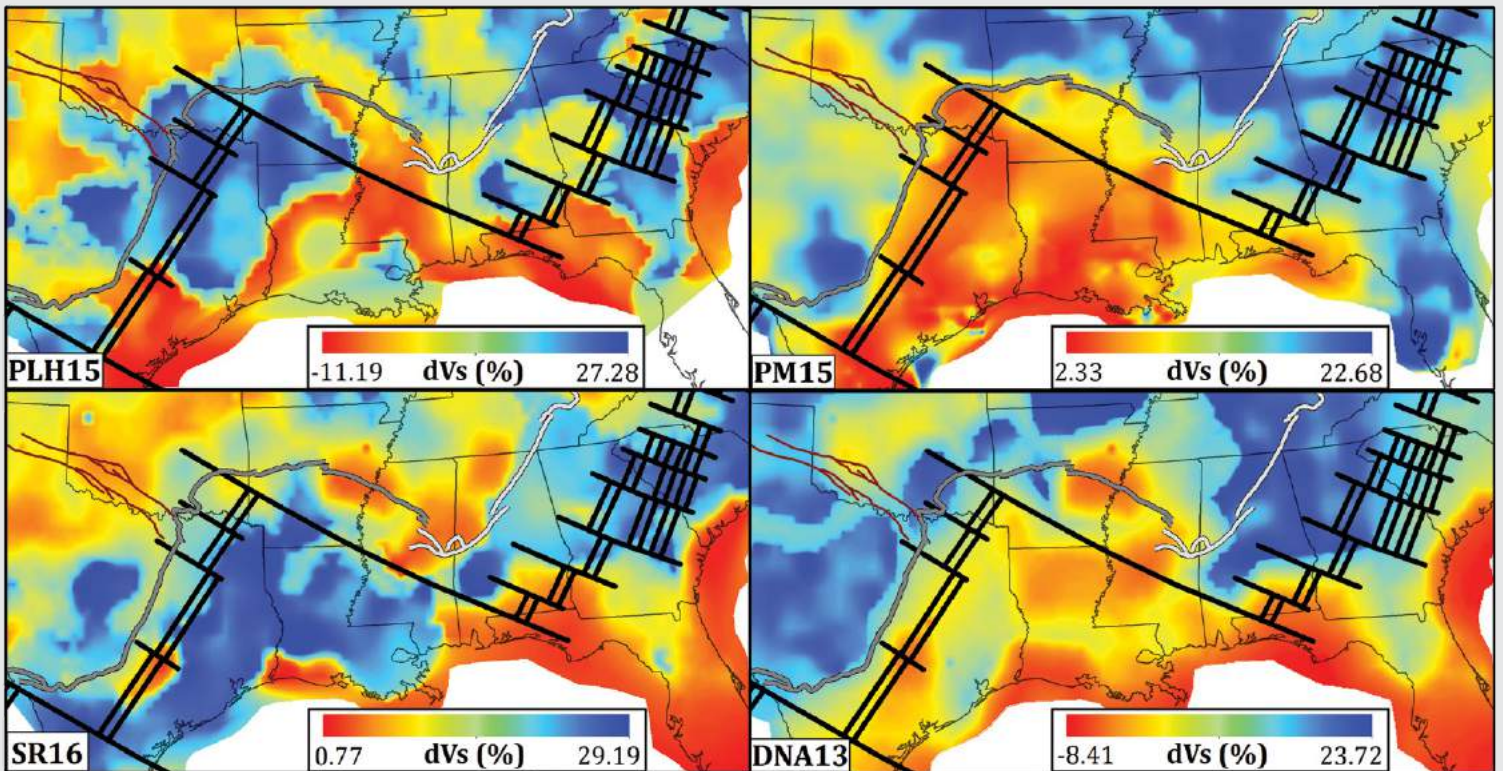


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Synoptic View of Lithospheric S-Wave Velocity Structure in the Southern United States: A Comparison of 3D Seismic Tomographic Models



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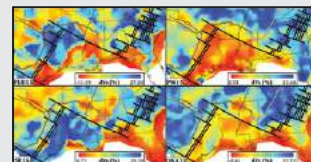
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SCIENCE

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Cover: Map view of four recent seismic shear wave models of the southern U.S. at 5 km above the Moho, plotted as perturbations with respect to the same average 1D model. Solid black lines represent a proposed rift and transform fault system. The southern U.S. has relatively low seismicity compared to western and northeastern North America, so few local earthquakes are available for imaging, and there have historically been few seismic stations to record distant earthquakes as well. These results were made possible by EarthScope's Transportable Array. See related article, p. 4–10.

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Synoptic View of Lithospheric S-Wave Velocity Structure in the Southern United States: A Comparison of 3D Seismic Tomographic Models

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ABSTRACT

The southern U.S. continental margin records a history spanning ca. 1.2 Ga, including two Wilson cycles. However, due to a thick sediment cover, the paucity of significant local seismicity, and, until recently, sparse instrumentation, details of this passive margin's tectonomagmatic evolution remain disputed. This paper compares recent S-wave tomography and crustal thickness models based on USArray data to help establish a framework for geodynamic interpretation. Large-scale patterns of crustal velocity anomalies, corresponding to major regional features such as the Ouachita orogenic front and the Precambrian margin, are generally consistent between the models. The spatial extent of smaller-scale tectonic features, such as the Sabine Uplift and Wiggins block, remains poorly resolved. An inverse relationship between crustal thickness and Bouguer gravity across the continental margin is observed. This model comparison highlights the need for additional P-wave tomography studies and targeted, higher density station deployments to better constrain tectonic features.

INTRODUCTION

The southern U.S. margin (Fig. 1) ranges from the stable Laurentia craton beneath Oklahoma to a stretched and thinned passive margin to oceanic lithosphere in the deep Gulf of Mexico, recording within it a geologic history that includes two complete Wilson cycles (Thomas, 2006). Due to its extensive hydrocarbon reserves, the southern U.S. has been the focus of intensive seismic exploration. However, until recently, studies of its deep structure trailed those of other U.S. continental margins. The result is that the tectonomagmatic

evolution of the southern U.S. margin remains poorly understood. The primary contributing factors to this status quo are (1) the presence of a thick sediment cover that obscures crustal structure through most of the region, (2) the paucity of significant local seismicity, and, until recently, (3) sparse seismic instrumentation in the region. Earthscope's USArray temporarily densified the set of broadband seismographs available for studies of the region's lithosphere (<http://www.usarray.org/researchers/obs/transportable>). Approximately 435 stations occupied a total of 1830 locations in the continental U.S., for two years each, at a nominal spacing of 70 km. In USArray's wake, there has been a surge in the number of continental-scale tomographic studies presenting snapshots of the compressional and shear wave velocities of the region's crust and upper mantle. Although the volume of seismic data available for studies of the region has increased dramatically and sampling of the subsurface has improved as well, the presence of a thick layer of sediments and relatively low levels of seismicity (with the exception of Oklahoma) continue to challenge efforts to image the lithosphere.

The collection of models for the southern U.S. region represents the state-of-the-art of seismic tomography: a broad range of approaches, the inclusion of various types of data, and different choices of solution schemes. These seismic velocity models can be used to study the mineralogical, compositional, and thermal state of the current crust and upper mantle, and thereby provide critical constraints on geodynamic models, as well as serving as a foundation to launch further investigations. They also showcase the various techniques and innovations of seismic

tomography. But, first, robust tectonic features must be identified. Well-constrained features should appear consistently across models. Differences between models could be due to (1) types of data incorporated, such as body wave arrival times, surface wave dispersion, receiver functions, or combinations of two or more data types; (2) measurement techniques employed; (3) the theoretical basis of the forward calculation, such as ray theory versus finite difference versus finite frequency; (4) the initial model and parameterization used; (5) regularization choices ("damping" and "smoothing" schemes and parameter values); and (6) inversion methods, such as gradient-based local minimization versus global optimization techniques.

The purpose of this study is to provide a systematic analysis of similarities and differences between recent shear wave tomographic models with respect to the lithospheric structure of the southern U.S. continental margin. Similar comparisons have been conducted for the western U.S. by Becker (2012) and Pavlis et al. (2012).

TECTONIC SETTING

The region that now comprises the southern U.S. has witnessed two complete Wilson cycles of orogeny and rifting (Fig. 1). These cycles can be chronologically split into four major tectonic events, beginning with the closing of an ocean and assembly of the Rodinia supercontinent.

1. The Mesoproterozoic Grenville orogeny along the southern margin of Laurentia is a result of continent-continent and continent-arc-continent collision, a result of which is the ca. 1.2 Ga granitic core of the Llano uplift (Fig. 1) (e.g., Culotta et al., 1992; Mosher et al., 2008).

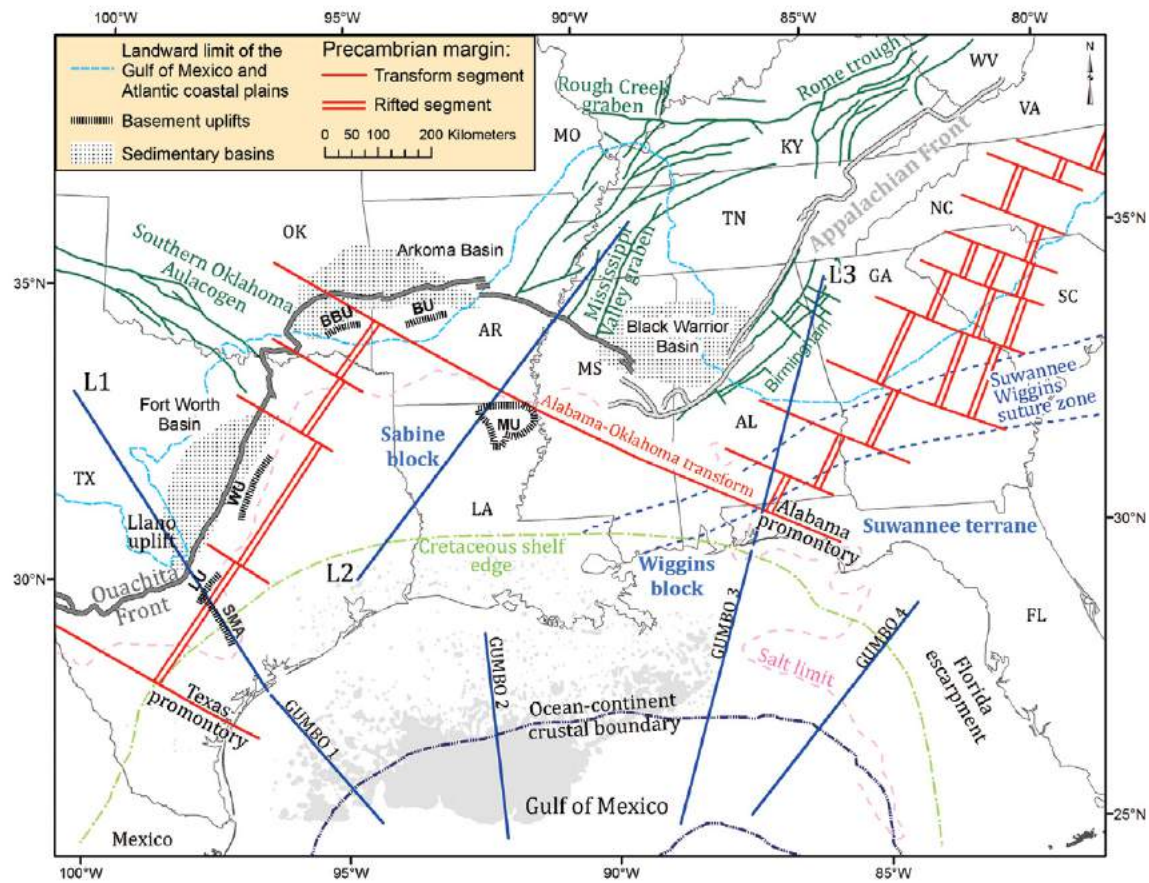


Figure 1. Tectonic map of the southern U.S. continental margin. Northern boundary of the Gulf of Mexico basin is represented by the Cretaceous shelf edge, adapted from Harry and Londono (2004). Locations of the GUMBO lines and the limit of oceanic crust in the Gulf of Mexico are from Christeson et al. (2014). Location of basinward salt limit is from Hudec et al. (2013). Louann salt province in the Gulf of Mexico, denoted by gray shading, is from Diegel et al. (1995). Locations of the Precambrian rift-transform margin, and other geologic structures and terranes, were derived from Thomas (1991, 2011). MU—Monroe Uplift; BU—Benton Uplift; BBU—Broken Bow Uplift; LU—Luling Uplift; WU—Waco Uplift; SMA—San Marcos Arch. L1 (onshore extension of GUMBO 1), L2, and L3 (onshore extension of GUMBO 3) are locations of cross-sectional profiles examined in Figures 4 and DR2 [see text footnote 1]. AL—Alabama; AR—Arkansas; LA—Louisiana; FL—Florida; GA—Georgia; KY—Kentucky; MO—Missouri; MS—Mississippi; NC—North Carolina; OK—Oklahoma; SC—South Carolina; TN—Tennessee; TX—Texas; VA—Virginia; WV—West Virginia.

2. The Grenville orogeny was followed by a Neoproterozoic rifting episode that resulted in the breakup of Rodinia and the subsequent opening of the Iapetus Ocean. The resulting passive margin, outlining the southeastern continental margin of Laurentia, is widely thought to be composed of a series of rift and transform segments (Hatcher et al., 1989; Thomas, 1991, 2011).
3. The closing of the Iapetus Ocean and the consequent assembly of the Pangaea supercontinent during the late Paleozoic included a collision between Laurentia, Gondwana, and enclosed island arcs, which resulted in the Ouachita orogeny. Contemporaneous terranes that participated in the Ouachita orogeny, the composition and origin of which are widely debated, are

associated with basement highs, such as the Sabine and Monroe uplifts in Louisiana and the Wiggins Arch in Alabama and Mississippi.

4. Finally, Late Triassic rifting episodes, during the breakup of Pangaea, led to the opening of the Atlantic Ocean and the Gulf of Mexico (Dickinson, 2009; Thomas, 2011; Huerta and Harry, 2012). Continental extension, followed by mid-Jurassic seafloor spreading, produced the current configuration of an arcuate wedge of oceanic crust beneath the deep Gulf of Mexico surrounded by transitional continental crust of variable width (Christeson et al., 2014).

Although there is general agreement on the sequence of tectonic events that formed the present-day crustal structure of the southern U.S. continental margin, several

details of its evolutionary history remain unresolved. These include, but are not limited to, the geometry of the Precambrian rift-transform margin, depth and spatial extent of the allochthonous terranes that participated in the Ouachita orogeny, and variations in continental stretching and magmatic activity across the northern Gulf of Mexico during Mesozoic rifting.

VELOCITY MODELS

The following eight models are compared in this study: DNA13 (Porritt et al., 2014); PLH15 (Porter et al., 2016); PM15 (Pollitz and Mooney, 2016); SR16 (Shen and Ritzwoller, 2016); SLK15 (Schmandt et al., 2015); NA07 (Bedle and van der Lee, 2009); SL14 (Schmandt and Lin, 2014); and YFCR14 (Yuan et al., 2014). Our comparison is limited to shear wave velocity (V_s)

TABLE 1. BRIEF SUMMARY OF VELOCITY MODELS THAT SPAN THE CRUST AND THE DATA SETS USED TO DETERMINE SHEAR WAVE VELOCITIES IN THE SOUTHERN U.S. REGION

Model acronym	Depth coverage	Vertical/lateral resolution*	Data set description	Modeling strategy
DNA13	0–1280 km	10 km; 0.5°	Relative teleseismic body wave travel times from 400 earthquakes	Finite frequency tomography
PLH15	0–300 km	1 km; 0.25°	Rayleigh wave phase velocities at short (8–40s) and long (20–150s) periods	Ambient noise tomography (Bensen et al., 2007) and wave gradiometry technique (Liu and Holt, 2015)
PM15	0–200 km	variable	Rayleigh wave phase velocity maps	“Nonplane wave” imaging method and inversion of Pollitz and Snoko (2010)
SR16	0–150 km	0.5 km; 0.25°	Rayleigh wave group and phase velocity, Rayleigh wave ellipticity (H/V) ratio, and receiver functions	Joint Bayesian Monte Carlo inversion technique of Shen et al. (2013)
SLK15	0–120 km	1 km; 0.2°	Rayleigh wave phase velocity, ellipticity (H/V ratio) measurements, and receiver functions	Rayleigh wave phase velocity and H/V ratio joint inversion method of Lin et al. (2014)

*Author estimates of resolution.

models because only a few P-wave velocity models span the southern U.S. Table 1 presents pertinent details about models that include the crust: SR16, DNA13, PLH15, PM15, and SLK15. The latter four models were generated via an iterative, linearized inversion algorithm. The global optimization technique used to generate SR16 makes it unique within our set of models, allowing for more formal estimates of uncertainties. An extended review of data types and methods used to generate all eight models examined in this study is presented in the GSA Data Repository¹; for further details readers are referred to the original publications.

CRUSTAL THICKNESS MODELS

Crustal thickness varies substantially across passive margins, including the northern Gulf of Mexico, and hence serves as an important parameter in reconstructing the tectonic evolution and pre-rift geometry of such regions (Reston and Morgan, 2004; Huismans and Beaumont,

2011; Sutra and Manatschal, 2012). To evaluate crustal thickness variations across the study region, four models were considered: SLK15, SR16, PnUS2016, and LITHO1.0. PnUS2016 (Buehler and Shearer, 2017) uses Pn arrivals, which are P waves that refract just below the Moho and are the first arrivals at regional distances, to constrain crustal thickness. PnUS2016 utilizes the seismic velocities from SR16 to map crustal thickness. LITHO1.0 (Pasyanos et al., 2014) is constructed by perturbing an initial model parameterized vertically as a series of geophysically identified layers, that is, a combination of the CRUST1.0 model (Laske et al., 2012) and the LLNL-G3D model (Simmons et al., 2012), to fit surface wave dispersion maps over the 5–40 mHz frequency band. Additionally, Moho depths from velocity models based on results from the 2010 GUMBO experiments, consisting of four long-offset seismic refraction profiles in the northern Gulf of Mexico (Fig. 1) (Eddy, 2014; Christeson et

al., 2014; Eddy et al., 2014; Van Avendonk et al., 2015), were digitized and added to the comparison. With 11–12-km station spacing and the incorporation of coincident seismic reflection data, crustal thickness estimates from the GUMBO lines have the highest resolution in this study.

DATA AND METHODS

Model comparisons with original figures are complicated by the different choices authors make with respect to presentation: color scales and ranges, color palettes, and perturbations with respect to a model average or a global standard, etc. Here we plot all models on the same scale, in terms of perturbations with respect to the average of all models, using a consistent color scale. Most models used in this study were downloaded from the IRIS Earth Model Collaboration (<http://ds.iris.edu/ds/products/emc/>); others were received via private correspondence. Using MATLAB, each velocity model was linearly interpolated onto a three-dimensional (3D) grid with $0.2^\circ \times 0.2^\circ$ uniform lateral spacing and 0.5-km depth spacing. For the southern U.S., the domain of interest was bounded latitudinally between 26° – 37° N and longitudinally between 78° – 102° W. Using the interpolated shear velocity models, the lateral root-mean-square velocity, V_{rms} , for each model was calculated and compiled to create average one-dimensional (1D) velocity individual models, and an average 1D model for the study area (SUSavg; Fig. 2A). This procedure was repeated to create

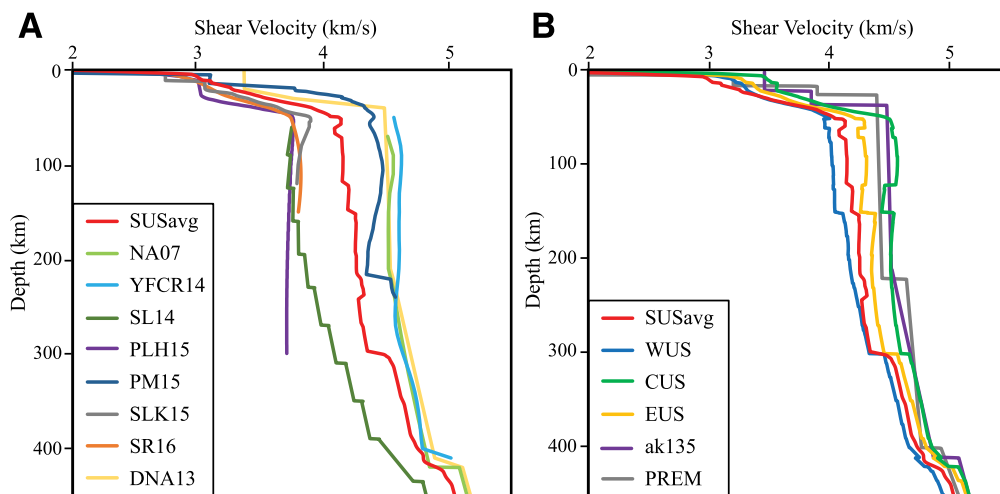


Figure 2. (A) RMS shear wave velocity computed from the eight velocity models spanning the southern U.S. (SUS), along with our average model (SUS_{avg}). (B) Comparison of SUS_{avg} with the average model for the other domains of the U.S.: WUS—Western U.S.; CUS—Central U.S.; and EUS—Eastern U.S., as well as the 1D reference models, ak135 and PREM.

¹GSA Data Repository item 2019099, an extended review of data types and methods used to generate all eight models examined in this study, is available online at www.geosociety.org/datarepository/2019.

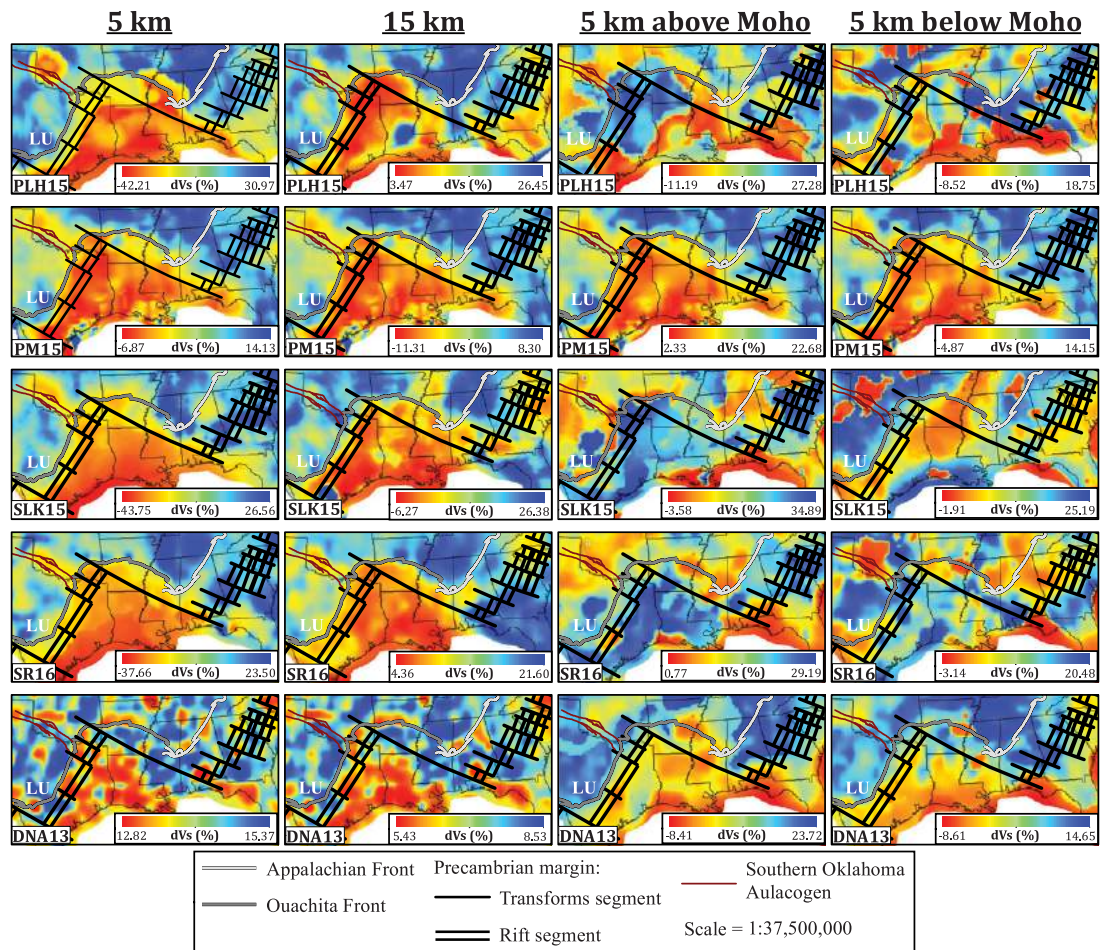


Figure 3. Depth slices of shear wave velocity perturbations of models PLH15, PM15, SLK15, SR16, and DNA13 (rows; top to bottom) at 5-km, 15-km, 5-km above the Moho, and 5-km below the Moho (columns; left to right), with LU (white) highlighting the location of the Llano Uplift.

similar 1D shear velocity models for the western U.S. (WUS), 28°–50° N by 102°–130° W; the central U.S. (CUS), 36°–50° N by 90°–102° W; and the eastern U.S. (EUS), 36°–50° N by 70°–90° W (Fig. 2B). In addition to the original data set, models by Schmandt and Humphreys (2010), James et al. (2011), Obrebski et al. (2011), and Chai et al. (2015) were used for the western U.S.; results from Chen et al. (2016) were used for the central U.S.; and the model by Savage et al. (2016) was used for the eastern U.S. Figure 3 displays model perturbations with respect to SUSavg at four depths: 5 km and 15 km plus 5 km above and 5 km below the Moho, with cooler colors (blue and green) representing faster regions and warmer colors (red and yellow) representing slower regions. Authors of each model indicate their best guess of the Moho depth throughout their model, so the last two panels represent different absolute depths for each model. Perturbations of models at

depths of 75 km, 150 km, 400 km, and 415 km are presented in the GSA Data Repository (see footnote 1).

