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## Triassic Eustatic Variations Reexamined



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## SCIENCE

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**Cover:** A view of the Dolomites from NW Italy where a nearly complete marine record of the Triassic is preserved in carbonate buildups. Over a century of studies have produced a detailed biostratigraphy that helps tie together eastern and western Tethys as well as boreal sections. Photo by Bilal Haq.



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# Triassic Eustatic Variations Reexamined

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## ABSTRACT

Documentation of eustatic variations for the Triassic is limited by the paucity of the preserved marine stratigraphic record, which is confined mostly to the low and middle paleolatitudes of the Tethys Ocean. A revised sea-level curve based on reevaluation of global stratigraphic data shows a clear trend of low seastands for an extended period that spans almost 80 m.y., from the latest Permian to the earliest Jurassic. In the Early and Middle Triassic, the long-term sea levels were similar to or 10–20 m higher than the present-day mean sea level (pdmsl). This trend was reversed in the late Ladinian, marked by a steady rise and culminating in peak sea levels of the Triassic (~50 m above pdmsl) in the late Carnian. The trend reverses again with a decline in the late Norian and the base level remaining close to the pdmsl, and then dipping further in the mid-Rhaetian to ~50 m below pdmsl into the latest Triassic and earliest Jurassic. Superimposed upon this long-term trend is the record of 22 widespread third-order sequence boundaries that have been identified, indicating sea-level falls of mostly minor (<25 m) to medium (25–75 m) amplitude. Only six of these falls are considered major, exceeding the amplitude of 75 m. The long interval of Triassic oceanic withdrawal is likely to have led to general scarcity of preserved marine record and large stratigraphic lacunae. Lacking evidence of continental ice sheets in the Triassic, glacio-eustasy as the driving mechanism for the third-order cyclicity can be ruled out. And even though transfer of water to and from land aquifers to the ocean as a potential cause is plausible for minor (a few tens of meters) sea-level falls, the process seems counter-intuitive for third-order events for much of the Triassic. Triassic paleoenvironmental scenarios demonstrate a close link between eustasy, climates, and biodiversity.

## INTRODUCTION

The Triassic Period encompasses 50.5 m.y., spanning an interval from 251.9 to 201.4 Ma (Ogg et al., 2016). By this time, the megacontinent of Pangaea had already assembled, surrounded by the Panthalassa Ocean that covered >70% of Earth's surface, and by the mid-Triassic the Pangaeon landmass was almost evenly distributed in the two hemispheres around the paleo-equator (see Fig. S1 in the GSA Data Repository<sup>1</sup>). The interval from latest Permian through the earliest Jurassic, a time span of nearly 80 m.y., represents the longest spell of low seastands of the Phanerozoic. The Triassic is also bracketed by two major biotic extinctions near the Permian-Triassic (P-T) and Triassic-Jurassic boundaries, the one at P-T boundary being the most severe biotic turnover of the Phanerozoic (Raup and Sepkowski, 1982; Hallam and Wignall, 1997; McElwain et al., 1999). The Late Triassic experienced the beginning of the lithospheric swell, ushering the breakup of Pangaea and its eventual split into discrete continents in the later Mesozoic (see Fig. S1 [see footnote 1]). The definite signs of the beginning of Pangaeon fragmentation were clearly manifest by the end of the Triassic with the basaltic outpouring of the massive Central Atlantic magmatic province (see, e.g., Marzoli et al., 1999, 2004; Davies et al., 2017).

In the past two decades substantial new stratigraphic data from Triassic sections has come to light, and there have been significant refinements in time scales, making a review and revision of the Triassic sea-level variations timely. The documentation for the revised Triassic sea-level curve, though still largely from northwestern and central Europe (western Tethys), now also includes sections further east from other parts of the Tethys, such as the Arabian Platform, Pakistan, India, China, and Australia. From the boreal latitudes

documentation includes sections from the Sverdrup Basin, Svalbard, and the Barents Sea. This paper serves to complete a review of the entire Mesozoic as both Cretaceous and Jurassic sea-level variations have already been reappraised (Haq, 2014, 2017). For a background of the paleoenvironmental conditions (oceans and climates) in the Triassic see the GSA data repository (see footnote 1).

## TRIASSIC TIME SCALE UPDATES

A succinct discussion of the methodological advancements and modifications to the Triassic time scale can be found in Preto et al. (2010), and a detailed discussion of Triassic stratigraphy has been presented by Ogg et al. (2014). Since the last update of the Triassic third-order sea-level variations (Haq and Al-Qahtani, 2005) that was calibrated to an earlier version of the time scale, there have been several refinements to the Triassic chronostratigraphy. The latest version of the time scale (Ogg et al., 2016) modifies the boundaries of Triassic standard stages (ages) by anywhere between <1 m.y. to almost 6 m.y. Like earlier versions, the new time scale is mainly based on biostratigraphy, anchored by selected radiometric dates, with some intervals refined by astronomical and cyclostratigraphical fine-tuning, and others aided by magnetostratigraphy. Conodonts and ammonoids constitute the mainstay of the Triassic biostratigraphic correlations. Special problems concerning wider correlations using these fossil groups in the Triassic include taxonomic standardization, rarity of markers, potential diachrony in conodonts' first and last appearance, and provinciality among ammonoids. Since much of the Pangaeon landscape was dominated by terrestrial sediments, regional correlations often rely on palynology, ostracods and tetrapods that do not lend themselves to wider correlations with marine records. Ogg et al. (2016) ascribe a

*GSA Today*, v.28, <https://doi.org/10.1130/GSATG381A.1>. Copyright 2018, The Geological Society of America. CC-BY-NC.

<sup>1</sup>Data Repository item 2018390, background and documentation of depositional sequences for the new Triassic sea-level curve, is online at [www.geosociety.org/datarepository/2018/](http://www.geosociety.org/datarepository/2018/).

composite error of between 0.2 and 0.59 m.y. for the stage boundaries in the Triassic depending on the type of data (see also the GSA data repository for further discussion of time scales [see footnote 1]).

### **LARGE TIME GAPS IN THE RECORD OF THE MIDDLE AND LATE TRIASSIC?**

Even a cursory look at the most recent update of the Triassic time scale (Ogg et al., 2016) reveals its extreme lopsidedness: while the Early Triassic spans only 5.1 m.y. and the Middle Triassic increases to 9.1 m.y., the Late Triassic jumps to a substantial span of 35.6 m.y. Some unevenness is to be expected, but this extreme asymmetry is also witnessed in the time spans of the stages (ages) and biostratigraphic zones within the stages, as well the lengths of the sequence cycles and corresponding sea-level events that all increase in duration in the Middle to Late Triassic.

If the above apparent chronostratigraphic asymmetry is real, then the large differences in the duration of fossil zones imply that evolutionary rates (as measured by appearance of new species/m.y.) were relatively rapid in the Early Triassic (thus the availability of a high-resolution biozonal subdivision), declining somewhat in the Middle Triassic, and slowing down to an extreme thereafter (characterized by a few long-duration biozones), especially in the later Late Triassic. However, the temporal lengths of sequence cycles (based on sedimentary facies shifts) do not have to follow the biotic evolutionary trends, and yet they do. Their long time spans (average of ~5 m.y./cycle in the Middle and Late Triassic) would imply a built-in bias in the record expressed as a lack of preserved marine stratigraphic record. This seems plausible in a scenario where the long-term trend of low seastands for the period means fewer marine records in favor of more terrestrial sedimentary records. This is exacerbated by mostly type-1 sequence boundaries (when the base line withdraws beyond the shelf edges) that may incorporate large erosional time gaps. Large temporal lacunae in the stratigraphic record could explain the potentially specious signal that comes across as slowdown in the biotic evolutionary rates, as well as the dearth of sequence cycles for the interval in question (i.e., Middle and Late Triassic). An oxygen-isotopic record of the Triassic derived from Tethyan conodont apatite shows trends that

are similar to the sea-level curve, recording only a long-duration signal in the Late Triassic (Trotter et al., 2015). This singular attribute of the Triassic stratigraphy (i.e., the potential of missing marine stratigraphic record and large time gaps that shows up in sequence-stratigraphic signal) requires further thought and inquiry.

### **REEVALUATION OF THE TRIASSIC SEA-LEVEL CURVE**

As stated above, the main correlative criteria for the Triassic marine strata are ammonoid and conodont biostratigraphies. The distribution of Triassic ammonoids taxa in the boreal latitudes (e.g., British Columbia, Siberia), however, was not the same as those in the Tethyan realm, and this provinciality poses limitations for direct correlations. The detailed cross-correlation schemes provided by Hardenbol et al. (1998) that have attempted to tie marine and terrestrial biostratigraphies from the Tethyan and high latitudes are invaluable for the longer distance correlations. The correlation chart of these authors also provides links to the stratigraphic distribution of other Tethyan fossil groups, such as calcareous nannofossils, dinoflagellates, larger foraminifera, ostracods, radiolarians, and spore and pollen, which can be invaluable in constraining some of the long-distance correlations (Hardenbol et al., 1998, chart number 8).

In this reappraisal of the Triassic sea-level variations, which uses all available sequence-stratigraphic data published since the last such compilation (Haq and Al-Qahtani, 2005) as well as older studies, was reevaluated before inclusion in the current synthesis. The documentation for the revised Triassic sea-level curve still comes largely from low to temperate paleolatitudes of the Tethys, but also includes its boreal counterpart sections from the Sverdrup Basin, Svalbard, and the Barents Sea. As indicated previously for the Jurassic (Haq, 2017), the reliance mainly on ammonoids and conodont biostratigraphies for correlations means that the built-in uncertainty in the proposed ages of sequence boundaries is equal to the duration of the biozone (or subzone) that is used to date the boundary. This means that error-bars are relatively small in the Induan through Anisian interval (average zonal duration = 0.34 m.y.), increase to medium levels for the Ladinian through earliest Tuvanian interval (average ammonoid zonal

duration = 0.77 m.y.), and expand for the remainder of the Carnian through Rhaetian interval (average ammonoid zonal duration = 2.43 m.y.). Using multiple overlapping criteria (i.e., several fossil groups), these uncertainties can sometimes be narrowed.

The long-term sea-level envelope for the Triassic is similar to those shown in Haq et al. (1987, 1988) and Hardenbol et al. (1998). The original long-term curve for the Triassic was based on continental flooding data and this is still the case, because other constraints for this envelope, such as mean age of oceanic crust, are not available since almost all of the Triassic age oceanic crust has since been subducted, with the exception of a limited area of the seafloor on Exmouth Plateau west of Australia (von Rad et al., 1989). Recently van der Meer et al. (2017) have produced independent estimates of the long-term sea level based on Sr-isotope data, which show close similarities to the continental flooding curves and to the long-term Triassic curve presented here, although the interpreted amplitudes differ. The documentation for the short-term (third-order) sea-level events is based on sequence-stratigraphic information pieced together from several available longer duration sections and augmented by some shorter-duration records. In addition to sequence-stratigraphic interpretive criteria that are now well established and do not require repetition, other features that were particularly helpful in stratigraphic interpretations (originally listed in Haq and Schutter, 2008) in the Triassic include forced-regressive facies, organic-rich facies of the condensed sections, transgressive coals, evaporites, exposure-related deposits (including incised valley fills, autochthonous coals, eolian sandstones, and karst), and laterite/bauxite deposits. These features can often aid in the identification of depositional surfaces and system tract boundaries on outcrops and in well logs.

The earlier syntheses for the Triassic period (Haq et al., 1987, 1988; Hardenbol et al., 1998; Haq and Al-Qahtani, 2005) continue to be the basis for the new revision presented here. The Triassic cycles presented in Haq et al. (1987, 1988) were based on sections from NW Europe (Italy, Austria), the Arctic (Svalbard, Bjørnøya in the Barents Sea), and Pakistan (the Salt Range). Hardenbol et al. (1998) considerably augmented this Triassic data from the European basins, putting it on better-defined biostratigraphic footing and

identifying 13 additional sequences as well. The Triassic portion of Haq and Al-Qahtani (2005) was mainly based on cycles identified from the Arabian Platform. For the current reappraisal, those data have been further augmented with third-order cycles from published sources as follows: the Triassic of Northern Germany (Aigner and Bachmann, 1992) and Induan through Ladinian of Black Forest (Bourquin et al., 2006); Induan through Carnian of Balaton, Hungary (Budai and Haas, 1997); the Triassic of Transdanubian Range in Hungary, the Calcareous Alps of Austria and of Germany, and the Lombardi Basin in Italy (vide Haas and Budai, 1999, and references therein; also see the GSA data repository [see footnote 1]); the Triassic of Sverdrup Basin (Embry, 1997); the Triassic of Norwegian Barents shelf, Bjørnøya and Svalbard (van Veen et al., 1992; Glørstad-Clark et al., 2010; Mørk et al., 1989); the Triassic of Arabian Platform (Sharland et al., 2001, 2004; Haq and Al-Qahtani, 2005); the Triassic of United Arab Emirates (Maurer et al., 2008); the Triassic of Spiti, northern India (Bhargava et al., 2004; Krystyn et al., 2005); Induan through mid-Anisian of eastern Yangtze Platform, China (Tong and Yin, 1998); and the Triassic of Carnarvon Basin, Australia (Gorter, 1994). It is apparent from this list that the Triassic sea-level variations as documented in the new cycle chart remain mostly centered in the Tethyan realm (its western boreal and its eastern low to temperate latitudes extensions) (see the GSA data repository [footnote 1] for the complete documentation of the sequence boundaries of the Tethys realm).

## RESULTS AND DISCUSSION

The results of the revision of the Triassic cycle chart are shown in Figure 1. Since the revised eustatic curve is largely based on the sections in the low- to mid-latitudes of the Tethys Ocean, the biochronological scheme that is adopted here (after Ogg et al., 2016) is also Tethys-centric.

The long-term eustatic trend shows that at the dawn of Triassic sea levels were near or a few meters higher than the present-day mean sea level (pdmsl) and then rose only ~10–20 m in the Induan and Olenekian.

