mexico

KIRK BRYAN AWARD
Quaternary Geology and Geomorphology Division
Evan N. Dethier, Occidental College

LAURENCE L. SLOSS AWARD
Sedimentary Geology Division
Gerilyn S. "Lynn" Soreghan, University of Oklahoma

CAREER CONTRIBUTION AWARD
Structural Geology and Tectonics Division
Terry L. Pavlis, University of Texas

GSA INTERNATIONAL DISTINGUISHED CAREER AWARD
International Committee
Bilal U. Haq, Sorbonne University, Paris, France, and Smithsonian Institute, Washington, D.C.

JAMES B. THOMPSON, JR. DISTINGUISHED INTERNATIONAL LECTURESHIP
International Committee
Alan E. Fryar, University of Kentucky

Congratulations 2024 GSA Fellows

Elected by Council — May 2024

Society Fellowship is an honor bestowed on the best of our profession by election at the spring GSA Council meeting. GSA members are nominated by other GSA members in recognition of a sustained record of distinguished contributions to the geosciences and the Geological Society of America through such avenues as publications, applied research, teaching, administration of geological programs, contributions to the public awareness of geology, leadership of professional organizations, and taking on editorial, bibliographic, and library responsibilities.

What their nominators had to say...

Gregory S. Baker (Colorado Mesa University)
"Dr. Greg Baker has advanced techniques in imaging, from shallow seismic reflection to the use of drones. His publication record is extensive and his grantsmanship is impressive. He conveys his enthusiasm to his students in a teaching career that has spanned three decades, through which he has recruited scores of geoscientists and provided them first-rate geoscience education. His record is rich with innovation and myriad efforts to include underrepresented peoples. Dr. Baker is a credit to the GSA and our profession."
—Dr. Patrick Albert Burkhart

Timothy Beach (University of Texas at Austin)
"Dr. Timothy Beach's significant interdisciplinary contributions include early work on post-settlement erosion and sedimentation in America; reconstructing ancient Maya history in Central America; and models explaining the formation and human uses of wetlands. A champion of geoscience education, Beach inspired and mentored countless students toward successful careers, especially underrepresented students."
—Anne Chin

Patricia Bobeck
"Patricia Bobeck is nominated for most meritorious service to her profession by her translating from French two fundamental reports, *The Public Fountains of the City of Dijon* by Henry Darcy (orig pub. 1856) and *The Art of Finding Springs* by Abbé Jean-Baptiste Paramelle (orig pub. 1856), as well as other translations." *—Gareth J. Davies*

Dan Breecker (University of Texas)
"We are nominating Dr. Breecker in recognition of his sustained scientific achievement through discovery and development of new applications and an impressive record of training and mentoring geoscientists." *—Neil J. Tabor*

Erick R. Burns (U.S. Geological Survey)
"Dr. Erick R. Burns is nominated to GSA Fellowship for his fundamental contributions to understanding heat flow in groundwater systems, machine learning applications for resource favorability mapping, development of assessment tools for low-temperature and underground energy resources, and his leadership for the U.S. Geological Survey geothermal resources investigations project."
—Hongbin Zhan

Michael Cardiff (University of Wisconsin–Madison)
"Professor Cardiff has a strong record of scientific achievement for both theoretical and applied geosciences. He also has an impressive record of mentoring the next generation of geoscientists. It is clear to me and my co-nominators that Dr. Michael Cardiff not only meets the requirements, but he also exemplifies many of the characteristics that we look to in a GSA Fellow."
—Dr. Randy Hunt

Sara Carena (Ludwig-Maximilians University)
"For sustained achievement in training and mentoring of geoscientists, pioneering work on virtual teaching tools including field trips and 3-D visualization, and scientific discovery in structural geology and active tectonics improving understanding of plate-boundary zone mechanics." *—Anke M. Friedrich*

Robinson Cecil (California State University–Northridge)
"Dr. Robinson Cecil has made outstanding contributions to the study of the genesis and tempos of Cordilleran batholiths and magmatism related to subduction initiation. Her dedication to GSA includes convening technical sessions, participating in critical committees, and, together with her students, attending and presenting research at our meetings." *—Nancy Riggs*

Thomas H. Darrah (The Ohio State University)
"Tom Darrah is a geochemist with an outstanding record of achievement in research around the environmental impacts of hydraulic fracturing, gasses in the Earth's crust, geology and health, and an innovative spirit that has led to the discovery of geological hydrocarbon as a novel new source of energy."
—Frank W. Schwartz

Gregg R. Davidson (University of Mississippi)
"Gregg Davidson is recognized for his outstanding research on the carbon isotope composition of soil and shallow groundwater and hydrogeologic studies of the Mississippi River alluvial aquifer system, as well as public outreach at the intersection of science and Christian faith."
—Daniel Larsen

Rhawn F. Denniston
(Cornell College)
"Rhawn Denniston has made outstanding contributions to the field of paleoclimatology using records of stalagmites and corals and has published in impactful journals including *Science Advances*, *Geology*, and the *Proceedings of the National Academy of Sciences*. He has also placed large numbers of Cornell College undergraduate advisees in top graduate programs." *—Matthew R. Saltzman*

Richard E. Ernst (Carleton University)
"Richard Ernst is a driving force in research of large igneous provinces (LIPs). He applies lessons learned from Earth to other planetary bodies (Moon, Mars, Venus) and has pioneered applications of LIPs degassing to climate change. He is a generous mentor, colleague, and supporter of the geological community, including the GSA." *—Timothy W. Lyons*

Rebecca Marie Flowers (University of Colorado)
"From the carving of the Grand Canyon to the development of Great Unconformities, Rebecca Flowers' studies linking geology and thermochronology have revealed unexpected and rich details to the history of the continents. She has catalyzed growth in thermochronology through developing the AGeS program, expanding access to data, and successful mentoring." *—Francis A. Macdonald*

Chris A. Gellasch (Eastern Michigan University)
"Dr. Christopher Gellasch has performed substantial and exemplary service to GSA and to the training and mentoring of youth and young and early career geoscientists. Through his volunteer efforts and his professional accomplishments, Dr. Gellasch has shown himself to be an exemplary representative of the geoscience community." *—Christopher P. Carlson*