RESULTS AND INTERPRETATIONS

Velocity Models for the Southern U.S. and Comparison to Other Regions

Root-mean-square velocities (V_{rms}) as a function of depth for the 3D models introduced above are shown in Figure 2A. The models fall into two distinct groupings: (1) PLH15, SLK15, SR16, and SL14 and (2) PM15, NA07, YFCR14, and DNA13, with as much as ~0.75 km/s difference between the two groups at upper mantle depths. The average of all models is shown in red (SUSavg). Comparable regional averages for the eastern, western, and central U.S. are shown in Figure 2B, along with the SUSavg, and the 1D reference models, ak135, and PREM.

All four average regional models (Fig. 2B) show the Moho at deeper depths than the reference 1D models. CUS has the highest velocities in the crust and upper mantle, which is consistent with the fact that it largely represents the cratonic core of Laurentia. Due to the presence of thick sedimentary basins in the southern U.S., SUSavg has the lowest velocities in the uppermost crust. In the upper mantle, however, the western U.S. (WUS) is the slowest of all models. Despite the lack of recent tectonism in the southern U.S. margin, the SUSavg model is more similar to the WUS model for the tectonically active western U.S. than any of the other models. Interestingly, Gulf Coast Q_0 -values (Q at 1 Hz) are also considerably lower than mid-continent values but similar to those in the western U.S., with boundaries that correspond to the Oklahoma-Alabama Transform and Ouachita thrust (Cramer, 2017). The

SUSavg model is also distinctly slower than the EUS model at all depths.

Geologic and Tectonic Patterns

In the upper crust, large-scale patterns of anomalies are consistent between all the models, matching the geometry of major features in the region; i.e., the Ouachita orogenic front and the Precambrian margin (Fig. 3 with locations in Fig. 1). Areas to the north of the Precambrian margin, which comprise cratonic continental crust, are faster at shallower depths than in the region enclosed between the Alabama-Oklahoma transform and Texas Rift segments, which is covered by thick sediments. This latter region displays a reversal in anomalies in three of the five models (PLH15, SR16, and SLK15) at depths around the Moho. This fast velocity zone could correspond to the base of the Sabine block, as proposed by Clift et al. (2018). The Southern Oklahoma Aulacogen is consistently represented in the models by a slow anomaly, although with varying size, geometry, and location. Conversely, the Llano Uplift is represented by a fast anomaly that is especially prominent at shallow depths. A large proportion of the seismic data used to generate the

models derives from the USArray's Transportable Array (TA), which has a nominal station spacing of ~70 km. The resulting relatively low horizontal resolution of these models makes it difficult to constrain effectively the exact geometry of small-scale geologic features in this region.

Amplitudes of anomalies vary significantly between models (note the different ranges in the color bars). There are at least two reasons to expect such variations. First, constraints imposed by data on model parameters usually range from overdetermined to underdetermined in tomography, so additional regularization is needed to stabilize the inversion numerically. Choices of values for regularization parameters are largely subjective and will therefore differ between authors. Second, only a portion of the travel time variance is explained by the 3D structure to be resolved. Other components of the variance include random and systematic errors in the data, inaccuracies in the model parameterization's representation of Earth, and oversimplifications in the physical theory that relates Earth's structure to travel time observations. Again, differences between individual choices will map

into differences in anomaly amplitudes, although patterns should be robust between techniques and parameterizations.

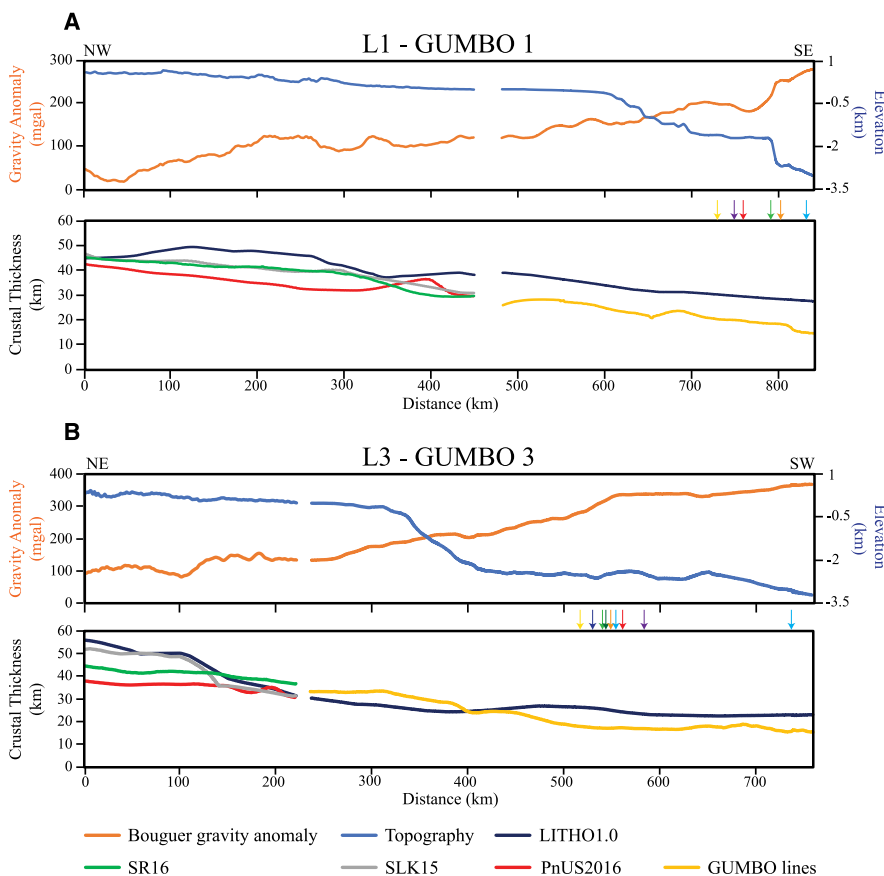
PM15 shows the least change in anomaly pattern from 5 km depth to 5 km below the Moho, reflecting its decreasing resolution with depth. DNA13 has a relatively small range of anomaly amplitudes at depths of 5 km and 15 km, with less consistent anomaly patterns compared to the other models (Fig. 2). This difference, with respect to other models, is likely due to the lack of surface wave data in DNA13.

Crustal Thickness Variations

Figure 4 shows the Bouguer gravity anomaly, topography, and crustal thickness along the L1-GUMBO1 and L3-GUMBO3 profiles (onshore extensions of GUMBO1 and GUMBO3; see locations in Fig. 1) based on the models discussed above. Similar profiles for L2, GUMBO2, and GUMBO4 are shown in GSA Data Repository Figure DR2 (see footnote 1). A general trend exhibiting crustal thinning toward the Gulf of Mexico basin, corresponding to a steady increase in Bouguer gravity anomalies, is consistent among the models. SLK15 and SR16 are consistent along the L1-GUMBO1 profile, while a crossover with PnUS2016 is observed around the 400-km profile distance, in the vicinity of the San Marcos Arch. The LITHO1.0 model has the largest deviations from the other models; due to its sparse parameterization, LITHO1.0 is not a reliable benchmark in regional studies.

There is a lack of general agreement between models concerning the landward limit of oceanic crust in the Gulf of Mexico (arrows in Fig. 4). Along GUMBO3, the majority of the proposed locations are coincident with a sharp increase in Bouguer gravity, which is not the case along GUMBO1 in the western Gulf of Mexico, where the large Louann salt province complicates geophysical interpretation.

Figure 4. Cross-sectional profiles of (A) the L1-GUMBO1 line and (B) the L3-GUMBO3 line (profile locations in Fig. 1), displaying lateral variation in Bouguer gravity anomaly, topography, and crustal thickness based on models SR16, SLK15, PnUS2016, and LITHO1.0, along with that from the GUMBO studies. The colored arrows represent the proposed location of the ocean-continent boundary from Marton and Buffler (1994) (yellow); Bird et al. (2005) (purple); Hudec et al. (2013) (light green); Christeson et al. (2014) (red); Pindell and Kennan (2009) (orange); Sandwell et al. (2014) (dark green); Pindell et al. (2014) (dark blue); and Sawyer et al. (1991) (light blue).



DISCUSSION AND CONCLUSIONS

The general consistency of large-scale anomaly patterns between models within the upper crust suggests that data selection is more important than model parameterization, forward modeling and inversion methods, and other methodological differences. However, disparities in anomaly amplitudes and the fact that the velocity models fall into two distinct groups (which is discussed in the GSA Data Repository [see footnote 1]) present a challenge for geodynamic interpretations of the margin, for understanding the margin's magmatic evolution, and for reconstructions of its pre-rift crustal and lithospheric thickness. It is clear that current 3D velocity models are unable to resolve the geometry of some smaller-scale tectonic features of this region, such as the spatial extent of the Wiggins block, or smaller arches (e.g., Luling, Waco, San Marcos), and to test the extent to which magmatic input facilitated rifting in the northern Gulf of Mexico.

This comparison serves as a baseline for future geological and geophysical investigations in the southern U.S. by providing a comprehensive assessment of currently available S-wave tomographic models. There is a need for additional P-wave tomography studies within this region which, given the lack of regional seismicity, is difficult but essential.

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Message from GSA President Donald I. Siegel



I invite you to GSA's 2019 Annual Meeting & Exposition on 22–25 September in Phoenix, Arizona, USA. This will be an inspiring meeting and I thank all the organizers and sponsors. It's the 100th anniversary of the iconic geologic wonder, Grand Canyon, becoming a U.S. National Park, and so having the meeting in Phoenix seems very appropriate indeed. We trust you will attend some of the 28 field trips, 200 topical sessions and specialty lectures, and six Pardee Symposia covering the gamut of our subdisciplines and dealing with geoscience topics ranging from applications to curiosity-driven research. Students and young professionals will have ample opportunities to take advantage of GSA mentoring and programs to get career advice and interview for jobs in our expanded recruitment programs. Visit the GSA GeoCareers Center to mingle, meet mentors and

potential employers, or just find a relaxing place to discuss the meeting with friends. Indulge in the smorgasbord of cuisines, museums, and entertainment venues in Phoenix.

I also encourage you to attend and celebrate GSA's awards ceremony. There, I will offer my vision of the geosciences in a future profoundly perturbed by climate disruption. Geoscientists will have great opportunities to contribute to how the world adapts to the changes as well as building out non-carbon and minimal carbon emission fuels. Multidisciplinary opportunities logically should abound for those geoscientists who choose to participate in these efforts.

Registration

Register today for best pricing!

Early registration deadline: 19 Aug., 11:59 p.m. MDT

Cancellation deadline: 26 Aug., 11:59 p.m. MDT

community.geosociety.org/gsa2019/attend/registration

Onsite Registration Hours

Sat., 21 Sept., 7 a.m.–7 p.m.

Sun., 22 Sept., 6:30 a.m.–6:30 p.m.

Mon.–Wed., 23–25 Sept., 7 a.m.–4:30 p.m.

Student Volunteers

Earn complimentary meeting registration when you volunteer to work at the meeting for ten hours, PLUS get an insider's view!

How to sign up:

1. Make sure you are a GSA student member in good standing. Not sure? Check your membership status at <https://rock.geosociety.org/membership/checkPaidThruDate.htm>;
2. Join GSA (if not already a member);
3. Sign up as a student volunteer at community.geosociety.org/gsa2019/attend/registration/volunteers; and
4. Register for the meeting at community.geosociety.org/gsa2019/attend/registration (click the "I am a Student Volunteer" button).

GSA Section Travel Grants

There is still time to apply! Application deadline: 19 Aug., 11:59 p.m. MDT
community.geosociety.org/gsa2019/connect/students-ecp/travel-grants

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GSA is committed to providing a professional environment at all of our events, welcoming people from diverse backgrounds and wide-ranging points of view. We are proud of our track record of providing **Respectful Inclusive Scientific Events** (RISE: ensuring a safe and welcoming environment for all participants), and look forward to hosting another great meeting. Attending GSA events is a privilege, and we expect all attendees of GSA events, including the Annual Meeting, to comply with our Events Code of Conduct in all venues at our meetings, including ancillary events, field trips, and official and unofficial social gatherings. To read the full document, go to <https://www.geosociety.org/GSA/Events/EventConductCode/GSA/Events/Conduct.aspx>.



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Learn more or get involved: <http://bit.ly/2q0iCCT>.

GeoCareers at the GSA Annual Meeting

Discover the diversity of careers available to you in the geosciences at GSA 2019.

- Résumé Library (deadline: 23 Aug.)
- Pre-Meeting Career Webinars (Aug. & Sept.)
- Geoscience Career Workshop (Sun.)
- Company Lightning Talks (Sun.)
- GeoCareers Panel Luncheon (Sun.)
- GeoCareers Center (Sun.–Wed.)
- Company Connection (Sun.–Wed.)
- Networking Events (Sun.–Wed.)
- Job Board (Sun.–Wed.)
- Résumé Clinic (Mon.–Wed.)



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Career Exploration Webinars

GeoCorps™ America participant Lauren Martz in Española, New Mexico, USA, collecting Eocene-age pronghorn fossils. Photo courtesy Lauren Martz.

Watch these two new webinars about careers in environmental consulting and paleontology. Learn about daily responsibilities and how best to prepare for a career in these fields.

Exploring a Career in the Environmental Industry:

<https://youtu.be/PXtwxWiUXg>

Exploring a Career in the Paleontology Field:

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Look for more career webinars in August and September.

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Katharine Hayhoe
Photo credit Artie Limmer,
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Michel T. Halbouty Distinguished Lecture

Climate Change: The Threat Multiplier

Tues., 24 Sept., 12:15–1:15 p.m., Phoenix Convention Center

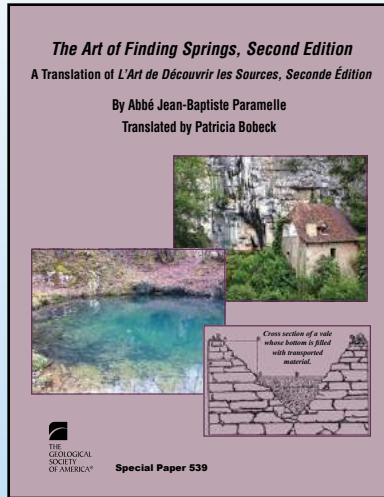
Katharine Hayhoe, 2019 Michel T. Halbouty Distinguished Lecturer

For generations, human civilization has been building a climate debt, borrowing from the stability of the future to power the economic growth of the present. Through fossil fuel combustion and land-use change we have disrupted the carbon cycle, overwhelming the influence of natural forcing on Earth's climate. As heat accumulates in the climate system, it drives long-term increases in temperature and sea level and supercharges hurricanes, heat waves, and heavy precipitation events. These changes in turn exacerbate poverty, hunger, disease, refugee crises, and more. Today, the choice is stark: Can we do what it takes to avoid widespread dangerous change? Or will we remain mired in inaction until the full cost of this unprecedented experiment we're conducting with our planet falls due?

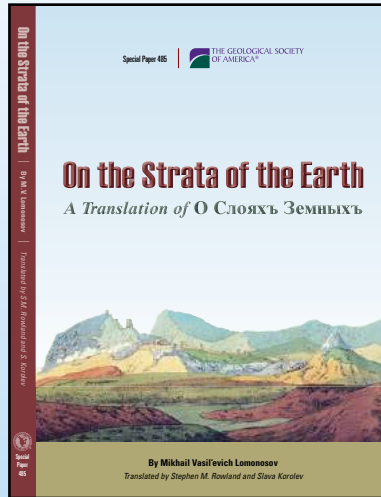
Katharine Hayhoe is an atmospheric scientist whose research focuses on developing and applying high-resolution climate projections to understand what climate change means for people and the natural environment. She is a professor and director of the Climate Science Center at Texas Tech University and has a B.Sc. in physics from the University of Toronto and an M.S. and Ph.D. in atmospheric science from the University of Illinois. Hayhoe has served as a lead author for the second, third, and fourth U.S. National Climate Assessments. She has also received the National Center for Science Education's Friend of the Planet Award, the American Geophysical Union's Climate Communication Prize, the Sierra Club's Distinguished Service Award, and the Stephen H. Schneider Climate Communication Award.

Evolution of the Geosciences

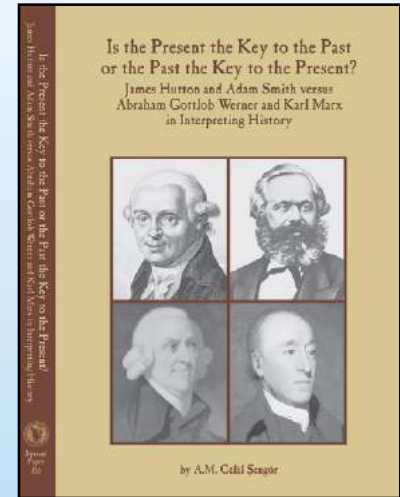
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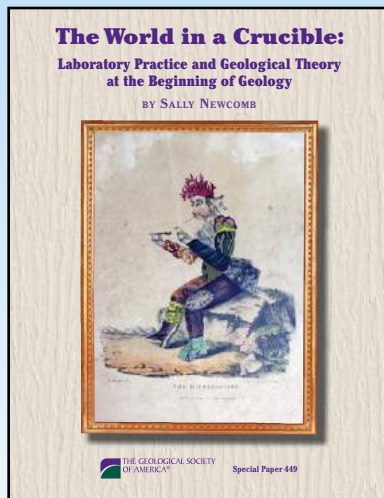
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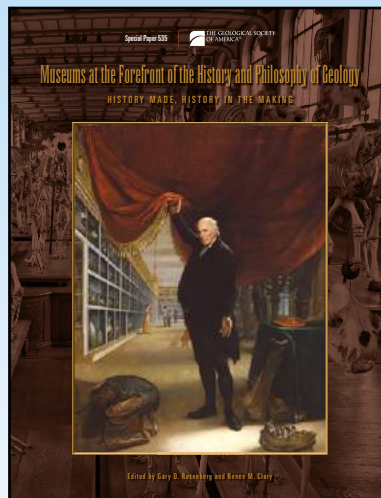
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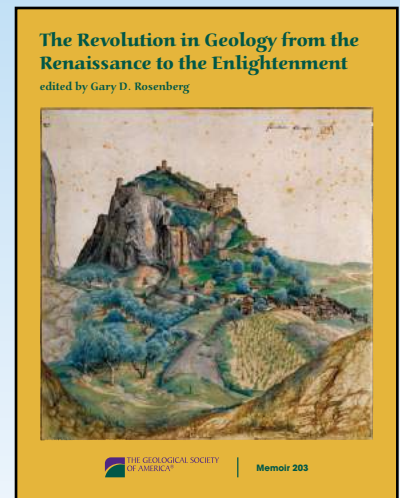
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Delaware Geological Survey, “Recommendation of Sea-Level Rise Planning Scenarios for Delaware: Technical Report, 2017.” Chair and principle author: **John Callahn**.

Other authors: SLR Technical Committee.

Honorary Fellows

Reynaldo Charrier Gonzalez, Universidad de Chile

Doerthe Tetzlaff, Leibniz Institute of Freshwater Ecology



Donald I. Siegel
GSA President

Honoring the Best at GSA 2019

Sunday, 22 Sept., noon–1:30 p.m.

Phoenix Convention Center, Phoenix, Arizona, USA.

Plan to attend GSA's Presidential Address & Awards Ceremony to honor GSA's awardees. GSA President Donald I. Siegel will deliver his address, “The Future of the Geosciences in the Twenty-First Century: A Speculation for Your Consideration.”

2019 GSA Scientific Division Primary Awards

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C. Blaine Cecil, U.S. Geological Survey

Israel C. Russell Award

Limnogeology Division

Thomas Johnson, University of Massachusetts Amherst

E.B. Burwell, Jr., Award

Engineering and Environmental Geology Division

Staley, D.M., Negri, J.A., Kean, J.W., Laber, J.L., Tillery, A.C., and Youberg, A.M., 2017, Prediction of spatially explicit rainfall intensity-duration thresholds for post-fire debris-flow generation in the western United States: *Geomorphology*, v. 278, p. 149–162, <https://doi.org/10.1016/j.geomorph.2016.10.019>.

Distinguished Geologic Career Award

Mineralogy, Geochemistry, Petrology, and Volcanology Division

Suzanne Mahlburg Kay, Cornell University

G.K. Gilbert Award

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Quaternary Geology and Geomorphology Division

Kristen L. Cook, Jens M. Turowski, and Niels Hovius, 2014, River gorge eradication by downstream sweep erosion: *Nature Geoscience*, v. 7, p. 682–686, <https://www.doi.org/10.1038/NCEO2224>.

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J. Douglas Walker, University of Kansas

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Sedimentary Geology Division

Marjorie Chan, University of Utah

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Structural Geology and Tectonics Division

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Paul J. Fox, Texas A&M University

Mary C. Rabbitt History of Geology Award

History and Philosophy of Geology Division

Naomi Oreskes, Harvard University

O.E. Meinzer Award

Hydrogeology Division

Bridget Scanlon, The University of Texas at Austin

2019 GSA Fellows

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 current GSA Fellows in recognition of their distinguished contributions to the geosciences. Learn more at www.geosociety.org/fellowship.