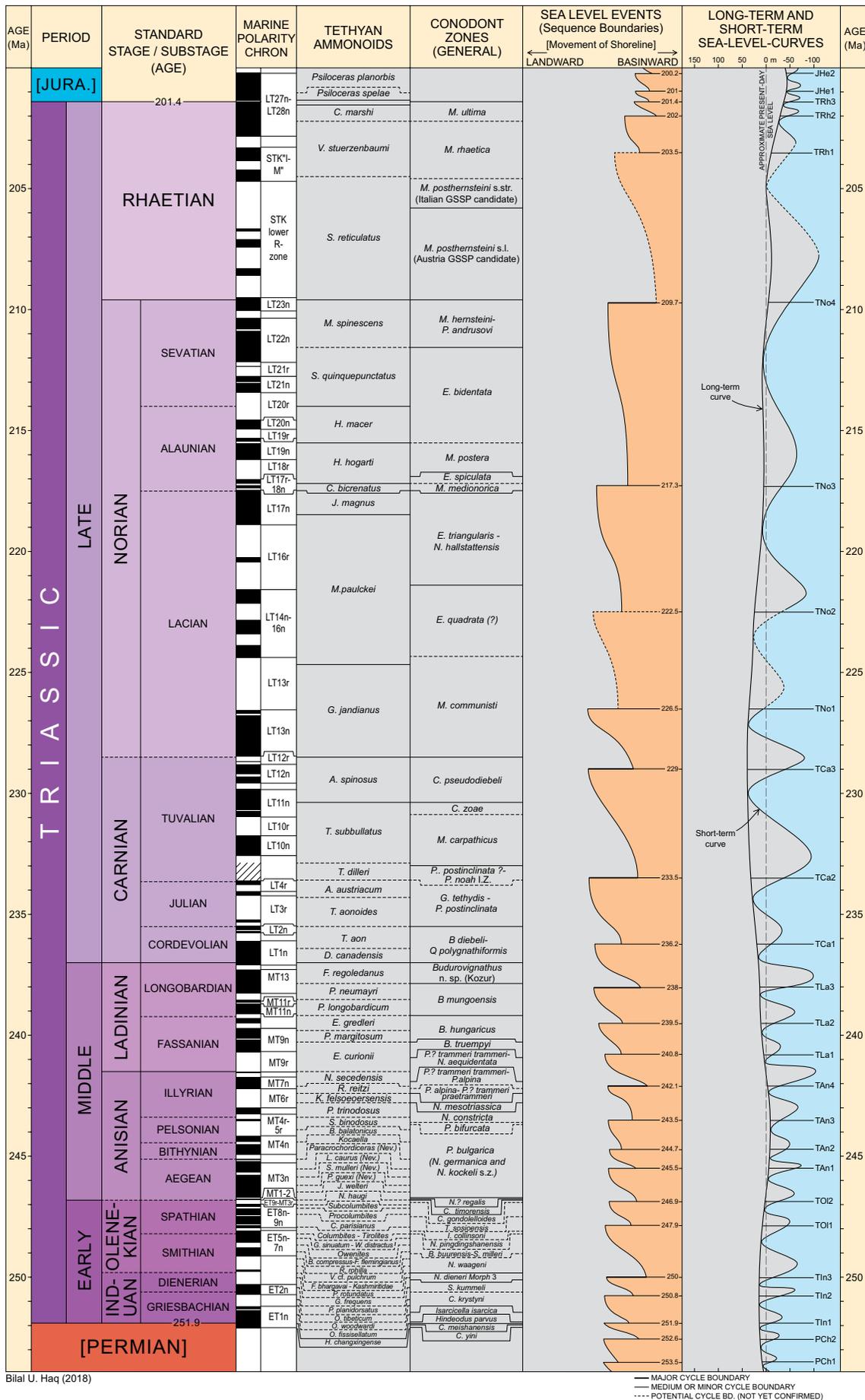
The base level actually fell just below pdmsl in the Anisian, reserving this trend in the Fassanian substage of the early Ladinian when a steady rise is seen that culminated in the highest sea levels of the Triassic (~50 m above pdmsl) in the Tuvalian substage of the late Carnian. From this peak the trend reverses again to a long-term decline in the Lacinian substage of the early Norian. Through the Alaunian and much of the Sevatian substages of the late Norian, the base level remained steady and very close to pdmsl. At the Norian-Rhaetian boundary the base level dips once again just below pdmsl, recovering for a short time in the mid-Rhaetian and then declining rapidly to almost 50 m below pdmsl in the latest Triassic and earliest Jurassic.

The short-term sea-level curve, superimposed on the long-term eustatic curve, is based on sequence boundaries that are consistently correlatable in several basins are therefore considered widespread. Two cycles, one each in the Norian and the Rhaetian (TNo2 at 222.5 Ma and TRh1 at 203.5 Ma), are included tentatively, pending their confirmation from other areas as being more widespread. The amplitudes of third-order cycles (measures of sea-level falls in meters) are particularly difficult to estimate. The estimates of sea-level falls are always relative to the preceding highstand, and their determination criteria can include such relative measure as thickness of the system tracks, bio- and lithofacies depth assessments, depth of incision of shelves (in case of type-1 sequences), and partial back-stripping (see Haq, 2014, for further discussion). In the cycle chart presented here (Fig. 1) they are averaged from stratigraphic estimates in several basins and should be considered best guesstimates. They are categorized into three groupings of sea-level falls: major (>75 m of fall relative to previous high), medium (25–75 m of relative fall), and minor (<25 m of relative fall). Most Triassic sea-level falls were apparently of medium to minor magnitudes. The six falls that exceeded the 75 m amplitude, and are therefore considered major, include TIn3 at 250 Ma; TAn4 at 242.1 Ma; TLa3 at 238 Ma; TCa2 at 233.5 Ma; TCa3 at 229 Ma; and TNo4 at 209.7 Ma.

One clear trend in the Triassic is the overall low seastands of this period. If one were to also include the lowstands on both ends of the Triassic, i.e., in the latest Permian (starting ca. 260 Ma) as well as the earlier Jurassic (ending ca. 180.5 Ma), it represents an interval of almost 80 m.y., when the sea levels were universally low and do not seem to have risen more than 50 m above pdmsl at the highest point (in the Carnian). This 80-m.y. period was also an interval when there is no known evidence of large continental glaciations anywhere in the higher latitudes. Such a long duration of oceanic withdrawal from the large landmass of Pangaea seems unique in the Phanerozoic Earth history and would have had important repercussions for global climates and biodiversity (see further discussion in the GSA data repository [see footnote 1]). These could potentially include the presence of large desert areas and widespread salinas in arid regions, extreme climates, especially in the continental interiors, high sea-surface temperatures, relatively flat equator-to-pole gradients, and sluggish surface circulation. Deeper circulation would be characterized by warm saline bottom waters with intermittent loss of vertical stratification leading to widespread anoxia. Tropical shallow marine areas during relative highs could be sites of carbonate and extensive evaporite deposition. Biodiversities would decline when summer temperatures exceeded a certain threshold both on land and at sea. A long period of lowstand and continuous high temperatures also mean a deficit of biologic evolutionary innovations, and evidence gathered by Triassic paleoclimatic and paleoceanographic studies confirms these paleoenvironmental consequences. Biodiversity was decimated at the end-Permian extinction event and, after the Early through Middle Triassic recovery, declined once again during the long interval of the Late Triassic (these issues are discussed in the GSA data repository [see footnote 1]). The Triassic paleoenvironmental scenarios demonstrate the close link between eustasy, climates, and biodiversity.

The driving mechanism for the third-order cyclicity in the Triassic remains unidentified, an interval characterized by exceptionally long sedimentary eustatic

**Figure 1.** Triassic sequences and variations of sea level. Time scale after Ogg et al. (2016). Biozone cross-correlations are after Hardenbol et al. (1998). Sequence boundaries (sea-level fall events) are redesignated following a numbering scheme suggested by Hardenbol et al. (1998), however, the letter T is prefixed to each designation for convenience to make the numbers unique and not to confuse them with similar numbers in other periods. (Two events, in the Norian and Rhaetian [TNo2 and TRh1] are included provisionally, pending documentation of more widespread occurrence.)



Bilal U. Haq (2018)

periodicities in the Middle and Late Triassic (~5-m.y./cycle on average for third-order sequences) and no evidence of wide-spread glaciation. However, the relatively moderate variations in third-order sea levels make it tempting to consider the possibility of changes driven by the transfer of water to and from land aquifers as a potential cause. Since the early suggestion by Hay and Leslie (1990) and Jacobs and Sahagian (1993) there has been considerable recent interest in this mechanism as a potential cause for eustatic changes (e.g., Föllmi, 2012; Wagreich et al., 2014; Wendler and Wendler, 2016; Sames et al., 2016). Nevertheless, this process is more attuned to explaining modest (20–30 m) input/sequestration of water from/to land groundwater aquifers (and to a much lesser extent, the lakes that contribute only a minute, almost unmeasurable, amount to the total) to the ocean on Milankovitch time scales (Hay and Leslie, 1990). In the Triassic the process seems counterintuitive as very dry periods on land coincide with lowstands of sea level when presumably continental interiors would tend toward depleted aquifers (and also lack large lakes). The reverse also seems to be the case; i.e., during the late Carnian Pluvial Episode, when the climates were wetter and characterized by a single third-order event, the long-term sea level was also relatively higher. Thus, if the process has to work in the Triassic, it would have to have been on the shorter, Milankovitch, time scales.

What solid-Earth tectonic controls could have potentially influenced the sea-level changes in the Triassic when the planet was characterized by a large supercontinent with no apparent major ice accumulations on land? Most of the recent insights into the understanding of tectonic influences on sea level (as measured locally) either try to explain it on very short time scales (isostatic response to elastic and viscous loading and unloading) or on the very long time scales of multiple millions of years (see discussions in Haq, 2014, 2017, and Cloetingh and Haq, 2015). These influences cannot account for the third-order cyclicity in the Early and Middle Triassic (average duration of ~1 m.y./cycle in the Early and ~1.4 m.y./cycle in the Middle Triassic). However, for the multiple million-year cycles of the Late Triassic (average of ~3.6 m.y./cycle, but as large as ~7 m.y. for the longest Triassic cycle in late Norian), we may want to look for explanations in dynamic topographic

effects that try to explain long-wavelength and long-term tectonic warping (see, e.g., Gurnis, 1993; Flament et al., 2013). On these longer scales subducting slabs underneath continents dramatically influence surface topography that in turn could drive local eurybathic sea-level changes. Thus, dynamic topography-driven variations seem to be a promising avenue to follow to explain the relatively small amplitude but long duration highs and lows (within the range of –50 m to +50 m of pdmsl) of the long-term eustatic sea level in the Triassic. So far such modeling for the Triassic supercontinent and its margins has not been attempted and is obviously an area of important future investigation.

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# 2019 Birdsall-Dreiss Distinguished Lecturer



Laura J. Crossey

**Laura J. Crossey** is a professor in the Dept. of Earth & Planetary Sciences at the University of New Mexico (UNM). She received her bachelor's degree in geology at Colorado College (1977), master's degree at Washington University in St. Louis (1979), and Ph.D. from the University of Wyoming (1985). She joined the UNM faculty in 1986 and was the first woman in the department to be tenured, promoted to full professor, and serve as chair.

Crossey's research group explores applications of low-temperature geochemistry to problems in hydrochemistry, diagenesis, geomicrobiology, and geothermal processes. Her approach combines field examination of modern laboratory analysis as well as core and outcrop study to evaluate paleohydrology, spring sustainability, and reservoir/aquifer characteristics. Related activities include geoscience outreach, K–12 outreach, science education research, and programs to increase the participation of underrepresented groups in science. She is a leader on the National Science Foundation–funded New Mexico Alliance for Minority Participation Award and has served on numerous review panels and volunteer boards.

A GSA member since 1997 and Fellow since 2012, Crossey has served as president of the Sedimentary Geology Division, Technical Program Chair for the Rocky Mountain Section, associate editor for *GSA Bulletin*, *Geochimica et Cosmochimica Acta*, and *Applied Geochemistry*, and was editor of SEPM (Society for Sedimentary Geology) Special Publications. She was awarded lifetime membership in the New Mexico Geological Society. She and her husband, Karl Karlstrom, were awarded an Outstanding Achievement Award by the American Institute of Professional Geologists in 2015 for designing and building the Trail of Time, a geoscience exhibition at the Grand Canyon (funded by the National Science Foundation, and recognized as Best Wayside Exhibit by the National Association for Interpretation in 2011).

Crossey's research on carbonic springs has taken her to the Great Artesian basin of Australia, the Western Desert of Egypt, and the Tibetan Plateau.

Institutions can schedule a lecture on one of the topics described below at [community.geosociety.org/hydrodivision/birdsall/about2019](http://community.geosociety.org/hydrodivision/birdsall/about2019). (Crossey is also happy to present brown bags or visit with faculty, staff, and/or students on topics such as inclusion and diversity in STEM.)

- 1. Chasing Helium: Mantle-to-Surface Connections to Water Quality and Geomicrobiology.** The discovery of oceanic black (and white) smokers revolutionized our understanding of mid-ocean ridges and led to the recognition of new organisms and ecosystems resulting from mixing of fluids. Continental smokers, defined here to include a broad range of carbonic springs, hot springs, and fumaroles that vent mantle-derived fluids in continental settings, exhibit many of the same processes of heat and mass transfer and ecosystem niche differentiation. The application of noble gas geochemistry (specifically helium isotope [ $^3\text{He}/^4\text{He}$ ] analyses) indicates widespread mantle degassing in perhaps unexpected tectonic locales including the western U.S., the Great Artesian basin of Australia, the Western Desert of Egypt, and the Tibetan Plateau. Variations in the mantle helium component measured in groundwaters correlate best with low seismic-velocity domains in the upper mantle and with abrupt lateral contrasts in mantle velocity rather than crustal parameters such as strain rate, proximity to volcanoes, crustal velocity, or composition. Microbial community analyses applied to several of these areas indicate that these springs can host novel microorganisms. Our work yielded the first published occurrence of chemolithoautotrophic Zetaproteobacteria in a continental setting. These observations led to two linked hypotheses. (1) Mantle-derived volatiles transit through conduits in extending continental lithosphere preferentially above and at the edges of mantle low-velocity domains. (2) Elevated concentrations of  $\text{CO}_2$  and other constituents ultimately derived from mantle volatiles drive water-rock interactions and heterogeneous fluid mixing that help structure diverse and distinctive microbial communities. This recognition of the small volume but chemically potent “lower world” contributions to groundwater systems has implications for topics as diverse as tectonics, fluid conduits, water quality, and microbial ecosystems.
- 2. Hydrochemistry and Geoscience Education at Grand Canyon and Beyond: Who Knew Groundwater Hydrology Could Be So Complicated?** Springs and associated riparian environments provide critical habitats for aquatic and terrestrial wildlife in the Grand Canyon region and drinking water for Grand Canyon National Park. Grand Canyon springs are fed by world-class karst aquifer systems on the Colorado Plateau, but increasing pressure on groundwater resources from climate change, mining, and other development poses major challenges to resource managers. The shallow and deep karst systems of the region interact in ways that are revealed by recent studies. General hydrologic models for the Colorado Plateau aquifers highlight the importance of recharge areas (“springsheds”) for water supply. Ongoing work helps explain these complex relationships using multiple tracer methods. A robust monitoring and geochemical sampling program provides data for understanding the sustainability of spring-fed water supplies for anthropogenic use. Geochemical studies of spring waters (including dissolved gases) have identified the importance of mantle-derived volatiles and  $\text{CO}_2$  that contribute dissolved salts and other products of water-rock

interactions at depth to the regional aquifer systems. Faults are important conduits for fluid transport and mixing and impart a tectonic influence on water quality. The result is a multi-porosity system resulting from variable ages and mixing of meteoric recharge, karst system transport, matrix sandstone transport, fault connectivity, and endogenic inputs.

Quantitative forecasting of the effects of climate change on water quality depends on understanding these deep inputs (diminishing surface flows affecting recharge rates), as well as aquifer recharge flowpaths and quantities. Results from Grand Canyon and other spring-supported stream systems in the western U.S. indicate the need for development of hydrologic baselines that recognize these complexities. This can be accomplished through use of both natural and artificial tracers to unravel mixing and environmental sensors to monitor real-time changes. These investments are needed to inform water management decisions that address societal and ecosystem needs.

## TRAVEL GRANTS TO NEGSA 2019

Undergraduate and graduate students who work full-time or care for dependents while earning a degree are eligible for generous travel funding to attend the GSA Northeastern Section Meeting, 17–19 March 2019, in Portland, Maine, USA. Students from all GSA Sections are welcome to apply before Friday, 22 Feb.

Questions: **Tahlia Bear**, [tbear@geosociety.org](mailto:tbear@geosociety.org)

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# GSA 2018 Honorary Fellows



**Bishal Upreti**

**Bishal Upreti** has furnished the most complete exposure of all major tectonic elements in the Himalayan orogen, from which our current paradigm on collisional orogenesis is derived. We also owe to this remarkable individual who has selflessly made the Nepal Himalaya accessible to fellow geologists around the world. In the past four decades since the early days of the plate tectonic revolution, Upreti has been an

integral part of every major scientific advance in Himalayan research, through sharing his deep knowledge on the stratigraphy, structural geology, and the rich and colorful history of Himalayan geologic studies with his international colleagues and mentoring the newcomers to his beloved country, Nepal. He has collaborated, as an equal partner, with the most preeminent research groups around the world. Without his tirelessly writing supporting letters, patient and persistent assistance in removing bureaucratic hurdles to obtain travel permits, and providing the most able logistic supports, none of the current scientific achievement in the Nepal Himalaya would be possible. Upreti has introduced many geologists to the Himalaya.

