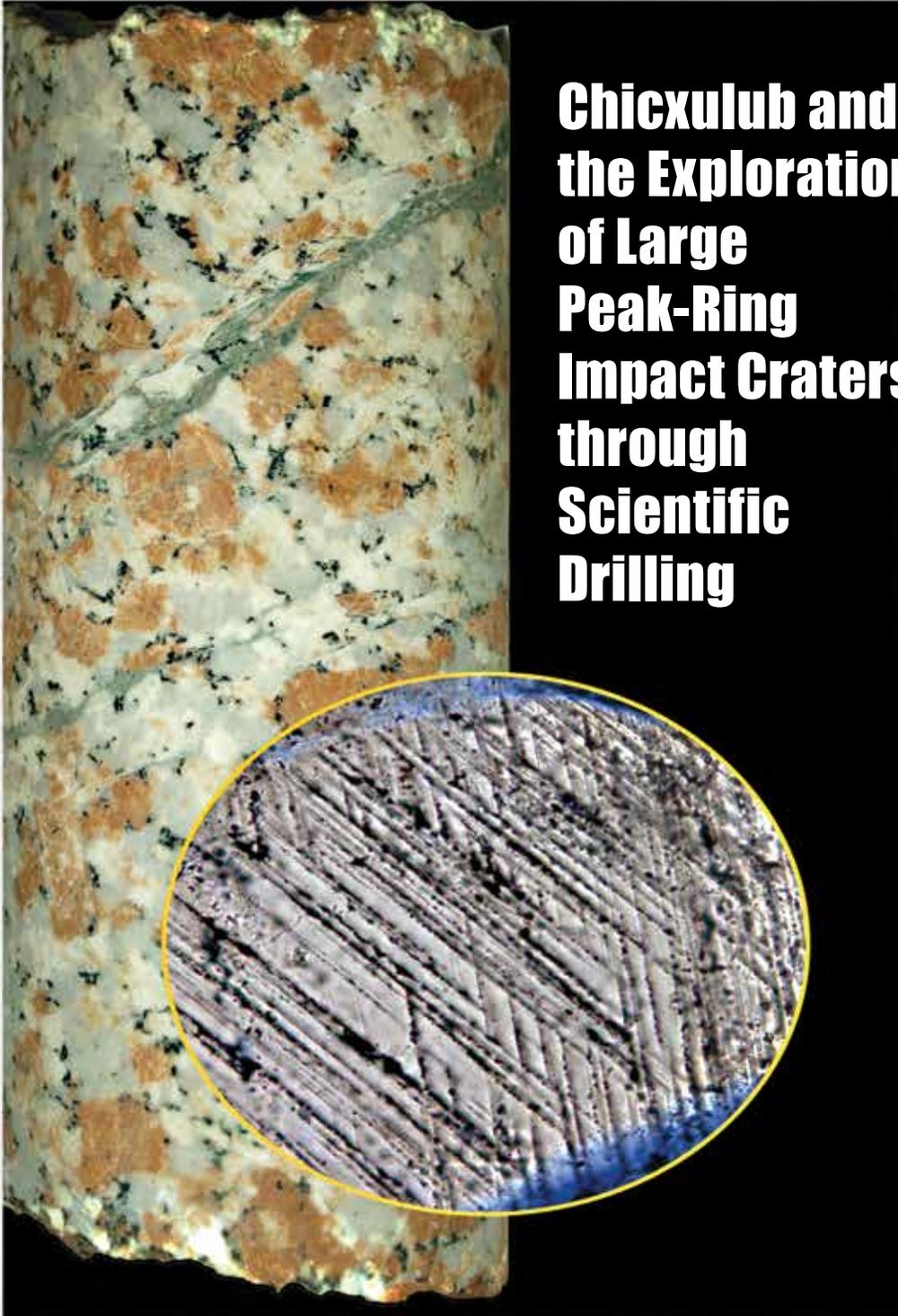


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**Chicxulub and
the Exploration
of Large
Peak-Ring
Impact Craters
through
Scientific
Drilling**

OCTOBER 2017 | VOL. 27, NO. 10

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GSA TODAY STAFF

Executive Director and Publisher: Vicki S. McConnell

Science Editors: **Steven Whitmeyer**, James Madison University Dept. of Geology & Environmental Science, 800 S. Main Street, MSC 6903, Harrisonburg, VA 22807, USA, whitmesj@jmu.edu; **Gerald Dickens**, Rice University School of Earth Science, MS-126, 6100 Main Street, Houston, Texas 77005, USA, jerry@rice.edu.