GSA's newly elected Fellows will be recognized at the GSA 2019 Annual Meeting Presidential Address & Awards Ceremony on 22 Sept. in Phoenix, Arizona, USA. We invite you to read some of what their nominators had to say:

Robert S. Anderson (University of Colorado): Recognized for developing rigorous, quantitative approaches to the study of earth-surface processes, and for making sustained and highly influential contributions across the entire spectrum of geomorphology. —John Pitlick

Suzanne P. Anderson (University of Colorado): For her contributions to our understanding of the geomorphology and geochemistry of the critical zone, her thoughtful teaching of undergraduates and graduate students, and her sustained leadership of the Boulder Creek Critical Zone Observatory. —David Dethier

Margaret E. Berry (U.S. Geological Survey): For her outstanding contributions in applied research through surficial geologic mapping throughout the western USA, Dr. Berry exemplifies the best in the great USGS tradition of detailed fieldwork to generate high-quality geologic maps for the American people. —Daniel Muhs

Emily E. Brodsky (University of California Santa Cruz): Dr. Brodsky is an innovative leader who has made foundational discoveries regarding the mechanics and hydrogeologic nature and behavior of fault systems, based on field, laboratory, and numerical studies. —Andrew Fisher

Roger Buick (University of Washington): Roger Buick has made significant contributions to our understanding of Precambrian geology, biology, oceans, and atmosphere. His contributions arise from forty years of geological field work in Archean and Proterozoic terrains, particularly in Australia, Greenland, South Africa, and Canada, prospecting for relics of the earliest life and its environment. —George Bergantz

Devon M. Burr (University of Tennessee): By combining laboratory experiments with mapping and analysis of spacecraft imagery and topography and of terrestrial analogues, Devon Burr's research on planetary geomorphology has enhanced understanding of fluvial and aeolian processes and landforms on Mars, Titan, and icy bodies. —Harry McSween

Wayne K. Camp (Anadarko Petroleum Corp.): Wayne Camp has contributed significantly to both geoscience and the profession through his many publications and editing of several proceedings from the conferences he has organized or helped

organize. He is recognized as a thought leader and global expert in unconventional resources by U.S. DOE, SEPM, SEG, and AAPG. —Richard Bishop

Susan M. Cashman (Humboldt State University): For fundamental contributions utilizing structural geology and tectonic analyses to unravel the plate tectonic evolution of the western margin of North America and its current deformational behavior, while providing exemplary mentoring of several generations of well-trained geologists and serving as a role model for women in science. —Kevin Furlong

Duane E. Champion (U.S. Geological Survey): Duane Champion's contributions in documenting and understanding geomagnetic secular variation, his application of paleomagnetic studies to volcano hazard assessment, and his stature in the field of paleomagnetism deserve recognition with election to fellowship in GSA. —Charles Bacon

Renee M. Clary (Mississippi State University): For the breadth and depth of her service to professional societies both international and domestic, especially for her service to the GSA History and Philosophy of Geology Division, and for distinguished public outreach and teaching of geology that have enhanced geoscience literacy in an underserved area of our nation. —Gary Rosenberg

David R. Cole (The Ohio State University): Professor Cole has been a global leader in geochemistry and mineralogy. His work includes seminal studies of subsurface fluid-mineral interactions. In addition, he has taken a leadership role in the understanding of carbon in the deep subsurface. —W. Berry Lyons

Craig M. dePolo (Nevada Bureau Mines & Geology): Dr. dePolo is widely recognized by his peers in the areas of neotectonics, paleoseismology, and earthquake preparedness. He has published numerous reports and maps at the NBMG and in peer-reviewed journals. Dr. dePolo has been a driving force for earthquake preparedness in Nevada for more than 30 years. —William Lund

Diane I. Doser (The University of Texas at El Paso): Dr. Doser has made numerous contributions to earthquake seismology including source mechanics in the western U.S., Alaska, New Zealand, and East Africa, and trying to understand the nature of earthquakes in different tectonic environments. —Kevin Mickus

Anne E. Egger (Central Washington University): Dr. Egger is an associate professor of geological sciences and science education at Central Washington University. Her contributions to geology have included the creation of exemplary educational resources, direction of professional development programs, leadership in a national professional organization (NAGT), and contributions to our discipline through the publication of research. —David McConnell

Susan C. Eriksson (Eriksson Associates LLC): Susan Eriksson deserves GSA fellowship for almost 40 years of service to the geologic profession through a career in industry and academia as a research scientist, faculty, administrator, and independent consultant. The hallmark of her career is selfless leadership in broadening participation through increasing equity and access particularly for underrepresented groups. —Shanaka de Silva

Carol Denison Frost (University of Wyoming): Carol Frost, a professor at the University of Wyoming, has served GSA through many capacities. She has been the director for earth sciences at NSF and has held a range of administrative positions at Wyoming. She has mentored many students, received several teaching awards, and coauthored a popular petrology textbook. —James Anderson

Robert R. Gaines (Pomona College): Dr. Robert Gaines helped revolutionize the study of Lagerstätten (exceptionally preserved fauna) through innovative integration of process-oriented sedimentology, geochemistry, taphonomy, and diagenesis. His work sheds light on the manner in which soft-bodied fauna are preserved and how these remarkable fossil sites have radically changed our understanding of early biological evolution. —Paul Myrow

Eduardo Garzanti (University of Milano–Bicocca): Elected to fellowship as a 2018 Honorary Fellow.

Daniel Goldman (University of Dayton): Dr. Goldman is a leading expert on graptolites and Paleozoic stratigraphy. His contributions span biogeography, biodiversity, and systematics of graptolites, modeling graptolite macroevolution, improving Ordovician time-scale resolution by integrating graptolite, conodont, and chitinozoan zonal schemes from clastic to carbonate systems, training geologists, and professional service to IUGS and GSA. —Stephen Leslie

Carlos M. González-León (Universidad Nacional Autónoma de México): The attainment of fellowship by Dr. Carlos M. González-León recognizes his important contributions to the fields of regional geology, stratigraphy, and tectonics of Sonora, Mexico, and adjoining regions, his training of Mexican geologists, and his service to the geological community of Sonora and all of Mexico. —Timothy Lawton

Karen B. Gran (University of Minnesota Duluth): Elected to fellowship as the 2018 Kirk Bryan awardee for research excellence.

Russell W. Graymer (U.S. Geological Survey): Russell W. Graymer is nominated for GSA fellowship for his fundamental contributions to the geology and tectonic evolution of the western Cordilleran margin in studies spanning the late Paleozoic to present, application of geology to earthquake and landslide hazard analysis, and effective science management and communication of geology to the public. —Robert McLaughlin

Steven J. Hageman (Appalachian State University): Steven J. Hageman merits GSA fellowship based on publication of his

internationally regarded research on fossil bryozoans with important implications for evolution, paleoecology, and sedimentology; dedicated teaching and mentoring of geology students with impacts beyond his institution; and service to the profession, particularly as editor of *Journal of Paleontology*. —Patricia Kelley

James W. Handschy (Indiana University): Jim is recognized for superb applied research in tectonics and sedimentation in over 100 basins and all tectonic environments in every continent except Antarctica while rising to the rank of Global Chief Geoscientist at ConocoPhillips; in addition, he has made important contributions to service and geoscience education, particularly field camps. —Virginia Sisson

Matthew T. Heizler (New Mexico Bureau of Geology): Dr. Matt Heizler has made significant research and educational contributions to earth science and our understanding of Earth's history through advancing argon geochronology, providing intercalibrations for multiple geochronological methods, advancing technological innovations in related dating methodology, and training to new generations of students in geochronological investigations. —Stephen Wells

Ingrid Henty (University of Michigan): For outstanding research on rapid climate change of the past 60 ky along the Pacific coasts of North America, detailing complex relationships between ocean chemistry, sea surface temperature, precipitation, and sediment delivery. The first researcher to identify Dansgaard/Oeschger cycles in the Pacific, correlating them with the Greenland ice core record. —John Barron

Mary S. Hubbard (Montana State University): Mary Hubbard pioneered the combined application of structural geology, metamorphic petrology, and thermochronology both to the Himalaya and to the deeply exhumed Norumbega strike-slip fault in Maine, and she has been a leader in helping geologists in developing countries escape the isolation intrinsic to their workplaces. —Peter Molnar

Gary Huckleberry: Elected to fellowship as the 2018 Rip Rapp Archaeological Geology awardee.

Robert B. Jacobson (U.S. Geological Survey): Robert Jacobson is nominated for publication of the results of his basic geologic research in geomorphology and his applied research that uses geomorphology toward policy and management of fluvial systems. —Joan Florsheim

Allan James (University of South Carolina): An active GSA member for 35 years, Dr. James published research on floodplain sedimentation, sediment budgets, Sierra Nevada Quaternary glaciation, water resources, urban flooding, and GIScience. His work on Gilbert's sediment wave, hydraulic mining, and legacy sediment has been widely read. He taught geomorphology and watershed science over three decades. —Anne Chin and Mary Ann Madej

Claudia C. Johnson (Indiana University): For her contributions to the understanding of past paleoenvironments and the links

between those environments and broader earth systems, in particular to our understanding of late Cretaceous events and threats of environmental changes to living reef communities. For her pedagogic research on methods of teaching complex geological concepts to students. —Chen Zhu

Michael R. Kaplan (Columbia University): Mike Kaplan began research on the glacial history of northeastern North America but soon refocused his research into the Southern Hemisphere where he has generated fundamental contributions that enhance understanding of changes in the cryosphere during the late Quaternary, mentored students, and developed strong collaborations with Chilean and Patagonian researchers. —Gifford Miller

Nazrul Khandaker (CUNY–York College): Elected to fellowship as a 2018 recipient of the GSA Distinguished Service Award.

David L. Kimbrough (San Diego State University): David Kimbrough has integrated geological fieldwork with geochronologic, geochemical, and isotopic analyses focused on the evolution of continental magmatic arcs, crustal exhumation, and basin evolution across four continents. His distinguished career is a model of scientific integrity and achievement coupled with a deep devotion to his students, department, university, and the geoscience community. —J. Mahoney

J. Steven Kite (West Virginia University): Dr. Kite has had an exemplary career as a geologist/physical geographer. In addition to a fine balance between research, teaching, and administration at WVU, during his 40 years as a GSA member he has held all QG&G Division elected positions. —David Mickelson

Jeffrey R. Knott (CSU Fullerton): For research on Late Cenozoic paleoenvironmental change and landscape evolution. In particular, contributions to the understanding of the Cenozoic evolution of Death Valley and the surrounding regions. In addition, for exceptional training of numerous undergraduate and graduate students in both pure and applied aspects of geology. —Lewis Owen

Nicole LaDue (Northern Illinois University): Elected to fellowship as the 2018 recipient of the Biggs Award for Excellence in Earth Science Teaching.

Laurel G. Larsen (University of California Berkeley): Elected to fellowship as the 2018 recipient of the Young Scientist Award (Donath Medal).

Norman S. Levine (College of Charleston): Dr. Norm Levine is a veritable “good-will ambassador” with infectious enthusiasm for increasing public understanding of geology. His commitment to applied science is reflected in the >50 master’s students that he has advised, all with projects designed to “make a difference” regarding specific earth hazard and environmental issues. —Richard Berg

Sarah L. Lewis (Oregon Dept. of Geology and Mineral Industries): Sarah Lewis is nominated for fellowship for her exceptional service to the geological community; administering

and contributing to multi-faceted geomorphic research programs; organizing ongoing activities that foster communication, education, and engagement; sustained service to the QG&G community; and helping students at all stages of their careers. —Gordon Grant

Joseph Licciardi (University of New Hampshire): Dr. Joseph M. Licciardi has made distinguished, sustained, and wide-ranging contributions to Quaternary geology and geomorphology that have significantly advanced our understanding of the geochronology of late Cenozoic glaciers and ice sheets and their implications for climate change. —Peter Clark

Shannon Mahan (U.S. Geological Survey): Shannon Mahan is internationally recognized for her applications of luminescence techniques to research questions related to earthquake activity, paleoclimate conditions, and geoarchaeological and Quaternary faunal records in the western U.S. and globally. Moreover, she is a strong advocate for the advancement of women in science and student education and training. —Tammy Rittenour

Paul J. McCarthy (University of Alaska): Dr. Paul McCarthy has a demonstrated career commitment to furthering the geosciences through technical publication and mentoring students. Because of his enthusiasm for his profession, Paul is a highly effective advocate for the geosciences not only to the scientific community but to the global lay community as well. —Anthony Fiorillo

Eric McDonald (Desert Research Institute): Prof. Eric McDonald is nominated as a Fellow of the GSA for research that elucidates the interplay of dust, hydrology, and climate during the evolution of desert landscapes and surfaces, for his application of these findings to questions of military importance, and for his training of professional geologists. —Eric Kirby

Jennifer C. McIntosh (University of Arizona): Jennifer McIntosh is a recognized leader in the field of hydrogeochemistry. Her work has greatly advanced our knowledge of basin fluids (gas and water) and critical zone interactions. She has led multiple cross-disciplinary research teams, prepared her undergraduate and graduate students well, and performed outstanding service for our community. —Anna Martini

Virginia T. McLemore (New Mexico Bureau of Geology): Dr. Virginia McLemore, throughout her career, has demonstrated a sustained record of distinguished contributions to the field of geoscience research. She has also been notably productive in applied geoscience and training of geologists. Her exceptional record makes her perfectly suited to receive the honor of GSA fellowship. —Nelia Dunbar

Jonathan S. Miller (San Jose State University): Jonathan Miller’s publications are important contributions to the understanding of magmatic processes, and he is an acknowledged expert in the use of the mineral zircon for study of silicic magmatism. His extraordinary service to GSA includes being chair of the Cordilleran Section and general chair for the 2005 Section Meeting. —Robert Miller

Thomas M. Missimer (Florida Gulf Coast University): Dr. Missimer's geologic work record makes him exceptionally qualified for GSA fellowship. He published 100+ peer-reviewed papers, authored, co-authored, or edited 11 books, and is *Groundwater* executive editor. He directed much applied research and was appointed by three Florida governors to positions, including Board of Professional Geologists chair. —Michael Sukop

David P. Moecher (University of Kentucky): Dr. David P. Moecher is nominated on the basis of significant and diverse contributions to understanding the metamorphic petrology of the lower crust, including the discovery of the extreme zircon fertility of Grenville-age granitoids. —Claudia Mora

Jeffrey M. Moore (NASA-Ames Research Center Space Sciences Division): Elected into fellowship as the 2018 recipient of the G.K. Gilbert Award.

Jean Morrison (Boston University): Dr. Jean Morrison, provost and chief academic officer at Boston University, is nominated for Fellowship in the Geological Society of America based on her academic leadership, her research into the role of fluids during metamorphism, and her mentorship of students. —John Valley

Jeffrey S. Munroe (Middlebury College): We recognize Dr. Jeff Munroe for an outstanding 20-year career excelling in both undergraduate education and Quaternary paleoclimate research. His work utilizes a wide range of techniques across many diverse landscapes. He has successfully integrated dozens of undergraduate students into cutting-edge, collaborative, field and laboratory research. —David West

Barbara P. Nash (University of Utah): In recognition of contributions to the study of the Earth through geochemical and mineralogical investigations of igneous rocks, characterization of new minerals formed only in the Anthropocene, correlation of volcanic Neogene and Quaternary ashes and obsidians, and LGBT advocacy and service to GSA. —Thure Cerling

Gerald Osborn (University of Calgary): Gerald (Jerry) David Osborn is a leading authority on the glacial history of the Canadian Rocky Mountains, demonstrated by his many seminal review papers in top peer-reviewed journals, along with his co-organizing of topical sessions for international conferences and co-editing of journal volumes on latest Pleistocene and Holocene glacial fluctuations. —P. Thompson Davis

Jeffrey G. Paine (The University of Texas Bureau of Economic Geology): Dr. Jeffrey Paine's research centers on application of near-surface geophysics to address environmental issues, including coastal erosion, groundwater salinization, and land subsidence. His work has substantially advanced the applications of electromagnetic induction to address environmental problems. His publications in these fields provide critical input to decision makers in managing natural hazards. —Bridget Scanlon

David S. Parks (Washington Dept. of Natural Resources): Elected into fellowship as the 2018 recipient of the E.B. Burwell Jr. Award.

Mark E. Patzkowsky (Pennsylvania State University): Professor Mark Patzkowsky has advanced the field of paleobiology by establishing ground rules for rigorous interpretation of the field and database paleontological record and applying them to further our understanding of extinction, radiation, function, and habitability of the whole ecosystem in deep time. —Timothy Bralower

Keith D. Putirka (California State University, Fresno): Dr. Putirka's distinguished career includes (1) a strong publication record; (2) becoming a world leader in the development, testing, and application of igneous thermobarometers; (3) revitalizing *American Mineralogist* while editor; and (4) GSA service through publications of field guides, running GSA meetings, and as a mentor to many GSA student members. —Scott Paterson

Eric J. Pyle (James Madison University): Eric Pyle is a nationally recognized teacher and researcher, and is a leading voice on geoscience education. He has been recognized for helping lead national efforts to update science education. He is also a leader in field-based education, pioneering assessment tools as well as statistical methods for field data collection. —Steven Whitmeyer

Sara L. Rathburn (Colorado State University): Nomination based on the categories of education, applied research, and professional service. Rathburn excels at undergraduate teaching, as recognized in multiple university teaching awards. Her research focuses on resources management on public lands, particularly hazard mitigation. GSA Division chair and panel member, along with numerous proposal and manuscript reviews. —Ellen Wohl

Maureen E. Raymo (Columbia University): For fundamental, groundbreaking, scientific contributions toward our understanding of the causes of Cenozoic climate change, our understanding of Earth's natural ice age climate variability and accompanying sea-level fluctuations, and outstanding science communication. —Howard Spero

Gary A. Robbins (University of Connecticut): Gary Robbins has developed seminal analytical solutions governing solute transport in groundwater and novel and important methods to characterize groundwater quality and aquifer material properties from monitoring wells. His work has advanced both the scientific understanding of contamination fate and transport as well as how best to remediate it in the future. —Donald Siegel

Brad S. Singer (University of Wisconsin-Madison): Brad Singer has made major contributions to a wide variety of important problems through the innovative use of radioisotope geochronology. He has also trained dozens of geologists at the undergraduate, graduate, and post-doc levels, and has tirelessly served as associate editor and science editor of *GSA Bulletin*. —Alan Carroll

Kathleen B. Springer (U.S. Geological Survey): Kathleen Springer is nominated for GSA fellowship for her work on the

stratigraphy, chronology, and paleohydrology of geologic deposits associated with springs and desert wetlands, establishing the geologic context of paleontologic resources, and acting as a lifelong geoscience educator and communicator, specializing in climate change and earthquake science messaging. —Jeff Pigati

George Thomas Stone: George Stone has a sustained record of distinguished contributions to the geosciences and to GSA, primarily through his teaching, public outreach, and organization of GSA topical sessions and Pardee Keynote Symposia. He has become one of the strongest voices in the geoscience community in raising the awareness of global warming. —Rolfe Mandel

Kathleen DeGraaff Surpless (Trinity University): Kathy's research on detrital zircons has provided important insights to provenance, paleotectonic, and paleogeographic models for sedimentary packages of the North American Cordillera. She has been a strong mentor and educator of undergraduates and has been greatly involved with GSA service activities. —Diane Smith

Glenn David Thackray (Idaho State University): Glenn Thackray has made insightful contributions to the understanding of glaciation and climate across the Pacific region. He also provided effective leadership for GSA's Quaternary Geology and Geomorphology Division, as well as for his academic department, and has been an inspirational mentor to many successful students over his career. —Grant Meyer

Ellen Thomas (Yale University): Ellen Thomas is being recognized with fellowship in the Geologic Society of America for her pioneering contributions to micropaleontology and paleoceanography, and distinguished editorial service to the journal *Geology*. —James Zachos

Woodrow B. Thompson (Maine Geological Survey): "Woody" Thompson is nominated to honor his continued surficial mapping in Maine and New England that documents the nature of the last glaciation. Woody has improved geology from continued reporting of results and leading numerous field trips. —Thomas Lowell

Jeffrey M. Trop (Bucknell University): Jeffrey Trop is a prominent researcher on the sedimentary/tectonic evolution of Alaska. He has also published on the geomorphology of alpine icy debris fans and paleoecology/environmental deposition of eurypterids and tetrapods in the Appalachians. Trop is an award-winning teacher who has mentored over 20 research students. —R. Craig Kochel

Bishal Upreti (University of Zambia): Elected into fellowship as a 2018 Honorary Fellow.

James W. Vallance (U.S. Geological Survey): Jim Vallance is nominated for his exceptional insights and accomplishments interpreting volcanic deposits in the U.S. and internationally, leading to substantial improvements in public safety and advances in the science of volcanology. —Thomas Sisson

Peter J. Vrolijk: Dr. Vrolijk's scientific contributions to structural geology and deep-earth fluid flow are integrative across multiple disciplines and have influenced the research of many others. He is exemplary in bridging industry and academia, in sharing results through publications, short courses, and mentoring students and colleagues, and in service to GSA and ODP/IODP. —Kevin Bohacs

Alan D. Wanamaker Jr. (Iowa State University): Alan Wanamaker is an outstanding geoscientist, educator, and community member as evidenced by his meaningful contributions to paleoclimate research, mentorship of his students, and efforts in organization of GSA meetings. —David Gillikin

Rich Whittecar (Old Dominion University): Rich Whittecar has conducted fundamental research on landscape evolution of the southern Appalachian provinces and on groundwater flow in wetlands. After 40 years of teaching geology, Rich has a legacy of professional geologists working across the United States. —Nora Noffke

Hong Yang (Bryant University): We nominate Dr. Hong Yang for his creative contribution to understanding the evolution of terrestrial ecosystems, for his outstanding accomplishments in developing and using molecular and isotopic proxies to investigate the impacts of past climate changes on terrestrial plant communities, and for his extraordinary commitment to training of young scientists. —Yang Wang

Pinar O. Yilmaz (ExxonMobil Exploration Company): Pinar Yilmaz—advocate for global geological collaboration—has organized 40–50 international forums bringing science and leadership together to educate professionals and students. She contributes to programs in GSA, AAPG, GeoConferences, IPTC, EAGE, and SEG and is dedicated to providing support to students as she manages the interface between professional societies and ExxonMobil. —Robbie Gries

Adolph Yonkee: Adolph Yonkee's seminal work on the tectonic evolution of the northern and southern Cordillera provides a better understanding of fold-thrust belts and foreland uplifts, fluid-rock interaction and deformation, geologic hazards, martian weathering processes, and Snowball Earth. He is also an outstanding teacher, mentor, and colleague. —Carol Dehler

Fellowship nominations are submitted in the following categories:

- Publication of the results of geologic research;
- Applied research;
- Training of geologists;
- Administration of geological programs;
- Public awareness of geology;
- Professional organizations; and
- Editorial, bibliographic, and library responsibilities.

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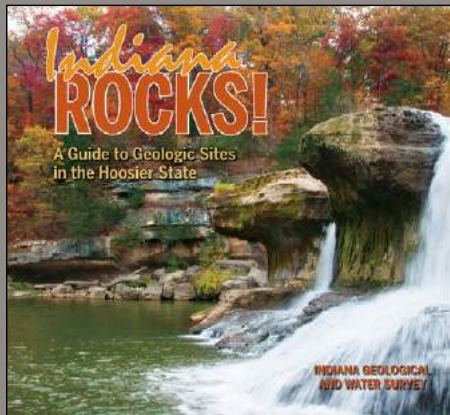
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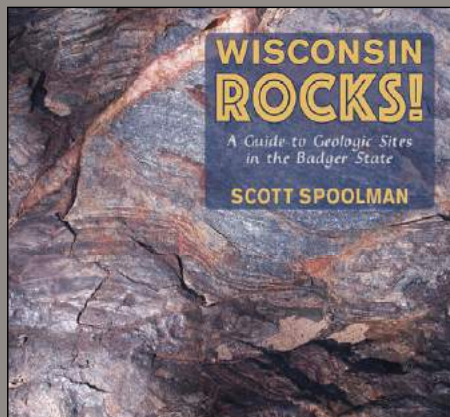
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GSA Celebrates Member Milestone Anniversaries

GSA salutes the following members and Fellows on their **25-year** membership anniversaries.
We appreciate their dedication and loyalty to GSA. Asterisks (*) indicate GSA Fellows.