Much of his personal research has focused on natural hazards, a field of obvious importance in Nepal, where a rapidly evolving orogenic system presents hazards ranging from glacial lake outbursts, to massive landslides, to—as we all were reminded this past spring—devastating earthquakes. Upreti has been a tireless emissary from the geologic community to the policy makers of Nepal for decades, and thus has contributed to Nepali society through applied research and public awareness of geology. Not only through his work over the years but also with other U.S. and international collaborators too numerous to mention, Upreti has opened the Nepali geologic community to the world community of geologic researchers, and has thus made his mark in the administration of geological programs. Our collective knowledge of Himalayan geology owes much to the quiet, mostly behind-the-scenes efforts of this man.

Upreti has been recognized by others: He was president of both the Nepal Geological Society and Disaster Preparedness Network–Nepal. He was rector of Tribhuvan University and honorary member of the Nepal Geological Society. He recently received the C.N.R. Rao Prize for Scientific Research awarded by The World Academy of Sciences and is active in the Nepal Academy of Science and Technology. He has been a key contributor on numerous reports and legislation for the Nepali government concerning disaster management and has provided numerous invited lectures, including at the GSA Annual Meeting.



**Eduardo Garzanti**

**Eduardo Garzanti** has been professor in stratigraphy and sedimentology at the University of Milano-Bicocca since 2001 and is currently vice-director of the Dept. of Earth and Environmental Science. A member of Academia Europaea, he has served as GEV for sedimentary geology and structural geology in the National VQR for the years 2004–2010 and as GEV for sedimentary geology for the years 2011–2014. He is associate editor

for prestigious international journals, including *Geology*, *Terra Nova*, and *Basin Research*.

Garzanti is an expert in the geology and tectonics of orogenic belts, with special emphasis on the Himalaya and the European Alps. He is also the world's leading authority on the provenance of and controls on global sand composition, and the leader of the most productive sedimentary provenance group. Since 1981, he has participated in more than 12 expeditions to the Himalaya of Pakistan, India, Nepal, South Tibet, and the Bengal Sea. His 1987 paper on the timing of initial India-Asia collision (Garzanti et al., “Sedimentary record of the northward flight of India and its collision with Eurasia [Ladakh Himalaya, India]”: *Geodinamica Acta*, v. 1, p. 297–312) is a pioneering contribution to the tectonics of Asia. This early work has stood the test of time and numerous further assessments of its conclusions and remains a gold standard in the Himalayan literature.

Garzanti has also worked extensively on the Paleozoic history of the Indian passive margin and the stratigraphic history of the Neotethys Ocean. His most recent scientific work, carried out in collaboration with researchers from British, French, North American, and Indian institutions, involves petrographic and mineralogical study of modern sands in Asian (Indus, Ganga, Brahmaputra, Ayeyarwadi), African (Nile, Orange, Congo, Zambesi), and European (Po, Rhône, Danube) big river systems, and of Cenozoic foreland basins associated with the Himalayan (Pakistan, India, Nepal, Bangladesh, Myanmar, and the Andaman Islands), and the Alps-Appennine orogenic systems.

Garzanti was part of the IODP Science Planning Committee for the recent Indus Fan Project. His sedimentary petrology work involving both light and dense minerals is now complemented by an increasing array of geochemical and isotopic approaches, along with sophisticated statistical apparatus. He continues to develop and refine schemes for interpreting tectonic processes based on petrological modes. Garzanti's phenomenal research productivity, including more than 215 published papers in respected international journals, is belied by his humble, self-deprecating sense of humor, generosity, and general conviviality.

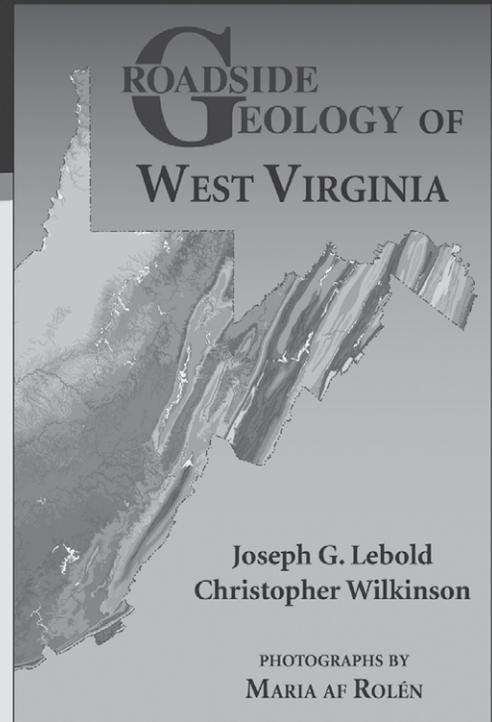
Garzanti shows no signs of slowing down, with approximately 30 published papers over the last two years. For his global research in sedimentary geology and his extraordinary research productivity, Garzanti is a model international scholar and highly meritorious selection to GSA Honorary Fellow.

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# 2019 Award Deadlines



For details, see the October *GSA Today* or go to [www.geosociety.org/awards/aboutawards.htm](http://www.geosociety.org/awards/aboutawards.htm). For award nominations, go to [www.geosociety.org/awardnoms](http://www.geosociety.org/awardnoms). You can also email GSA Grants and Awards at [awards@geosociety.org](mailto:awards@geosociety.org).

## GSA Medals & Awards

**Nomination deadline:** 1 Feb.

- Penrose Medal
- Day Medal
- Young Scientist Award (Donath Medal)
- Randolph W. “Bill” and Cecile T. Bromery Award for Minorities
- GSA Distinguished Service Award
- Doris M. Curtis Outstanding Woman in Science Award
- Florence Bascom Geologic Mapping Award
- GSA Public Service Award
- Honorary Fellow

**Nomination deadline:** 1 Mar.

- GSA International Distinguished Career Award
- GSA James B. Thompson, Jr., Distinguished International Lecturers

## John C. Frye Environmental Geology Award

**Nomination deadline:** 31 Mar.

In cooperation with the Association of American State Geologists and supported by endowment income from the GSA Foundation’s John C. Frye Memorial Fund, GSA makes an annual award for the best paper on environmental geology published either by GSA or by a state geological survey. Learn more at [www.geosociety.org/GSA/Awards/Frye.aspx](http://www.geosociety.org/GSA/Awards/Frye.aspx).

## 2019 Post-Doctoral Research Awards

**Application deadline:** 1 Feb.

- The Gladys W. Cole Memorial Research Award for research on the geomorphology of semiarid and arid terrains in the United States and Mexico is awarded annually to a GSA member or Fellow between 30 and 65 years of age who has published one or more significant papers on geomorphology.
- The W. Storrs Cole Memorial Research Award for research on invertebrate micropaleontology is awarded annually to a GSA member or Fellow between 30 and 65 years of age who has published one or more significant papers on micropaleontology.

Learn more about these post-doctoral research awards at

[www.geosociety.org/GSA/grants/postdoc.aspx](http://www.geosociety.org/GSA/grants/postdoc.aspx).

## AGI Awards

**Nomination deadline:** 1 Feb.

Submit nominations for the following awards at

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

- AGI Medal in Memory of Ian Campbell recognizes singular performance in and contribution to the profession of geology.
- The AGI Marcus Milling Legendary Geoscientist Medal is given to a recipient with consistent contributions of high-quality scientific achievements and service to the earth sciences having lasting, historic value; who has been recognized for accomplishments in field(s) of expertise by professional societies, universities, or other organizations; and is a senior scientist nearing completion or who has completed full-time regular employment.

## Other Awards

For a listing of other national awards and links to information and nomination forms, visit [www.geosociety.org/awards/national.htm](http://www.geosociety.org/awards/national.htm). If you know of an award not listed there, please send the details to [awards@geosociety.org](mailto:awards@geosociety.org).

# GSA Fellowship

## Recent Changes to Fellowship Requirements

### *A message from the GSA Membership and Fellowship Committee*

As current chair of the GSA Membership and Fellowship Committee, I just completed my third year of service. I've had the pleasure of working with this Committee and the privilege of reviewing and evaluating some 240 nomination packages and CVs for Fellowship. My overarching takeaway from this experience is that we have many outstanding members who love and contribute to the science and the Society.

The Committee has maintained consistent standards for Fellowship over the years; however, this year the Committee determined that modest adjustments to the requirements were needed. The Committee reviewed the entire process and requirements for Fellowship and submitted recommendations to GSA Council; Council approved, and the recommendations have been implemented.

One of the requirements for Fellowship is to have had an established career. The most common reason for not recommending Fellowship has been that the nomination was premature and the evidence for a "distinguished career" was lacking. The Committee discussed and determined that establishing a distinguished career today requires 15 years past

terminal (highest) degree, given the proclivity of post-docs and other short-term appointments (the previous requirement was 10 years past terminal degree). A few exceptions may be considered for those with substantial previous experience.

The Committee and Council felt that GSA Fellowship requires active participation in the Society, with five years of continuous membership being a reasonable period to demonstrate involvement in and contributions to the GSA. The Committee would see a few nominations each year where involvement consisted only of paying dues for a short period. The Committee will place a greater emphasis on active GSA participation, which may involve a wide variety of activities, such as participation in annual and Section meetings, publishing in or reviewing for GSA journals, service on committees, work with Scientific Divisions or geographic Sections, or leading field trips.

GSA Fellowship is an honor bestowed on the best of our profession, and we warmly thank all of our Fellows for their support of and involvement with GSA.

### **Peter L. Guth**

Chair, Membership and Fellowship Committee  
GSA member since 1976; GSA Fellow since 1997

## Call for GSA Fellowship Nominations

**Deadline:** 1 Feb.

Nominate a deserving colleague with the honor of GSA Fellowship. GSA members are elected to Fellowship in recognition of distinguished contributions to the geosciences.

### **How to Nominate**

The primary nominator (who must be a GSA member and Fellow):

1. Completes the online nomination form at **[www.geosociety.org/FellowNoms](http://www.geosociety.org/FellowNoms)**;
2. Writes a letter of support;
3. Collects two additional letters of support (one must be from a Fellow; both must be GSA members); and
4. Obtains the nominee's current CV or résumé.

Questions? Email [awards@geosociety.org](mailto:awards@geosociety.org).

## Recent Changes to GSA Fellowship Requirements

Initiated by the Membership and Fellowship Committee and approved by GSA Council in May 2018:

- Nominees shall have an established career with at least fifteen years past their terminal degree in geology.
- Nominees are required to have at least five years of continuous professional membership in GSA.
- Nominees must have exhibited participation in and/or service to GSA.

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



Stewards Individual  
Placement Program



Geological Society of America  
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Sally and Robert Newcomb

# GSA, AGI, and New Mexico Bureau of Geology and Mineral Resources Bring Educational Opportunities to Students in New Mexico



Photo by Tahlia Bear.



Photo by Dean Moosavi.

On 27 Sept., 8th grade students from the Jemez Pueblo in Northern New Mexico got a real taste of what it means to be a geoscientist. GSA partnered with the American Geosciences Institute (AGI), geoscientists from New Mexico Bureau of Geology and Mineral Resources at New Mexico Tech, and the National Park Service to bring a geoscience educational program about the Valles Caldera supervolcano to 45 students, teachers, and chaperones from this tribal community.

Teams of students, teachers, and scientists collaborated in a hands-on, inquiry-based exploration of an outcrop containing both an ash fall and ash flow from a 74,000 year-old eruption. With extra encouragement and guidance from former Interior Secretary Sally Jewell, AGI's Earth Science Education Ambassador for 2018, and former GSA President Claudia Mora, the students sieved samples of each material to determine the particle size distributions amongst the ash, pumice, and lapilli, quantitatively demonstrating the differences between these materials with their very different hazard potential and response requirements.

After a lunch break, further discussion with the geoscientists and park rangers at the Valles Caldera National Preserve helped the students connect the geologic environment of their homeland to thousands of years of history of farming, trading obsidian, and even carving homes from the tuff deposits left behind by the eruptions of the volcano. The students experienced not only the what and how of the science they were exploring but also why it matters given the environmental challenges they must plan for, the mineral, agricultural, and energy resources arising from their state's volcanism, and the professional opportunities the geosciences offers them as they grow into adulthood.

Discussions with the participants suggest this was the first time many of the students realized how they might have a future working in the geosciences whether as a geologist, geoscience educator, park ranger, or land-use manager. Don't be surprised if you see students from this program in your classes, a national park, or a GSA meeting in the next decade or so. Look for a short documentary on this activity as part of AGI's Earth as Inspiration series for more details and the students' insights in their own words.

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For more information, email [researchgrants@geosociety.org](mailto:researchgrants@geosociety.org) or call +1-303-357-1025.

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



# FIELD CAMP



## Scholarships

GSA and the GSA Foundation are proud to announce that Field Camp Scholarships will be available to undergraduate geology students for the summer of 2019. These scholarships will provide students with US\$2,000 each to attend the field camp of their choice. Applications are reviewed based on diversity, economic/financial need, and merit. Applications are due in early April 2019. Questions? Contact Jennifer Nocerino at [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).



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“ A vibrant and diverse society ensuring that I am always exposed to new innovative ideas from every corner of the globe, which keeps my thought-processes on edge. ”

“ A huge part of networking and advancing as a young professional. I have felt supported and challenged by participating in GSA. ”



“ Opportunity to connect, reconnect, get inspired, and inspire others. ”

“ Being part of a larger community that galvanizes the voice of scientists and helps us share ideas, communicate their findings, interact with the public, and connect with policymakers. ”



“ Working in industry, GSA is critical to stay current on research in the geosciences, and GSA provides a "lifeline" to the research community. ”

\*Member quotes are from GSA's Strategic Planning Survey

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Melanie R. Thornton

# Working Together When Conservation Matters

Those who defend our natural environment fear that we will not act until it is too late. Due to Americans' increasing concern about our environment's health, Congress enacted our country's bedrock environmental laws—the Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, and the Endangered Species Act in the 1960s and 1970s. Today, environmental protection and conservation policy continues to be at the forefront of political discussion. As a GSA-USGS Congressional Science Fellow, I am continuing to work on policies that protect our environment and America's native fish, wildlife, and plant species—an important legacy to pass on to future generations.

Last October, a handful of environmental nongovernmental organizations hosted a discussion with E.O. Wilson in the U.S. Capitol about his book, *The Half Earth*, and how best to protect America's wildlife. This conversation highlighted how habitat loss and threats from a changing climate are the greatest concerns to species extinction, and wildlife corridors and federal policies are important ways in which we can continue to protect fish, wildlife, and plant species. Reflecting on the takeaways from this discussion, Senator Tom Udall (D-NM) asked his natural resources staff to craft a wildlife corridors bill in the Senate.

Many believe that the designation of wildlife corridors needs a systemic approach, best directed by legislation. That approach should expand the science and stewardship of America's most important native fish, wildlife, and plant species and their habitats. However, wildlife corridors legislation is not a new concept. It has been introduced twice in Congress: by Representative Rush Holt (D-NJ-12) in 2010, and again six years later by Representative Donald Beyer (D-VA-8). However, wildlife corridors legislation has not been introduced in the Senate. Introduction of a bill in both the House and the Senate is an important step in moving legislation forward, because bills must pass both chambers of Congress in identical form and be signed by the president to become law.

The purpose of a wildlife corridors bill is to create a framework for establishing a national wildlife corridors program. Specifically, this bill would direct key federal agencies to create a strategy to identify data and research needs for better understanding species' habitats and corridors and to develop a corridor system. This would create a geographical information system database to compile native species habitat and corridors data. And it would grant authority to several federal agencies to designate wildlife corridors on federal lands. The goal is to support states, Indian tribes, and the public and to be used as a tool to inform planning and development decisions.