David A. Grimley (University of Illinois; Illinois State Geological Survey)
"A GSA member since 1992, David Grimley's expertise in loess, fly ash, terrestrial gastropods, stratigraphic framework, and geologic mapping helps lead the Illinois State Geological Survey in its Quaternary studies. Dave enjoys collaborating with and supporting early career, underrepresented geoscientists, as well as mentoring numerous undergraduate and graduate students." *—Ben Curry*

Don A. Haas (The Paleontological Research Institute)
"Don Haas has made significant contributions for more than two decades in advancing geoscience education in K–12, science teacher education, and informal science environments. He is a keen advocate for climate change education, an innovator in virtual geology instruction, and a driver of education policy for understanding of the Earth system."*—Eric J. Pyle*

Mark A. Helper (University of Texas at Austin)
"Dr. Mark Helper has had an indelible impact on hundreds of students over 32 years of teaching and directing the Jackson School of Geosciences field camp. He has made outstanding contributions to modern NASA astronaut training in geology, which will directly benefit our future exploration of the Moon and Mars."
—Dr. Claudia I. Mora

Linda A. Hinnov (George Mason University)
"Professor Linda Hinnov is an international leader in astrochronology and a pioneer of quantitative cyclostratigraphic analysis. Her career, spanning three decades and over 150 publications, has guided both practical and theoretical developments in the field, shepherding the growth of astrochronology as an essential tool for the state-of-the-art geologic time scale." *—Stephen R. Meyers*

David S. Jones (Amherst College)
"David S. Jones is a sedimentary geologist who examines the sedimentary record over critical time periods when Earth's climate and biota changed markedly, including when mass extinctions occurred. He has made significant contributions in original research and as an educator by mentoring future earth scientists." *—Tekla A. Harms*

Daniel Jones (New Mexico Tech)
"Dr. Daniel Jones is a geobiologist who studies the influence of microbial metabolisms on mineralogical and biogeochemical processes, crossing disciplinary boundaries between biology and geosciences. His support and promotion of the work of students and early career geoscientists is helping to build the future of the Geological Society of America." *—Lewis Land*

Matthew Kirk (Kansas State University)
"Matthew Kirk is an outstanding teaching scholar, passionate about environmental sciences and the pursuit of diversity, equity, and inclusion. He is a leader in service to GSA and the profession and renowned for his interdisciplinary research on topics ranging from arsenic contamination in groundwater to microbial generation of natural gas."
—Pamela D. Kempton

Craig Lundstrom (University of Illinois)
"Craig has advanced understanding of igneous processes through impactful and creative research that combines experimentation, isotopic measurements, field observation, numerical models, and new conceptual models. He has mentored thirty graduate students and postdocs, served as department head at a major research university, and worked to diversify the department's graduate program."
—Thomas M. Johnson

Lawrence L. Malinconico, Jr. (Lafayette College)
"Dr. Lawrence L. Malinconico, Jr. is an exceptional, innovative, and multi-talented geoscientist and mentor who has made significant contributions to digital field methods with iPad apps including GeoFieldBook. He has an impressive track record across geoscience education and research and has served GSA as a continuous member since 1974." *—Nazrul I. Khandaker*

Joseph A. Mason (University of Wisconsin–Madison)
"Dr. Joseph Mason has an exceptional and sustained record of innovative research in eolian hillslope geomorphology, generous mentoring, effective academic leadership, and engagement with GSA. Through theoretical, field-based, experimental, and modeling research, Dr. Mason has demonstrated how the study of geomorphology can provide insights into eolian systems and past climate."
—Erika Marin-Spiotta

Florentin J. Maurrasse (Florida International University)
"Dr. Maurrasse has a long and consistent history of excellence in administration of geoscience programs, training, mentoring, scientific achievement, and exemplary GSA membership since 1972. He has made outstanding contributions to geoscience throughout Caribbean/Latin American regions and to understanding of paleoenvironments related to Cretaceous greenhouse climate and ocean oxygen depletion worldwide."
—Miguel E. Valencia

Kirsten M. Menking (Vassar College)
"Dr. Menking is an outstanding paleoclimatologist, a dedicated educator, and a GSA community leader, as evidenced by her meaningful contributions to paleoclimate research, mentorship of students and public outreach, and efforts at GSA meetings and committees. She has a strong commitment to educating the public about climate change." *—David P. Gillikin*

Leslie A. Melim (Western Illinois University)
"Dr. Leslie A. Melim, professor of geology at Western Illinois University, was nominated as GSA Fellow for distinguished contributions to GSA and the geologic profession through authorship of numerous research articles, presentations at GSA meetings, exemplary service as a journal editor and peer reviewer, and award-winning achievements in mentoring undergraduate research." *—Jack B. Bailey*

Ellen P. Metzger (San Jose State University)
"Ellen Metzger has made important contributions through her teaching and mentorship of geoscientists, and in increasing public awareness of geology. She is a national leader in geoscience education. Her columns for the Journal of Geoscience Education set the standard for our approach to K–12 teacher preparation in earth science." *—Robert B. Miller*

Benjamin H. Passey (University of Michigan)
"For outstanding contributions to the measurement and interpretation for stable isotopes for problems ranging from paleoecology to paleoclimatology to diagenesis." *—Nathan D. Sheldon*

Dr. Lee Ann Munk (University of Alaska)
"Dr. Lee Ann Munk is a world-class geochemist who has used laboratory and field measurements to unravel key processes in lithium-brine systems. She has actively led diverse research teams and undergraduate researchers to improve the understanding of low-temperature aqueous environments. Her dedication to training and sharing science between academia and industry reflects her impact on the geosciences discipline." *—David F. Boutt*

Tara L. Root (U.S. Geological Survey)
"Dr. Root has been exceptionally active in supporting the Hydrogeology Division as newsletter editor since 2019. She trained and mentored many geoscientists at Florida Atlantic University and conducted substantive hydrogeologic work with a particular focus on public awareness of geology at both Florida Atlantic and in her current USGS position." *—Prof. Michael C. Sukop*

James D. Schiffbauer (University of Missouri)
"Dr. Schiffbauer has made many outstanding contributions in Precambrian–Cambrian Earth history, paleobiology, and taphonomy. His work addresses crucial challenges in paleontology, particularly the taphonomy of exceptional fossil preservation and how it may bias the fossil record."
—Shuhai Xiao