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Sam Earman	Phillip Larson	Peter B. Sak	Jerome E. Zaykoski
Carl W. Ebeling	George V. Last	Elias Samankassou	Ronald P. Zurawski
John M. Eiler*	Jeanette H. Leete	William E. Sanford	
William S. Elliott Jr.	Michael B. Leite	Juergen Schieber	

GSA Celebrates Member Milestone Anniversaries

GSA salutes the following members and Fellows on their **50-year** membership anniversaries. We appreciate their dedication and loyalty to GSA. Asterisks (*) indicate GSA Fellows. For a list of GSA Fellows who have surpassed the 50-year mark, go to <https://rock.geosociety.org/membership/50YearFellows.asp>.

William H. Abbott
John B. Anderson*
Thomas F. Anderson*
Earl William Behrens*
Donald D. Biederman
Kelsey L. Boltz
Emanuel G. Bombolakis
John C. Bowman Jr.
Edwin H. Brown*
Michael E. Brownfield
Caryl Edward Buchwald*
M. Raymond Buyce
Stephen I. Chazen
Eric N. Clausen
Walter Coppinger
Darrel S. Cowan*
John William Creasy
Pierre-Michel Crepeau
Charles G. Cunningham*
Norbert E. Cygan*
Heinz H. Damberger*
Rene A. De Hon*
Edmond G. Deal*

Patricia Wood Dickerson*
Terry Engelder*
Murray Felsher*
Robert H. Fickies*
Neil J. Gilbert*
Paul Goldberg*
Jonathan H. Goodwin*
Joseph L. Graf Jr.
Harry J. Graff
Robert C. Greene
Edward S. Grew*
Robbie R. Gries*
R.H. Groshong Jr.*
Larry E. Hall
Albert C. Hine
David A. Holmes
Dolores Mary Hughes
Christoph W. Hulbe
Donald W. Hyndman*
Michael S. Johnson*
Ralph O. Kehle*
Harley J. Knebel*
James E. Lacey

Edwin E. Larson*
Robert I. Lewellen
Stephen T. Lofthouse
Richard B. Loring
Paul C. Lyons*
Ian G. Macintyre*
Charles F. Mansfield III
Walter V. Maresch*
Robert K. Mark
Michael S. Miller
Peter H. Molnar*
Bruce Franklin Molnia*
James T. Neal*
Robert S. Nelson*
John L. Nold
Richard R. Parizek*
Tom S. Patty
Michael T. Roberts
Richard E.A. Robertson*
C. Eugene Ronco
Peter R. Rose*
William I. Rose*
Robert T. Ryder

Richard A. Schweickert
Vernon P. Scott
Roy J. Shlemon*
Eli A. Silver*
Edvardas K. Simonis
Charles S. Smith
Eugene I. Smith*
Minze Stuver*
M. Ray Thomasson*
Thomas L. Thompson
Dennis F. Unites
Kenneth J. Van Dellen
Stephen P. Vonder Haar
Jesse R. Wagner
Roger H. Wallis
Ronald R. West*
Robert C. Whisonant*
John W. Williams*
Larry D. Woodfork*
Richard E. Wright

2019 GSA Research Grant Recipients



The 2019 GSA Committee on Research Grants awarded US\$812,000 to 392 graduate students (~52% of the 748 who applied), with an average grant of US\$2071. The committee also selected 10 alternate candidates in the event that any grantees return all or part of their funds due to a change in their research project or receipt of funds from another source. The GSA Graduate Student Research Grant Program is funded by GSA, the GSA Foundation, GSA Divisions, and the National Science Foundation (award no. 1712071).

Committee members: William Ian Ridley, Lyndsay B. Ball, James V. Browning, William C. Burton, Cathy J. Busby, Gwen M. Daley, Timothy M. Demko, Stephanie DeSisto, Besim Dragovic, James E. Faulds, Julie C. Fosdick, David L. Fox, Josh C. Galster, Andrew M. Gombos, Jr., Steven J. Hageman, Andrea

D. Hawkes, Ellen K. Herman, Miquela Ingalls, Alexandra R. Isern, Brian R. Jicha, Rebecca A. Lange, Andrew Leier, Michelle M. Lorah, Peter J. Modreski, Nathan A. Niemi, Bryan A. Oakley, Cindy Palinkas, Stephen J. Piercey, Christopher J. Potter, William Ian Ridley, Michael R. Rosen, Randall J. Schaeztl, Jennifer A. Thomson, Ben van der Pluijm, Gary S. Weissmann, Mark A. Wilson, and James D. Wright.

Alternate committee members: Zeynep Oner Baran, Whitney M. Behr, John Bershaw, Mark J. Caddick, Michelle L. Coombs, Martin B. Goldhaber, Judith L. Hannah, Qinhong Hu, Sharon L. Kanfoush, Gregory Nadon, Mohammad Hassan Rezaie-Boroon, and Ellen Thomas.

The following awards will be presented at the 2019 GSA Annual Meeting & Exposition in Phoenix, Arizona, USA.

2019 Outstanding Mentions

(Proposals having exceptional merit in conception and presentation.)

Adele Conde
University of Vermont

Trista Mckenzie
University of Hawaii at Mānoa

Christopher Svoboda
Michigan State University

Malcolm Hodgskiss
Stanford University

Catherine Ross
The University of Texas at Austin

Chia Pei Teoh
Texas A&M University

Iva Lihter
University of British Columbia Okanagan

Claire Ruggles
Iowa State University

Sara Warix
Idaho State University

Corrie Lucchesi
Northern Illinois University

2019 ExxonMobil/GSA Student Geoscience Grants

ExxonMobil recognized 10 of the top 30 GSA student research grant proposals with a grant of US\$5,000 each.

Kyle Henderson
McGill University

Claire Ruggles
Iowa State University

Liannie Velazquez Santana
Miami University

Siyun Liu
University of Kansas

Ben Suranovic
University of Alaska Anchorage

Sara Warix
Idaho State University

Scott Pantaleone
University of Alaska Anchorage

Logan Tegler
Massachusetts Institute of Technology

Joshua Zimmt
University of California Berkeley

Catherine Ross
The University of Texas at Austin



2019 Specialized Awards



Sponsored by the GSA Foundation

Michele Aldrich History and Philosophy of Geology Student Research Award

Joseph Moffitt, Mississippi State University

The Michele Aldrich History and Philosophy of Geology Student Research Award Fund supports research grants through the History and Philosophy of Geology Division for students who conduct historical research within the geosciences. Preference will be given first to doctoral then master's-level students. Graduates who received their Ph.D. in the previous five years may also be considered. The recipient is determined by the GSA History and Philosophy of Geology Division.

Marland Pratt Billings and Katharine Fowler-Billings Research Award

Ian Hillenbrand, University of Massachusetts Amherst

Joshua Zimmt, University of California Berkeley

The Marland Pratt Billings and Katharine Fowler-Billings Research Award encourages and promotes geological fieldwork and related research in New England and adjacent regions.

John A. Black Award

Katya Jay, Oregon State University

The John A. Black Award supports graduate student field-based research on coastal processes. All field-based coastal geomorphology research should be located in the United States, Puerto Rico, or Canada. In the event there are no worthy graduate student field-based research projects in coastal geomorphology, the award may be used to support graduate student field-based research in volcanology. All field-based volcanology research should be located in the United States, New Zealand, or Iceland.

Gretchen L. Blechschmidt Award

Rebecca Smith, University of Massachusetts Amherst

The Gretchen Louise Blechschmidt Award Fund was established for women in the geological sciences who have an interest in achieving a Ph.D. in the fields of biostratigraphy and/or paleoceanography, sequence stratigraphy analysis, particularly in conjunction with research in deep-sea sedimentology, and a career in academic research.

Ian S.E. Carmichael Research Award

Allison Pease, University of Michigan

The Ian S.E. Carmichael Research Award supports graduate student research and related activities in the fields of igneous petrology and volcanology. The recipient is determined by the GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division.

Allan V. Cox Research Award

Ogochukwu Ozotta, University of North Dakota

The Allan V. Cox Research Award supports research grants in geophysics. The recipient is determined by the GSA Geophysics and Geodynamics Division.

John T. Dillon Alaska Research Award

Joseph Biasi, California Institute of Technology

Caitlin Meadows, The University of Chicago

Scott Pantaleone, University of Alaska Anchorage

Ben Suranovic, University of Alaska Anchorage

Matthew Trembath, University of Iowa

The John T. Dillon Alaska Research Award honors the memory of Dr. Dillon, who was particularly noted for his radiometric age-dating work in the Brooks Range, Alaska, USA. Two areas that serve as guidelines for selection of the award are field-based studies dealing with the structural and tectonic development of Alaska and studies that include some aspect of geochronology (either paleontologic or radiometric) to provide new age control for significant rock units in Alaska.

Robert K. Fahnestock Award

Ian Armstrong, Indiana University Bloomington

The Robert K. Fahnestock Award honors the memory of Dr. Fahnestock, a former member of the Research Grants Committee, who died indirectly as a result of service on the committee. The grant is awarded for the best proposal in sediment transport or related aspects of fluvial geomorphology, Dr. Fahnestock's field.

Gould Research Grant

Alan Seltzer, University of California San Diego–Scripps Institution of Oceanography

Michelle Valkanas, Duquesne University

The Gould Research Grant supports graduate student research in the geosciences.

Robert D. Hatcher Research Award

Michael Say, University of Nevada, Reno

The Robert D. Hatcher Research Award supports field-based research and geologic mapping through an annual award to an outstanding graduate student in the earth sciences to conduct research for that student's master's thesis or Ph.D. dissertation. Preference may be given to students working in the Appalachian orogeny broadly construed, but it is not restricted to this region.

William B. & Dorothy Heroy Research Grant

Michael Frothingham, University of Colorado Boulder

Megan Saalfeld, Montana State University

Christina Seeger, Western Washington University

Rachelle Turnier, University of Wisconsin–Madison

The William B. & Dorothy Heroy Research Grant supports graduate student research in the geosciences.

John W. Hess Research Grant

Jonathan Wilson, University of Kentucky

The John W. Hess Research Grant in Karst Research Studies supports student research involving any aspect of cave and karst studies aimed at providing improved understanding of how caves and karst work, including how these resources can be better managed. The recipient is determined by the GSA Karst Division.

Roscoe G. Jackson II Award

Adrian Broz, University of Oregon

The Roscoe G. Jackson II Award funds one recipient per year in the field of sedimentology.

Lipman Research Award

Kirkland Broadwell, Virginia Polytechnic Institute and State University

Richard Chow, Dalhousie University

Seth Coursey, Northern Illinois University

Rose Gallo, Northern Arizona University

Brenna Halverson, University of Missouri Columbia

Coleman Hiatt, Utah State University

Jordan Lubbers, Oregon State University

Alex Maruszczak, University of South Florida

Suzanne Mulligan, University of Nevada, Las Vegas

Tyler Schlieder, University of California Davis

Jesse Scholpp, Utah State University

Marie Takach, Oregon State University

Jennifer Thines, University of Iowa

Karissa Vermillion, New Mexico State University

Dani Vitarelli, New Mexico State University

The Lipman Research Fund was established in 1993 and is supported by gifts from the Howard and Jean Lipman Foundation. The purpose of the fund is to promote and support student research grants in volcanology and petrology. The president of the Lipman Foundation, Peter W. Lipman, was the recipient of a GSA research grant in 1965. The recipient is determined by the GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division.

John T. and Carol G. McGill Award

Joel Leonard, Arizona State University

Eyal Marder, Colorado State University

Seth Williams, University of Washington

Nicholas Wondolowski, University of Pittsburgh

The John T. and Carol G. McGill Award, which is in memory of John T. McGill, supports graduate student scholarships and research grants in engineering geology and geomorphology.

On To the Future (OTF) Research Grant

Elisandra Hernandez, Missouri University of Science and Technology

The purpose of this grant is to recognize an excellent student research proposal and connect the student to GSA's On To the Future (OTF) program. OTF is a grassroots initiative that

addresses GSA's overall strategic commitment to building a diverse geoscience community by engaging groups traditionally underrepresented in the geosciences. The student chosen for this grant will be invited to participate in the On To the Future program and receive a partial travel award, full meeting registration, and be recognized at the Diversity in the Geosciences Reception at the GSA Annual Meeting.

Bruce L. "Biff" Reed Scholarship Award

Michael Hudak, University of Oregon

The Bruce L. "Biff" Reed Scholarship Fund was established to provide research grants to graduate students pursuing studies in the tectonic and magmatic evolution of Alaska primarily, and also can fund other geologic research.

Charles A. & June R.P. Ross Research Award

Troy Ferland, Pennsylvania State University

Scarlette Hsia, The University of Texas at Austin

Elena Robakiewicz, University of Connecticut

Jesus Robles, California State University, Bakersfield

Logan Tegler, Massachusetts Institute of Technology

Tyler Winkler, Texas A&M University

Boyang Zhao, University of Massachusetts Amherst

The Charles A. & June R.P. Ross Research Fund is awarded to support research projects for graduate students, post-graduate students, and post-doctorate researchers in the fields of biostratigraphy (including, but not limited to, fossil age dating and the study of evolutionary faunal successions), stratigraphy and stratigraphic correlation, paleogeography and paleobiogeography, interpreting past environments of deposition and their biological significance, and the integration of these research areas into better global understanding of (1) past plate motions (plate tectonics and sea-floor spreading); (2) past sea-level events, including their identification and ages; and/or (3) climate changes and effects of those climate changes on Earth's inhabitants through geologic time. There should be, over time, a balance of money among the awards across these various subject subfield categories depending on the merit of the annual project proposals.

Alexander Sisson Research Award

Maximilian Barczok, Kent State University

Family members of the Alexander Sisson family established a fund in his memory to promote and support research for students pursuing studies in Alaska and the Caribbean.

Parke D. Snavely, Jr., Cascadia Research Award

Katherine Lang, Western Washington University

The Parke D. Snavely, Jr., Cascadia Research Award Fund provides support for field-oriented graduate-student research that contributes to the understanding of the geologic processes and history of the Pacific Northwest convergent margin or to the evaluation of its hazard or resource potential.

Harold T. Stearns Fellowship Award

Christopher DeFelice, University of Nevada, Las Vegas

Dr. Stearns established the Harold T. Stearns Fellowship Award in 1973 for student research on aspects of the geology of the Pacific Islands and the circum-Pacific region.

Lauren A. Wright & Bennie W. Troxel Student Research Award

Nadine Reitman, University of Colorado Boulder

Elijah Turner, University of Nevada, Las Vegas

The Lauren A. Wright & Bennie W. Troxel Student Research Fund supports two graduate students in master's or Ph.D.

programs conducting field-based research (1) in the region broadly centered on Death Valley National Park, or (2) in the western and southern Basin and Range tectonic province. This research grant is associated with the GSA Structural Geology and Tectonics Division.

2019 GSA Graduate Student Research Grant Recipients

(Listed in alphabetical order by university.)

Acadia University

Jackson Malone

Arizona State University

Jisoo Kim

Joel Leonard

Logan Raming

Boise State University

Mayara Fernanda Cizina

Scott Ducar

Anna Roser

Allison Vincent

Boston University

Justin Holcomb

Brandon University

Janelle Vachon

Brown University

Brendan Anzures

Sarah Cooley

Christopher Kremer

Sarah McGrath

Nora Richter

Ningli Zhao

California Institute of Technology

Joseph Biasi

California State University, Bakersfield

Toni Ramirez

Jesus Robles

Cindy Rodriguez

California State University, Chico

Alexis Lopez

California State University, Long Beach

Clay Kely

California State University, Northridge

Anthony Downey

Alison Franco

Rachel Hohn

California State University, Sacramento

Zack Levinson

Theron Sowers

Central Michigan University

Stephan Hlohowskyj

Leah Jackson

Central Washington University

David Bruce

Coastal Carolina University

Madison Fink

Colorado School of Mines

William Aertker

Mark Hansford

Haipeng Li

Logan Powell

Ariel Rickel

Colorado State University

John Kemper

Eyal Marder

Brianna Rick

Columbia University

Clara Chang

Sarah Giles

Cornell University

Aristides Alfaro

Dalhousie University

Shaomin Chen

Richard Chow

Yuqiu Zhao

Dartmouth College

Jordan Fields

Drexel University

Johannes Krause

Duquesne University

Michelle Valkanas

Florida International University

Kimberly Beck

Florida State University

Daniel Govert

Nevin Kozik

Georgia College & State University

Idah Ngoma

Georgia State University

Shellby Miller

Harvard University

Longfeng Wu

Idaho State University

Patience Bosompemaa

Sara Warix

Indiana University–Purdue University

Indianapolis

Derek Gibson

Indiana University Bloomington

Ian Armstrong

Sarah Burgess

Clarke Delisle

Marissa Schorr

Instituto Politécnico Nacional (IPN)

María Flores

Violeta J. Marcial

Mario Martínez Yáñez

Iowa State University

Hannah Carroll

Claire Ruggles

Johns Hopkins University
Joseph Browning-Hanson

Kansas State University
Emily Fenner
Abbey Marcotte
Christine Ward

Kent State University
Maximilian Barczok
Md Abu Chowdhury
Sydney Laubscher
Zachary Loffer

Laurentian University
Xuyang Meng

Louisiana State University
Larry Tuttle
Leslie Valentine

Massachusetts Institute of Technology
Logan Tegler

McGill University
Kyle Henderson
Noah Phillips
Caroline Seyler

McMaster University
Rebecca Lee

Miami University
Masoomah Kousehlar
Liannie Velazquez Santana

Michigan State University
Patricia Jaimes
Eleanor Rappolee
Ronald Steiner
Christopher Svoboda

Mississippi State University
Joseph Moffitt

Missouri University of Science and Technology
Damian Cardenas
Edward Duarte
Elisandra Hernandez

Montana State University
Elijah Adeniyi
Caden Howlett
Aislin Reynolds
Mariah Romero
Megan Saalfeld

Moss Landing Marine Laboratories
Jacqueline Chisholm

New Mexico Institute of Mining and Technology
Landon Daniell
Lochlan Vaughn

New Mexico State University
Ronny Sholdt
Karissa Vermillion
Dani Vitarelli

North Carolina State University
Rachel Atkins
Corbin Kling
Rachael McCaully
Allison Vo

Northern Arizona University
Rose Gallo
Claire Pringle
Alexis Riche

Northern Illinois University
Seth Coursey
Corrie Lucchesi
Lillian Lueck
Valerie Voisin

Oklahoma State University
Michelle Abshire
David Herman
Rohit Raj
Seyi Sholanke

Oregon State University
Alexander Bippus
Jennifer Fedenko
Katya Jay
Meghan King
Jordan Lubbers
Pichawut Manopkawe
Erin Rooney
Marie Takach

Pennsylvania State University
Troy Ferland

Portland State University
Jane Eisenberg
Ryan Levinson
Alexander Mclean

Purdue University
Yang Zhang

Queen's University
Alison Martin

Rutgers University
Chen Wang

Saint Louis University
Abigail Ritter

San Diego State University
Drake Singleton

Simon Fraser University
Jocelyn Ross-Lindeman

Southern Illinois University
Joseph Krienert

Stanford University
Zachary Burton
Malcolm Hodgskiss
Tyler Kukla
Richard Stockey
Arden Wells

State University of New York at Binghamton
Joshua Novello
Mebrahtu Weldeghebriel

Syracuse University
Julio Beltran
Kyle Makovsky
Nicolas Perez

Texas A&M University
Matthew Dorsey
Yibin Huang
James Martell
Samuel Neely
Richard Sullivan
Anne Tamalavage
Chia Pei Teoh
Tyler Winkler

Texas A&M University—Corpus Christi
Hao Yu

Texas Tech University
Ethan Backus
Katie Gates
Donald Maute
Giovanni Zanoni

The Ohio State University
Teresa Avila
Adolfo Calero
Melisa Diaz
Ji-Eun Kim

The University of Chicago
Caitlin Meadows

The University of Texas at Austin

Kendra Bunnell
Cansu Demir
Natchanan Doungkaew
Scott Eckley
Abdulah Eljalafi
Megan Flansburg
Scarlette Hsia
Estefania Jauregui
Cullen Kortyna
Ingrid Lundeen
Micaela Pedrazas
Eirini Poulaki
Evan Ramos
Catherine Ross
Lily Serach

The University of Texas at Dallas

Ning Wang

The University of Texas at El Paso

David Lankford-Bravo
Alondra Soltero

The University of Tulsa

Alana Bobka
Jonathan Major

Tulane University

Kevin Reece

Universidad Nacional Autónoma de México (UNAM)

María del Mar Almazán López
Jonathan Anaya
Rodrigo Gutierrez
Fernanda Lases-Hernandez
Norma Betania Palacios Garcia
Mildred Zepeda-Martínez

University at Buffalo, SUNY

Maggie Leclair

University of Alabama

Jian Chen

University of Alaska Anchorage

Scott Pantaleone
Ben Suranovic

University of Alaska Fairbanks

Zena Robert

University of Arizona

Robert Hayes
Jihyun Kim
Alexandra Wallenberg

University of Arkansas

Cole Jimerson

University of British Columbia Okanagan

Iva Lihter

University of Calgary

Jacob Forshaw
Henry Galvis-Portilla
Ryan McKay
Simone Pujatti
Thomas Wilson

University of California Berkeley

Larry Taylor
Joshua Zimmt

University of California Davis

Alexander Lombardo
Margarita McInnis
Alba Mar Rodriguez Padilla
Tyler Schlieder
Melissa Ward

University of California Irvine

Elizabeth Patterson

University of California Los Angeles

Kevin Shao

University of California Riverside

Rachel Surprenant

University of California San Diego

Benjamin Birner
Jacob Morgan
Jessica Ng

University of California San Diego—Scripps Institution of Oceanography

Alan Seltzer

University of California Santa Barbara

Jenna Adams
Andrew McGrath
Mary Ringwood

University of Cincinnati

Abigail Kelly
Christopher Sheehan

University of Colorado Boulder

Michael Frothingham
Aaron Hurst
Nadine Reitman
Brittany Selander

University of Connecticut

Elena Robakiewicz

University of Delaware

Elizabeth Davis

University of Florida

Scott Miller
Sean Moran

University of Georgia

Rachel Rotz

University of Hawai'i at Mānoa

Krista Evans
Trista Mckenzie

University of Idaho

Wesley Sandlin
Kelsey Wetzel

University of Iowa

Jennifer Thines
Matthew Trembath

University of Kansas

Christine Chan
Siyan Liu
Anna Whitaker

University of Kentucky

Elizabeth Avery
Felicia Harris
Autumn Helfrich
Brandon Spencer
Jonathan Wilson

University of Maine

Scott Braddock
Tess Walther

University of Maryland Center for Environmental Science (UMCES)

Hunter Hughes

University of Maryland, College Park

Kayleigh Harvey
Haley Talbot-Wendlandt

University of Massachusetts Amherst

Ian Hillenbrand
Karin Lehnigk
Rebecca Smith
Evan Thaler
Boyang Zhao

University of Michigan

Madelyn Cook
Elizabeth Crowther

Sarah Katz
Nikolas Midttun
Mara Page
Allison Pease

University of Minnesota Duluth

Samuel Duncanson
Collin Murphy

University of Minnesota Twin Cities

Hannah Blatchford
Kathryn Hobart
Christine Newville
Natalie Raia

University of Missouri–Columbia

Grace Allison
Brenna Halverson

University of Missouri–Kansas City

Joseph Nolan
Kaylee Thomas

University of Nebraska–Lincoln

Robert Gillham

University of Nevada, Las Vegas

Shaimaa Abdelhaleem
William Barba
Christopher DeFelice
Emily Dektar
Deborah Morales
Suzanne Mulligan

University of Nevada, Reno

Scott Feehan
Ann Hanson
Michael Say
Elijah Turner

University of New Hampshire

Maria Fahnestock
Douglas Macleod

University of New Orleans

Jessica Villers

**University of North Carolina
Wilmington**

Adam Collins
Frank Marshall
Jack Nolan
Benjamin Snyder
Elizabeth Yanuskiewicz

University of North Dakota

Chioma Onwumelu
Ogochukwu Ozotta

University of Northern Colorado

Haylie Brown

University of Notre Dame

Keith O'Connor

University of Oklahoma

Evan Hamilton
Dalila Jesus

University of Oregon

Adrian Broz
Michael Hudak
Brooke Hunter
Marian Tate-Jones

University of Pittsburgh

Rebecca Forgrave
Nicholas Wondolowski

University of Puerto Rico–Mayagüez

Brian Minkin

University of Rochester

Wriju Chowdhury
Fabiana Richter

University of Saskatchewan

Hoang Anh Tu Nguyen

University of South Florida

Robert Constantinescu
Abigail Martens
Alex Maruszczak
Danielle Molisee
Surui Xie

University of Southern California

Tarryn Cawood
Alison Cribb
Amanda Godbold
Abigail Wesley

University of Tennessee

Maggie Limbeck

University of Tennessee, Knoxville

Jake Alexander
Jacob Cecil
Jeremy Leierzapf
Anthony Maue

University of Utah

Jeremiah Bernau
Benjamin Breeden
Robin Fults
Courtney Wagner

University of Vermont

Adele Conde

University of Victoria

Sandy McLachlan

University of Washington

Joel Gombiner
Michael Kipp
Alexander Lowe
Kelsay Stanton
Seth Williams
Paige Wilson

University of Waterloo

Jillian Kendrick

University of Wisconsin–Madison

Naomi Barshi
Lisa Haas
Dougal Hansen
Aaron Kufner
Emily Mixon
Nicholas Sullivan
Rachelle Turnier

University of Wyoming

Cole Messa
Nathan Swaim

Utah State University

Matthew Ellison
Coleman Hiatt
Cayla Kennedy
Rebekah Riemann
Jesse Scholpp
Dominique Shore
Kayla Smith

Vanderbilt University

Cameron de Wet

Villanova University

Nicole Marks

**Virginia Polytechnic Institute
and State University**

Kirkland Broadwell
Graydon Konzen
Morrison Nolan
Maxwel Schwid
Michael Vadman
Hao Wu
Yezi Yang

Washington State University

Nolan Blackford
Ross Salerno

West Virginia University
Autum Downey

Western Washington University
Eric Brown
Cassandra King
Eve Lalor
Katherine Lang

David Ryan
Christina Seeger
Grace Sutherland

William Marsh Rice University
Ben Belzer
Chenliang Wu

Yale University
Neta Bar
Erica Evans
Alexie Millikin
Jasmina Wiemann

2019 GSA International, GSA Division, and GSA Section Student Research Grants

GSA International, GSA Divisions, and GSA Sections have recognized the following student research grant recipients who submitted proposals of exceptionally high merit in conception and presentation in their fields. These students will be honored at the 2019 GSA Annual Meeting in Phoenix, Arizona, USA.