As part of Senator Udall's natural resources team, I began the process of working on a Senate companion bill of the previously introduced Wildlife Corridors Conservation Act. Legislative staff works to draft measures so that they will accomplish the policy goals set out by members of Congress. Staff considers items such as the timing of introducing the bill, to what committee the bill is likely to be referred, potential bill cosponsors, and constituent and stakeholder support or opposition of the bill. For this specific bill, our goal was to update and revise the previous wildlife corridors bill with cosponsors of each political party. The plan also included collaborating with bipartisan members in the House to encourage bicameral consideration.

Initially, I learned about wildlife corridors by understanding the on-the-ground logistics of implementation and gathering diverse perspectives from stakeholders with a vested interest in the management of native species. I met with experts from the Congressional Research Service, congressional staff that have worked on previous wildlife corridors legislation, and stakeholders from the nongovernmental organization community, state and federal government, scientists and researchers, and with constituents working on wildlife issues in New Mexico.

The next phase of work on this bill included thoroughly vetting the legislation and asking for feedback from stakeholders who support and oppose different provisions of the bill. Some stakeholders were concerned about the process of engaging private landowners. Others provided input on the role and authority of state government, and wanted the legislation to provide more detail about how species would be prioritized for compiling habitat data and designating their corridor. We learned about successful projects with similar goals of this bill, where communities are conducting research and collecting geographical data on certain species to better understand wildlife connectivity. In addition, the Department of the Interior provided technical assistance, reviewing and providing feedback on the wildlife corridors draft bill. Then, I, in coordination with my House counterparts, developed a plan to modify and improve the bill by addressing the differing feedback gathered from stakeholders.

My colleagues and I are still working on making changes to the draft in an effort to address the feedback we have received on the bill, while still meeting Senator Udall's goals. Unlike the scientific method, the process of working on and improving a draft bill is not always simple or straightforward. Legislative staff has to work together and negotiate provisions to settle the differences, often between different stakeholders and offices of different political parties. Throughout this process, I provide updates to Senator Udall to ensure we continue to incorporate his priorities within the bill. In many cases, drafting robust legislation takes time and persistence, as I have learned directly through this process. This has given me the experience of applying my scientific training—mainly my critical thinking and problem solving skills—to the public-policy-making process. And it is just one example of how Congress continues to work on policies that protect species and our environment.

The manuscript is submitted for publication by Melanie R. Thornton, 2017–2018 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 Number G16AP00179. 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. Thornton works in the office of Senator Tom Udall (D-NM) and can be contacted by e-mail at [Melanie\\_Thornton@tomudall.senate.gov](mailto:Melanie_Thornton@tomudall.senate.gov).



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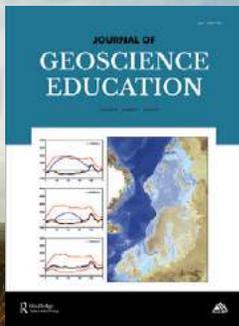
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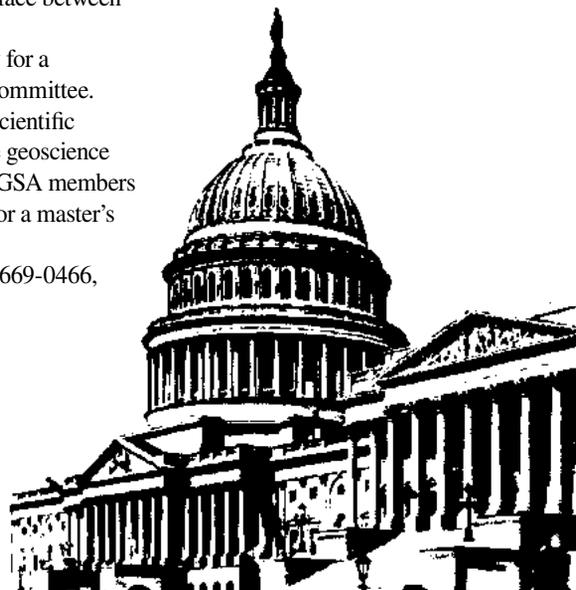
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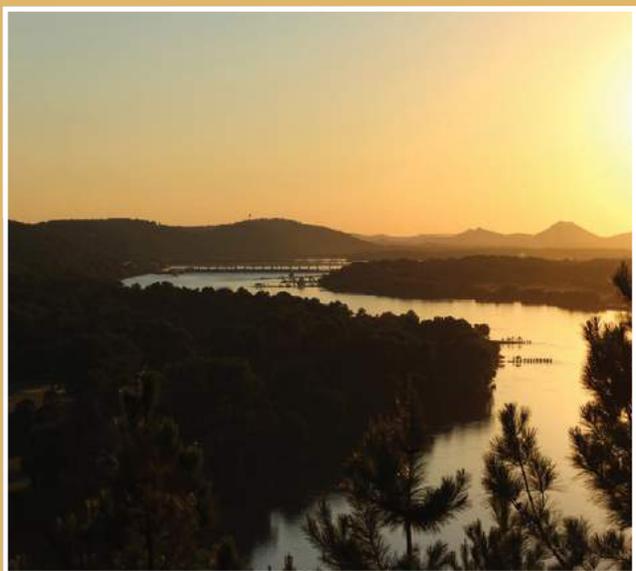
## Second Announcement and Call for Papers

# SOUTHEASTERN SECTION

68th Annual Meeting of the  
Southeastern Section, GSA

Charleston, South Carolina, USA  
28–29 March 2019

[www.geosociety.org/se-mtg](http://www.geosociety.org/se-mtg)



South Carolina, USA. Photo by Oliver Beland.

## *Southeastern Hospitality in the Geosciences: From Ancient Systems to Modern Resiliency*

### LOCATION

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geologic hazards past and present, new technologies for mapping, hydrologic processes and applications in the coastal plain, limnology, terrane accretion, and the origin of ultramafic bodies in suture zones. Please bring a guest with you to the conference, as we are developing a rich program for them, including culinary tours, trips to the plantations and national parks, as well as visits to the beaches and tours of downtown. Spring is one of the most lovely times of year in Charleston, and we look forward to seeing you here when the azaleas are in bloom!

### REGISTRATION

**Early registration deadline:** 19 Feb.

**Cancellation deadline:** 25 Feb.

For further information or if you need special accommodations, please contact one of the general co-chairs, M. Scott Harris, [harris@cofc.edu](mailto:harris@cofc.edu), or Katie Luciano, [lucianok@dnr.sc.gov](mailto:lucianok@dnr.sc.gov).

### REGISTRATION FEES

	Early		Standard	
	Full Mtg	One day	Full Mtg	One day
Professional member	US\$225	US\$145	US\$250	US\$170
Professional nonmember	US\$255	US\$170	US\$275	US\$190
Early career professional	US\$175	US\$110	US\$185	US\$125
Student member	US\$80	US\$65	US\$100	US\$80
Student nonmember	US\$105	US\$95	US\$130	US\$110
K–12 Professional	US\$50	US\$45	US\$55	US\$50
Guest	US\$40	n/a	US\$40	n/a
Field trip/workshop only	n/a	US\$40	n/a	US\$40

### ACCOMMODATIONS

**Reservation deadline:** 26 Feb., 5 p.m. eastern time

A block of rooms has been reserved at the Francis Marion Hotel, 387 King Street, Charleston, South Carolina 29403, USA, in the center of Historic Charleston. The meeting rate is US\$219 per night plus tax. Reservations can be made by calling +1-843-722-0600. Group code: SEGSA19.

### TECHNICAL PROGRAM

#### Theme Sessions

- T1. Behavior of Animals, Dead or Alive: Neoichnology Informing Ichnology.** *Cosponsor: Paleontological Society.* Patricia Kelley, Univ. of North Carolina–Wilmington, [kelleyp@uncw.edu](mailto:kelleyp@uncw.edu); Anthony J. Martin, Emory Univ., [geoam@emory.edu](mailto:geoam@emory.edu).
- T2. Climate Change and Geologic Hazards in the Caribbean: Past, Present, and Future.** *Cosponsors: GSA Geochronology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division; GSA Karst Division.* Blair Tormey, Western Carolina Univ., [btormey@wcu.edu](mailto:btormey@wcu.edu); Kelly Best Lazar, Clemson Univ., [klazar@clemson.edu](mailto:klazar@clemson.edu); Katie McDowell Peek, Western Carolina Univ., [kmcowell@wcu.edu](mailto:kmcowell@wcu.edu).

- T3. Gondwana vs. Laurentia: Terrane Accretion and Crustal Growth in the Southeastern United States.** *Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geochronology Division; GSA Structural Geology and Tectonics Division.* Paul A. Mueller, Univ. of Florida, pamueller@ufl.edu; James Tull, Florida State Univ., jtull@fsu.edu; Jim Knapp, Univ. of South Carolina, knapp@geol.sc.edu.
- T4. Marine Vertebrate Paleontology of the Atlantic and Gulf Coastal Plains.** *Cosponsors: Paleontological Society; GSA Geochronology Division.* Robert W. Boessenecker, College of Charleston, boesseneckerrw@cofc.edu; Rachel A. Racicot, Claremont College, rachel.racicot@gmail.com; Sarah J. Boessenecker, College of Charleston, michaliess@cofc.edu; Matthew L. Gibson, Charleston Museum, mgibson@charlestonmuseum.org; N. Adam Smith, Clemson Univ., smith23@clemson.edu.
- T5. A Window into Regional Deformation and Sedimentation through Geo-, Thermo-, and Petrochronology.** *Cosponsors: Mineralogical Society of America; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geochronology Division; GSA Structural Geology and Tectonics Division.* David L. Barbeau, Jr., Univ. of South Carolina, dbarbeau@geol.sc.edu; Alex Pullen, Clemson Univ., apullen@clemson.edu; Andrew L. Leier, Univ. of South Carolina, aleier@geol.sc.edu.
- T6. Limnogeology: Sedimentary Records from Modern and Ancient Lakes.** *Cosponsors: GSA Limnogeology Division; GSA Geochronology Division; GSA Quaternary Geology and Geomorphology Division.* Michael McGlue, Univ. of Kentucky, michael.mcglue@uky.edu; Eva Lyon, Univ. of Kentucky, eva.lyon@uky.edu.
- T7. Past and Future Coastal Evolution in Response to Sea-Level Changes and Storm Impacts.** *Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division.* Michael Fenster, Randolph-Macon College, mfenster@rmc.edu; Duncan FitzGerald, Boston Univ., dunc@bu.edu.
- T8. Innovations in Earth-Science Education.** *Cosponsor: GSA Energy Geology Division.* Cynthia Hall, College of Charleston, haller@cofc.edu; Rodney Moore, Charleston County School District, rodney\_moore@charleston.k12.sc.us; Gina Boyd, Berkeley County School District, boydd@bcscschools.net.
- T9. Offshore Research on the Mid- and South-Atlantic Continental Shelf.** *Cosponsor: GSA Energy Geology Division.* Katie Luciano, South Carolina Geological Survey, lucianok@dnr.sc.gov; William Lassetter, DMME-DGMR, william.lassetter@dmme.virginia.gov; D. Reide Corbett, East Carolina Univ., corbettd@ecu.edu; Clark Alexander, Skidaway Institute of Oceanography, clark.alexander@skio.uga.edu; David Mallinson, East Carolina Univ., mallinsond@ecu.edu; Scott Howard, South Carolina Geological Survey, howards@dnr.sc.gov; Scott Harris, College of Charleston, harriss@cofc.edu.
- T10. Sedimentary Systems of the Post-Alleghanian Eastern U.S. Atlantic Margin: Implications for Geologic Evolution, Resource Potential, and Carbon Sequestration.** *Cosponsors: GSA Energy Geology Division; GSA Geology and Society Division.* Andrew Parent, Virginia Tech, amparent@vt.edu; Cody Mason, Univ. of West Georgia, cmason80@vt.edu.
- T11. UAV/Drone Technology and Spatial Metrics for the Coastal Zone.** *Cosponsor: GSA Quaternary Geology and Geomorphology Division.* Narcisa Pricope, Univ. of North Carolina–Wilmington, pricopen@uncw.edu; Joanne Halls, Univ. of North Carolina–Wilmington, hallsj@uncw.edu.
- T12. Natural Hazards Prediction.** *Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division; GSA Karst Division.* Antonios E. Marsellos, Hofstra Univ., antonios.marsellos@hofstra.edu; Katerina Tsakiri, Rider Univ., ktsakiri@rider.edu; Bret Bennington, Hofstra Univ., j.b.bennington@hofstra.edu; Jase Bernhardt, Hofstra Univ., jase.e.bernhardt@hofstra.edu; Menas Kafatos, Chapman Univ., kafatos@chapman.edu.
- T13. Reconstructing Paleo-Environmental Changes.** *Cosponsors: GSA Limnogeology Division; GSA Soils and Soil Processes Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division.* Theodore Them, College of Charleston, themtr@cofc.edu; Benjamin Gill, Virginia Tech, bcgill@vt.edu; Jeremy Owens, Florida State Univ., jdowens@fsu.edu; Seth Young, Florida State Univ., sayoung2@fsu.edu.
- T14. Origin and Significance of Ultramafic Bodies in Suture Zones from the Appalachians and Beyond.** *Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Structural Geology and Tectonics Division.* Céline Martin, Univ. of North Carolina–Charlotte, cmart175@unc.edu; Christopher M. Bailey, College of William & Mary, cmbail@wm.edu.
- T15. Geologic Studies of the U.S. Atlantic Coastal Plain.** *Cosponsors: GSA Soils and Soil Processes Division; GSA Geochronology Division; GSA Quaternary Geology and Geomorphology Division.* William R. Doar III, South Carolina Geological Survey, doarw@dnr.sc.gov; Christopher S. Swezey, U.S. Geological Survey, cswezey@usgs.gov.
- T16. Undergraduate Research (Posters).** *Cosponsors: Council on Undergraduate Research Geosciences Division; GSA Limnogeology Division; GSA Energy Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Structural Geology and Tectonics Division.* Lee Phillips, Univ. of North Carolina–Greensboro, plphilli@uncg.edu; Jeff Ryan, Univ. of South Florida, ryan@mail.usf.edu.
- T17. Recent Advances and New Approaches in the Study of Faults and Shear Zones in Orogenic Systems.** *Cosponsor: GSA Structural Geology and Tectonics Division.* Jackie Langille, Univ. of North Carolina–Asheville, jlangill@unca.edu; Timothy Diedesch, Georgia Southern Univ., tdiedesch@georgiasouthern.edu.