Member Communications Manager: Matt Hudson, mhudson@geosociety.org

Managing Editor: Kristen "Kee" Giles, kgiles@geosociety.org, gsatoday@geosociety.org

Graphics Production: Margo McGrew, mmcgrew@geosociety.org

Advertising Manager: Ann Crawford, +1-800-472-1988 ext. 1053; +1-303-357-1053; Fax: +1-303-357-1070; advertising@geosociety.org; acrawford@geosociety.org

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SCIENCE

4 Chicxulub and the Exploration of Large Peak-Ring Impact Craters through Scientific Drilling

David A. Kring, Philippe Claeys, Sean P.S. Gulick, Joanna V. Morgan and Gareth S. Collins

Cover: The Chicxulub peak ring in 83-mm-diameter core is composed of granitic rocks crosscut with cataclastic and hydrothermal veins and has also been shock-metamorphosed as illustrated with planar deformation features with ~5 micron spacing in quartz (inset, with field of view 245 microns wide). See related article, p. 4–8.



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Erratum

In the In Memoriam section of the July 2017 issue of *GSA Today* (p. 45), Bennie W. Troxel was incorrectly listed as Bernie Troxel. GSA regrets this error.

Chicxulub and the Exploration of Large Peak-Ring Impact Craters through Scientific Drilling

David A. Kring, Lunar and Planetary Institute, Houston, Texas 77058, USA; **Philippe Claeys**, Analytical, Environmental and Geo-Chemistry, Vrije Universiteit Brussel, Pleinlaan 2, Brussels 1050, Belgium; **Sean P.S. Gulick**, Institute for Geophysics and Dept. of Geological Sciences, Jackson School of Geosciences, University of Texas at Austin, Austin, Texas 78758, USA; **Joanna V. Morgan** and **Gareth S. Collins**, Dept. of Earth Science and Engineering, Imperial College London SW7 2AZ, UK; and the **IODP-ICDP Expedition 364 Science Party**.

ABSTRACT

The Chicxulub crater is the only well-preserved peak-ring crater on Earth and linked, famously, to the K-T or K-Pg mass extinction event. For the first time, geologists have drilled into the peak ring of that crater in the International Ocean Discovery Program and International Continental Scientific Drilling Program (IODP-ICDP) Expedition 364. The Chicxulub impact event, the environmental calamity it produced, and the paleobiological consequences are among the most captivating topics being discussed in the geologic community. Here we focus attention on the geological processes that shaped the ~200-km-wide impact crater responsible for that discussion and the expedition's first year results.

INTRODUCTION

The Chicxulub crater (Hildebrand et al., 1991) on the Yucatán Peninsula of Mexico was produced by a terminal Cretaceous impact that has been linked to regional and global K-T or K-Pg boundary deposits (see reviews by Smit, 1999; Kring, 2000, 2007; Schulte et al., 2010). The subsurface structure was initially detected with geophysical techniques (Cornejo Toledo and Hernandez Osuna, 1950). While exploring the source of those anomalies, Petróleos Mexicanos (PEMEX) drilled three exploration wells (all dry) into the structure. Petrologic analyses of polymict breccias and melt rock in recovered core samples revealed shock-metamorphic and shock-melted features diagnostic of impact cratering (Kring et al., 1991; Kring and Boynton, 1992; Swisher et al., 1992; Sharpton et al., 1992; Claeys et al., 2003),

proving the structure had an impact origin. The buried structure was confirmed by seismic surveys conducted in 1996 and 2005 to be a large ~180–200-km-diameter impact crater with an intact peak ring (Morgan et al., 1997; Gulick et al., 2008).

The discovery of the Chicxulub impact structure initially prompted two scientific drilling campaigns. In the mid-1990s, a series of shallow onshore wells up to 700 m deep were drilled by the Universidad Nacional Autónoma de México (UNAM; Urrutia-Fucugauchi et al., 1996) to sample near-surface impact breccias in the ejecta blanket surrounding the crater. In 2002, the International Continental Scientific Drilling Program (ICDP) also sponsored a deep drilling project, producing a 1511 m borehole between the peak ring and the crater rim. Continuous core beneath 404 m included Tertiary marine sediments, polymict impact breccias, an impact melt unit, and one or more blocks of Cretaceous sedimentary target rocks. We refer readers to two special issues of *Meteoritics & Planetary Science* (Jull, 2004a, 2004b) for the major results of that ICDP project, but note that the project left unresolved, among other things, the geologic processes that produced the peak-ring morphology of the crater.