GSA International

Farouk El-Baz Student Research Grants

Nicholas McCarroll, Utah State University, for “Evolution of the Book Cliffs Dryland Escarpment in Central Utah—Testing Models of Dryland Escarpment Retreat.”

Rachel Rotz, University of Georgia, for “Investigation of Linear Dune Erosion and Lacustral Events in the Simpson Desert of Australia during the Late Quaternary.”

This grant is to encourage and support desert studies by students worldwide either in their senior year of their undergraduate studies or at the master’s or Ph.D. level.

Division Graduate Research Grants

Continental Scientific Drilling Division

Continental Scientific Drilling Division Student Research Grant

Samuel Duncanson, University of Minnesota Duluth

Collin Murphy, University of Minnesota Duluth

Marissa Spencer, Missouri University of Science and Technology

Caroline Studnicky, Utah State University

Geophysics & Geodynamics Division

Allan V. Cox Research Award and Supplement

Ogochukwu Ozotta, University of North Dakota

Geophysics Student Research Grant Award and Supplement

Evan Hamilton, University of Oklahoma

Hydrogeology Division

Hydrogeology Division Student Research Grant Awards and Travel Grants

Patience Bosompemaa, Illinois State University

Frank Marshall, University of North Carolina Wilmington

Haley Talbot-Wendlandt, University of Maryland

Allison Vincent, Boise State University

Valerie Voisin, Northern Illinois University

Mineralogy, Geochemistry, Petrology, and Volcanology Division

MGPV Division Student Research Grant Awards

Mayara Fernanda Cizina, Boise State University

Maria Fahnestock, University of New Hampshire

Mebrahtu Weldegebriel, State University of New York at Binghamton

Quaternary Geology and Geomorphology Division

Peter Birkeland Soil Geomorphology Research Award

Evan Thaler, University of Massachusetts

Arthur D. Howard Student Research Award

Zena Robert, University of Alaska Fairbanks

J. Hoover Mackin Student Research Award

Joel Gombiner, University of Washington

Marie Morisawa Research Award

Tess Walther, University of Maine

Stanley A. Schumm Research Grant Award

John Kemper, Colorado State University

Sedimentary Geology Division

Sedimentary Geology Division Student Research Grant Award

Eve Lalor, Western Washington University

Structural Geology and Tectonics Division

Structural Geology and Tectonics Division Student Research Travel Grant Awards

Michael Frothingham, University of Colorado Boulder

Katherine Lang, Western Washington University

Iva Lihter, University of British Columbia Okanagan

Claire Ruggles, Iowa State University

Elijah Turner, University of Nevada, Las Vegas

Section Graduate Research Grants

Southeastern Section Graduate Research Grants

Cristopher A. Alvarez Villa, University of Kentucky
Alexandra Bridges, University of Georgia
Mohammed Harthy, University of Mississippi
Eva Lyon, University of Kentucky
Md Sharif Mustaque, Auburn University
Jasmin Naher, Auburn University
Nicholas Smith, The University of Tennessee, Knoxville
Lisa Tanh, University of Miami
Alireza Valian, University of Kentucky
Elizabeth Vitale, University of Mississippi
Kristan Watkins, The University of Tennessee, Knoxville

Section Undergraduate Research Grants

Rocky Mountain Section Undergraduate Research Grants

Kaitlyn Crouch, Utah State University
Kofoworola Fadeyi, The University of Texas at El Paso
Rudolph Hummel, Montana State University
Alec Martin, Brigham Young University
Andrew Perkins, Utah State University
Megan Tarmichael, University of Montana Western

North-Central Section Undergraduate Research Grants

Shannon Brink, University of Wisconsin Oshkosh
Stephanie Connell, University of Winnipeg
Kaela Gollob, Iowa State University
Mary Humphreys, Missouri State University
Alexis Parkinson, University of Winnipeg
Catherine Seguin, University of Michigan
Nathalie Turenne, University of Winnipeg
Hannah Veldhuizen, Indiana State University
Joshua Weimer, University of Wisconsin Oshkosh

Northeastern Section Stephen G. Pollock Undergraduate Research Grants

Jeng Hann Chong, University of Maryland
Evan Fillion, Bucknell University
Kyle Fouke, Bucknell University
Sabrina Koetter, Wesleyan University
Edward Ruger, Lafayette College
Landon Williamson, University of Vermont
Jonnathan Zuna, Kingsboro Community College

South-Central Section Undergraduate Research Grants

Christopher Jones, Oklahoma State University
Skylar Kaminski, Oklahoma State University
Wade Leibach, University of Kansas
Erin Roark, Oklahoma State University
Tristan Tompkins, University of Arkansas
Joshua Wynn, Wayland Baptist University

Southeastern Section Undergraduate Research Grants

Emily Fischer, Georgia Southern University
Anna Foster, Tennessee Technological University
Meredith Helmick, Concord University
James Melton, Concord University
Jane Wadhams, Florida State University
Annelise Waling, Clemson University
Marie White, Murray State University
Matthew Yandle, Clemson University

2019 AGeS2 (Awards for Geochronology Student Research2) Grants

AGeS offers opportunities for graduate students to develop the scientific rationale for projects involving geochronology and then provides them with hands-on experience acquiring data in labs, all while being mentored by geochronologists. This grants program is available to GSA student members and is separate from, but complementary to, GSA's longstanding Graduate Student Research Grants program. In 2019, 78 students submitted proposals, and awards were made to 20 students. The average award amount was US\$8,186. These AGeS2 awardees will participate in teleconferences with the cohort of funded AGeS students over a two-year interval. Each awardee will also receive an additional US\$500 to attend an AGeS cohort workshop preceding the 2020 or 2021 GSA Annual Meeting, and will be encouraged to present their results at the meeting. For more information, see the AGeS2 homepage: www.geosociety.org/ages. The AGeS2 program is supported by the National Science Foundation under the following awards: EAR-1759200, EAR-1759353, and EAR-1759201.

Francisco Apen, University of California Santa Barbara
Joseph Biasi, California Institute of Technology
Tarryn Cawood, University of Southern California
Johanna Eidmann, Colorado State University
Karol Faehnrich, Dartmouth College
Joel Gombiner, University of Washington
Lisa Grohn, University of Rochester
David Hernandez Uribe, Colorado School of Mines
Ellen Lamont, Oregon State University
Drew Levy, University of Nevada, Reno
Madeline Lewis, California Institute of Technology
Craig Martin, Massachusetts Institute of Technology
Kirsty McKenzie, Pennsylvania State University
Nikolas Midttun, University of Michigan
Erin Peck, Oregon State University
Logan Powell, Colorado School of Mines
Maria Alejandra Rodriguez Mustafa, University of Michigan
Jennifer Thines, University of Iowa
Kirk Townsend, University of Michigan
Karissa Vermillion, New Mexico State University

2019 Cole Awards



The Gladys W. Cole and W. Storrs Cole Memorial Awards for postdoctoral research are funded by the GSA Foundation.

Gladys W. Cole Memorial Research Award

Glenn Thackray, Idaho State University, will be awarded US\$8,750 from the Gladys W. Cole Fund for research in geomorphology of semiarid and arid terrains for his project, "Stream capture, glacier capture, and the Big Lost River Flood(s), east-central Idaho." The award will be presented on Tues., 24 Sept., at the Quaternary Geology and Geomorphology Division Awards Ceremony at the 2019 GSA Annual Meeting in Phoenix, Arizona, USA.

W. Storrs Cole Memorial Research Award

Ashley Burkett, Oklahoma State University, will be awarded US\$8,000 from the W. Storrs Cole Fund for research in invertebrate micropaleontology for the project, "Using cutting-edge technologies to analyze the morphology and geochemistry of foraminifera for comprehensive oxygen proxy development." The award will be presented on Tues., 24 Sept., at the Cushman Foundation for Foraminiferal Research Awards Ceremony at the 2019 GSA Annual Meeting in Phoenix, Arizona, USA.

GSA Minority Scholarships

GSA has awarded six undergraduate students from minority backgrounds scholarships in the amount of US\$1,500 plus one-year GSA memberships and full meeting registration to the GSA 2019 Annual Meeting & Exposition.

Natalea Cohen, Fort Lewis College

Brianna Mellerson, James Madison University

Gabriela Ramirez, Missouri University of Science and Technology

Katherine Garcia, Franklin and Marshall College

Lazaro Garza, Oxnard College

Julie Coulombe, University of Tennessee, Knoxville

Watch Your Email for An Important Opportunity to Add Your Voice to the Discussion

In the coming months, GSA will replace its aspirational Code of Conduct—adopted in the 1970s—with a new enforceable Code of Ethics. GSA's new Code of Ethics will describe the professional ethical standards of conduct we expect of our members together with examples of prohibited behavior that may result in a member's discipline, suspension, or termination from the Society.

An ad hoc committee has begun drafting the new Code of Ethics based on an outline approved by the GSA Council. Once the committee has completed an initial draft, members will be invited to review and submit comments before it is finalized. Look for an email this month with further details.

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Welcome New GSA Members

The following new members joined between 6 Sept. 2018 and 6 Mar. 2019 and were approved by GSA Council at its spring meeting.

PROFESSIONALS

Ahmed K. Abdelraof Abdelaal	Mayra Dudrenova	Valerie Keinath	Niklas Henry Putnam
Daniel Bruce Abrams	Holly Marie Duff	Lauren Kelley	Cheryl Emerson Resnick
Warren Fred Agena	Brian J. Dunst	Pavel Kepezhinskias	Matthew Elliot Richards
Masud Ahmed	Rifaat S. El-Mallakh	Steve Knollmeyer	Kelly Rose
Bjarne Almqvist	Mohamed Elsaadany	Lindsay Marie Kolbus	Teresa Ann Rose
Alberto O. Alvarado	Jonathan Erez	Martha T. Kopper	James Robert Rustad
Jennifer Anderson	Alfred Espinosa	Jun Korenaga	Shawki Mahmoud Salem
Michael K. Anderson	Xiang Fang	Anthony Kramer	Seriwat Saminpanya
Linda M. Angeloni	Iskhak Farkhutdinov	Adam J. Kuban	Judd Sampson
Brian Atkinson	Muhammad Ahmed Farooqui	Jennifer Maciejewski Kugler	Dan Sayre
Muhammad Babar	Joshua Field	Julie E. Laity	Thomas Scaife
John Bacheller III	Shawn Fiore	Hannes Leetaru	Marco Scambelluri
Janet Bader	Robert Andrew Foley	Haibing Li	Urs Schaltegger
Jeffrey W. Bader	Danielle J. Ford	Claudio Coelho de Lima	Amina T. Schartup
Eric Christopher Beam	Everett Howard Fortner III	Shaofeng Liu	Wouter Pieter Schellart
Timothy John Beck	Francis Fosu	Yvonne Sena Akosua Loh	Naomi Scher
Asmeret Asefaw Berhe	James Franklin	William Lovis	Gregory P. Schrader
Jacob G. Berman	Cristina García Lasanta	Raul Ernesto Lugo Zazueta	Richard David Schulerbrandt
Kim M. Bishop	Vicki Anne Garlington	Prasun Mahanti	Gragg III
Daniel R. Blake	Ian Richard Gendall	Safwan Saber Mandeeli	Krystina R. Scott
Dawnika Blatter	Aurelie Germa	Richard Ernest Mansker	Thomas Serenico
Roger B. Bloch	Garry Lynn Getz	Jonathan D. Marcot	Peter C. Smith
Aurora C. Bouchier	Thomas Giachetti	Raleigh L. Martin	Paul Spahr
James Brasington	Carol Gibson	Kenji Marc Raymond	Kevin Spindler
Bruce Braswell	Deborah Glickson	Matsuzaki	Aleksandr Sasha Stepanov
Eckart Buhlmann	Larry Gore	Mika McKinnon	Seiji Sugita
Daniel Bulger	Jerry Grant	Kevin McNichol	James H. Sullivan
Bill Burgel	Katherine Grote	Gopal Mohapatra	Rjeffrey Swope
Katherine Burgess	Brian Hamilton	Nicholas Alexander Moran	Nicholas David Tailby
Amanda Burt	Trinity L. Hamilton	John Mundell	Daniel M. Tartakovsky
Tom Byl	Sarah Hammer	Charles Musiba	Patrick Toth
Leonardo Arias Cardona	Dwight W. Harbaugh	Zachary Neal	Ozan Unsalan
Adam R. Carr	Kevin J. Harmon	Craig Nelson	Shelby Ray Valenzuela
Samuel Raul Chama	Clay D. Harris	Ryan Newton	Alexander Van Geen
Katarzyna Charzynski	Shannon K. Hayes	Claire O'Neal	Leon Van Paassen
Ting Chen	Charles Head	Phil Odenkirk	Paul Vellom
Zhonghong Chen	Erin Heard	Lydia Olaka	Jessica Vieira
Andrey Cheremisin	Kelly Heid	Davide Oppo	Channon Visscher
Eric Chojnowski	R. Chadwick Holmes	Rick E. Otto	Otis H. Walter
Philip Coholich	Wendy Holtom	Ibrahim A. Oyediran	Yu Wang
Jennifer Rivers Cole	James A. Honert	Andrés Pardo	Stephen Warren
Michael Cornyn	Lauren M. Humphreys	Yoram Paz II	Matthew N. Waters
Thomas Carter Crafford	Robin R. Humphreys	John M. Pazel	Heather Watson
Shane Jason Cronin	A.T.M. Shakhawat Hyossain	Marco U. Perez	Paula V. Welander
Grant W. Cushing	Manavi Jadhav	José Noel Pérez-Asensio	Karlyn Sara Westover
Youssef Daafi	Andrew Jalbert	Rose Marie Petefish	Christine B. White
Tais W. Dahl	Anish D. Jani	Gregg M. Petrie	Paul Barry Wignall
Nicolas Dauphas	Judith Ann Johnson	James Spencer Phelps Jr.	Scott Wilkinson
Lawrence Diko Makia	Brandon Jones	Mark Pleasants	Donna Caraway Willette
Eric Richard Dott	Donald Jones	Maria-Serena Poli	Ben D. Williams
Allison S. Drouin	Clark Jorgensen	Jason C. Poole	Jason Williams
	Ulrich Kamp	Mike Power	Amos Winter

Dixie Lorraine Wright
Hai Xu
Mo Xu
Han Zeng
Qiang Zhang

EARLY CAREER PROFESSIONALS

Anthony Joseph Arbise
Sarah Arpin
Zachary Holt Baird
Mairin Balisi
Joshua Barna
Sarah Elizabeth Baxter
Caroline Johanna Bedwell
Marissa Berger
Walter Ethan Biglow
Michael Black
Jason Daniel Boettger
Danielle Bogen
Maitrayee Bose
Josephine Marie Brandlin
Sarah Brokus
Alec Brooks
Montana Carter
Nadia N. Casillas Ituarte
Daniel Castany
Breana N. Chavez
Gisela Cobenas
Robert B. Congdon
Grace Conyers
Hunter D. Cook
Sarah Cosby
Katarina David
Patrick Deery
William Defliese
Ian Cody Desjarlais
Luis De Vera
Stephanie Devries
Abdurrahman Dokuz
Lin Dong
Edward Allen Driggers Jr.
Catherine Elder
Molly Elkins
Andria P. Ellis
Olugbenga Temitope Fajemila
Alexander Farnsworth
Ye Feng
Edwin Fonnies
Danielle Fraser
Greg Todd Frommer
Lauren Fuelling
Christine Nicole Garcia
Wael Ragab Gaweish
Daniel Gebregiorgis
Raddiete Ghion
Troy Gilmore
Vida Golubovic
Vanessa Gonzalez

Erin Marie King Haacker
Dalton Hardisty
Jack Hemstreet
Chris Herman
Jennifer Hertzberg
Skuyler Herzog
Jenna Emilie Hill
Meghan Gabriella Hospedales
Samuel M. Howell
Fang Huang
Tom Hudgins
Magdalena Huyskens
Jason Jakary
Andrew Ryan Jennings
Jena E. Johnson
Nick C. Johnson
Laura Marie Jones
Christopher Adam King
Nichole Kirk
Colleen Klockow
Bess G. Koffman
Bjørn Tore Kopperud
Zachary Kovach
Gavin Kreitman
Artur Andrzej Kuligiewicz
Barret Kurylyk
Joshua Laird
Simon Large
Lainey Le Blanc
Kelly L. Lee
Shan Li
Xiyao Li
Yang Li
Anders Lindskog
Joseph Lotz
Jingwen Lu
Chinomso Madubuike
Antonios Marsellos
Catherine Martin-Jones
Tobias Mattsson
Kiana D. McFadden
Kristen McKinley
Christ Milliner
Michael C. Moghadasi
Jordon Munizzi
Samuel Munoz
Daysi Nemecio
Gunnar Norback
Philip O'Brien
Keely O'Farrell
Caitlin O'Neill
Katie O'Sullivan
Lisa Oakley
Holly J. Oldroyd
Ivan D. Ortiz Sr.
Gengxin Ou
Ricardo Jose Penaloza
Alan Peterson
Martin Pratt

Tabb Prissel
Daniel Quinn
Hannah S. Rabinowitz
Vahid Rahmani
James Patrick Reed
Hervé Rezeau
Barbara Rich
Alex Richman
Jeremy Spencer Rohrman
Valentina Romano
Brian Bernhard Rudolph
Tiffany Rugger
Oguz Sariyildiz
Frank Sattler
Madeline P. Schiller
Colby Wyatt Schwaderer
Susanne Seitz
Jean-Francois Smekens
Ryan G. Smith
Christopher Spalding
Andy Stacey
Michael Stoehr
Bambang Sugiarto
Alexander Taylor
Juan Teng
Pierce Thieme
Gregory Thill
Michelle Thompson
Alex Tkaczyk
Antonio Turtu
Lisa Ann Tutty
John Umek
Sarah Valencia
Michael Joseph Valko
Charles Verdel
Johann Villalvir Miranda
Corey James Wall
Kristina Walowski
Talor Walsh
Hao Wang
William Warren
David Waterman
Grant Weaver II
Jeremy Dale Wiles
Dave Willis
Timothy Wojtaszek
Charles Andrew Wykel

Lara Yagodzinski
Chuan Yang
Heng Zhang
Hai Zhu
Margaret Zimmer

STUDENTS

(By professional interest)

Archaeological Geology

Edgar Alarcon Tinajero
Zach Allen
Kimberly Bartlett
Alexander Bearden
Joseph Donald Beck
Karissa Beierle Pavek
Tristan Bench
Lindsay Bettke
Lisa Forrester Clark
Alex Crooks
Jedidiah Dale
Chelsea Deboutte
Eliza Marie Dent
Brandon Duthler
Falisha Gabrielle Hougland
Hannah M. Johnston
Lauren Jones
Benjamin Keenan
Cayla Kennedy
Stephanie Luckasevic
David Wesley Miller Jr.
Matthew Panner
Concetta Pounds
Ian Thomas Gordon Predham
Michaela Joy Sandeno
Joseph Smitherman
Sofi Spatola
Kialye K. Wainwright

Biogeosciences

Harpreet Kaur Bather
Annastacia Bennett
Hayley Bennett
Emily K. Blackaby
Elizabeth Cilia
Evan Collins
Andrea Corpolongo

Top 3 reasons for joining GSA



1. GSA Meetings



2. Career Development



3. Research Grants

Kevin Cottingham
Weiming Ding
Warren Dunegan
Mohamed Elwaraky
Byron Call Essert
Rebecca Courtney Evans
Nicole Ann Fiore
Max Gerhardt
Valarie Joyner Harrison
Madisen E. Hilligoss
Valerie L. Ibarra

Katya Jay
Christopher Kent Jones
Erin M. Keenan Early
Jonathan Stanford Keller
Jane Kelly
Katriel Kennedy
Aster Lei
Mary Catherine Lonsdale
Jonathan D. Major
Judy Malas
Matthew R. Mers
Archibald D. Mills
Ashlynn Christiana Morin
Megan Marie Mullis
Heidi O'Hora
Daniela Osorio
Erin Kathleen Peck
Anasley Shea Petherick
Zachary Stephen William Pollock
Sarah Schwartz
Araceli Serrano
Peter Richard Steiner
Sierra E. Swisher
Lauren Todorov
Gabriela Villegas
Rachel Wheatley
Micah Wiesner
Robert Austin Wilson
Cat Wood
Chaochao Xing
Cristobal Pablo Yanez

Climatology/Meteorology

Rene Paul Acosta
Madeline C. Allen
Alexandrea Arnold
Lucia Grace Bellino
Helena Eve Bierly
Benjamin Birer
Elizabeth Duniec
Kimberly Duong
Stephen Fengler
Dylan S. Fox
Jie Geng
Mia R. Gerace
Nicole Marie Greco
Jacob W. Honeck

Ginny Johnson
Rachel M. Kirpes
Lauren Elaine Mahoney
Cari Rand
Emily Nicole Sambuco
Celina M. Scott-Buechler
Rachel Faye Silvern
Alaina Tocci
Paige Rachelle Voss
Emily Wilcox
Michael Yanchuck