- T18. Hydrological Processes and Problems across the Southeastern United States.** *Cosponsors: GSA Soils and Soil Processes Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division; GSA Karst Division.* JP Gannon, Western Carolina Univ., jpgannon@wcu.edu; Mark Lord, Western Carolina Univ., mlord@wcu.edu; David Kinner, Western Carolina Univ., dkinner@wcu.edu.
- T19. Recent Advances in Saltmarsh Evolution, (Eco) Geomorphology, and Sustainability.** *Cosponsors: GSA Soils and Soil Processes Division; GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division.* Carol Wilson, Louisiana State Univ., carolw@lsu.edu; Zoe Hughes, Boston Univ., zoeh@bu.edu; Alejandra C. Ortiz, North Carolina State Univ., aortiz4@ncsu.edu.
- T20. The Science, Environmental Impacts, and Policy of Beach Nourishment.** *Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Geology and Society Division.* Robert S. Young, Western Carolina Univ., ryoung@email.wcu.edu; Andrew Coburn, Western Carolina Univ., acoburn@email.wcu.edu.
- T21. Mesozoic to Cenozoic Tectonics and Magmatism of the Southeastern United States.** *Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geochronology Division; GSA Structural Geology and Tectonics Division.* Erin Beutel, College of Charleston, beutele@cofc.edu; John Chadwick, College of Charleston, chadwickj@cofc.edu.
- T22. Applications of Hydrology and Biogeochemistry to Stormwater Management.** *Cosponsors: GSA Limnogeology Division; GSA Geology and Society Division; GSA Karst Division.* James J. Connors, James J. Connors & Associates LLC, jjc@jamesjconnors.com; Barbara A. Beckingham, College of Charleston, beckinghamba@cofc.edu; Vijay M. Vulava, College of Charleston, vulavav@cofc.edu; Timothy J. Callahan, College of Charleston, callahant@cofc.edu; M. Richard DeVoe, South Carolina Sea Grant Consortium, devoerm@scseagrant.org.
- T23. Technology and Mapping in the 21st Century.** *Cosponsor: GSA Structural Geology and Tectonics Division.* Norman S. Levine, College of Charleston, levinen@cofc.edu; K. Adem Ali, College of Charleston, alika@cofc.edu; M. Scott Harris, College of Charleston, harriss@cofc.edu; Leslie R. Sautter, College of Charleston, sautterl@cofc.edu.
- T24. Geoarchaeology.** *Cosponsors: GSA Soils and Soil Processes Division; GSA Quaternary Geology and Geomorphology Division; GSA Geoarchaeology Division.* Ervan Garrison, Univ. of Georgia, egarriso@uga.edu; Jessica Cook Hale, Univ. of Georgia, jcook@uga.edu.

## FIELD TRIPS

For additional information, please see the meeting website or contact the Field Trip Co-Chairs: John Chadwick, chadwickj@cofc.edu, and Steve Jaume, jaumes@cofc.edu.

## Pre-Meeting

**1. A Walking Tour of Earthquake Damage in Historic Charleston.** Wed., 27 Mar., 1–4 p.m. Cost: US\$10. Max.: 25 participants. Steven C. Jaume, College of Charleston, jaumes@cofc.edu; Norman Levine, College of Charleston, levinen@cofc.edu.

**2. Rerouting Water: Understanding and Managing Urban Hydrology in Historic Charleston.** Wed., 27 Mar., 1–4 p.m. Cost: US\$25. Max.: 30 participants. Guinn Wallover, Clemson Univ. Cooperative Extension Service, cggarre@clemson.edu; Timothy Callahan, College of Charleston, callahant@cofc.edu; Amy Scaroni, Clemson Univ. Cooperative Extension Service, ascaron@clemson.edu; Kim Morganello, Clemson Univ. Cooperative Extension Service, kcounts@clemson.edu.

## Post-Meeting

**3. Fossil Collection, Collaboration, and Citizen Science Using the myFOSSIL Mobile App.** Sat., 30 Mar., 8 a.m.–noon. Cost: US\$40. Max.: 24 participants. Leaders: Richard Bex, The FOSSIL Project, Univ. of Florida, rbex@ufl.edu; Victor Perez, Florida Museum of Natural History, victorjperez@ufl.edu; Bruce MacFadden, Florida Museum of Natural History, bmacfadd@flmnh.ufl.edu; Sadie Mills, Florida Museum of Natural History, smills@floridamuseum.ufl.edu; Robert Boessenecker, College of Charleston, boesseneckerrw@cofc.edu; Kent Crippen, Univ. of Florida, kcrippen@coe.ufl.edu.

**4. Neoichnology of Edisto Island: Eat, Prey, Love, Burrow.** Sat., 30 Mar., 8 a.m.–5 p.m. Cost: US\$45. Max.: 20 participants. Leaders: Anthony J. Martin, Emory Univ., geoam@emory.edu; Patricia Kelley, Univ. of North Carolina–Wilmington, kelleyp@uncw.edu.

**5. A Walking Tour of Earthquake Damage in Historic Charleston.** Sat., 30 Mar., 9 a.m.–noon. Cost: US\$10. Max.: 25 participants. Steven C. Jaume, College of Charleston, jaumes@cofc.edu; Norman Levine, College of Charleston, levinen@cofc.edu.

**6. Paleontology of the “Ashley Phosphate Beds” of Charleston.** Sat., 30 Mar., 10 a.m.–1 p.m. Cost: US\$25. Max.: 30 participants. Leaders: Robert W. Boessenecker, College of Charleston, boesseneckerrw@cofc.edu; Rachel A. Racicot, Claremont College, rachel.racicot@gmail.com; Sarah J. Boessenecker, College of Charleston, michaliess@cofc.edu; Matthew L. Gibson, Charleston Museum, mgibson@charlestonmuseum.org; N. Adam Smith, Clemson Univ., smith23@clemson.edu.

**7. The Dynamics of the South Carolina Coast—Barrier Islands, Wetlands, Rivers, and the Delta.** Sat., 30 Mar.–Sun., 31 Mar. Cost: US\$350. Max.: 15 participants. Leaders: Till J.J. Hanebuth, Coastal Carolina Univ., thanebuth@coastal.edu; Zoe Hughes, Boston Univ., zoeh@bu.edu; Joshua H. Long, Coastal Carolina Univ., jhlong@coastal.edu; Duncan M. Fitzgerald, Boston Univ., dunc@bu.edu.

## SHORT COURSES

**1. Earthquakes, Sea-Level Rise, and Fossils, Oh My ... Earth-Science Issues from the Lowcountry to Engage Your K–12 Students.** Sat., 30 Mar., 9 a.m.–noon. Cost: Free. Max.: 25

participants. Leaders: Cynthia Hall, College of Charleston, hallcr@cofc.edu; Erin Beutel, College of Charleston, beutele@cofc.edu; Sarah Michalies, College of Charleston, michaliess@cofc.edu; Cass Runyon, College of Charleston, runyonc@cofc.edu.

**2. Field Geophysics Using ABEM WalkTEM, ABEM Terrameter, and Mala Ground-Penetrating Radar:** Sat., 30 Mar., 9 a.m.–noon. Cost: Free. Leaders: Amber Onufer, Guideline Geo (ABEM and Mala), aon@malags.com; Per Westholm, Guideline Geo, per.westholm@guidelinegeo.com.

## OPPORTUNITIES FOR STUDENTS AND EARLY CAREER PROFESSIONALS

### Mentor Programs

#### Roy J. Shlemon Mentor Program in Applied Geoscience

**Luncheon:** Thurs., 28 Mar. Students and early career professionals will have the opportunity to discuss career prospects and challenges with applied geoscientists from various sectors over a FREE lunch.

#### John Mann Mentors in Applied Hydrogeology Program

**Luncheon:** Fri., 29 Mar. Students and early career professionals interested in applied hydrogeology or hydrology as a career will have the opportunity to network with professionals in these fields over a FREE lunch.

Learn more at [www.geosociety.org/mentors/](http://www.geosociety.org/mentors/).

## GEOSCIENCE CAREER WORKSHOPS

### Part 1: Career Planning and Informational Interviewing:

Thurs., 28 Mar., 9–10 a.m. Your job hunting process should begin with career planning, not when you apply for jobs. This workshop will help you begin this process and will introduce you to informational interviewing. This section is highly recommended for freshmen, sophomores, and juniors. The earlier you start your career planning the better.

**Part 2: Geoscience Career Exploration:** Thurs., 28 Mar., 10–11 a.m. What do geologists in various sectors earn? What do they do? What are the pros and cons to working in academia, government, and industry? Workshop presenters and professionals in the field will address these issues.

**Part 3: Cover Letters, Résumés, and CVs:** Fri., 29 Mar., 9–10 a.m. How do you prepare a cover letter? Does your résumé need a good edit? Whether you are currently in the market for a job or not, learn how to prepare the best résumé possible. You will review numerous résumés helping you to learn important résumé dos and don'ts.

## TRAVEL GRANTS

**Deadline to apply:** 19 Feb.

The GSA Southeastern Section is pleased to offer support for the cost of student travel the meeting. For more information, go to [www.geosociety.org/gsa/about/sections/GSA/Sections/se/students.aspx#travel](http://www.geosociety.org/gsa/about/sections/GSA/Sections/se/students.aspx#travel).

## PROFESSIONALS

Interested in sharing information about your applied geoscience or hydrology career with students, or interested in earning CEUs by attending the meeting? Being a mentor is a rewarding experience. To learn more about serving as a mentor at Southeastern GSA, contact Jennifer Nocerino at [jnocerino@geosociety.org](mailto:jnocerino@geosociety.org).

The Southeastern Section Meeting also offers an excellent opportunity to earn CEUs toward your continuing education requirements for your employer, K–12 school, or professional registration. Please check the meeting website after the meeting to download your CEU certificate.

## LOCAL COMMITTEE

**General Co-Chairs:** M. Scott Harris, [harriss@cofc.edu](mailto:harriss@cofc.edu); Katie Luciano, [lucianok@dnr.sc.gov](mailto:lucianok@dnr.sc.gov)

**Technical Program Co-Chairs:** Erin Beutel, [beutele@cofc.edu](mailto:beutele@cofc.edu); Chris Hein, [hein@vims.edu](mailto:hein@vims.edu)

**Field Trip Co-Chairs:** John Chadwick, [chadwickj@cofc.edu](mailto:chadwickj@cofc.edu); Steve Jaume, [jaumes@cofc.edu](mailto:jaumes@cofc.edu)

**Sponsorships Chair:** Amber Onufer, [amber.onufer@guidelinegeo.com](mailto:amber.onufer@guidelinegeo.com)

**Exhibits Chair:** Blair Tormey, [btormey@wcu.edu](mailto:btormey@wcu.edu)

**Treasurer:** Adem Ali, [alika@cofc.edu](mailto:alika@cofc.edu)

**Student Volunteer Chair:** Cyndi Hall, [hallcr@cofc.edu](mailto:hallcr@cofc.edu)



# SCIENCE EDITOR

## OPENINGS

# 2020

GSA is soliciting applications and nominations for science co-editors with **four-year terms beginning 1 January 2020**. Duties include: ensuring stringent peer review and expeditious processing of manuscripts; making final acceptance or rejection decisions after considering reviewer recommendations; and maintaining excellent content through active solicitation of diverse and definitive manuscripts.

### POSITIONS AVAILABLE

**GEOLOGY** Research interests that complement those of the continuing editors include, but are not limited to: energy geology, engineering geology, geomorphology, neotectonics, paleobotany, paleoceanography, paleoclimatology, paleontology, paleoseismicity, Quaternary geology, sedimentary geology, seismology, soils, stratigraphy, tectonics, volcanology.

*Geology* ▶ 3 positions

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

*GSA Books* ▶ 1 position

**LITHOSPHERE** Research interests that complement those of the continuing editors include, but are not limited to: geochronology, geodynamics, petrology, Precambrian geology, structural geology, tectonics.

*Lithosphere* ▶ 1 position

**GSA BULLETIN** Research interests that complement those of the continuing editors include, but are not limited to: geochemistry, geochronology, geomorphology, mineralogy, paleoclimatology, Quaternary geology, stratigraphy, thermochronology, volcanology.

*GSA Bulletin* ▶ 1 position

Note that candidates should not feel they must have expertise in *every* area listed; however, editors will sometimes need to handle papers outside of their main disciplines.

### INTERESTED?

- ▶ Submit a curriculum vitae and a letter describing why you (or your nominee) are suited for the position to Jeanette Hammann, [jhammann@geosociety.org](mailto:jhammann@geosociety.org).

Editors work out of their current locations at work or at home. The positions are considered voluntary, but GSA provides an annual stipend and funds for office expenses. **DEADLINE:** First consideration will be given to nominations or applications received by **15 February 2019**.

### A SUCCESSFUL EDITOR WILL HAVE

- ▶ a broad interest and experience in geosciences, including familiarity with new trends;
- ▶ international recognition and familiarity with many geoscientists and their work;
- ▶ a progressive attitude and a willingness to take risks and encourage innovation;
- ▶ experience with online manuscript systems and the ability to make timely decisions; and
- ▶ a sense of perspective and humor.

**FUTURE OPENINGS** (terms begin January 2021):

*GSA Bulletin* (one position), *Geology* (one position), *Lithosphere* (one position), GSA books (one position).

# In Memoriam



The Society notes with regret the deaths of the following members  
(notifications received between 1 Aug. and 1 Oct. 2018).

**John J. Amoruso**

Houston, Texas, USA  
Date of death: 29 Jan. 2018

**Lanny H. Fisk**

Auburn, California, USA  
Date of death: 19 July 2018

**Paul A. Lindberg**

Sedona, Arizona, USA  
Date of death: 16 June 2018

**Wolfgang H. Berger**

La Jolla, California, USA  
Date of death: 6 Aug. 2018

**Robert J. Floyd**

Knoxville, Tennessee, USA  
Notified: 6 Aug. 2018

**Esther R. Magathan**

Boulder, Colorado, USA  
Notified: 28 Sept. 2018

**William L. Chenoweth**

Grand Junction, Colorado, USA  
Date of death: 23 July 2018

**John C. Harms**

Littleton, Colorado, USA  
Notified: 4 Aug. 2018

**Steven G. Martindale**

Mission Viejo, California, USA  
Notified: 24 Sept. 2018

**Ivan P. Colburn**

Pasadena, California, USA  
Date of death: 1 July 2018

**John P. Kempton**

Fairhope, Alabama, USA  
Date of death: 12 Aug. 2018

**J. Cotter Tharin**

Holland, Michigan, USA  
Date of death: 9 Aug. 2018

**H. Basil Cooke**

Surrey, British Columbia, Canada  
Date of death: 3 May 2018

**Frank C. Kresse**

Petaluma, California, USA  
Date of death: 26 Apr. 2018

## Recent, Rare, and Out-of-Print Books

Geoscience Books (now including Pegmatites)  
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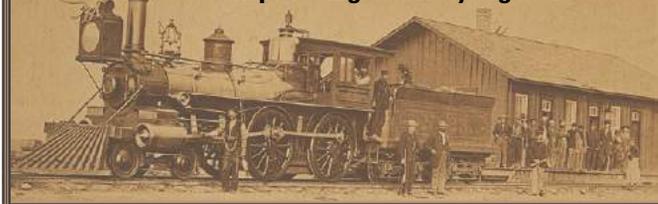
## Tracks, Trails & Thieves

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and Brent H. Breithaupt

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# GSA Today Science Editor Changes



Peter Copeland

Incoming science editor Peter Copeland is a professor in the Dept. of Earth and Atmospheric Sciences at the University of Houston. His research has focused primarily on thermochronology and its application to continental tectonics. He is the author of *Communicating Rocks: Writing, Speaking, and Thinking about Geology* (2012, Pearson). From 2001–2004, he was the co-editor of the *Geological Society of America Bulletin*.



Mihai Ducea

Mihai Ducea remains on board through 2021. He is a professor of geology at the University of Arizona and also holds a courtesy appointment at the University of Bucharest. He received a Ph.D. at the California Institute of Technology. Ducea's research is aimed at understanding the links between igneous and metamorphic petrologic processes and the tectonic evolution of continents. He is interested in continental margin

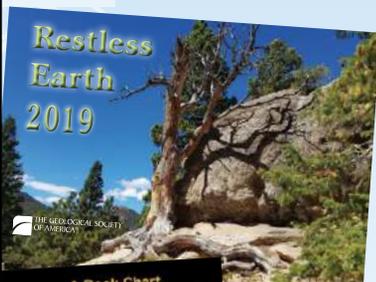
processes and conducts fieldwork at various locations in the western North American Cordillera, the central Andes, the Carpathians, and southern Tibet. He runs a geochemical and radiogenic isotope laboratory at the University of Arizona. Ducea is a GSA Fellow who has published 31 papers in GSA journals (*Geology*, *GSA Today*, *GSA Bulletin*, *Geosphere*, and *Lithosphere*) over the past 16 years and has co-edited a GSA Memoir (2015) and a GSA Special Paper (2005).