Dr. Anjana K. Shah (U.S. Geological Survey)
"Dr. Anjana Shah is a leader in geophysical data acquisition and interpretation. As a research geophysicist at the U.S. Geological Survey, her research has led to advances in interpreting seismic risk in intraplate seismic zones, 3-D imaging of the crust, and discovery of new rare earth element (REE) occurrences." *—Gregory J. Walsh*

Mona C. Sirbescu (Central Michigan University)
"Mona Sirbescu is a dedicated teacher-scholar. She has advanced our understanding of the origins and prospectivity of lithium-rich pegmatites while mentoring 56 undergraduate research projects since 2003. She and her students use field work, petrology, geochemistry, and experiments to investigate the mechanisms of pegmatite crystallization at unusually low temperatures." *—Dr. Lawrence D. Lemke*

Gary S. Solar (Buffalo State University)
"Dr. Solar is a field-based structural geologist with expertise in crustal melting. His professional leadership (GSA Section Meeting organizer and field trip leader, department chair over 13 years) and his mentorship (75 undergraduate researchers leading to 38 GSA presentations) have been sustained and impactful."
—Paul Tomascak

Andrew J. Stumpf (University of Illinois Urbana-Champaign)
"Dr. Stumpf has built a diverse career in the geosciences that includes geologic mapping, critical-zone studies, and innovative applied research in geothermal systems and their design. This diverse career has allowed his mentorship of dozens of students, and it has contributed to his long-standing participation in GSA." *—Jason F. Thomason*

Fangzhen Teng (University of Washington)
"Fangzhen Teng is a world leader in the development and deployment of nontraditional stable isotopes to understand Earth and planetary processes." *—Roberta L. Rudnick*

Wan Yang (Missouri University of Science and Technology)
"Wan Yang has made profound contributions to geology through insightful studies in important areas such as basin analysis, Milankovitch cycles, the Permian–Triassic boundary, and carbon capture utilization and storage, bridging theoretical and practical aspects of geosciences."
—Stephen Shangxing Gao

Celebrating 50 Years of Service

GSA salutes the following members and Fellows on their 50-year membership anniversaries. We appreciate their dedication and loyalty to GSA.

Asterisk (*) indicate GSA Fellows.

Richard W. Allmendinger*
Olive W. Baganz
Calvin G. Barnes*
Bruce Barnum
Sandra M. Barr*
John N. Batchelder
Zvi Ben-Avraham*
John F. Bender
Alan I. Benimoff*
Mary Lou Bevier
Ellen Morris Bishop
Richard J. Blakely*
Jack A. Blanke
Andy Russell Bobyarchick
Rena M. Bonem*
Glenn Borchardt
Lawrence W. Braile*
Scott Brande
Duane D. Braun
Gerald Brautigam
Charles H. Breitsprecher
Carl E. Brett*
Laurie Brown*
Matthew J. Brunengo
T. Scott Bryan
Marita Bryant
Clive F. Burrett
Charles A. Burshears
Donald M. Burt*
Joseph A. Caggiano Jr.
Michael D. Campbell*
Michael H. Carr*
Tom Ann Casey
Susan M. Cashman*
Stephen B. Castor
David Cehrs
A.V. Chadwick
George R. Clark II
Gaylord Cleveland
Raymond A. Coish
Benjamin I. Collins
Jim Combs
William Connelly
Theodore F. Cota
Sidney L. Covington
Gerald D. Cox
Rex E. Crick
Dennis A. Darby*
P. Thompson Davis*
Paul D. Davis
Stephen J. Derksen
John M. Dixon
Frederick R. Dowsett
Theodore A. Drescher
James I. Drever*
Fletcher G. Driscoll*
Kenneth James Drummond
Hermann Duque-Caro
Herbert B. Eagon Jr.
Marco T. Einaudi*
Gerhard Heinz Eisbacher*
Ahmed El Goresy*
David H. Elliot*
Edward E. Erb*
Kenneth M. Euge
Benjamin L. Everitt
Christopher D. Farrar
Howard R.R. Feldman*
Karl W. Flessa*
Robert G. Font*
Stephen W. Forster
Don E. French
Mark W. Frye
G. Robert Ganis*
Lynette D. W. George
Billy E. Giles
James B. Gill
Gary L. Guacci
Myron R. Hagen
John H. Hansen
Richard E. Hanson*
Paul W. Heiple
Page A. Herbert
John W. Hess*
Claude Hillaire-Marcel
Robert J. Hite
John K. Hofer
Paul F. Hoffman*
Troy L. Holcombe
Timothy B. Holst*
Mark Hostetter
William H. Hoyt
Scott S. Hughes*
Raymond Ellison Irwin
Chacko J. John*
Carl Alan Johnson
Kenneth S. Johnson*
Ovid M. Johnson Jr.
Verner C. Johnson
Barry J. Katz
Jeffrey R. Keaton*
Stanley B. Keith
Joseph T. Kelley*
John Duncan Keppie*
Scott W. Keyes
David T. King Jr.*
Jan H. Knox
Philip Kyle*
Laurence Lackey
Robert O. Laidlaw
Stephen A. Langford
John T. Leftwich Jr.*
Margaret S. Leinen*
Paul H. Lewis
Wardell Lavon Lewis
Beth Zigmont Lincoln
Edwin D. Lindgren
Everett H. Lindsay
Steven H. Lingrey
Stephen F. Lintner
Steven P. Lund
Michael A. Lynch-Blosse
Bruce J. MacFadden*
Michael N. Machette*
Thomas C. MacKinnon
Logan T. MacMillan
Lawrence L. Malinconico Jr.
Ned Mamula
Hampik S. Maroukian
Bruce D. Marsh*
Alan L. Mayo
Charles M. McCulloch
George R. McGhee Jr.*
Timothy R. McHargue
Sam W. McNary
James M. McNeal
Keith L. Meekins
Jeffrey K. Miller
Jesse W. Miller Jr.
Herbert C. Mills
Carla W. Montgomery*
Glenn L. Mooney
Thomas E. Moore*
Syver W. More
John A. Moser
Peter D. Muller
David A. Mustart
Robert Gene Myers
Jerome N. Namy
Thomas R. Nardin
Dennis I. Netoff
Dianne R. Nielson*
R. LaRell Nielson
Charles A. Nittrouer*
Edward B. Nuhfer
Lawrence Edward O'Brien
Theodore M. Oberlander*
Steven C. Okulewicz
Adolph A. Oliver III
Fred S. Olsen
William Scott Parks
Ronald L. Parsley*
Peter C. Patton*
Stanley T. Paxton
Darryll T. Pederson*
James B. Phipps
Dennis W. Powers*
Isabella Premoli-Silva*
Marshall A. Reiter*
G Todd Ririe
John L. Rogers
Samuel B. Romberger*
Dave Mark Romero
Derek Rust
Tommy R. Sanders
Jeffrey P. Sgambato
Frederick C. Shaw*
Russell G. Shepherd
Alcides N. Sial*
Robert W. Simpson Jr.
Akhaury K. Sinha*
William J. Siok
Norman H. Sleep*
Braven R. Smillie
Dallas B. Spear
Doug A. Sprinkel*
Craig L. Sprinkle