Economic Geology

Jack Franklin Barber
Carson Beattie
Thomas John Bihler Jr.
Edward Tankerville Bonner
Alexandra J. Bridges
Richard William Butts
Rajarshi Chakravarti
Daniel Coffey
Seth Coursey
Landon Daniell
Hannah Jane Eppard
Edith Fuentes
Daniel Goch
Alexander Arai Goodsohm
Manuela Grajales
Kyle Henderson
Colton Herman
Sarah Hostetler
Matthew David Johnson
Sean Michael Jones
Jesse Kolodin
Lucas Edward Leiningner
Corrie Lucchesi
Nicholas Mann
Mitchell Marcelissen
Steffen Matthews
Duncan Caesar McIntire
Anthony Scott McIntyre
Dylan McLane
Gillian Kelsey Roberts
Eric Lane Schuemann
Rachel Lauren Smith
Nathan T. Swaim
Erik Tharalson
Conner M. Truskowski
Jacob Vanderwal
Mathew Weinberger
Randi Jean Wible
Ahmet Yilmazgoz
Imren Yilmazgoz
Hao-cheng Yu

Energy Geology

Moath Al-qaod
Eric Anderson
Olawale Emmanuel Ariyibi

Jordan Arnold
Victor Akinbola Awosiji Jr.
Charles Adam Ball
Garrett Beacom
Evan Bas Blackburn
Brightin Rex Blanton
Alana Marie Bobka
Jacob Ryan Borowiak
Michael John Chaborek Sr.
Jian Chen
Abdul Rauf Choudhry
Hayden D. Clay
John Michael Clymer
John Connor Cunningham
Kalli Alyse Dubois
Heather Mae Dudley
Nathan Dulaney
Matt Edwards
Jane Lyra Eisenberg
Jordan Oswald Ellard
Clayton Palmer Ervin
Chibuikem Akaolisa Esomeju
Trenity Ford
Brynn L. Galindo
Kate Gutterman
Thomas McGurty Hawley
Joel Hendricks
Andrew Hollenbach
Yizhou Huang
Mireille Gilberte Jaser
Samuel C. Johnson
Cody Keith
Sheyenne Kneedy
Hunter V. Kraynak
Julien Y-son Kuhn de Chizelle
Brent A. Lary
Dengke Liu
Siyan Liu
Xiaoxue Liu
Iaos Lizarazu
Bryana Mckay
Corey Vincent Milar
Sara Anne Mitchell
Mitchell Moore
William G. Mynatt
Stephen Lynn Ogden Jr.
Lars Alex Olivan
Aishat Olowoshile
Nathan Pastorek
Chris Perna
Mason Pitchel
Buddy James Price
Shaun T. Prines
Rohit Raj
Garrett Rakes
Savannah Rice
Shay Parker Ridl
Moses Riley
Michael Say

Seyi Sholanke
Ethan Frederick Siegenthaler
Jarrett Smith
Pomeroy Smith III
Benjamin W. Snyder
Elizabeth Sweda
Mitchell Tarantolo
Hossein Tavakoli
Claire Elizabeth Thomassen
Richie Jeffery Torney
Zachery T. Tunin
Kirill A. Vorobyev
Ian Daniel Wachino
Chase Sterling Watkins
Emily Grayson Welch
Justin Chance Yandell
Donglai Yang
Giovanni Zandoni
Kun Zhang
Marcus Zinecker
Fabian Zowam

Engineering Geology

Murtadha Al-malallah
Emma E. Bachman
David Barrick
Justin Borchert
Charles Burt
Sean Thomas Butler
Andrew Culleton
David Wayne Drash
William Trenton Edwards
Jonn Geer
Elizabeth Gutberlet
Ryan Hogan
Dorcas Oluwabimpe Idowu
Tea R. Jackson-Strong
Dylan Karrick
Natasha Jean Kendrick
Kiah L. Kraus
Lacy Rose P. Lackey
Daniel Martinez
Samia Noor
Patrick Wayne Paladino
Derek Pansze
Josiah J. Peterson
Jeffrey Pope
Ariel Rickel
Mateo Sanabria
Shuayb Rahman Siddique
Christopher Tran
Victor Manuel Valencia
Eric James Wzientek

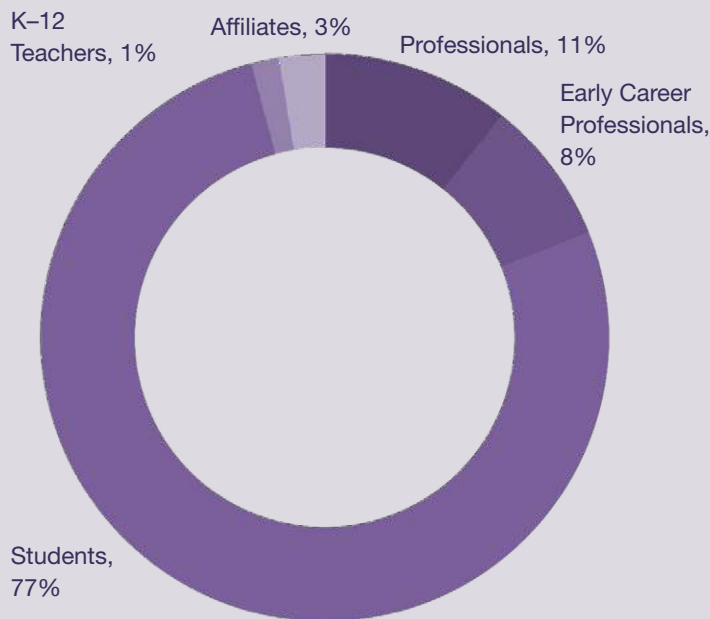
Environmental Science

Ariyanna Allen
Rebecca Lynn Anderson
Nicholas James Asreen
Lauren Elizabeth Badding

Maximilian Barczok
 Samantha Marie Barnett
 John Reges Marshall Beck
 Jeremy Ryan Bekis
 Charity G. Betters
 Bridget Marie Bittmann
 Sarah Patrice
 Bonnelle-Roberts
 Janel Bowen
 Caitlin M. Bristol
 Miles Gordon Brooks
 Victoria Brown
 Zoe Kristen Brown
 Marlo Cabannes
 Adolfo Eberhard Calero
 Nicholas Cancalosi-Dean
 Caleb Carlton
 Jessica Chamberlin
 Chasalin T. Cobb
 Sarah Cooley
 Clayton M. Davis
 Stuart Davis
 Jonathon Deeter
 Carly Dellis
 Kendra Devereux
 Lynn Marie Dietrich
 Alexander Marshall Dombeck
 Mitchell Dorsk
 Anthony Downey
 Jarod A. Drummond
 Andriana Eley
 Adedugbe Damilola Emmanuel
 Reza Ershadnia
 Madeline P. Ess
 Kenan Estes
 Michael Evans
 Madelyn Renae Flores
 Sullivan Bishop Ford
 Cameron French
 Ian Ray Pikula Gallagher
 Madysen Hunter Gilbert
 Myrna Nicole Girald
 Chase Braden Glass
 Isbel Gonzalez
 Dennis Alexander Gordon
 Seth Lee Gorman
 Jocelin Noemi
 Gregorio-Alarcon
 Pedro E. Gutierrez
 Julia Hageman-Pettitt
 Madeline Hall
 Jevon V. Harding
 Madison M. Hays
 Hashindra Kumari Herath
 Hunter Edward Hershey
 Rachel Hohn
 Zachary Daniel Hoyer
 Kenna Hunter
 Yasmin Jamalial Jackson

Micah Jaffe
 Louise Wilma Jean Jennings
 Hansheng (Max) Jin
 Carson Olivia Jones
 Melissa M. Joseph
 Kathryn Eldora Kehler
 Harrison Patrick Kelly
 Madeleine Becker Killough
 Kendall R. King
 Victoria Henrye Langham
 Megan Larson
 Sydney Laubscher
 Jayce Lazuhrcatt
 Jianghanyang Li
 Spencer Lindgren
 Molly Lohss
 Soely E. Luyando-Flusa
 Lucas Karl Mangold
 Jaclyn Rose Manker
 Abbey L. Marcotte
 Joel V. Marcotte
 Nicole Kristine Marks
 Frank Moser Marshall
 Emily Grant Martin
 Melanie Ann
 Martin-Capestany
 Connor James Mayhack
 Cait Mazzoleni
 Anastasia Marie Cox
 McClanahan
 Alyssa McClung
 Michael McCullough
 Andrew T. McGrady
 Alexander Mclean
 Meagan Meier
 James Dean Melton
 Marcos Mendez
 Megan M. Miller
 Dustin Joseph Mimnaugh
 Lindsey Monito
 Lucas Hunter Monroe
 Chelsea Moore
 Elizabeth Mary Morehead
 Grant Morey
 Megan Morgan
 Benjamin Arthur Morris
 Nicole Mueller
 Dillon Murphy
 Kevin Nosiglia
 Nick Nweeia
 Timothy Ohlert
 Megan Kathleen O'Leary
 Amy Olgers
 Eric Parker
 Amanda Pechacek
 Sonasha Perera
 Victoria Phillips
 Paula Pletnikoff
 Kaelyn Marie Quinlan

New members by member type



Victoria Race
 Shaundra Rasmussen
 Simone Rawal
 Rowann Remie
 Uziel Rendon
 Suzanne Ruth Rice
 Tracy Marie Roberts
 Virginia Rodriguez
 Sally Louise Roscoe
 Jesus Alfonso Sancen
 William Reed Sanchez
 Katharine Scanlan
 Nadia Schenck
 Riley Schmitter
 Elinor Scholtz
 Rhiannon Scott
 Juwan Louis Lee Shabazz
 Abigail Cook Sheehan
 John T. Shukle
 Erin Siebert
 Camila Silva
 Kacie Marie Silver
 Mary Sirgo
 Lillian Slajus
 Alexandra Nicole Smith
 Cody J. Smith
 Matthew Smith
 Jessica A. Snow
 Yi Song
 Anthony Jake Spinella
 Liana Catherine Stachowicz
 Matthew Wesley Stevens
 Selsey Stribling

Jakob Q. Suri
 Seth Swearingen
 Anthony L. Taylor
 Julie Alicia Torres
 Jacob Paul VanderRoest
 Sean Vanzeeland
 Mariana Velazquez
 Hannah J. Veldhuizen
 Alison Veresh
 Daniel Ryan Wade
 Jordan Waltermann
 Melissa Ward
 Adam Michael Weinzapfel
 Jessie Wheeler
 Rachel Whiteman
 Natalie Wigger
 Andie Celeste Wilkerson
 Paul Wilkerson
 Jacob Ryan Williams
 Sheri J. Williams
 Ryan Patrick Wizner
 Caralena Wren
 Rachel Morgan Wright
 Crystal Wu
 Ryan Wysocki
 Yiruo Xu
 Yiding Zhang
 Murodjon Zubaydov

Geography
 William Benfield
 Jacob Cecil
 Barrie Chileen

Adam Collins
Bridgette Ingram Fritz
Bria Goldade
Dawn Marie Grice
Josie Hoiem
Brendan A. Hoover
Sean L. Hopkins
Chance Nolan Howard
Chelsea Huckbody
Jacob Aaron Parente
Marcella Rose
Anna Roser
Forrest Scott Schoessow
Billy Jack Traversie
Jeanette Littlejohn Williams
Kyle Woodward
Qiuyue Zhang

Geoinformatics

Ryan T. Cox
Cindy Hendry
Bryce Johnson
Michael Aaron Lipkowitz
James Matlock
Hoang Anh Tu Nguyen
Anirudh Prabhu
Jonathan Teboul

Geology and Health

Tokunbo Clara Akinrinbola
Gianna Antunovich
Sophie Bernstein
Roman Gabriel Carrion
Michael Chacko
Daniel Chavez
Rachel Marylee Coyte
Jennifer Freeman
Lauren Elizabeth Hansen
Jill Morgan Johnson
Changho Kim
Micaela Nicole Pedrazas
Kalia Jade Richardson
Gus Wusin
He Zhao

Geophysics/Tectonophysics

Stephen Beresh
Jayson Dreshon Blankenship
Brandon Boring
Jimmy Bradford
Julia Elaine Brazo
Joshua Alexander Burstein
Yueyi Che
Guo Cheng
Elaine Collins
Matthew Couchman
Jordan Croll
Franklyn Dunbar II
Vlada Filippova

Michael Foust
Jared M. Fox
William P. Gapasin
Yiwen Personal Gong
Natalie M. Harmon
Heather Hingst
Owen Huff
Hannah Keane
Kyle P. Koselke
Patrick G. Lachapelle
Jaewook Lee
Dominique Luna-Joyce
Martinez
Jacob Ray Miller
Balam Molina De Artola
Keith Alex Nolte
Israel Olaoye
Justine Overacker
Scott Thomas Pantaleone
Nicholas Priehs
Kaleb Punzalan
Rodrigo Correa Rangel
Pranshu Ratre
Sarah Elizabeth Robinson
Rush Lee Rodwan
Audra Sawyer
Md Zonaed Hossain Szal
Derek Travis Scott
Francesca Settanni
Joseph Skutca
Holly Jessica Staley
Mayukh Talukdar
Chelsea Lauren Thibodeau
Hannah Marie Thornton
Janet Tran
William Aidyn Trubey
Steffany Wire
Surui Xie

Geoscience Education

Joseph A. Ayers-Irusota
Leesi Bright Barinem
Richard T. Bex II
Cindy Mhay Borja
Tim Brau
Landon Grey Breeding
Brittany Brelle
Gizel D. Brewer
Muhammad Nawaz Bugti
Mariko Cappello
Patrick Chandler
Zachary Clowdus
Jessica J. Cruz
Aliyah Davis
Clare L. Decelles
Michael Delligatti
Megan Helene Doorlag
Benjamin Fellows
Andrea N. Floyd

Michelle Frankel
Andrew Garcia
Lane Cooper Hluch
Estefania Salgado Jauregui
Amanda Jo Key
Rebecca Kleinman
Camryn Kozachek
Harkjun Lee
Jade Mclaughlin
Isabelle Moore
Abdelhak Moumou
Mara Lynn Nasiatka
Victoria Ng-Breckwoltd
Emily M. Passmore
Brianna A. Payne
Julian Christian Perez
Brooke Peritore
Oluwarotimi Akindele Popoola
Rebecca L. Richards
Sriparna Saha
Emily Scribner
William Segura
Shawn Alan Steckenfinger
Garrett Walker Sullivan
Sarah G. Thompson
Catherine Anne Trehwella
Siloa Willis
Brianna Delaney Wilson

Geothermal

Kurt Otto Kraal
Laura Varone

History and Philosophy of Geology

Ronald Chichester

Hydrogeology/Hydrology

Bidisha Faruque Abesh
Dominic Aluia
Gare Ambrose-Igho
Ryan Apfel
Sebastian Dominic Barkett
Fern Beetle-Moorcroft
Julio Beltran
Nicholas D. Benton
Riley Lucas Blais
Joseph Patrick Blauss
Patience Bosompemaa
Erin Nicole Boulger
Jacob M. Bradley
Christopher Brown
Morgan A. Brown
Austin Bruckner
Austin Douglas Bruner
Trevor Richard Burns
Richelle Carney
Cameron Robert Chambers
Anne Chase

Universities with the most new student members

1. California State University
2. SUNY Geneseo
3. Georgia State University
4. College of Charleston
5. Oklahoma State University

Jacqueline M. Chisholm
Lily Conrad
Bennett Conway
Sarah B. Cook
Julia Irene Corradino
Olivia Lynn Costantino
Aaron Coutino
Raymond Craddock
Owen Daly
Alan Jared Deglmann
Cansu Demir
Ivy Do
Michael Dollar
Coury Ivan Dorn
Hailey Dorer
Mikayla Drost
Jamekia Alexandria
Durrrough-Pritchard
Donald J. Enos
Jacqueline J. Epperson
Alexander Feroe
Juliann M. Fiallos
Michael David Flowers
Ashley Fox
Joel Frisch
Gabrielle R. Garcia
Ricki Garden
Daulton Geyer
Gordon O. Gianniny
Ian Godwin
Katherine Haile
Jenny Ann Hambleton
Andrew Hardman
Dru-Ann Elizabeth Harris
Md Rizwanul Hasan
Meredith Elise Helmick
Kimberly Jean Henning
Mark E. Heyer
Michael Hodges
Sarah Nicole Hoffmeier
Rachel Humes
Rania Khelfi IV
Ji-Hyun Kim
Erina Babirye Kironde
Jerome Michael Komasa
Graydon Konzen
Joseph M. Krienert
Dongjae Kwon

Lori Labelle
Alexander F. Lamore
Maggie Savannah Leclair
Martin Lentz
Ann Marie Lindley
Emily Lizotte
Spencer K. Lynn
Muhammad Qasim Mahmood
Thomas Andrew Marrone
Meghan Jane McCarroll
Henry McCormick
Trista McKenzie
Jack Riley Mclaughlin
Justin Miceli
Mason Taylor Miller
Shellby Jo Miller
Tia Misuraca
Jonney Mitchell
Louise McCain Moore
Carol Morel
William Huck Morris
Brodey Ian Murbarger
Shahidul Muzemder
Rebecca Nesel
Monica Kelly Norton
Madison Olp
Andrew Osborne
Adlai Rosenblum Ostrer
Anner Paldor
Jeeban Panthi
Joseph C. Petralia
Grant Armstrong Plunkett
Michael Polashenski
Khaled Pordel
Lily Poteete
Wesley Todd Prater
Amy Bronwan Curtis Pritt
Mary Hastings Puckett
Jowaher Raza
Katie Richwine
Kayla Rooney
Yon-gyung Ryuh
Wesley Sandlin
Matthew Seigler
Evan L. Shadbolt
Jaremy Jamie Shaw
Jonah Shoemaker-Gagnon
Grace Sieggreen
Silas Sleeper
Christian David Smith
Matthew Smith
Bradley Squires
Miryah Squires
Julia Kim Steele
Hannah Stefanoff
Julianne Sweeney
Megan Lee Tarmichael
Michael Tchintcharauli-
Harrison

Justin Cameron Thompson
Andrew Tilton
Robert Troy
Ozan Turkes
Allison Vincent
Katalyn Voss
Jeffrey Wade
Chen Wang
William Burr Ward IV
Caroline Weidner
Jacob Clarin Westrich
Lauren Whitehouse
Thomas Daniel Wilson
Ryan Wolbert
Kaitlyn Wolschlager
Summer Wright
Leann Xiomara Zuniga

Karst
Kendra Bunnell
Sarah Asha Burgess
Jonathan Mark Camelo
Jessica Abadie Coffey
James Edward Troxell
Abigail Taylor Williams

Limnogeology
Lane Allen
Mckenzie Ann Brannon
Joshua Antonio Covas
Derek Gibson
Meredith Lord Labelle
Jordyn Nicole Loveall
Collin Andrew Murphy
Emma Tucker

**Mineralogy/Geochemistry/
Petrology/Volcanology**
Shah Bilawal Ali
Austyn Thomas Allen
Lindi Jane Allman
María Del Mar Almazán López
James Allan Anderson
Alejandra Angulo
Mónica E. Aparicio
Luka Badurina
Desiree Baker
Claudia Banks
Katelyn Barton
Yvonne N. Baur
Claudia Bautista
Naomi Becker
Jeff Richard Benoit
Ellie Biebesheimer
Cassandra Black
Patrick Ryan Bobbitt
Jacob Bonessi
Andre Bourret
Raul Brens Jr.

Kenneth Andrew Britton
Sarah Elizabeth Brooker
Benjamin Thomas Bruck
Karoline M. Bruckel
Carolyn J. Bryant
Alexis Bryson
Diana Bullen
Cole J. Burchiel
Reid Buskirk
Brooke Byars
Colton Byers
Manlio Jonathan Calentti
Mckinzie Campbell
Emily Carrigan
Stephanie Ilkenhans Carroll
Saige Brook Carter
Rachel Chan
Sukalpa Chatterjee
Proteek Chowdhury
Penelope Christy
Mayara Fernanda Cizina
Cristian Francisco Clothier
Killian H. Cochran
Julian Michael Cohen
Daniel John Colwell
Eve Corbett
Thomas Maurice Corcoran
Hannah R. Cothren
Dominique Tiara Cottrell
Brianna Kathleen Crenshaw
Fabio Da Prat
Brian Dalbo
Ryan J. Desjarlais
Charlotte Devitre
Malik Donatien
Kaitlyn Brooke Dooley
PJ Doughty
Taylor Ducharme
Hannah Duncan
Madeleine Escudie
Maria Florencia Fahnstock
Miguel Andrés Figueroa
Emily Finger
Emily Fischer
Celeste Flores
Jacob Benedict Forshaw
Lena Fox
Daniela García
Hannah Ghotbi
Sophie Glaubius
Rachel Gnieski
Brooklyne Mechelle Goode
Elizabeth Grant
Kailey Gray
Kate Marie Grosswiler
Emily L. Guest
Samantha L. Hall
Megan Hanks
Jonathan Hardman

Felicia Harris
Jamie A. Hayward
Ran He
Daniel Phillip Heerema
Porter Henze
Andres Hernandez Nava
Kelsey Barr Hewett
Coleman Hielt
Emily Robertson Hinshaw
Alexandria Hoehner
Christopher M. Hoff
Emma Louise Huber
Nathan Hunter
Johanna Jacobson
Marissa Laura Jerden
Audrianna L. Johnson
Sofia J. Johnson
Toby Brooks Johnson
Marcella Maxine Jurotich
Lukas Karuza
Sarah Keenan
Liam J. Kelly
Jillian Kendrick
Michael T. Kensell
Faizan Ahmad Khan
Jisoo Kim
Woohee Kim
Matthew L. Klempp II
Allison Raeann Kusick
Chandler Laduke
Hunter Quinlin Landis
Elizabeth Anne
Langdon-Lassagne
Erin Lary
Brandi Lawler
Kayla Lazer
Catherine Leblanc
Yung Ping Lee
Brandon Matthew Levenstein
Kristen Lewis
Carter Robert Lindeman
Dakota M. Little
Wanyi Lu
Scott Angus Maclennan
Chloe Rae Malin
Eleni Manesiotis
Violeta J. Marcial
Juan Pablo Marin Jr.
Jennifer Marsh
Abigail Martens
Collin F. Maurtua
Luke Maxwell
Joseph Sean McCarthy
Kelly Nell McCartney
Alexander Ian Mclaughlin
Cameron McNeely
John F. McQueeney II
Clara Meier
Cole Messa

Gabrielle Dominique Miller
Rachel Miller
Geoffrey Ethan Montour
Ramsey Nersinger
Caitlin Noseworthy
Alexandra Ostroverkhova
Michael Ozier
Narysse Emma Rose Palmer
Tristan Palmer
Sierra Nicole Patterson
Jhamila A. Perrier
Rachel Faye Phillips
Sean Pinardi
Brian Casey Pinke
Raven M. Polk
Tyler Pollock
Sean Michael Price
Zach Price
Kelsey Prissel
Simone Pujatti
Bryan Thomas Puleri
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Megan Ryan
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Hiroshi Suzuki
Reno D. Tarquinio
Brian Todd Teaney
Katherine Thomson
Benjamin James Thyer
Amanda Tomlinson

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Kurtis Joseph Tucci
Kassidy Nicole Ulmer
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Cecillia Anne Utterback
William Matthew Vaccaro
Alireza Valian
Dani Vitarelli
Natasha Voss
Jessica Renee Ware
Sondra Warren
Elena Watts
Stu Webb
Jake Weiss
William John White
Kelly Wilson
Jackie Wrage
Matthew Yandle
Cathleen Yung
Oscar Daniel Zarate
Jacob J. Zieziul
Thomas Edwards Zur Loye

**Oceanography/
Marine Geology**

Cody Wayne Allen
Jenna Chapman
Shaomin Chen
Madelyn Cook
Darina Rose Debenedictis
Hayley Drennon
Michael Fratian
Lauren Cecilia Hayden
Emily Ann Kaiser
Meg Kikkeri
Ji-eun Kim
Kyle Krezdorn
Mary E. Kule
Rachel Anne Lunstroth
Doug Macleod
Amelia Grace McCarthy
Quinne Murphy
Colby Taylor Peffer
Jessica Riley
Jesus Robles
Christine M. Saturno
Alan M. Seltzer