Jerry Dickens

Jerry Dickens rotates off as science editor at the end of the month. He is a professor of oceanography in the Dept. of Earth, Environmental and Planetary Science at Rice University. His research interests range from past changes in climate and carbon cycling to marine methane systems, mixed siliciclastic-carbonate margins, and sediment-hosted ore deposits. He previously was editor for *Paleoceanography* and is a Fellow of both GSA and AGU.

## Geologist gift-giving made easy!



Geologists may be some of the few who welcome a lump of coal in their stockings, but the GSA store has what they really want this holiday season. Find all of GSA's current books, selected books from other publishers, field tools, charts, posters, and the 2019 GSA 12-month calendar "Restless Earth." Or surprise that lucky geologist with a journal subscription or GSA membership.

And if you've got a stocking to fill, here are just some of the gifts you'll find for under \$10:

- Geologic Time Scale Poster v. 5.0 (newly updated for 2018!)
- The Geology of Plate Tectonics chart
- Rock Chart Poster
- Geology Terms in English and Spanish pocket guide
- GSA Note Cards featuring stunning geologic images (box of 10)
- Pocket-Sized Sand Grain Sizing Folder
- Doohickey 6x Key Tool from Nite Ize®
- Rite in the Rain® Spiral Notebooks and Field-Flex Memo Book
- EarthCache geocoins, patches, pins, bumper stickers, and baseball caps



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# Geoscience Jobs & Opportunities

## Positions Open

### ASSISTANT PROFESSOR, DEPARTMENT OF GEOSCIENCES, PRINCETON UNIVERSITY

The Dept. of Geosciences at Princeton University is seeking applications for a tenure-track assistant professor faculty position in geology, broadly defined. We are particularly interested in interdisciplinary scientists who could interact productively with existing faculty working in geophysics and/or climate. Possible fields of specialty include, but are not limited to, petrology, volcanology, tectonics, glaciology, rock deformation, earth surface processes, and paleontology.

Applicants should send a curriculum vitae, including a publication list, a statement of research and teaching interests, and contact information for three references to <https://www.princeton.edu/acad-positions/position/9581>. Evaluation of applications will begin as they arrive; for fullest consideration, apply by December 21, 2018, but applications will be accepted until the position is filled.

Princeton is especially interested in candidates who can contribute to the diversity and excellence of our academic community. For general information about applying to Princeton and how to self-identify, please link to <http://web.princeton.edu/sites/dof/ApplicantsInfo.htm>.

Princeton University is an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability status, protected veteran status, or any other characteristic protected by law.

This position is subject to the University's background check policy.

Information about the research activities of the Dept. of Geosciences may be viewed at <http://geoweb.princeton.edu>.

### TENURE TRACK POSITION, SOLID EARTH GEOSCIENCES OR ENGINEERING SEISMOLOGY, UNIVERSITY OF MEMPHIS

The Center for Earthquake Research and Information (CERI) at the University of Memphis invites applications for a tenure-track faculty position at the Assistant Professor level to begin in August 2019. We are searching broadly and seeking an individual to complement our existing strengths in seismology, geodesy, computational tectonics, earthquake physics and seismic hazard. We particularly encourage applicants with research interests related to Active tectonics, Continental/Lithospheric dynamics, Computational Geophysics, Exploration Geophysics, or Engineering Seismology. Applicants must have a Ph.D. at the time of employment, and show a demonstrated record or strong promise of research productivity. The successful candidate is expected to build a vigorous, externally funded research program, mentor M.S. and Ph.D. graduate students, and teach graduate courses in her or his specialty. As part of a University interdisciplinary research center, CERI faculty are engaged in a variety of regional, national, and international research projects (<https://www.memphis.edu/ceri>). More

information about this position can be obtained by contacting the chair of the search committee, Eunseo Choi ([echoi2@memphis.edu](mailto:echoi2@memphis.edu)).

Applicants should submit an application letter, full curriculum vitae, statements of research and teaching interests, and the names and addresses (with phone numbers and email) of at least three references. To receive full consideration, applications must be submitted through the University of Memphis WorkForUM online application system (<https://workforum.memphis.edu>) by December 17, 2018. The University of Memphis is an Equal Opportunity/Affirmative Action employer.

### ASSISTANT PROFESSOR, PALEOBIOLOGY

#### UNIVERSITY OF SOUTH FLORIDA

The School of Geosciences at the University of South Florida seeks to fill a 9-month, full-time and tenure-earning, Assistant Professor position in Paleobiology. We seek candidates with outstanding potential to develop an externally funded research program, mentor graduate students, and teach undergraduate and/or graduate courses in paleobiology, with preference given to exceptional candidates with strengths in stratigraphy and sedimentology, broadly construed. The successful candidate will complement and integrate with our existing school strengths in paleobiology, geology, environmental science, and geography, and with university-wide working groups in evolutionary biology and/or the Anthropocene. A Ph.D. in Geology or related field is required and must be conferred by appointment start date.

Salary is negotiable. To apply, please visit <http://employment.usf.edu> and attach a cover letter, CV, teaching philosophy, research interests, and provide names and contact information for three references. Review of applications will begin on November 29, 2018. Additional information is available at the School of Geosciences website: <http://hennarot.forest.usf.edu/main/depts/geosci/> and by emailing the search committee chair, Dr. Gregory Herbert ([gherbert@usf.edu](mailto:gherbert@usf.edu)).

The University of South Florida, established in 1956 and located in Tampa, is a high-impact global research university serving more than 50,000 students. USF ranks in the top 30 nationally for research expenditures among public universities, according to the National Science Foundation. In 2018, the Florida Board of Governors designated USF as a Preeminent State Research University, placing USF in the most elite category among the state's 12 public universities. For more information on the USF Paleobiology Research Group, please visit our web site at <http://hennarot.forest.usf.edu/main/depts/geosci/research/paleo/paleo/>.

Conclusion of this search is subject to final budget approval. According to Florida Law, applications and meetings regarding them are open to the public. USF is an Equal Opportunity/Equal Access Institution.

### EXECUTIVE DIRECTOR SEARCH NATIONAL ASSOCIATION OF GEOSCIENCE TEACHERS

NAGT is seeking a qualified individual to serve as the Association's Executive Director to begin early summer 2019.

NAGT's mission is to support a diverse, inclusive, and thriving community of educators and education researchers to improve teaching and learning about the Earth. NAGT represents the collective voice of K-12 teachers, college and university faculty, and informal educators in museums and science centers who share a vision to build geoscience expertise and an Earth-literate society through high-quality education. We seek an exceptional Executive Director to build on past successes and to provide strategic leadership to guide NAGT toward new opportunities for growth.

To learn more about the position and find instructions to apply, visit [https://nagt.org/nagt/about/nagt\\_executive\\_director\\_search.html](https://nagt.org/nagt/about/nagt_executive_director_search.html).

### POSTDOC/RESEARCH SCIENTIST/ LAB MANAGER, NOBLE GAS GEOCHRONOLOGY/GEOCHEMISTRY, DEPARTMENT OF GEOSCIENCES, UNIVERSITY OF ARIZONA

We seek an experienced and dynamic scientist to help establish, manage, and lead a new noble gas mass spectrometry facility with two new sector instruments focusing on  $^{40}\text{Ar}/^{39}\text{Ar}$ ,  $^4\text{He}/^3\text{He}$ ,  $^{21}\text{Ne}$ , and other types of analyses in applications ranging from geo/thermochronology, cosmogenic and nucleogenic dating, subsurface fluids, and meteorite exposure histories. The scientist will lead development of routine and experimental approaches in collaboration with geologists, planetary scientists, and hydrogeologists at the UofA and collaborating institutions and will be expected to take initiative in establishing robust analytical protocols, co-directing facility development and maintenance, and helping train users. Experience with noble gas analysis, mass spectrometry, electronic and instrument interfacing, and programming is preferred.

Required: MS or PhD degree upon hire.

Outstanding benefits include health/dental/life, paid vacation, sick leave & holidays, UA/ASU/NAU tuition reduction for employee & qualified family, state retirement, and more.

Review of materials will begin 12/1/2018 and will continue until position is filled.

The University of Arizona is an EEO/AA Employer - M/W/D/V.

To apply, please log into: <http://uacareers.com/postings/32754>.

### TENURE-TRACK POSITION IN CRUSTAL PROCESSES AND DYNAMICS, EARTH & ENVIRONMENTAL SCIENCES, VANDERBILT UNIVERSITY

The Dept. of Earth and Environmental Sciences at Vanderbilt University has an opening for a tenure-track faculty member in Solid Earth Sciences with expertise in Crustal Processes and Dynamics. We are committed to excellence and diversity in research and teaching, and we seek to foster collegiality and collaboration among our members.

The desired concentration of study centers on crustal processes and dynamics, including (but not limited to) the study of crustal structure and dynamics; magma formation, evolution, and eruption; hydrothermal fluids and their effects on crustal processes; and could also involve interactions with Earth surface dynamics. Expertise can include geophysics, geochemistry, or the study of geomaterials.

Research using a combination of approaches (e.g. field, theoretical, modeling, analytical) is preferred, as well as interest in or experience with both modern and ancient systems.

This faculty position presents an opportunity to join a productive department at a highly ranked research university. We seek an individual aimed at the highest standards of scholarship in research and teaching at both the graduate (MSc and PhD) and undergraduate levels, and who would be drawn to interact with a diverse, interdisciplinary faculty and student body in the Earth and Environmental Sciences and related fields. Connections with campus initiatives in transdisciplinary research, data science, digital learning, or immersive experiences for undergraduates are desirable.

The department is committed to increasing diversity in the geoscience community, and is especially interested in candidates who, through their research, teaching, and/or service, will contribute to the diversity and inclusivity of the academic community. Minorities, women, individuals with disabilities, and members of other underrepresented groups, in particular, are encouraged to apply. Vanderbilt is an Equal Opportunity/Affirmative Action employer.

The position is effective for the Fall 2019 semester at the Assistant Professor level. Applications should include a vita, a statement of research and teaching interests, and names of at least three references (including mail and e-mail addresses, as well as phone numbers). Select applicants will later be asked to provide student evaluations of teaching, if available. The successful applicant must have the Ph.D. in hand by August 2019. Applications should be submitted online via Interfolio at <https://apply.interfolio.com/56462>. The review of files will begin on December 1, 2018. Inquiries about the position can be directed to Guilherme Gualda [atg.gualda@vanderbilt.edu](mailto:atg.gualda@vanderbilt.edu).

Vanderbilt University is located in Nashville, Tennessee, a thriving state-capital city that enjoys a moderate climate, excellent parks and natural areas, a strong and varied economy, and diverse food, music, and cultural opportunities.

**TENURE-TRACK ASSISTANT PROFESSOR  
(PHYSICAL HYDROGEOLOGY) AND  
VISITING ASSISTANT PROFESSOR  
(PALEONTOLOGY/PALEOBIOLOGY),  
UNIVERSITY OF WISCONSIN-  
MILWAUKEE**

The Dept. of Geosciences at the University of Wisconsin-Milwaukee seeks to fill two positions beginning August 19, 2019: one tenure-track faculty position in Physical Hydrogeology (Position # 28007) and one (renewable) visiting assistant professor position in Paleontology/Paleobiology (Position # 28018).

Review of applications will begin December 11, 2018, but the position remains open until filled.

The University of Wisconsin-Milwaukee is a Research 1 institution located on the north side of Milwaukee. The department of Geosciences offers B.S./B.A., M.S., and Ph.D. degree programs and is staffed by 10 full-time faculty. The University of Wisconsin-Milwaukee is an Equal Opportunity/Affirmative Action Employer.

For complete information about these positions, including qualifications and application materials, please visit <http://jobs.uwm.edu/postings/search> (positions 28007 and 28018). If you have any questions, please contact Shangping Xu ([xus@uwm.edu](mailto:xus@uwm.edu)), Physical Hydrogeology Position Contact; Lindsay McHenry ([lmchenry@uwm.edu](mailto:lmchenry@uwm.edu)), Paleontology Position Contact; or John L. Isbell, Dept. of Geosciences Chair ([jisbell@uwm.edu](mailto:jisbell@uwm.edu)).

**PROFESSOR OF GEOLOGICAL  
SCIENCES, DEPARTMENT OF  
GEOLOGICAL SCIENCES,  
UNIVERSITY OF TEXAS AT EL PASO**

The Department is proud to announce the newly created Kenneth F. and Patricia Clark Distinguished Chair in Economic Geology. The one-million-dollar endowment shall be used to support the activities of the Distinguished Chair, in particular to enhance research in the field of Economic Geology and/or Resource Extraction, and to support the development of students' abilities to gain employment in such sectors. We are interested in applicants with an exceptional record of successful projects in the area of Economic Geology. The candidate must demonstrate the capacity to develop and strengthen the Department's ties with the mining and extractive industries, as well as the capacity to mentor students and guide their projects through to publication. The successful candidate will teach a combination of undergraduate and graduate classes. The candidate will be expected to attract research funding from external sources. The hired person will have the opportunity to participate in the Department's Center for Entrepreneurial Geosciences (<https://science.utep.edu/cegs/index.php>). Salary for this Full Professor position is negotiable.

The University of Texas at El Paso is a burgeoning national and international research university committed to access and excellence. A leader among Hispanic-serving institutions, UTEP enrolls over 25,000 students and is the only doctoral research university in the nation with a majority Mexican-American student body. UTEP is designated by the Carnegie Foundation for the Advancement of Teaching as "Community Engaged," and UTEP faculty have been nationally recognized for their commitment to student success, teaching, research, and scholarship.

**Required Qualifications:** The Dept. of Geological Sciences is interested in hiring a faculty member with a distinguished career in the area of Economic Geology that is capable of teaching at the Undergraduate and Graduate level, conducting fundamental research, publishing in peer-reviewed journals, and mentoring students in applied mineral exploration, genesis of ore deposits and/or other related areas. Candidates capable of building active research programs and engaging in collaborative research are encouraged to apply. Preferred Qualifications: Candidates with either industrial and/or academic backgrounds are encouraged to apply. Such achievements as: a track record of peer-reviewed publications, attainment of research funding, leadership, project management, discoveries and/or exploration success and entrepreneurship would be viewed favorably. Teaching experience in the field, laboratory or classroom will also be a con-

sideration. Demonstrated collaborations in research are valued as well.

**To Apply:** Please view the full ad and apply online at <http://utep.edu/employment>. Applications must include the following: (1) a letter of interest; (2) a curriculum vitae; (3) a description of research and teaching interests; (4) description of major achievements and contributions to economic geology; (5) a description of how the applicant would approach broadening participation of underrepresented groups in the geosciences; and (5) complete contact information for at least five references. Review of applications will begin on Nov. 15, 2018, and continue until the position is filled. The anticipated appointment date is August 1, 2019.

For more information about the position, please contact: Dr. Nicholas Pingitore ([npingitore@utep.edu](mailto:npingitore@utep.edu)), Search Committee Chair or Dr. James Kubicki ([kubicki@utep.edu](mailto:kubicki@utep.edu)), Department Chair.

The University of Texas at El Paso is an Equal Opportunity/Affirmative Action Employer. The University does not discriminate on the basis of race, color, national origin, sex, religion, age, disability, genetic information, veteran status, or sexual orientation in employment or the provision of services. Hiring decisions are based on budget approval.

**FACULTY POSITION, ISOTOPE  
GEOCHEMISTRY AND GEOCHEMISTRY,  
UNIVERSITY OF TENNESSEE,  
KNOXVILLE**

The Dept. of Earth and Planetary Sciences, University of Tennessee, Knoxville, invites applications for a nine-month, tenure-line position in Isotope Geochemistry and Geochemistry to be hired at the rank of Associate Professor. The successful candidate will develop a successful program of externally funded research in isotope geochemistry and geochemistry that includes supervision of undergraduate and graduate students, post-doctoral researchers, and technical staff. The candidate will provide primary oversight of a newly created ICP-MS core facility, which will include quadrupole and multi-collector ICP-MS instruments, a laser ablation system, and a clean laboratory housed in the Dept. of Earth and Planetary Sciences, located within the newly constructed Strong Hall. All laboratory spaces are new and purpose-built for the core facility, with significant university resources available for equipment purchase. Associated responsibilities include financial oversight and subsequent set-up, operation, and maintenance of a recharge-based, multi-instrument facility available for department, university, and external users. In addition, the candidate is expected to perform rank-appropriate departmental and university service. The successful candidate will instruct undergraduate courses, as well as graduate courses in the candidate's specialty.