GSA is proud to celebrate our members and Fellows who have reached their 25-year membership anniversaries. We thank them for dedication, loyalty, and contributions to GSA. View members reaching this milestone at **https://bit.ly/3ysKxCA.**

James T. Sprinkle*
Larry A. Standlee
Edward M. Stolper*
Byron Stone
Neil M. Sullivan
Finn Surlyk
Jerry J. Sweeney
John A. Talent
Colin E. Thorn
Edward C. Thornton
John C. Tinsley III
Robert C. Titus
M. Nafi Toksoz*
Margaret A. Townsend*
John Trummel
Donald L. Turcotte*
Gleb B. Udintsev
Jean-Claude Vicente*
David L. Wagner
John R. Wagner
Marguerite Walsh
James C. Walters*
Steve L. Wampler
Lawrence C. Weber
Elaine G.A. Weed
Ray E. Wells*
Neil Williams
James C. Wise
Kermit G. Witherbee
Akhtar Zaman
Mary Lou Zoback*

Meet Your Fiscal Year 2025 Officers & Councilors

GSA OFFICERS

ACTING PRESIDENT
(1 July–31 Dec. 2024)

IMMEDIATE PAST PRESIDENT
(1 Jan.–30 June 2025)
Christopher (Chuck) M. Bailey
William & Mary
Williamsburg, Virginia, USA

PRESIDENT-ELECT
(1 July–31 Dec. 2024)

ACTING PRESIDENT
(1 Jan.–30 June 2025)
Nathan A. Niemi
University of Michigan
Ann Arbor, Michigan, USA

ACTING PRESIDENT-ELECT
(1 Jan.–30 June 2025)
Glenn Thackray
Idaho State University
Pocatello, Idaho, USA

GSA COUNCILORS

July 2021–June 2025

J. Wright Horton Jr.
U.S. Geological Survey
Reston, Virginia, USA

Jean C.C. Hsieh
Sedimentary Geology Consultants
Calgary, Alberta, Canada

Donna M. Jurdy
Northwestern University
Evanston, Illinois, USA

July 2022–June 2026

Carol D. Frost
University of Wyoming
Laramie, Wyoming, USA

Kathleen DeGraaff Surpless
(Sections Liaison)
Trinity University
San Antonio, Texas, USA

Richard M. Ortiz
Lettis Consultants Internationtal Inc. (LCI)
Sacramento, California, USA

July 2023–June 2027

Craig H. Jones
University of Colorado
Boulder, Colorado, USA

Patricia Persaud
University of Arizona
Tucson, Arizona, USA

Nicholas P. Lang
(Divisions Liaison)
NASA Planetary Science Div.
Mercyhurst University
Erie, Pennsylvania, USA

NEWLY ELECTED
July 2024–June 2028

Martha Cary (Missy) Eppes
University of North Carolina
Charlotte, North Carolina, USA

Eric Kirby
University of North Carolina
Chapel Hill, North Carolina, USA

Darryl Reano
Arizona State University
Tempe, Arizona, USA

GSA OFFICERS

ACTING IMMEDIATE PAST PRESIDENT
(1 July–31 Dec. 2024)
Mark Gabriel Little
NCGrowth (formerly CREATE)
University of North Carolina
Chapel Hill, North Carolina, USA

TREASURER
Brian G. Katz
Environmental Consultant
Weaverville, North Carolina, USA

COUNCILOR MEMBER-AT-LARGE
Kathleen DeGraaff Surpless
Trinity University
San Antonio, Texas, USA

GSA STUDENT ADVISORY COUNCIL

Voting Member of GSA Council Term: July 2024–June 2025

CHAIR
Madison Rafter
University of Minnesota–Twin Cities
Minneapolis, Minnesota, USA

IMMEDIATE PAST CHAIR
Matt Dorsey
Texas A&M University
College Station, Texas, USA

NEWLY ELECTED MEMBERS
Term: July 2024–June 2026

Riliwan Abioye
Isabella Harnett
Samantha Khatri
Esther Oyedele
Gladys Pantoja
Erik Schoonover
Sinjini Sinha
Megan Wilson

Notice To Membership of Leadership Succession Changes

The GSA Council accepted the resignation of President-Elect Carmala N. Garzione with deepest sympathy and recognition of the unforeseen circumstances involved in her decision. The GSA Council thanks her for her valuable contributions to the leadership of the Society.

During its meeting on 28 May 2024, the GSA Council, working in alignment with the GSA Society Constitution and Bylaws, approved a leadership succession plan as follows:

The service term of President Christopher Bailey is extended, conferring upon him the title of Acting President to cover the first part of the vacated Presidential Term of Garzione beginning 1 July 2024 and ending 31 December 2024, or until such time as President-Elect Nathan Niemi is able to assume the role of Acting President and complete the vacated Presidential Term of Garzione that ends on 30 June 2025.

When the Acting President role transitions to Niemi, Bailey will move into his natural role of Immediate Past President until 30 June 2025. The GSA Council further approves that Bailey extend his term to be retitled Acting Immediate Past President from 1 July 2025 through 30 June 2026 to fill the vacancy created by the Garzione absent third year of service as Immediate Past President.