Mary Stack
Gabriel Tagliaro
Logan Ashley Tegler
Andrea Marie Traffichini
Yi Wang
Daniel E. Wood
Elizabeth Yanuskiewicz
Hao Yu

Paleo Sciences

Elizabeth Bickley Altier
Irisa Danielle Arney
Alexandria Aspey
Lucas Paul Ayers
Jessica Bailey
Bryce Barney
Rachael M. Barry
Austin Alexander Bell
Martina Bennick
Martina Trachelle Bixler
Patricia Blankenship
Randall T. Borden
Maya Yamei Bradford
Brynne E. Burgy
Nathan Carroll
Aja Mia Carter
Clara Chang
Anissa M. Croft
Katherine Curran
Rylan Victor Dievert
Wenna Ding
Ian Joseph Douglas
Travis Lee Durham
Lucas Estrada
Adam James Fitch
Austin Thomas Ford
Morgan A. Fries
William Michael Gipson
Anna Rose Golub
Rebecca L. Goughnour
Laura Shalene Grenot Jones
Sarah Grove
Neal Mark Handkamer
Lorelei M. Hayden
Emilie Ann Henry
Alexander V. Hernandez
Matthew Michael James
Hoenig
Kaitlyn Horisk
Emily Hughes
Qigao Jiangzuo
Kendall Ann Johnson
Mark Sunwoo Juhn
Robert Antulio Kane
Samuel Kelley
Patrick Ryan Kelly
Ethan Gilbert Killian
Zachary Joseph Kovach
Aaron Michael Kufner

Alexis Kussman
Cannon Henry Lambert
Minh Le
Nam Le
Olivia Leadbetter
Rowan Lee
Andrew E. Levy
Leyi Li
Siqi Li
Hanyue Lin
Jacob Julius Lindner
Jon Richard Logan
Zachary J. Lyons
Namiko Machida
Tylor Patrick Mahany
Bohao Mai
Cooper Malanoski
William McCuen
Gary Allen McGaughey
Sean Minchak
Jacob Davies Morgan
Cameron Muskelly
Chris Neff
Enquye Wondimu Negash
Rhiannon Zoe Nolan
Kylie Laine Palmer
Katherine Pippenger
Jack Nathan Purcell
Shujian Qin
Cashmere Rakstis
Anna Reside
Eleanor Rettew
Daniel Patrick Rhoda
Andrew James Rich
Benjamin Eli Riddell-Young
Autumn Robinson
Nick Rose
Erica Ann Scarpitti
Ryan Shell
Candice Elizabeth Simon
Emily Michelle Bruff Simpson
Joshua Smith
Mellisha Stokes
Ali Sultan
Joshua R. Sundgren
Rachel Surprenant
Aidan Renée Sweeney
Ludwig Marc Tamari
Nicholas A. Thurber
Emily Jane Tibbett
Yuen Ting Tse
Janelle Marie Vachon
Andrew John Valgardson
Kristin Marie Veillon
Jane Alexandra Wadhams
Tess L. Walther
Bryanna N. West
Walker Camden Weyland
Marie White

Top professional interests of new student members

1. Mineralogy, Geochemistry, Petrology, and Volcanology
2. Environmental Geology
3. Hydrogeology
4. Structural Geology
5. Stratigraphy/Sedimentary

Jasmina Wiemann
Matthew Wayne Wierenga
Matt T. Wileyto
Mengxiao Wu
Yun-hsin Wu
Megan Renee Wyatt
Yezi Yang
Meghan Zulian

Planetary/Space Science

Samantha Rose Baker
Katherine Billings
Matthew C. Brennan
Jared Thomas Brum
Brian T. Buchanan
Aidan Buie
Jalen La'morris Campbell
Patrick D. Cavanagh
Simone Cogliati
Hunter Cole
Stephanie Ann Connell
Samuel Courville
Karl Cronberger
Daniel Cross
Joshua Michael Cuellar
Haley Deese
Eden Edge
David Fitzpatrick
James Frye
Michael Gatewood
Lacee Lynn Griffiths
Nickayla Griggs
Shelby Gunnells
Emma Ruth Hartke
Robert Jay Hensley II
Dessiree Michelle Hurst
Victoria Michell Ann Karnes
Jasen Klingaman
Yajui Ku
Blake Oswell Ladouceur
Jordan Christopher Ludyan
Elena Mata
Nicholas Mehmel
Evan Blaine Miller
Leyla Namazie
Natasha Maria Neto
Rebekah Nickerson
Eric Payne
Christina Polcino
Ari Powell
Nicolas Randazzo
Jocelyn Nicole Reahl
Jonathan E. Rich
Samuel Rogers
Sarah Schroeder
Noel Alexander Scudder
Mason Christian Sellman
Morgan Shusterman
Prakhar Sinha

Matthew Smith
Shelby Dwaine Smith
Sara Sobolewska
Cole Stocki
Christopher M. Stoutenger
Charlotte Tierney
Anna Emilia Villasenor
William Hunter West
Bailey Eryn Williams

Policy/Regulatory

Sophia Barron
Eileen E. Dunn
Alexandra Giese
Jessica Anne Mayers
Christopher D. Thomas
Gabriel Emmett Thomas

Quaternary Geology/ Geomorphology

Brian Agenbroad
Nathan Anderson
Ian Armstrong
Phillip Royce Banks
Haylie Brown
Charles A. Bruce Jr.
Russell Callahan
Mary K. Campbell
Timothy D. Campbell
Julia Carr
Chanista Chansom
Amaya S. Cherian-Hall
Ethan Curtis
Elizabeth Davis
Nico de Toledo
Alyssa Demott
Madison Douglas
Sarah Jean Dyal
Alyssa Ervin
Scott Feehan
Alejandro Fernandez
Maximilian Fraleigh
India Futterman
Travis B. Gingerich
Joel Gombiner
Jennifer E. Hamel
Justin Takeshi Higa
Bethany Michelle Hobart
Brooke Hunter
Aaron Ashley Hurst
Sarah Joerger
Sarah Johnson
Mark C. Jordan
John Trusal Kemper
Norjmaa Khosbaatar
Kara Kingen
Will Kleeman III
Karley Lecompte
Michael Levenson

Evan Morrow Lindroth
Alessandro Longhi
Emily Loucks
Eyal Marder
John Marke
Margarita McInnis
Kian Paul McIntosh
Marion McKenzie
Lea Rose Milando
Brian Minkin
Lester A. Olivares
Elizabeth Olliver
Opal Cherish Otenburg
Nicholas Ross Patton
Andrew J. Perkins
April Ivy Phinney
Michael C. Powers
Brianna Rick
Zena Valentina Robert
Nelmary Rico
Rodríguez Sepúlveda
Corey Scheip
Sarahmay Schlea
Marissa Rose Schorr
Kevin Shao
Jose Silvestre
Lindsey Michelle Smith
Brian Sockness
Aashima Sodhi
Mary Katherine Sorensen
Jens Christoph Suhr
Savannah Thielbar
Heath Ulrich
Jessica Julia Villers
Penelope Vorster
Braedon Warner
Riley Elizabeth Whitney
Jordan Zabrecky

Seismology

Kylie Anne Arcaris
Robert M. Bonhoff Jr.
Molly Margaret Gallahue
Samuel Ulices Garcia
James Andrew Hays
Harris Helms
Md Mohimanul Islam
Rachelle Reisinger

Soil Science

Eleanor Amann
Kait E. Aromy
Christopher Baish
Edward A. Dabsys
Victoria A. Daly
Christian Dewey
Kylie Dupuis
Qian Fang
Eliza Fitzgerald

Rachael Nicole Haggren
Sarah Leanne Harris
Trey Scott Jonas
Sean M. Kacur
Stephan Koenigsberger
Brandon Michael Kopfer
Jonathan Lee Montano
Rebecca Pitcock
Edwin Rivas Meraz
Jeremy Scott
Melissa Enyo Sherman
Ashlee Stradford
Lulu Zhao
Luke Daniel Zimmerman

Stratigraphy/Sedimentology

Waqar Ahmad
Ayodeji Israel Aina
Samsideen Olamilekan Ajala
Kachalla Aliyuda
Mahnad Al-Jabri
Jonathan Abimael Anaya
Kathleen Andrews
Eliel Anttila
Brian J. Ares
Iffat Azmi
Terryll Bandy
Jared Beavers
Graham Stephen Bonnot
Bryan Paul Bosserman
Evon Branton
Matthew Braun
Nicole Bulger
Hehe Chen
Daniel Coutts
Max E. Deckman
Arwin W. Dobber
Arnold Eatmon
Julianne Marie Ensey
Adeline Rose Evans
Cole Farnam
Vincent Farruggia
Glen Feola
Nicholas Ferry
Evan William Filion
Alison Marie Franco
Willis Benton Pipkin Franklin
Regan Nicole French
Jason R. Gentry
Omar M. Ghamedi
Hayley Guyer
Patrick Hackett
Scott D. Harrison
Robert George Hayes
Megan Nicole Heath
Carlos Manuel Herdocia
Beatriz Hernandez
Ashley Michelle Hill
Kristi Lynn Hill

Brianna House
Alexis Imperial
Clayton Jacks
Manuel Jaramillo
Ruofei Jia
Wen Lai
Anlin Ma
Jackson Daniel Malone
Nicholas Mammone
Andy Alan Margason
Mario Martínez-Yáñez
Christopher Robert Mau
Akshay K. Mehra
Christopher Metz
Jessica Monique Middleton
Jack Thomas Miles
Jacob Milton
Sam T. Moorer
Jasmin Naher
Brielle Paladino
Emma Palko
Edwin Chase Porter
Kevin Reece
Mariano Nicolas Remirez
Cindy Rodriguez
Chance Seckinger
Skip Sleister
Alondra Soltero
Blake M. Stubbins
Lisa Tanh
Nadiyah Tengku
Leslie Anne Valentine
James Joseph Van hook
Natalia Varela
Elise Vecchio
Paige Catherine Walsh
Kristan L. Watkins
Sydney M. Welch
Amanda Rose Whaling
Sixuan Wu
Allison Leigh Young
Matylda Zaklicki
Samuel M. Zapp
Thomas Zerquera

**Structural Geology/
Tectonics**

Curtis Franklin Anderson
Mathilde Banjan
Nicholas Edward Barks
Kenneth Douglas Bonnette
Betina Brockamp
Cade A. Campbell
Alexander J. Carte
Karol Roxana Casas
Tarryn Kim Cawood
Hee Jun Cheong
Katherine Addisyn Cobb
Mark Coleman

Zoe M. Conklin
Kaitlyn Crouch
Elizabeth Rose Curtiss
Margaret Deahn
Cole Andrew Denham
Joel H. Dietrich
Maximilian Kevin Ehrenfels
Sonia M. Ellison
Brianna M. Ernst
Tess Fillman
Jackson Blue Flanagan
Haley Elizabeth Garrow
Andrew Giles
Bibek Giri
Belyn Nicole Grant
Bradley Allen Gray
Thomas Harris
Hannah Beth Hartley
Reese Philip Hartshorne
Ian Hillenbrand
Caden James Howlett
Cathleen Hana Humm
Joseph William Jeruc
Wes McKellar Johns
Sloane Audrey Kennedy
Drake Dennis Kerr
Soujung Kim
Ann Marie Klyce
Megan Koch
Alexandra Julienne Kovaleski
Begum Kurtoglu
Jesse Lee
Jeremy Leierzapf
Carl Lilly Jr.
Zachary James Loffer
Rince K. Longo
Alison Ann Martin
Craig R. Martin
Kellen Nolen Martin
Cormac Reed McCarthy
Ryan McKay
Matthew Joseph Mockaitis
Mena Moerike
Levi Moos
Cody Wynn Morgan
Katherine Morgan
Olivia Myers
Renee Nassif
Thomas Tracey Overacker II
Rhys Park
Jason Travis Parsons
Jarret William Pidgeon
Thomas Plitnick
Charles Adrian Previte
Samuel Grant Robbins
Georgina Rodriguez Gonzalez
Claire E. Ruggles
David Ryan
Caitlin Serowik

Elisheva Sherman
Ronny Sholdt
Iris Smith
Kayla Smith
Clara Stanbury
Tabatha Ann Stedge
Morgan Lee Stewart
Falyn Strey
Carl Swindle
Haley Elizabeth Thoresen
Jan Tomasek
Jude Waguespack
Benjamin R. Weinmann
Kelsey F. Wetzell
Seth McEwen Williams
Casey Yamamoto-Hillman
Yao Zhang
Yuqiu Zhao

Other Professional Interests

James J. Atkins
Abigail C. Axness
Wakil Bunu Balumi
Amanda Lee Bednarick
Justin Benton
Liam Bhajan
Bianca Boggs
Delany Ann Bopp
Amy R. Bottge
Kelsi Broich
Christopher Campe
Yang Cao
Rachel Quinn Capps
Eden Velvet Carroll
Junjun Chen
Cole G. Deanda
Brooke Dykstra
Stormy Leigh Eshelman
Edgar Ray Ferguson III
Tia Francis
Ella Fried
Benjamin Mason Fry
Katie Frye
Chelsea Hilda Gaju
Hannah Grachen
Aistis Grazulis
Laura Hanawalt
Myranda Anne Hollenbeck
Ya-Huei Huang
Mary Jane Hughes
Anika Chan Huq
Simon Hutton
Andrew Klein
Jacqueline E. Kloos
Marisa Danielle Knight
Cecilia Larson
Dinghua Li
Geyang Li
Wenjje Li

Yu Liu
Funing Ma
Ziqi Ma
Katie Mandera
Catherine M. Martin
Adam Mattson
Katerina Mazari
Dylan Morton
Reuben Ng
Samantha Allison
Nowakowski
Rachel Nutter
Bradley Older
Adele J. Olson
Cash Owens
Marissa Palmer
Bimal Pandit
Md Sanoar Rahman
Toni Ramirez
Paul Remmler
Wanli Ren
Zachariah N. Seaman
Elaina JoLynn Sherman
Zac Shirer
Nathaniel J. Spitz
Harrison Tamayo
Maursey Thomas
Olivia Grace Thurston
Hayley Torres
Jose Trujillo
Jennifer Dawn Wagner
Reinhardt Warkentien
Caleigh Malia Warner
Fauve Leanne Wilson
Chuanjun Zhan
Yan Zhou

K-12 TEACHERS

Stephen Adeniran
Tim P. Beasley Jr.
Leonard Block
Marc Brousseau
Janet Carter
Cayeann Cowan
Phillip Cox
Melanie Cutler
Natalie Davis-McGrath
Clarence Eugene Dillon
Tom Gazda
Dan Gruhlke
Matt Haverty
Jeff Karlin
Jennifer Lingeman
Vincente J. Lorenz
Steven M.G. McClean
Angie D. Nelson
Brenda Paul
Andrew Peterson
Collin Reichert

Connie Robbins
Dennis Rohr
Stephanie Seevers
Anna Suggs
Diane Tom-Ogata
Elizabeth Torres-Rodriguez
John Wesley Warren
John Thurman Wilson IV
Robin Wright
Jana Young

AFFILIATES

Trevor Ager
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Ranjan Kumar Bhagobaty
Robert B. Bralliar
Greg Braswell
Robert Camp
Maria L. Carrillo
Jeff A. Chalup
Christa Cherava
Kory Michael Chesnut
Christopher Dwain Clark
Amy Collette
Dan Cooper
Manuel Etter
James Fulper
Maritsa K. George
Jack Ghazalian

Betty L. Gibbs
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Richard G. Keyes
Kyle William Kubitz
Juria Lee
Kristen Leonard
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Ethan Monceaux
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John Colin Nevins
William J. Ott
Allen John Palmer
Leander Pearson

Annie Pennella
Tobias Pool
Janice M. Ransom
Caroline Smith
Susan Tablack
Michael Tew
Andrew Scott Tidd
Al Tomas
Nguyen Van Trung Sr.
Franco Vallabriga
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Dean Warren
Linn L. Weaver
Ab I. Wescott
Raymond Joseph Williams

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Looking to spend some time at the beach? Pick up Special Paper 491, *Geology and Geomorphology of Barbados*, before your next trip to the Caribbean, or download *The Eastern Pacific Ocean and Hawaii* (volume N of the DNAG series) before flying to the islands.

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In Memoriam



The Society notes with regret the deaths of the following members (notifications received between 28 Jan. and 29 Apr. 2019). Memorials to deceased members are published open access at www.geosociety.org/memorial. Visit that page to learn how to honor someone with a memorial.

Prahlad K.N. Ayengar
Seattle, Washington, USA
Date of death: 17 Dec. 2017

William H. Duhling Jr.
Athens, Georgia, USA
Date of death: 14 Oct. 2017

Ian McDougall
Canberra, Australia
Date of death: 10 Nov. 2018

S. George Pemberton
Edmonton, Alberta, Canada
Date of death: 4 Aug. 2018

Harold H. Beaver
Waco, Texas, USA
Date of death: 25 Oct. 2018

John W. Gabelman
Butte, Montana, USA
Date of death: 1 July 2018

Roland C. McEldowney
Evergreen, Colorado, USA
Date of death: 3 Feb. 2019

Warren R. Rehfeldt
Grafton, Wisconsin, USA
Notified: 30 Jan. 2019

Lowell E. Bogart
Port Townsend, Washington,
USA
Date of death: 23 Feb. 2018

David C. Hedlund
Parker, Colorado, USA
Date of death: 22 Apr. 2018

Andrew McIntyre
Washington, Virginia, USA
Date of death: 2 Mar. 2019

Charles B. Reynolds
Albuquerque, New Mexico,
USA
Date of death: 29 Jan. 2018

Raymond J.T. Butler
South Guildford, Australia
Date of death: 1 June 2018

Charles S. Hutchinson Jr.
Tucson, Arizona, USA
Date of death: 3 Mar. 2019

Conrad Neumann
Durham, North Carolina, USA
Date of death: 28 Jan. 2019

Peter Robinson
Trondheim, Norway
Date of death: 25 Mar. 2019

James R. Chaplin
Noble, Oklahoma, USA
Date of death: 15 Mar. 2018

Louise H. Kellogg
Davis, California, USA
Date of death: 15 Apr. 2019

Laurence H. Nobles
Port Ludlow, Washington, USA
Date of death: 1 Apr. 2018

Floyd F. Sabins Jr.
Fullerton, California, USA
Date of death: 4 Feb. 2019

Charles Benjamin Chapman
Danbury, Connecticut, USA
Date of death: 11 Apr. 2019

William T. Kirchgasser
Colton, New York, USA
Date of death: 14 Jan. 2019

Neal R. O'Brien
West Stockholm, New York,
USA
Date of death: 26 Mar. 2019

Sanford I. Strausberg
Ormond Beach, Florida, USA
Notified: 29 Mar. 2019

E. Julius Dasch Jr.
Alpine, Texas, USA
Date of death: 14 Feb. 2019

Keith Richard Long
Marana, Arizona, USA
Date of death: 29 Mar. 2019

Charles Harris Parsons
Cypress, California, USA
Notified: 4 Mar. 2019

Jane H. Wallace
Washington, D.C.
Date of death: 3 Dec. 2018

Robert E. Maurer
Fayetteville, Pennsylvania, USA
Date of death: 21 Dec. 2018

2019 Field Award Recipients

Get into the Field with GSA!



GSA FOUNDATION

GSA Field Camp Scholars Award

These undergraduate students will be awarded US\$2,000 each to attend the summer field camp of their choice based on diversity, economic/financial need, and merit.

Jacob Adam, University of South Florida
Dominic Aluia, Michigan State University
Saida Burns-Moore, University of Memphis
Yueyi Che, University of California Berkeley
Jeng Hann Chong, University of Maryland
David Davis, Georgia State University
Lisa Duong, Georgia State University
Rebecca Goughnour, Adrian College
Cody Keith, University of Alaska Fairbanks
Carlos Montejo, California State University, Bakersfield
Kara Naegeli, Angelo State University
Holly Olivarez, University of New Mexico
Nelmary Rodríguez Sepúlveda, University of Puerto Rico–Mayagüez
Laura Taylor, University of Houston
Paige Voss, Pomona College



GSA FOUNDATION

ExxonMobil

GSA/ExxonMobil Field Camp Excellence Award

This field camp will receive an award of US\$10,000 to assist with the summer field season. This award will be based on safety awareness, diversity, and technical excellence.

Nicolas Barth, University of California Riverside

GSA/ExxonMobil Bighorn Basin Field Award

These awardees will attend a one-week field seminar in the Bighorn Basin of north-central Wyoming, USA, emphasizing multi-disciplinary integrated basin analysis. All costs will be covered.

UNDERGRADUATES

Desiree Baker, Southern Illinois University
Claudia Banks, University of Florida
Ekaterina Bolotskaya, Massachusetts Institute of Technology
John Butkevicius, Austin Peay State University
Alex Crooks, Georgia State University
Hailey Dorner, University of Nebraska–Lincoln
Stephanie Evans, Indiana University
Nicole Gonzalez, University of Colorado Boulder
Megan Heins, State University of New York Potsdam
Caje Kindred, Ohio State University
Sophia Leiter, Middlebury College
Emily Loucks, Pennsylvania State University
Andrew McGrady, West Virginia University
Andrew Michel, University of Cincinnati
Savannah Rice, Miami University
Amanda Rossi, University of Vermont

GRADUATES

Victoria Buford Parks, University of Pittsburgh
William Chandonia, Missouri University of Science and Technology
Kristen Cuellar, The University of Texas of the Permian Basin
Nicholas Ferry, University of Cincinnati
Elizabeth Ives, University of Wisconsin–Milwaukee
Jacob Thacker, University of New Mexico

PROFESSIONALS

Raphael Gottardi, University of Louisiana at Lafayette
Megan Rohrsen, Central Michigan University

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 Chapel Hill, North Carolina, USA



Marjorie A. Chan
 University of Utah
 Salt Lake City, Utah, USA

Term: July 2017–June 2021



Carmala N. Garzione
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Joan E. Fryxell
 California State University, San Bernadino
 San Bernadino, California, USA



Suzanne OConnell
 Wesleyan University
 Middletown, Connecticut, USA

Term: July 2018–June 2022



Jeff N. Rubin
 Tualatin Valley Fire & Rescue
 Tigard, Oregon, USA



Nathan A. Niemi
 University of Michigan
 Ann Arbor, Michigan, USA



Wendy A. Bohrsen (Sections Liason)
 Central Washington University
 Ellensburg, Washington, USA

NEWLY ELECTED

Term: July 2019–June 2023



Glenn Thackray
 (Divisions Liaison)
 Idaho State University
 Pocatello, Idaho, USA



Margaret Eggers
 Eggers Environmental Inc.
 Oceanside, California, USA



Katharine Huntington
 University of Washington
 Seattle, Washington, USA



GSA STUDENT ADVISORY COUNCIL CHAIR
Tyler King (through Sept. 2019)
 Utah State University
 Logan, Utah, USA



Iceland: The Formation and Evolution of a Young, Dynamic, Volcanic Island—A Field Trip Guide

By Brennan T. Jordan, Tamara L. Carley, and Tenley J. Banik

This field trip guide contains an introduction to the geology of Iceland and an itinerary for a 10-day journey around the island. The itinerary consists of 55 stops and 15 optional stops. These stops include exposure to representative examples of most phenomena typical of the island's geology and all of the major tectonic elements of Iceland. The primary focus of this guide is on volcanic and tectonic features, but topics such as glaciation, geothermal energy, geomorphology, paleontology, soil loss, and geo-tourism are also addressed.

FLD054, 118 p., ISBN 9780813700540

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A Geologist's Role in Congress



Caitlin Keating-Bitonti

On 25 Sept. 2018 I started my year-long GSA-USGS Congressional Science Fellowship in the office of Senator Tom Udall (D-NM), working on both the energy and environment portfolio and the wildlife, natural resources, and public lands portfolio teams. Thus far, the best compliment I've received from a congressional staffer was not for me, but rather for our geoscience community at large. I was told that "geologists make

for some of the best congressional fellows." I was immediately flattered after being told that geoscientists were great to work with on Capitol Hill. Then, on reflection, it became obvious why members of our community would be sought after and so valued by congressional personnel and committee offices.