Applicants must hold a Ph.D. (or equivalent) degree in solid-earth geoscience or a related discipline, and demonstrate excellence and innovation through publications and grants/contracts in isotope geochemistry (radiogenic and/or non-traditional stable isotope) or geochemistry, with the capacity to lead research in isotope geochemistry. The specific research specialty is open. The candidate must have a minimum of 7 years of research experience beyond the Ph.D. degree, and must have

first-hand experience in setting up, running, and maintaining a multiple instrument ICP-MS facility and clean laboratory.

To apply, please email the following to [epsicpms@utk.edu](mailto:epsicpms@utk.edu), with the subject line "Isotope geochemistry search": full curriculum vitae, cover letter describing research and teaching experience, philosophy, and plans, and names of 4 references with contact information. Applications received by 7 January, 2019, are ensured review, but earlier submission is highly encouraged. The position will remain open until filled. Questions about the position should be directed to Dr. Chris Fedo ([cfedo@utk.edu](mailto:cfedo@utk.edu)). For those attending, we will meet with selected candidates at the 2018 AGU Fall Meeting in Washington DC. Please contact Dr. Chris Fedo, chair, with any questions at [cfedo@utk.edu](mailto:cfedo@utk.edu).

The University of Tennessee is seeking candidates who have the ability to contribute in meaningful ways to the diversity and intercultural goals of the University. The University is an EEO/AA/Title VI/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services. All qualified applicants will receive equal consideration for employment without regard to race, color, national origin, religion, sex, pregnancy, marital status, sexual orientation, gender identity, age, physical or mental disability, or covered veteran status.

#### **ASSISTANT/ASSOCIATE RESEARCH PROFESSOR, CENTER FOR ENERGY STUDIES (ENERGY RELATED FIELD), LOUISIANA STATE UNIVERSITY**

The Center for Energy Studies ("CES") at the Louisiana State University ("LSU") seeks applicants at the Assistant and Associate Professor-Research rank. Geologists are encouraged to apply.

LSU is committed to diversity and is an equal opportunity/equal access employer

Please find additional information and apply here: [https://lsu.wd1.myworkdayjobs.com/LSU/job/LSU---Baton-Rouge/Assistant-Associate-Research-Professor--Energy-Related-Field-\\_R00027646](https://lsu.wd1.myworkdayjobs.com/LSU/job/LSU---Baton-Rouge/Assistant-Associate-Research-Professor--Energy-Related-Field-_R00027646).

#### **TENURE-TRACK FACULTY, HYDROGEOLOGY,**

**THE PENNSYLVANIA STATE UNIVERSITY**  
The Dept. of Geosciences at The Pennsylvania State University, on the University Park Campus, invites applications for a tenure-track faculty position in the field of Hydrogeology. We seek a creative colleague who will develop a vigorous externally funded research program, teach undergraduate and graduate courses, and demonstrate commitment to advancing equity and inclusion. The Dept. of Geosciences is part of the College of Earth and Mineral Sciences, and houses top-ranked research programs in environmental and climate sciences, geology, geophysics, and geochemistry. Water is an important component of the University Strategic Plan, and Penn State hosts several campus-wide initiatives in water resources through, for example, the Penn State Institutes of Energy and the Environment (<http://www.iee.psu.edu>) and the Earth and Environmental Systems Institute (<http://www.eesi.psu.edu>). Applicants must have a Ph.D. in geosciences or related field at the time of appointment. We anticipate filling the position

at the Assistant Professor level; but applications at higher rank may be considered in exceptional circumstances. Appointment could begin as early as July 1, 2019. Review of applications will begin on December 1, 2018 and continue until the position is filled. Applications should be submitted online and include: cover letter, curriculum vitae, statement of research vision, statement of teaching interests, evidence, either woven through their application materials, or as a separate diversity statement, of a commitment to fostering diversity, equity, and an inclusive environment in their department/workplace, and names and contact information for four references. For additional information, please contact Don Fisher, Chair of the Search Committee, at [mailto:dmf6@psu.edu](mailto:mailto:dmf6@psu.edu).

Apply online at <http://apptrkr.com/1319964>

Campus Security Crime Statistics: For more about safety at Penn State, and to review the Annual Security Report which contains information about crime statistics and other safety and security matters, please go to <http://www.police.psu.edu/clery/>, which will also provide you with detail on how to request a hard copy of the Annual Security Report.

Penn State is an equal opportunity, affirmative action employer, and is committed to providing employment opportunities to all qualified applicants without regard to race, color, religion, age, sex, sexual orientation, gender identity, national origin, disability or protected veteran status.

#### **TWO RESEARCH GEOLOGIST POSITIONS, KENTUCKY GEOLOGICAL SURVEY**

The Kentucky Geological Survey, a research center at the University of Kentucky, seeks applications for two research geologist positions:

**Geologist III (Geohealth and Environmental Geochemistry).** The successful candidate will have a demonstrated ability to perform applied research and outreach related to geologic controls on the origin, transport, and fate of contaminants and carcinogens in Kentucky. Work will include continuation of existing KGS collaborations to investigate geological controls on indoor radon concentrations, heavy metal anomalies, and cancer clusters in addition to new research topics identified by the candidate and consistent with the KGS and UK strategic plans. Preference will be given to candidates with demonstrated experience in environmental or geohealth applications of geostatistics; development of innovative geochemical sampling or analysis methods; integration of geologic and epidemiological information; use of geologic information to support public policy decisions; and/or publication of geohealth research in major journals. This position will require CITI human subjects research certification (available through UK after employment begins).

**Geologist III (Quaternary Geology, Geomorphology, and Geohazards).** The successful candidate will have a demonstrated ability to perform applied research and outreach on Quaternary geology, geomorphology, and near-surface geologic hazards such as landslides, debris flows, sinkholes, liquefaction, and fluvial erosion/sedimentation in Kentucky. Work will include responsibility for day-to-day operation of the KGS Digital Earth Analysis Lab; geomorphological, geochronological, and geohazard research relevant to Kentucky; and con-

tinuation of ongoing research collaborations, all in a manner consistent with the KGS and UK strategic plans. Preference will be given to candidates with demonstrated experience in LiDAR-based digital terrain modeling using large (e.g., statewide) data sets; geologic applications of structure-from-motion photogrammetry and/or UAV-based LiDAR data; Quaternary dating methods; use of geologic information to support engineering and/or public policy decisions; economic analysis of geohazards and mitigation strategies; and/or publication of research in major journals.

#### **Both positions require:**

- A Ph.D. in a relevant field at the time of appointment AND at least one degree in geology, geosciences, or geological sciences.
- Demonstrated proficiency in the use of modern computational tools such as Matlab, Mathematica, R, or Python, in addition to GIS, for advanced geologic data visualization, analysis, and/or simulation.
- Demonstrated ability to work toward common goals as part of a high-performance team.
- Demonstrated potential to (1) publish research results in peer-reviewed scientific journals, reports, and conference abstracts, (2) conceive and acquire outside funding for research projects relevant to Kentucky, (3) foster existing and develop new research collaborations within the University and the broader scientific community, and (4) engage in a program of continuous professional development leading to national or international stature in the candidate's field(s) of specialization.
- Ability to perform laboratory work, geological fieldwork, and general office work in support of KGS research and outreach objectives. This may include fieldwork in rough terrain or inclement weather, occasional lifting of 50 lb or more, and occasional overnight travel.

About KGS: The Kentucky Geological Survey is a research center within the University of Kentucky, with an organizational history stretching back to the first publicly funded geological reconnaissance of Kentucky in 1838. With main offices on the UK campus in the heart of Kentucky's Bluegrass region, KGS comprises approximately 50 FTE scientists and support staff engaged in a wide range of geological research and service activities beneficial to the Commonwealth of Kentucky. This includes active collaborations with colleagues in the UK Departments of Earth and Environmental Sciences, Civil Engineering, Mining Engineering, Plant and Soil Sciences, Preventive Medicine and Environmental Health, as well as the UK College of Nursing and other research centers such as the Kentucky Water Resources Research Institute and the UK Center for Applied Energy Research. Most KGS doctoral-level scientists have adjunct faculty appointments that offer optional opportunities for teaching and advising. UK, an R1 research university with 16 degree-granting colleges and more than 200 academic programs, is one of only eight institutions in the country with liberal arts, engineering, professional, agricultural, and medical colleges and disciplines on one contiguous campus. Lexington is a midsize city of about 320,000 people that offers a wide range of cultural, social, and recreational

amenities in addition to easy commuting and an affordable cost of living. Please visit [kgs.uky.edu](http://kgs.uky.edu) for additional information about KGS.

To apply for job #RE RE15944 Geologist III (Geohealth and Environmental Geochemistry), submit a UK Online Application at <http://ukjobs.uky.edu/postings/204602>.

To apply for job #RE15931 Geologist III (Quaternary Geology, Geomorphology, and Geohazards), submit a UK Online Application at <http://ukjobs.uky.edu/postings/204454>.

If you have any questions, contact HR/ Employment, phone (859) 257-9555, then press 2. Application deadline is Dec. 31, 2018.

The University of Kentucky is an Equal Opportunity University that values diversity and inclusion. Individuals with disabilities, minorities, veterans, women, and members of other underrepresented groups are encouraged to apply.

**TENURE-TRACK FACULTY POSITION,  
SEDIMENTARY GEOLOGY,  
DEPARTMENT OF GEOLOGICAL  
AND ATMOSPHERIC SCIENCES,  
IOWA STATE UNIVERSITY**

The Dept. of Geological and Atmospheric Sciences in the College of Liberal Arts and Sciences at Iowa State University invites applications for a tenure-track faculty position at the assistant professor level in the area of sedimentary geology, to begin August 2019. The selected candidate will be expected to teach courses at the undergraduate and graduate levels, including sedimentary geology, and to establish a nationally recognized, externally funded research program. This research should complement existing strengths in the department, which include climate modeling, paleoclimatology, environmental geochemistry, glaciology, hydrogeology, geophysics, economic geology, structural geology, and geoscience education. Research and teaching opportunities exist at the Iowa State University Geology Field Station, located in the Bighorn Basin, Wyoming. A commitment to excellence in research, teaching at all levels, and performance of service duties is essential. Internal grants at the college and university levels support faculty travel, teaching, and scholarship. Information about the Department appears at <https://ge-at.iastate.edu/>. For more information contact department chair, Sven Morgan ([smorgan@iastate.edu](mailto:smorgan@iastate.edu)), or search committee chair, Neal Iverson ([niverson@iastate.edu](mailto:niverson@iastate.edu)).

Candidates must hold a Ph.D. by the time of appointment. All applications must be submitted electronically at [www.iastatejobs.com](http://www.iastatejobs.com) (search vacancy ID#: 800202). Please be prepared to attach a letter of application, concise statements of teaching and research interests, curriculum vitae, and the names, addresses, e-mail addresses, and phone numbers of at least three references.

The position will remain open until filled. Full consideration will be given to those applications received by January 7, 2019. Iowa State University is an Equal Opportunity/Affirmative Action employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability or protected veteran status and will not be discriminated against. ISU is committed to attracting and retaining the

highest quality faculty and staff and therefore works to find positions for partners/spouses seeking employment, either within ISU or in the surrounding community. Iowa State University is located in Ames, Iowa, a vibrant community of 63,000 people 30 miles north of Des Moines. Ames is routinely singled out as one of the most livable, economical, and healthiest small cities in the U.S.

**ASSISTANT PROFESSOR OF SEISMOLOGY,  
PURDUE UNIVERSITY**

The Dept. of Earth, Atmospheric, and Planetary Sciences (EAPS), within the College of Science at Purdue University, invites applications for a tenure-track faculty position at the rank of Assistant Professor in the area of seismology. As part of a large-scale interdisciplinary hiring effort across key strategic areas in the College of Science—Purdue's second-largest college, comprising the physical, life, and computing sciences—this position comes at a time when the College is under new leadership and with multiple commitments of significant investment.

EAPS has strengths in exploration geophysics, seismic imaging, geophysical modeling, earth material properties, geodesy, and tectonics. We seek to add a quantitative seismologist interested in addressing questions on the solid earth at a range of scales. Areas of specialization could include earthquake geophysics, and/or natural/active source seismic imaging. Candidates are expected to develop a vigorous, externally funded, internationally recognized research program, that is complementary to existing research and teaching needs at the undergraduate and graduate levels. The potential to develop interdisciplinary research that cuts across specialty areas within the department, the College of Science, and Purdue's research community is desirable. Candidates must have completed their Ph.D. in the area of Geophysics or a related field by the time of employment. Within EAPS and Purdue, candidates will find supportive colleagues, a diverse and vibrant academic community, with ample opportunities for professional and personal growth.

Purdue University's Dept. of Earth, Atmospheric, and Planetary Sciences is committed to advancing diversity in all areas of faculty effort, including scholarship, instruction, and engagement. Candidates should address at least one of these areas in their cover letter, indicating their past experiences, current interests or activities, and/or future goals to promote a climate that values diversity and inclusion.

Interested applicants should visit <https://hiring.science.purdue.edu>, submit a curriculum vitae, a research statement, a teaching statement, and complete contact information for at least 3 references. Review of applications will begin December 20, 2018, and will continue until the position is filled. Questions related to this position should be sent to Douglas Schmitt ([schmitt@purdue.edu](mailto:schmitt@purdue.edu)) or Christopher Andronicos ([candroni@purdue.edu](mailto:candroni@purdue.edu)). Applications will be accepted until the position is filled. A background check will be required for employment in this position. Purdue University is an ADVANCE institution.

Purdue University is an EOE/AA employer. All individuals, including minorities, women, individuals with disabilities, and veterans are encouraged to apply.

**HYDROLOGY,  
UTAH VALLEY UNIVERSITY**

The Dept. of Earth Science at Utah Valley University invites applications for a full-time, tenure-track position in Hydrology to begin August 2019. The successful candidate will have a Ph.D. in hydrology or related field, research experience in hydrology, and a demonstrated commitment to excellence in teaching. Responsibilities will include teaching majors courses in hydrology plus lower division environmental management and/or geology courses, as well as engaging in scholarship, supervising undergraduate research, participating in professional organizations, and serving the university. Excellent teaching skills and a strong commitment to effective teaching and undergraduate research are necessary. Experience as a professional hydrologist is a positive.

For more information, please visit [www.uvu.edu/earthscience](http://www.uvu.edu/earthscience) or contact the search committee co-chairs, Jim Callison ([jcallison@uvu.edu](mailto:jcallison@uvu.edu)) and Hilary Hungerford ([hilary.hungerford@uvu.edu](mailto:hilary.hungerford@uvu.edu)).

To apply, please visit <http://www.uvu.jobs/postings/9210>. The application deadline is Jan 5, 2019.

Utah Valley University is an Equal Opportunity Employer/Veterans/Disabled/Equal Access Employer. Utah Valley University is committed to an inclusive hiring process and the welcoming of diverse candidates.