When President-Elect Niemi moves into the role of Acting President, GSA member Glenn Thackray will complete Niemi's vacated term of service as President-Elect until 30 June 2025, during which time Thackray will be known as Acting President-Elect. This is due to Thackray being second ranked (after Niemi) on the vetted list of candidates for President-Elect in the 2023 Nominations Committee Report approved by Council. Further, the GSA Council supports placing Thackray on the annual membership ballot so that he may serve subsequent one-year terms as President-Elect (1 July 2025–30 June 2026), President (1 July 2026–30 June 2027), and Immediate Past President (1 July 2027–30 June 2028).

To fill the vacated seat of Immediate Past President beginning 1 July 2024, when Bailey transitions into the role of Acting President, and ending 31 December 2024, or until Bailey moves into the role of Immediate Past President and Niemi moves into the role of Acting President, the GSA Council approves extending the term of Mark Little, conferring upon him the title of Acting Immediate Past President.

The GSA Council recognizes that further adjustments may be made to this approved succession leadership plan as deemed necessary to align with GSA governance.

J. David Lowell Field Camp Scholarship Awardees

Congratulations to this year's J. David Lowell Field Camp Scholarship recipients! Each will be awarded US$2,000 to attend the summer field camp of their choice, plus a new engraved Gold Standard Transit with the special 130th anniversary tag. These 23 undergraduate students were chosen based on diversity, economic need, and merit.

Teagan Duenkel, a past J. David Lowell Field Camp Scholarship Awardee, in the field.

Charlie Alavi, West Virginia University
Rodiat Amusan, Federal University of Technology Akure
Kaylah Arnold, Sam Houston State University
Miriam Bartleson, University of Michigan
Mary Covell, Berea College
Adrian Dias, University of Texas at Arlington
Pamela Doig, University of Arizona
Aleigha Dollens, University of Missouri–Kansas City
Kyle Fakhrshafaei, University of Oklahoma
Ella Holiman, Minnesota State University Moorhead
Marcos Jimenez, Sam Houston State University
Bianca Joseph, Georgia Southern University
Ruth Kanipiau, Western Michigan University
Olivia Key, Appalachian State University
Farid Mohammed, Universiti Brunei Darussalam
Xochitl Muñoz, University of Alaska Fairbanks
Maximillian Richter, Indiana University Purdue University Indianapolis
William Prettyman, Hillsborough Community College
Brianna Shepherd, Eastern Michigan University
Elishua Shepherd, Arizona State University
Juliet Talaber, Georgia Southern University
Kylie Wilson, Lewis-Clark State College
Alexus Wuertemburg, Arizona Western College

GSA FOUNDATION

BRUNTON

Cole Awards

W. Storrs Cole was a GSA Fellow for 58 years, a member of the Cushman Foundation, and one of the Society's leading benefactors. He established the Gladys W. Cole Research Award in memory of his wife in 1982. The first presentation of the W. Storrs Cole Memorial Research Award was in 1991 after his passing in 1989.

W. STORRS COLE MEMORIAL RESEARCH AWARD

Jonathan Schueth, University of Nebraska

Jonathan Schueth will be honored at the Cushman Foundation for Foraminiferal Research and at the GSA Presidential Address and Awards Ceremony at GSA Connects 2024, 22–26 September in Anaheim, California, USA.

GLADYS W. COLE MEMORIAL RESEARCH AWARD

Tyler Huth, Washington University, St. Louis

Tyler Huth will be honored at the GSA Quaternary Geology and Geomorphology Division Annual Awards Ceremony and at the Presidential Address and Awards Ceremony at GSA Connects 2024, 22–25 September in Anaheim, California, USA.

GSA FOUNDATION

Cushman Foundation for Foraminiferal Research
Est. 1950

John C. Frye Memorial Award in Environmental Geology

Did you know that John C. Frye was Executive Director of GSA from 1974 to 1982? He was a triple-threat geologist: researcher, teacher, administrator.

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.

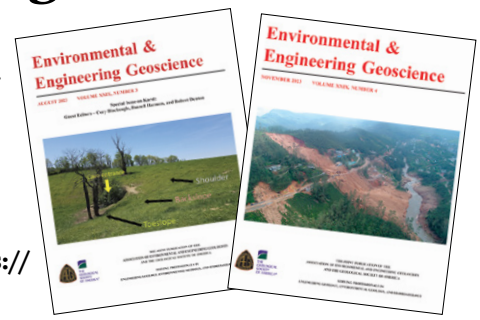
Authors **Gregory M. Guthrie, Gary A. Hastert,** and **Mary Hastings Puckett** will be honored at GSA Connects in Anaheim for their 2022 publication: Geological Survey of Alabama Bulletin 192, "An Aquifer Recharge Potential Model for Alabama."

GSA FOUNDATION

AASG
Association of American State Geologists

PUBLICATIONS

Submit Your Research to *Environmental & Engineering Geoscience*



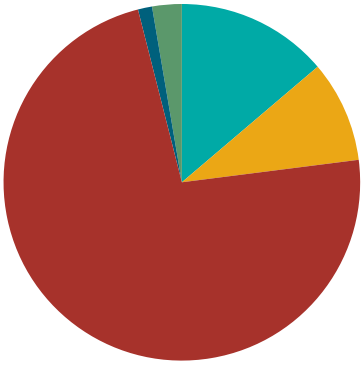
Environmental & Engineering Geoscience (*E&EG*) is a joint publication of the Association of Environmental & Engineering Geologists (AEG) and the Geological Society of America (GSA). This quarterly journal is hosted at GeoScienceWorld (**https://pubs.geoscienceworld.org/eeg**).

E&EG publishes peer-reviewed, high-quality original research, case studies, and technical notes (manuscripts of fewer than 10 pages) on environmental geology, engineering geology, engineering geophysics, geotechnical engineering, geomorphology, low-temperature geochemistry, applied hydrogeology, and near-surface processes.

For more information and to submit your paper, visit the *E&EG* manuscript submission platform at **www.editorialmanager.com/eeg/**. Be sure to read the Style Guide for Authors, which contains valuable information about the accepted topics and types of manuscripts, as well as how to prepare your manuscript for submission and what to expect from the review, revision, and publication processes.

Welcome New GSA Members!

Breakdown of members who joined between August 2023 and March 2024 and were approved by GSA Council in May 2024.