Geology is inherently interdisciplinary. Earth and its processes are dynamic, requiring a command of the core, basic sciences to understand all of Earth's interacting physical, chemical, and biological aspects. This leads geologists to generally be comfortable with tackling a variety of issues outside our expertise. Our geology undergraduate degrees required introduction to physics, chemistry, calculus, and sometimes biology and statistics. Although our undergraduate schedules were overloaded with labs and our backpacks weighed down with oversized textbooks, I appreciated the opportunity to broaden my overall knowledge of the sciences.

To answer our research questions, we collaborate heavily with geologists specializing in different fields from our own and with scientists across disciplines, ranging from computer scientists to material scientists to engineers. Often, our research and collaborations involve travel to attend conferences, use labs, or collect samples. Through these travels, we experience new cultures and interact with a diversity of individuals. I've often found that geologists are genuinely interested in getting to know others and spending time together—GSA's Annual Meeting feels more like a reunion of friends instead of a society conference. Our ability to communicate, engage, and navigate within our community and among foreign colleagues, rural communities, private landowners, government agencies, etc., in our travels are highly transferable skills. A day in Congress might have you meeting with the Frankfurt Zoological Society to discuss preservation needs in the Serengeti National Park, sitting down with World Wildlife Federation representatives who flew in from Brazil to raise concerns regarding the violation of indigenous people's rights in the Amazon, or inviting academic forest ecologists to brief Hill staff on the increasing intensity and frequency of wildfires occurring in western states. Our willingness to travel makes us in tune with how interconnected Earth is, and our effective communication skills have prepared us to hold crucial, needed conversations.

Geologists care deeply for our planet's well-being, and our research on Earth's past, present, and future states reflects this. Thus, I believe geologists are more willing than scientists in other

fields to work on tangentially related earth-science policy issues. During the time that I've been on Hill, I've been involved in conversations related to water security (e.g., Colorado River Drought Contingency Plan Authorization Act of 2019), wildlife and public land conservation (e.g., America's Public Land Act of 2019), climate change (e.g., Green New Deal Resolution), data availability (e.g., Geospatial Data Act of 2017), etc., and none of these topics were part of my dissertation. I have also reviewed legislation for increased investment in clean and renewable energies to mitigate climate change and analyzed policy for hard rock mining reform to preserve our nation's cherished public lands.

Particularly unique to our field is our ability to grasp the concept of deep time and geologic rates. Thinking of cyclical processes that occur on decadal timescales to those that occur on hundreds of million-year timescales comes second nature to geologists, whereas the average person likely thinks of time on the scale of years to months to the number of hours left in the work day. Once at a GSA Annual Meeting I overheard someone refer to the Cenozoic as "recent," remarking that it was "too young of a time interval" to be of interest to them. The Cenozoic spans the past 65 million years of Earth's history!

Our broad and long-term perspective of earth processes has value in policy making. When considering new methane venting and flaring regulations, geologists can reflect on the rates of global warming associated with the hypothesized dissociation of oceanic methane clathrate and its oceanographic consequences in the early Eocene. When confronting PFAS water contamination issues, geologists can examine the rates and directions of groundwater flow to anticipate impacted communities and mitigate timely clean-up efforts. When anticipating the next "big one," geologists can advocate for improved transportation and building infrastructure. My favorite story from a congressional natural-hazard briefing was about the 2002 M7.9 earthquake on the Alaska Denali fault—"the biggest natural hazard that no one heard about." The reason this large earthquake did not make the news was that geologists projected fault movement up to 20 feet, and when engineers built the Trans-Alaska Oil Pipeline they mounted it on steel beams that allowed it to freely slide where it crossed the fault. Thus, when the rupture crossed the pipeline, there was no structural damage or oil spill associated with the earthquake. Thus, geologists have the foresight to include this type of research in the drafting of energy and infrastructure legislation. Thus, our knowledge of deep time and geologic rates is essential for understanding what is and, perhaps more relevant to today, is not normal in Earth's history.

Our investigations use a variety of data sources and analytical approaches. We ask our colleagues both thoughtful and demanding questions. We readily critique data and statistics and understand the verbal, written, and visual information presented to us. (Trust me, people will try to gloss over or omit key data when speaking with policy makers!) Geologists know how to make persuasive arguments—we spend a good chunk of our office time writing competitive grant applications and letters to editors

in hopes of getting funded or published. Along those lines, we can also handle rejection, thereby writing more persuasive arguments next time around. These are skills that geologists, and more broadly scientists, learned early on in their careers that come in handy daily in Congress.

Although some, including members of our field, might think that our expertise does not directly relate to legislative policy, the skills and perspectives geologists possess bring great value to the Hill. We are a community of smart, adventurous, hard-working people. Our insight and expertise is sought after and appreciated by policy makers. If someone on the Hill reaches out with an earth-science-related policy question, you and your earth-science peers are more capable and prepared to provide the answer than you might expect.

This manuscript is submitted for publication by Caitlin Keating-Bitonti, 2018–2019 GSA-USGS Congressional Science Fellow, with the understanding that the U.S. government is authorized to reproduce and distribute reprints for governmental use. The one-year fellowship is supported by GSA and the U.S. Geological Survey, Department of the Interior, under Assistance Award no. G18AP00098. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. government. Keating-Bitonti works in the office of Senator Tom Udall (D-NM) and can be contacted by e-mail at crkeatin@gmail.com.

36th International Geological Congress (IGC) Mentoring and Travel Grant Program

Delhi, India | 2–8 March 2020

GSA is accepting applications for its mentoring and travel-grant program to the 36th International Geological Congress (IGC) in Delhi, India. Students and early career professionals (those within seven years of receiving their Ph.D.) are welcome to apply.

To be eligible, the applicant must be a resident or citizen of the United States and be enrolled in, or employed at, a U.S. institution. Each award is anticipated to be a maximum of US\$3,500.

Complete applications will consist of

- An online application form;
- A cover letter addressing your reasons for attending the meeting;
- A prioritized budget of expenses;
- A copy of your submitted abstract; and
- One letter of recommendation.

Applications must be received electronically no later than 3 Sept. 2019 at www.geosociety.org/GSA/Education_Careers/Field_Experiences/GSA/fieldexp/home.aspx.

This program is organized in collaboration with the GSA Foundation, the U.S. National Committee for Geological Sciences (of the National Academy of Sciences), and the American Geosciences Institute.

Questions? Contact Jennifer Nocerino, jnocerino@geosociety.org, +1-303-357-1036.

Congressional Visits and the Power of a Good “Ask”



Sarah Derouin
GSA Science
Communication Fellow

Geologists like to follow the clues, collecting evidence to reconstruct past histories. We use facts to decide what questions to answer and what sort of information still needs to be uncovered. Geoscientists are great stewards for the planet—considering the problem-solving we do every day, we are also a valuable resource to representatives as they make important policy decisions.

Throughout the year, scientific organizations like the Geological Society of America sponsor Congressional Visits Days, matching scientists with congressional representatives. During these visits, small groups of scientists meet with staffers to talk about issues facing their districts, the country, and even the entire planet. The goal of these meetings is to foster trusted relationships with the representative’s staff through a face-to-face conversation while building awareness of scientific issues.

This spring, I attended Climate Science Day (CSD) in Washington, D.C., representing GSA. The goal of CSD was to emphasize the importance of incorporating the scientific community’s consensus on climate science into policy discussions and decisions.

An important part of that discussion is to spur your representative to action on science policy, all by leveraging an important technique: the “ask.”

What Is an Ask?

During a congressional visit, the most important message for your representative is the ask. An ask is something that you would like them to do—a call to action. A topic as big as tackling climate change can be overwhelming, but breaking down the issue into smaller pieces is an effective approach for moving science further into policy decisions. Representatives appreciate a concrete task to work toward, and it is your job to help them understand what is needed.

Our goal for CSD was to remind representatives that climate science can be used for bipartisan decision making. The ask, or how they could implement this goal, could include:

- Contact scientists with questions on climate science and other issues;
- Visit a research institution and/or field site;
- Host discussions with scientists and community leaders about the impacts of a changing climate in your state/district;
- Bring climate science to relevant policy discussions, such as infrastructure, hazards, coasts, and agriculture;
- Hold hearings that are interdisciplinary, explore groundbreaking impacts, or garner bipartisan support;
- Make a floor speech regarding the scientific community’s understanding of the changing climate and the influence of humans, the impacts of a changing climate on your district/

state, or the research happening on the topic in your state;

- Circulate a “Dear Colleague” letter sharing the scientific community’s view of climate change and the role of humans; and
- Speak out when policymakers state a view that is inconsistent with scientific consensus on climate change.

Tailoring an Ask

The ask should be as specific as possible—avoid generalities and open-ended tasks. Although following the latest scientific research on climate change might seem like an obvious choice to you, this request is too vague and too big. Representatives, and the staff who support them, juggle a long list of to-dos, and expecting a non-scientifically trained staffer to scour through the literature is unrealistic.

Instead, dig into the details. For example, if you know a bill is being sponsored to address coastal erosion, and you are a coastal geomorphologist, offer up your expertise as they navigate through the policy language. If your laboratory is making exciting strides in solar battery life expectancy, invite your representative to the lab to see the scientific strides you are making and highlight any business interests your research has created.

Once you present the ask, try to connect it to issues near and dear to the representative’s heart. Before the congressional visit, look up the representative online and get a feel for their passions—are they an advocate for health care? Perhaps you can connect climate science to health concerns in the district, mentioning new research linking climate change to cardiopulmonary distress (<https://www.who.int/en/news-room/fact-sheets/detail/climate-change-and-health>) during your meeting.

Tailoring your ask to their interests and creating a personalized message will stick with the staffer long after your meeting is done.

The Impact of an Ask

A 2016 survey (http://www.congressfoundation.org/storage/documents/CMF_Pubs/cmf-citizen-centric-advocacy.pdf) showed that only 11% of voters thought that representatives listen to them, and I have to say that I was one of the cynical majority. But it turns out that 94% of congressional staff said “in-person issue visits from constituents” influence representatives on undecided issues.

I came away from my congressional visit feeling inspired and motivated to continue reaching out to my representatives. My experience at CSD was extremely positive and revealed that scientists’ voices are a valuable resource on policy issues—we just need to show up.

To be a part of the science policy process, apply to be a representative for this fall’s GEO–Congressional Visits Day: www.geosociety.org/geocvd.

Ads (or cancellations) must reach the GSA advertising office no later than the first of the month, one month prior to the issue in which they are to be published. (Note: Combined March/April issue releases on March schedule.) Print ads will also appear on the Geoscience Job Board to coincide with the month of print issue. **Contact: advertising@geosociety.org**, +1-800-472-1988 ext. 1053, or +1-303-357-1053. Email correspondence should include complete contact information (including phone and mailing address). Rates are in U.S. dollars.

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Fellowship Opportunities	\$9.35	\$9.30
Opportunities for Students		
First 25 lines	FREE	\$5.00
Additional lines	\$5.00	\$5.00

POSITIONS OPEN

Assistant Professor (Tenure Track) in Paleoclimate Sedimentology, University of Lausanne

The Faculty of Geosciences and the Environment (FGSE) of the University of Lausanne invites applications for a professorship in Paleoclimate Sedimentology, to be based in the Institute of Earth Sciences (ISTE).

We are looking for an excellent sedimentologist who focuses on the reconstruction of past climate changes (including sedimentary, paleoclimate, biological and paleoceanography changes) at geological timescales using the stratigraphic and sedimentary record. We seek a candidate who can provide an innovative interpretation of sedimentary archives, using laboratory, and field techniques and reconstructing Earth system history. The ideal candidate should have a strong background in geology, a strong commitment to field-based research and a willingness to contribute to field-based teaching.

The successful candidate will actively participate in the research activities of the Institute of Earth Sciences, will teach in the Bachelor of Geosciences and Environment and in relevant Masters taught by the FGSE, and will supervise masters and doctoral students.

Appointment will be at the Assistant Professor level (tenure track). However, exceptionally, we will consider outstanding candidates for direct appointment to the Associate or Ordinary Professor level, notably if this corresponds with our equal opportunity objectives.

The application should include a cover letter (max 0.5 page), a full Curriculum Vitae, a research statement (max. 4 pages), a teaching statement (max. 2 pages), PDFs of the three most significant publications, and the names and contact information of five referees. For further information, contact Prof. Frédéric Herman, Dean of the FGSE (frederic.herman@unil.ch).

Application deadline: August 24th, 2019 (23:59 Swiss time GMT+2).

The application in PDF must be shared in several document not bigger than 9.9 MB and will be considered only if sent through this website where you find a full description of the position: <https://bit.ly/2PPF6Da>.

Or www.unil.ch/central/en/home.html → **Jobs** → **search sedimentology**.

Application deadline: August 24th, 2019 (23:59 Swiss time GMT+2).

Assistant (Tenure-Track) or Associate (Tenured) Professor in Solid Earth Geophysics, The University of Texas at Austin

The Dept. of Geological Sciences in the Jackson School of Geosciences at The University of Texas at Austin seeks to hire a faculty member in the field of solid Earth geophysics at the Assistant (tenure-track) or Associate Professor (tenured) level. We are looking for an outstanding scientist who will establish an innovative, externally funded research program and will be committed to both teaching and mentoring at the undergraduate and graduate levels. The successful applicant is expected to develop a vibrant research program that contributes to the understanding of the dynamics and evolution of the solid Earth and complements existing strengths within the Jackson School. Areas of specialization might include, but are not limited to, seismology, geodesy, and geodynamics. Review of applications will begin September 1, 2019, and will continue until the position is filled.

The Dept. of Geological Sciences is part of the Jackson School of Geosciences (JSG), which also includes two research units, the Institute for Geophysics and the Bureau of Economic Geology. With over 190 research scientists and faculty, the Jackson School of Geosciences is one of the largest academic earth science schools in the country. The University of Texas is also home to the Oden Institute for Computational Engineering and Sciences and the Texas Advanced Computing Center. The University is located in a thriving metropolitan area with a dynamic, multicultural community of over one million people. The department is interested in building a culturally diverse intellectual community and we strongly encourage applications from all underrepresented groups. The University of Texas at Austin is an Equal Opportunity Employer with a commitment to diversity at all levels.

Interested applicants should submit a cover letter, CV, research statement, teaching statement, statement addressing past and/or potential contributions to diversity through research, teaching, and/or service, and a list of at least three individuals who would be able to provide letters of refer-

ence. Submit copies of these materials online at <https://apply.interfolio.com/63707>. Questions concerning the application process or receipt of application materials should be sent to Patrick Stafford (stafford.patrick@jsg.utexas.edu).

OPPORTUNITIES FOR STUDENTS

Ph.D. Opportunity in Active Tectonics and Remote Sensing, University of Canterbury. One fully funded Ph.D. scholarship in active tectonics and remote sensing is available through a joint research initiative with Dr. Tim Stahl at the University of Canterbury and Dr. Kate Clark at the Institute of Geological and Nuclear Sciences (GNS). The successful applicant will join a research team utilising novel photogrammetric datasets and techniques, alongside field work, to research historical earthquake fault ruptures in a range of tectonic environments in New Zealand. Research topics include (1) developing techniques for processing historical aerial photographs into digital elevation data; (2) analysis of pre- and post-earthquake data for the purpose of assessing fault geometries, connectivity and kinematics; (3) modelling multi-fault ruptures using geologic and remotely sensed validation datasets, and exploring the implications of this research for seismic hazard analysis.

The ideal candidate will have strengths in active tectonics, paleoseismology, and/or geomorphology, and will have worked with remote sensing data. Field experience in active tectonics/geomorphology would be beneficial and experience in computational science, programming &/or numerical modelling is required. Masters degree or BS/BSc degree with significant research and work experience required. The Ph.D. position will be based in Christchurch, New Zealand, at the University of Canterbury. There will be opportunities to undertake research visits to GNS Science, Lower Hutt. Applications will be accepted until 15 July 2019 or until the position is filled. Please email timothy.stahl@canterbury.ac.nz with your CV and cover letter. Candidates from under-represented and diverse backgrounds are encouraged to apply.

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Use print issues of GSA Today and GSA's Geoscience Job Board (www.geosociety.org/jobs). Bundle and save for best pricing options.

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Why I Give: The GSA Foundation's Board of Trustees

The GSA Foundation is fortunate to have a strong volunteer base of dedicated geologists from across the full breadth of our science. The members of our Board of Trustees generously volunteer their time and resources to ensure both our success and that of the Society's. Several board members wanted to share with you why they invest their time, talents, and resources in GSA—and why they hope you will do the same.

Judy Parrish: GSA is a premier geological society that has strong and diverse programs to serve students. Its journals are among the top ones in our discipline, and the membership has a strong appreciation for the continued value of fieldwork, as well as the development and application of new technologies. It is one place where you really can see the impact of your giving.

Jack Shroder: You could give your money in a variety of ways or to a lot of different organizations but your donation to GSA can be followed easily from donation, through student application, to recipient so that you can see where it goes or what it is being used for.

Wes Ward: Many people, most of whom I will never meet, made it possible for me to have a great career in geology. They had the foresight to set up or contribute to a fund to help undergrads and graduate students such as I was then. Their faith in future generations is something I admire and feel obligated to emulate—something I very much enjoy. I am proud to do my part in the development and continuation of our science.

Darrel Cowan: GSA has always been my home society, even as an undergraduate. I published my first paper in the *GSA Bulletin* and presented my first talks while a graduate student at Section Meetings. I give to GSA partly as thanks for everything it provides to our community.

Terri Bowers: GSA members were such a community for me when I was young that now is the time for me to help on the other end. There has never been a time when earth-science education was so important as it is now—yet resources for this support are ever more limited. I don't know if we, the Society members, can make up the gaps, but we have to try.

Rex Buchanan: The discipline of geology has been a welcoming professional home to me. I've developed relationships in the community that I value highly. Supporting GSA is one way to pay back the discipline for what it's given me. This is also a challenging time for science and scientific societies. And that makes support of GSA more important than ever.

Steve Wells: The Geological Society of America has been my professional society of choice since I was a graduate student in the early 1970s. As a student, young professional, professor, and academic administrator, I have benefited from the Society in ways that I cannot measure. From support for my graduate research to honing my professional leadership skills, the Society has been one of the most important factors in my career over the past 40 years. Giving is a very small step I can take to ensure that GSA will continue to provide these types of positive impacts in the future.

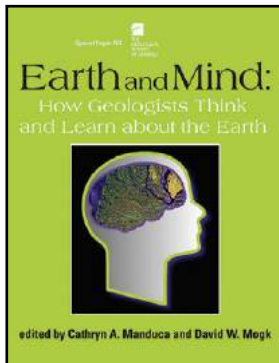
Do you have a similar experience? Are you ready to give back? Your generosity will support the broader geoscience community and aid GSA members from their student years to retirement. If you have questions about ways to significantly support GSA programs, please contact Clifton Cullen at +1-303-357-1007 or ccullen@geosociety.org. To learn more about the GSAF Board of Trustees, visit gsa-foundation.org/trustees.

Tom Holzer, GSAF Board Treasurer, presents his financial report during the Trustees meeting held before GSA 2019 in Indianapolis. GSAF Trustees graciously donate their time to provide guidance and leadership for the Foundation.

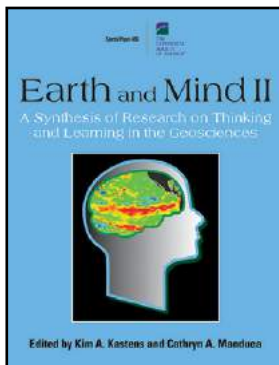


Geology in the Classroom

If you're an educator looking for insight and inspiration to help keep you motivated, you'll want to check out these Special Papers from GSA. Both volumes, which are available for download from the GSA bookstore, explore how improved understanding of how humans think and learn about the Earth can help educators prepare the next generation of geoscientists.



Earth and Mind: How Geologists Think and Learn about the Earth presents essays by geoscientists, cognitive scientists, and educators that explore how geoscientists learn and what the implications are for student learning. (SPE413P, 188 p., ISBN 0813724139, US\$9.99)

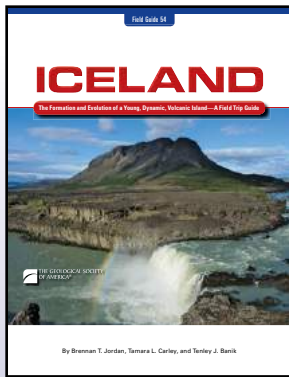


Earth and Mind II: A Synthesis of Research on Thinking and Learning in the Geosciences explores the ways in which geoscientists use the human senses and mind to perceive, analyze, and explain the workings of the earth system and how to help students master the thought processes of the geosciences. (SPE486P, 210 p., ISBN 9780813724867, US\$9.99)

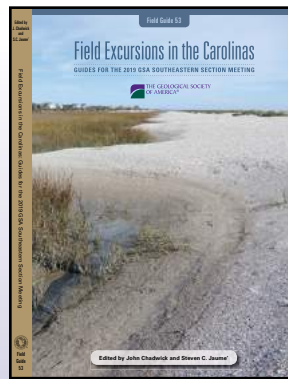


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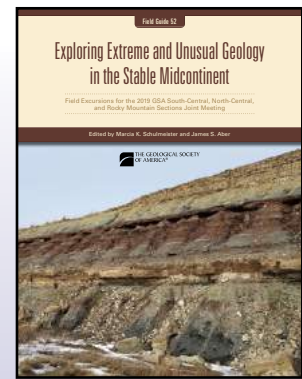
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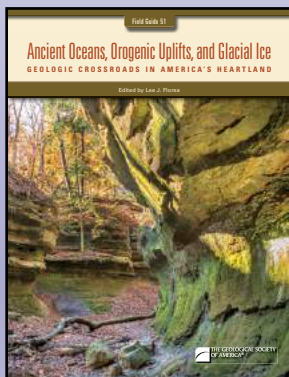
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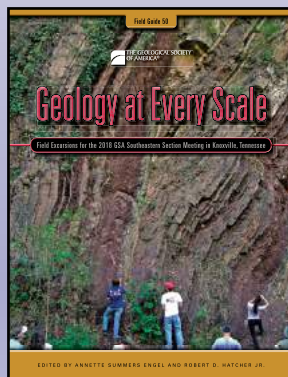
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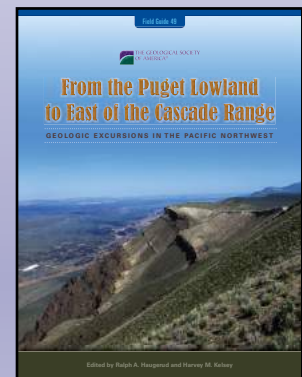
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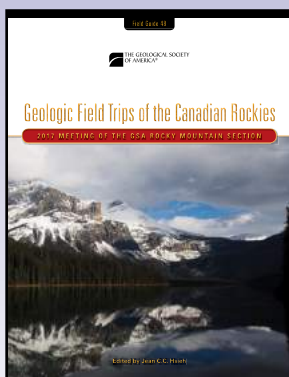
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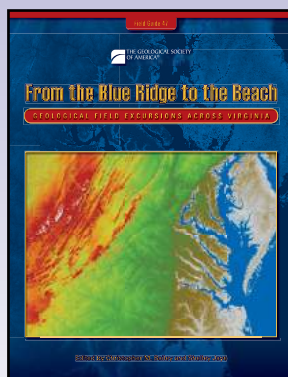
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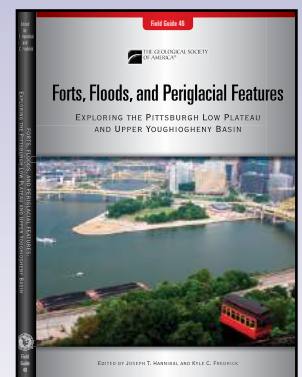
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