**ASSISTANT PROFESSOR  
OF GEOLOGY, CALIFORNIA STATE  
UNIVERSITY, BAKERSFIELD**

The Dept. of Geological Sciences at California State University, Bakersfield (CSUB) invites applications for a tenure-track Assistant Professor position to start in Fall 2019. We seek a broadly trained geologist with applied research and teaching interests that includes (but are not limited to) hydrogeology, subsurface fluid dynamics, groundwater contamination, and groundwater sustainability. Use of GIS techniques is desirable. Teaching responsibilities will include introductory-level courses, hydrogeology, and upper-level undergraduate and graduate courses in the faculty member's specialty. Review of applications will begin December 1, 2018, and continue until the position is filled. CSUB fosters and appreciates ethnic and cultural diversity among its faculty and students, and is committed to increasing the diversity of its faculty to reflect the diversity of the campus community. Applications from women, ethnic minorities, veterans, and individuals with disabilities are welcome. The full announcement and instructions on how to apply can be found at: <http://www.csub.edu/Geology/>  
Email: [geologysearch@csub.edu](mailto:geologysearch@csub.edu).

**TENURE-TRACK ASSISTANT  
PROFESSORS, CLIMATE SCIENCE,  
SURFACE PROCESSES/  
GEOMORPHOLOGY,  
UNIVERSITY OF ROCHESTER**

The Dept. of Earth and Environmental Sciences at the University of Rochester will be hiring two tenure-track Assistant Professors in the general fields of Climate Science and Surface Processes/Geomorphology. While the department welcomes all applicants whose research lies in these general

fields, we are particularly interested in candidates who bridge Solid Earth and Climate Science disciplines. In Surface Processes/Geomorphology, we encourage interdisciplinary applicants who focus on the critical zone between solid Earth systems and the Earth's fluid envelopes. In Climate Science, we encourage applicants whose research focusses on the Carbon Cycle with emphasis on stabilizing atmospheric greenhouse gas concentrations, terrestrial carbon-climate feedbacks, linkages between carbon and other biogeochemical cycles, and connections between physical climate processes and carbon dynamics. The start dates of the positions are July 1, 2020 and 2021. We are interested in dynamic researchers and educators who can establish an externally funded, internationally recognized research program. See <http://www.ees.rochester.edu> for more information about the EES Department. The University of Rochester is a highly ranked research university, and the Rochester area's cultural, educational, and recreational assets frequently place it among the best places to live, work, and raise a family in the United States. Applicants should submit materials via: <https://www.rochester.edu/faculty-recruiting>. Materials include a curriculum vitae, select reprints, statements of research and teaching goals, and the names and contact information of four references. The review of applications will begin December 20, 2018 and will continue until the positions are filled. The University of Rochester has a strong commitment to principles of diversity and, in that spirit, actively encourages applications from groups underrepresented in higher education. EOE/ Minorities/ Females/ Protected Veterans/ Disabled

**ONE-YEAR FACULTY FELLOW,  
SEDIMENTARY SYSTEMS,  
COLBY COLLEGE**

The Colby College Dept. of Geology invites applications for a one-year faculty fellow specializing in sedimentology and stratigraphy or a related field to begin September 1, 2019. The successful candidate will teach a sophomore-level undergraduate course in sedimentary processes and stratigraphy, as well as introductory geology laboratories and possibly an introductory non-majors course. Ideal candidates will be able to offer field trips to examine sedimentary rocks and/or sedimentary environments in the northeast USA or adjacent Canada. The successful candidate also will have access to instrumentation and facilities in the Dept. of Geology for research and teaching. These include a powder-XRD, micro-XRF, SEM-EDS, CHNSO Elemental Analyzer, petrographic microscopes, sediment-sieving equipment, rock cutting and powdering equipment, and thin-section-making equipment. The search committee is especially interested in candidates with a demonstrated ability to teach and advise a diverse student population. A Ph.D. at the time of appointment is preferred, but ABD candidates will be considered.

Complete applications will include a brief cover letter, curriculum vitae, statement of teaching philosophy, and three letters of recommendation. Please submit all materials via Interfolio at: [apply.interfolio.com/55080](https://apply.interfolio.com/55080). Applications received by January 7, 2019 will receive full consideration,

but applications will be reviewed until the position is filled. Inquiries may also be directed to [sedstrat19@colby.edu](mailto:sedstrat19@colby.edu).

Colby is a private, coeducational liberal arts college that admits students and makes employment decisions on the basis of the individual's qualifications to contribute to Colby's educational objectives and institutional needs. Colby College does not discriminate on the basis of race, color, gender, sexual orientation, gender identity or expression, disability, religion, ancestry or national origin, age, marital status, genetic information, or veteran's status in employment or in our educational programs. Colby is an Equal Opportunity employer, committed to excellence through diversity, and encourages applications from qualified persons of color, women, persons with disabilities, military veterans and members of other under-represented groups. Colby complies with Title IX, which prohibits discrimination on the basis of sex in an institution's education programs and activities. Questions regarding Title IX may be referred to Colby's Title IX coordinator or to the federal Office of Civil Rights. For more information about the College, please visit our website: [www.colby.edu](http://www.colby.edu).

**ASSISTANT PROFESSOR, GEOLOGY,  
UTAH VALLEY UNIVERSITY**

The Dept. of Earth Science at Utah Valley University invites applications for a tenure-track assistant professor position in geology, to begin August 2019. In our broad search of talented candidates, we seek a committed educator with expertise in geoscience education, a proven record of effective pedagogy, and a passion for teaching lower-division Earth science courses. Expertise in applied geophysics and/or engineering geology is a plus but is not required. The successful candidate must have a Ph.D. in geology or a closely related field at the time of appointment. Responsibilities will include: 1) designing and teaching introductory-level Earth science courses using various delivery methods (i.e., face-to-face, flipped, hybrid, and online courses); 2) assisting other faculty in designing courses and in developing learning activities that follow sound pedagogical principles; 3) supervising undergraduate research (in science education and/or a geological discipline); and 4) service to the institution. Other possible responsibilities may include participation in our multi-instructor summer field geology capstone course, development of new upper division course(s) in the successful applicant's area of expertise, and coordination of curricula design among full-time faculty and adjunct instructors. A strong commitment to an evidence-based approach to teaching and to undergraduate research is necessary.

For more information, please see <https://www.uvu.edu/earthscience/> or contact the search committee co-chairs Alessandro Zanazzi ([alessandro.zanazzi@uvu.edu](mailto:alessandro.zanazzi@uvu.edu)) and Michael Stearns ([mstearns@uvu.edu](mailto:mstearns@uvu.edu)). For those attending, we will meet with potential candidates 2018 AGU Fall Meeting in Washington, D.C.

To apply, please visit <http://www.uvu.jobs/postings/9182>. Applications deadline: 1/7/19.

Utah Valley University is an Equal Opportunity Employer/Veterans/Disabled/Equal Access

Employer. Utah Valley University is committed to an inclusive hiring process and the welcoming of diverse candidates.

**PALEONTOLOGY AND HISTORICAL  
GEOLOGY FULL-TIME LECTURER  
(NON-TENURE-TRACK),  
TUFTS UNIVERSITY**

Tufts University invites applications for a full-time lecturer in the Dept. of Earth and Ocean Sciences to begin September 1st 2019. This position is for a 1-year initial contract with possibility of continued renewal of multiyear contracts, and it is included in the union for full-time lecturers (Service Employees International Union). The lecturer will teach courses in Paleontology, Historical Geology, their specialty (with a preference for Geographic Information Systems), and labs for other introductory courses that include afternoon field trips. Earth and Ocean Sciences is an undergraduate-only program offering degrees in Environmental Geology and Geological Sciences. Full details and application materials via Interfolio at <https://apply.interfolio.com/53715>.

**Fellowship Opportunities**

**HARRY HESS FELLOWS PROGRAM,  
DEPARTMENT OF GEOSCIENCES,  
PRINCETON UNIVERSITY**

The Dept. of Geosciences at Princeton University announces competition for the 2019–2020 Harry Hess Fellows Program. This honorific postdoctoral fellowship program provides opportunities for outstanding geoscientists to work in the field of their choice. Research may be carried out independently or in collaboration with members of the Geosciences Department. One or more Hess Fellows may be appointed. Applications are welcome from candidates who have earned a Ph.D. in the last five years or expect to have a Ph.D. by the start of the fellowship. Current areas of research include:

Biogeochemical Cycles, Paleoclimatology, Environmental Chemistry, Paleontology, Geochemistry, Petrology, Glaciology, Seismology, Geomicrobiology, Tectonics, Mineral Physics. Atmospheric Science, Oceanography, Planetary Science, Geochronology, Earth History

Applications are due on January 1, 2019, but evaluation of applications and interviews of candidates will begin immediately. Applicants should include a cover letter, a curriculum vitae including a publication list, a 1–2 page statement of research interests and goals, and name, address and email address of three referees familiar with their work by applying on the Princeton University jobsite <https://www.princeton.edu/acad-positions/position/9602>.

Hess Fellowships provide a competitive annual salary, depending upon experience, along with a significant allowance for travel to meetings and for research support. Initial awards are for one year, with the possibility of renewal for additional years depending upon satisfactory performance and available funding. A preferred starting date is on or before September 1st, 2019.

This position is subject to the University's background check policy.

Princeton University is an equal opportunity employer. All qualified applicants will receive con-

sideration for employment without regard to race, color, religion, sex, national origin, disability status, protected veteran status, or any other characteristic protected by law.

Information about the research activities of the Dept. of Geosciences may be viewed at <http://geoweb.princeton.edu>.

### Opportunities for Students

**Graduate Student Opportunities (MS), Ohio University.** The Dept. of Geological Sciences at Ohio University invites applications to its graduate program for the Fall of 2019. The department offers thesis and non-thesis MS degrees in Geological Sciences with areas of emphasis in three research clusters: paleobiology and sedimentary geology, solid earth and planetary dynamics, and environmental and surficial processes. Prospective students are encouraged to contact faculty directly to discuss potential research topics. Qualified students are eligible to receive teaching or research assistantships that carry a full tuition scholarship and a competitive stipend. For additional program and application information, visit the department website at <http://www.ohio.edu/cas/geology> or contact the graduate chair, Dr. Daniel Hembree ([hembree@ohio.edu](mailto:hembree@ohio.edu)). Review of applications begins February 1, 2019.



Photo by Bret Webster.

## Get Connected ...

“What a great discussion.” —Andrew Cullen

“Thank you for joining in. I believe this type of discussion is exactly what was intended by GSA for this open forum.” —Michael Tarullo

“I would like to add to this very interesting discussion.” —Georges Pardo

... *in the Community*

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Lend your voice to your community  
[community.geosociety.org](http://community.geosociety.org)





## Note Cards

GSA publications have sported stunning cover images over the years, and we have chosen ten of them for these note cards. Blank inside for your personal message.

CRD004 (box of 10 cards, 4.25" × 5.5")

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## Your Support Makes a Difference— Stories from 2018 Field Camp Scholarship Recipients

We have written a lot lately about GSA’s field opportunity initiatives, and with good reason—for many of us, geoscience first came alive in the field. However, a number of students find that rising education costs make attending a field camp prohibitively expensive, depriving them of this formative experience. As you consider your year-end gift, join us in supporting GSAF’s **Field Camp Opportunities Fund**. We rely on the generosity of members like you, whose financial support can immediately impact the lives of students as well as create new opportunities for the next generation of aspiring geoscientists.

But don’t take my word for it—some of our 2018 Field Camp Scholarship recipients shared with us the importance of their time at field camp to their professional and scientific growth:

Kuzipa Kapayi, University of Texas at San Antonio: “During the summer of 2018, I participated in a life-changing field program that focused on sustainability of natural resources and hydrology for the exploration of water quality in southern Africa. The field camp scholarship awarded by the Geological Society of America was tremendously helpful as it covered all my expenses related to field equipment, tuition, as well as transportation. The equipment I purchased will continue to serve great purpose throughout my geologic career. I formed long lasting professional relationships with other students and professors. I am humbled by GSA’s generosity and very thankful for encouraging a bright and successful future to one of many students. Overall, field camp was the highlight of my geologic career and the experience and knowledge I gained has provided a smooth transition into graduate school.”

Tamara Adams, University of Texas at Arlington: “The field camp I attended this summer consisted of four weeks of field study. Overall, it was an amazing experience and I would not have been able to attend without the funds from GSA to help cover the cost of tuition. Thank you all from the bottom of my heart!”

Shirley Tsotsoo Mensah, Eastern Illinois University: “First of all, I would like to express my utmost gratitude to GSA for making my participation in field camp possible through the generous funds provided to me. As I look back on field camp, I realize the benefits it gave me. I was proud of myself when I was able to map a whole area by the end of field camp and actually understand what I was doing. This built my confidence

and made me more comfortable with mapping. Being out in the field made me stronger physically, mentally, and academically. I felt more confident and ready to start my senior year at Eastern with all the knowledge I had gained at field camp. I made life-long friends and also developed a love for hiking and doing more outdoor activities. Overall, field camp helped me decide what career paths in geology I would like to go for after completing my undergraduate studies. It was indeed an experience worth going through.”

**This is the impact of your support of field camp opportunities through GSAF—and with your help, we can provide field camp opportunities to even more students!** You can make your year-end gift at [gsafweb.org/donate](http://gsafweb.org/donate), or to discuss in-depth ways that you can support field camp scholarships, please contact Debbie Marcinkowski at +1-303-357-1047 or via email at [dmarcinkowski@geosociety.org](mailto:dmarcinkowski@geosociety.org).



2018 Field Camp Scholarship recipient Dalila A. De Jesus, University of Oklahoma, found her field camp experience to be “a very rewarding and empowering one.”

# 2019 CALENDAR

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## Restless Earth

This 12-month, 9.5" × 12.5" calendar showcases compelling submissions to the GSA calendar photo search. Featuring images of Mount Rundle (Canada), 3-minute-old pahoehoe lava (Hawai'i), the Liwu River carving through the Taroko Gorge (Taiwan), and even a photomicrograph of dinosaur bone (Utah), this stunning calendar will delight the geologist in all of us. **CAL2019 | \$9.95**

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- Birthdates of famous geoscientists
- Calendar of GSA events, meetings, & deadlines

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## CALL FOR FIELD TRIP, SHORT COURSE, AND TECHNICAL SESSION PROPOSALS



It's already time to plan for our 2019 Annual Meeting in Phoenix, Arizona, USA. Help ensure that your area of research and expertise is represented at next year's annual meeting. Any individual or geoscience organization is welcome to submit proposals. The proposal form is online at [www.geosociety.org/amnext](http://www.geosociety.org/amnext).

**Show** the geology by leading a Scientific Field Trip.

**Field Trip proposal deadline:** 3 Dec. 2018

Trips can be anywhere from a half day to five days long. Field trip proposals may be submitted by any member of GSA, its affiliated societies, or anyone else.

**Exchange** the geology by organizing and chairing a Technical Session.

**Technical Session deadline:** 1 Feb. 2019

Proposals are being taken for both Pardee Keynote and Topical Sessions.

**Share** the geology as an instructor through a Short Course.

**Short Course proposal deadline:** 1 Feb. 2019

Courses run the Friday and Saturday before the Annual Meeting and are typically a half day to two full days.

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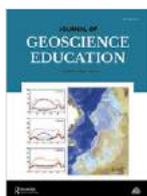
## Take Advantage of the following GSA Partnerships with your 2019 Membership



### Geofacets

Supercharge your research with Geofacets—web-based research tool to access thousands of georeferenced maps. Search by keyword, map coordinates, scale, map type, and more.

**FREE**



### Journal of Geoscience Education (JGE)

Peer-reviewed publication for geoscience education research concerning the pedagogy, assessment, and philosophy of teaching and learning—published for the National Association of Geoscience Teachers (NAGT) by Taylor & Francis. Online subscription US\$45 including archives (US\$35 savings).

**Special Offer**



### Interior Federal Credit Union Membership (IFCU)

IFCU funds the first US\$25 deposit into a savings account to establish membership. IFCU also offers a young adult account—ideal for GSA student and early career professional members.

**Special Offer**



### Mappt Standard

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