- **1198** Students
- **226** Professionals
- **151** Early Career Professionals
- **44** Affiliates
- **21** K–12 Teachers

POLICY

House Committee Advances Geothermal Energy Bills

During the House Committee on Natural Resources markup session on 16 April 2024, the committee ordered four bills related to geothermal energy regulations to be reported to the House of Representatives. These bills largely seek to streamline the permitting process for geothermal energy production projects on federal lands.

H.R. 7370, a bipartisan bill introduced by Rep. John Curtis (R-UT-3), would create a categorical exclusion for geothermal exploration drilling and well-field development, akin to oil and gas permitting. H.R. 7422, introduced by Rep. Alexandria Ocasio-Cortez (D-NY-14), amends the Geothermal Steam Act of 1970 to require holders of geothermal leases to reimburse the United States for costs related to application and permit processing, as well as inspection and monitoring of these sites.

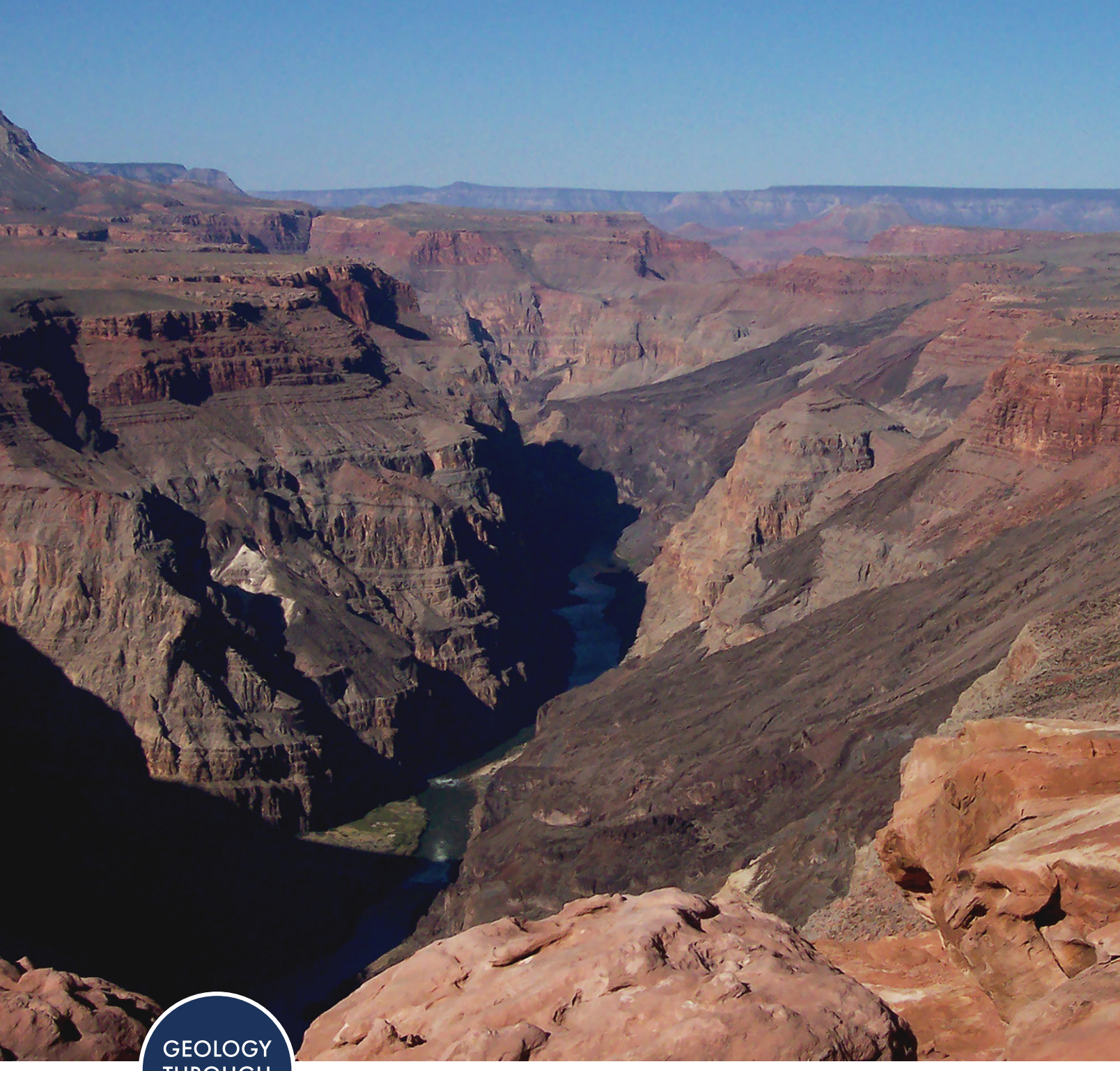
Read more at **https://bit.ly/44XjUBR**.

Member Memorials: Leaving a Lasting Legacy

Over the past 53 years, GSA has published nearly 1300 memorials to GSA members who have passed. These memorials are written by associates, friends, or relatives who wish to honor the lives and careers of these esteemed geoscientists.

Read these touching tributes at **www.geosociety.org/memorials.**

Interested in writing a memorial? Learn how at **https://tinyurl.com/2uwf9bvj.**



GEOLOGY THROUGH THE LENS

Go with the Flow

Basalt flows cascading into the North Rim of the Grand Canyon from the Uinkaret volcanic field. Vulcan's Throne, a basalt cinder cone formed in the Pleistocene (~73,000 years old), sits out of the frame as one of the sources of the lava that at one time dammed the Colorado River.

Photo credit: Sara R. Kimmig is a scientific researcher with the Institute of Applied Geosciences (AGW) at the Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany.

Want your photo to be featured in *GSA Today*? Email submissions to gsatoday@geosociety.org.

Remembering a Giant: Honoring the Legacy of Bob Fuchs (1929–2023)

In October 2023, the geological community lost a titan with the passing of Robert (Bob) Fuchs. Bob's remarkable contributions to both the Geological Society of America Foundation (GSAF) and the Geological Society of America (GSA) have left an indelible mark on our organizations and the field of geology in general. Dr. Robert Hatcher, Jr., GSA President 1993, remembered Bob thus: "I had many interactions with Bob Fuchs and had great respect for him as both a geologist and one who had the acumen to perform in the financial aspects of GSA and the GSAF. As GSA treasurer, Bob helped GSA through some difficult financial times and did a great job in helping keep the ship afloat."

Bob's dedication to GSAF was unparalleled. As one of the founding trustees of GSAF (1980–1982), he played a pivotal role in shaping its early years and guiding its growth, later serving a second term (1998–2003). His tenure as president of GSAF from 1993 to 1998 exemplified his commitment to advancing the organization's mission.

On the GSA side, Bob's leadership was equally impactful. Serving as treasurer of the Society during his tenure on Council from 1983 to 1992, Bob demonstrated his financial acumen and strategic vision. His involvement in key GSA committees, including the Investments Committee, the Development Committee, and the Committee on Long-Range Planning, further underscored his dedication to advancing the Society's goals.

BOB'S DEDICATION TO GSAF WAS UNPARALLELED. AS ONE OF THE FOUNDING TRUSTEES OF GSAF (1980–1982), HE PLAYED A PIVOTAL ROLE IN SHAPING ITS EARLY YEARS AND GUIDING ITS GROWTH.

Beyond his contributions to GSA, Bob's influence extended to the broader geological community. His executive role in the American Association of Petroleum Geologists (AAPG), a GSA Associated Society, showcased his passion for advancing the field of geology on multiple fronts.

Bob's legacy is also evident in his professional accomplishments as a petroleum geologist and business executive. With a solid foundation in geology from Cornell University (BA, 1951) and the University of Illinois (MS, 1952), Bob brought his expertise to field areas around the world. He led and managed successful resource exploration companies, leaving an indelible mark on the industry.

The GSAF of today stands proudly on the strong base built by Bob and his colleagues. Their vision and dedication set a high standard for the organization, ensuring that it has remained a trusted steward of generous gifts for over 44 years.

At present, GSAF manages over 120 active funds, continuously creating new opportunities for students in the geosciences as generous donors step forward with fresh ideas. The following four funds highlight the diverse range of support provided to students at all stages of their academic and professional journeys. The **Roy J. Shlemon Mentor Program in Applied Geoscience Fund** was designed to match students with GSA mentors who are practicing geoscientists; this connection occurs over lunch at GSA Section Meetings and students get guidance from the mentors regarding their career paths, opportunities, and challenges. The **Peter Birkeland Soil Geomorphology Award Fund** is attached to the GSA Quaternary Geology and Geomorphology Division; proceeds from the fund support students by providing research grants in the field of soil geomorphology. The **Christopher I. and Irene N. Chalokwu Travel Grants for Students in Africa Fund** supports undergrad and graduate students in Africa, working on African geology, to attend and present their work at GSA Connects. And the **Pete Mouginis-Mark Prize in Planetary Volcanology Fund,** just created in late 2023, provides monetary awards to both undergraduate and graduate students for their presentation at a GSA Connects meeting; the awards are managed and judged by the GSA Planetary Geology Division.

And of course, there are numerous funds that support awards recognizing outstanding scientists for their contributions to the geosciences and society. These awards serve as a testament to the values Bob Fuchs cherished—excellence, innovation, and service to the community. Regardless of the specific nature of any of the GSAF managed funds, all are intended to support the mission of GSA to ensure that we all succeed in developing and honoring the next generation of geoscientists. Please visit **https://gsa-foundation.org/** for more information on these and other funds managed by GSAF.

As we remember Bob's legacy, let us recommit ourselves to the mission he held: developing and honoring the next generation of geoscientists. His impact will continue to inspire and guide us for years to come.

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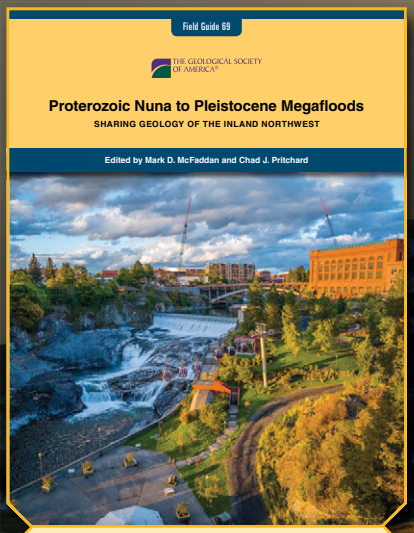

Proterozoic Nuna to Pleistocene Megafloods: Sharing Geology of the Inland Northwest

Edited by Mark D. McFaddan and Chad J. Pritchard

The Inland Pacific Northwest documents geologic processes from the Proterozoic to the present. This volume presents field guides from the GSA 2024 Joint Cordilleran and Rocky Mountain Section Meeting, exploring the genesis of bedrock in Idaho, Neoproterozoic development of supercontinents in Washington, Cambrian tectonic and biostratigraphic history of Washington, paleoecology of Miocene woodlands in Idaho, and the critical connection between Anthropocene activity and the past in Spokane. An overview of Pleistocene megaflood effects is shown through outcrops and drone images. Advances in understanding of the Columbia River Basalt Group are presented with an emphasis on volcanology and flood basalt evolution. The story of the Sevier orogeny accretionary margin is examined, as are the landmark studies of the Mesoproterozoic Belt Basin through a Missoula to Spokane transect.

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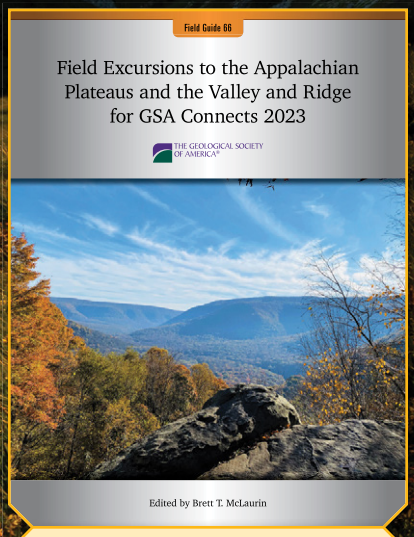

Field Excursions to the Appalachian Plateaus and the Valley and Ridge for GSA Connects 2023

Edited by Brett T. McLaurin

This volume offers guides for GSA Connects 2023 in Pittsburgh, Pennsylvania, USA, that cover a diverse range of geologic time and processes from the Paleozoic to Recent. Chapters address Paleozoic and Pleistocene glaciation; the interplay of geology and climate in shaping the landscape; and aspects of cultural geology, including Frank Lloyd Wright's Fallingwater and the setting of Youngstown, Ohio, USA.

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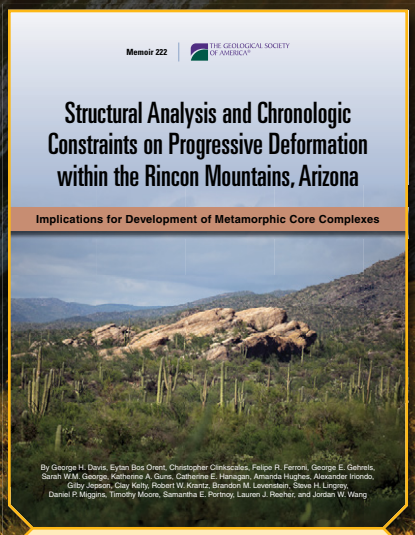

Structural Analysis and Chronologic Constraints on Progressive Deformation within the Rincon Mountains, Arizona: Implications for Development of Metamorphic Core Complexes

By G.H. Davis, E. Bos Orent, C. Clinkscales, F.R. Ferroni, et al.

The Catalina-Rincon metamorphic core complex (Tucson, Arizona, USA) is a type Cordilleran metamorphic core complex. This volume draws together decades of studies into the geology of the Rincons, and presents results of multi-scale mapping and structural analysis of the Catalina detachment zone, a superbly exposed crustal-scale shear zone. A structural model for progressive incremental deformation synthesizes geological observations into a kinematic/mechanical framework. To this is added the first substantive application of multi-method geochronology and thermochronology, results of which place the evolution of the detachment zone (from mylonitization to exhumation) into a narrow time window, i.e., from ca. 26 to 17 Ma.

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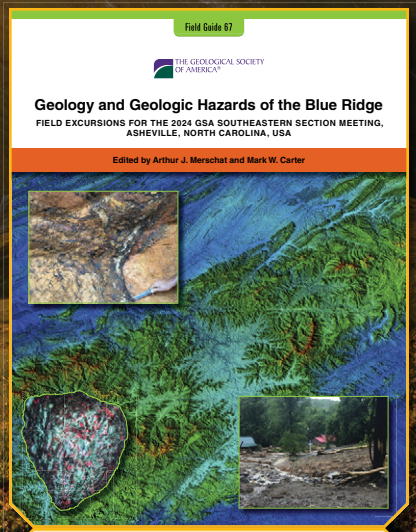

Geology and Geologic Hazards of the Blue Ridge: Field Excursions for the 2024 GSA Southeastern Section Meeting, Asheville, North Carolina, USA

Edited by Arthur J. Merschat and Mark W. Carter

The field guides in this volume explore facets of the geology of western North Carolina, USA. The trip to Buck Creek and Chunky Gal Mountain examines high-temperature mafic and ultramafic rocks interpreted to be part of a dismembered ophiolite thrust onto Laurentian crust during the Taconic orogeny. The second trip traverses rugged terrain along the Blue Ridge Escarpment from near the South Carolina state line to Hickory Nut Gorge just southeast of Asheville to examine rockfalls, rockslides, debris flows, and debris slides triggered by extreme rainfall events. The trip to Sparta, North Carolina, highlights the results of interdisciplinary studies following the 2020 M_w 5.1 earthquake.

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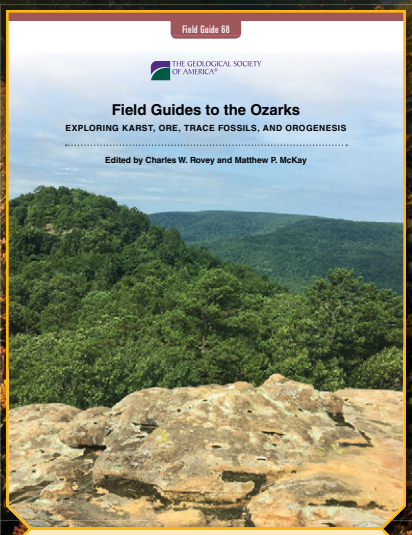

Field Guides to the Ozarks: Exploring Karst, Ore, Trace Fossils, and Orogenesis

Edited by Charles W. Rovey and Matthew P. McKay

The four guides in this volume are associated with the GSA 2024 Joint North-Central and South-Central Section Meeting in Springfield, Missouri, USA, near the heart of the Ozarks physiographic province. They explore urbanization in a karst terrane as well as the geology and genesis of the Viburnum Trend Mississippi Valley–type ore district. One chapter tackles the trace fossils and paleosalinity of the Northview Formation. The last chapter addresses the geology of the Ouachita Mountains and linkages to North American late Paleozoic orogenesis.

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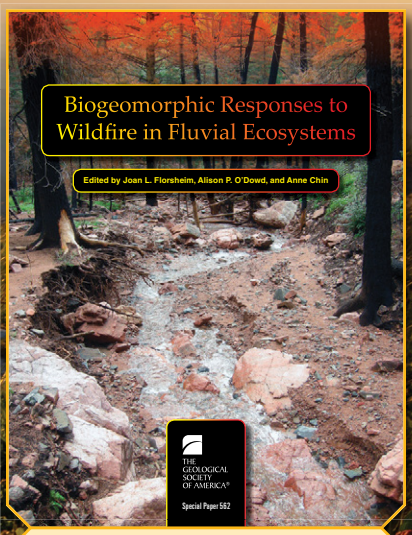

Biogeomorphic Responses to Wildfire in Fluvial Ecosystems

Edited by Joan L. Florsheim, Alison P. O'Dowd, and Anne Chin

Wildfire biogeomorphology is fundamental in understanding the dynamic processes of adjustment that occur after wildfires. This volume draws together interdisciplinary studies that highlight insights important to support heterogeneity, biodiversity, and resilience in fluvial ecosystems. Post-wildfire sediment pulses that change the elements of fluvial habitat may be transitory or long-lasting, for example, depending on variations in post-wildfire climate conditions. How biological processes and feedback alter post-wildfire geomorphic responses is also important to enhance ecosystem resilience. These syntheses point to greater emphasis on integrated approaches to advance strategies for ecosystem management toward conservation, restoration, and sustainable practices, in particular, to accommodate multiple postfire disturbance and recovery trajectories.

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