The Chicxulub crater is the best-preserved peak-ring impact basin on Earth, so it is an essential target for additional study. The only other known similarly sized surviving impact structures, Sudbury and Vredefort, are tectonically deformed and eroded. Recently, the International Ocean Discovery Program (IODP) and ICDP drilled an offshore borehole into the crater (Fig. 1), recovering core from a depth of 505.7–1334.7 m below the sea floor (mbsf),

to assess the depth of origin of the peak-ring rock types and determine how they were deformed during the crater-forming event. That information is needed to effectively test how peak-ring craters form on planetary bodies.

The expedition was also designed to measure any hydrothermal alteration in the peak ring and physical properties of the rocks, such as porosity and permeability, to calibrate geophysical data, test models of impact-generated hydrothermal systems, evaluate the habitability of the peak ring, and investigate the recovery of life in a sterilized portion of Earth's surface. The recovered rocks also make it possible to evaluate shock deformation of Earth's crust, including the vaporization of rocks that may have contributed to climate-altering effects of the impact. A large number of geological, environmental, and biological results will emerge from the expedition. Here, we focus on the planetary geoscience findings: how the peak-ring crater formed and what peak-ring and multi-ring craters can reveal about deep planetary crusts. As the borehole pierced only a single location within the crater, we begin by looking at a fully exposed peak-ring crater on the Moon, which provides a picture of a similar structure to that targeted by Expedition 364.

EXPOSED PEAK-RING CRATERS

The Schrödinger basin near the south pole on the lunar far side is the youngest and best preserved peak-ring crater on the Moon (Fig. 2A). The ~320-km-diameter crater contains an ~150-km-diameter peak ring that rises up to 2.5 km above the crater floor (Shoemaker et al., 1994). The peak ring is topographically complex, with

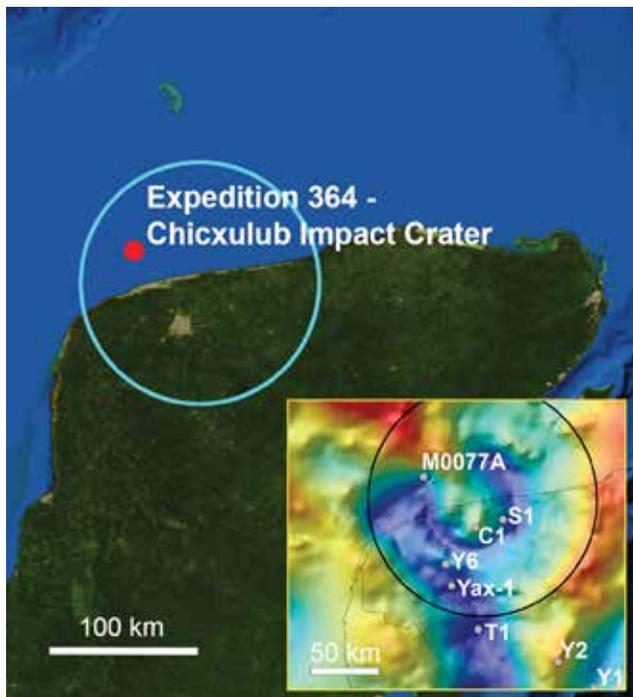


Figure 1. IODP-ICDP Expedition 364 drilled into the subsurface Chicxulub peak ring at borehole M0077A (red dot), which was ~30 km northwest of Progreso and the north shore of the Yucatán Peninsula. The blue circle represents the approximate diameter of the 180–200-km subsurface impact structure. The gravity signature of the structure (from lows of -16 to highs of +30 mgal) and locations of other drilling sites are shown in the inset. The only two sites with continuous core are the ICDP Yaxcopoil-1 (Yax-1) and IODP-ICDP M0077A boreholes. Other boreholes are Yucatán-1 (Y1), Yucatán-2 (Y2), Yucatán-6 (Y6), Chicxulub-1 (C1), Sacapuc-1 (S1), and Ticul-1 (T1).

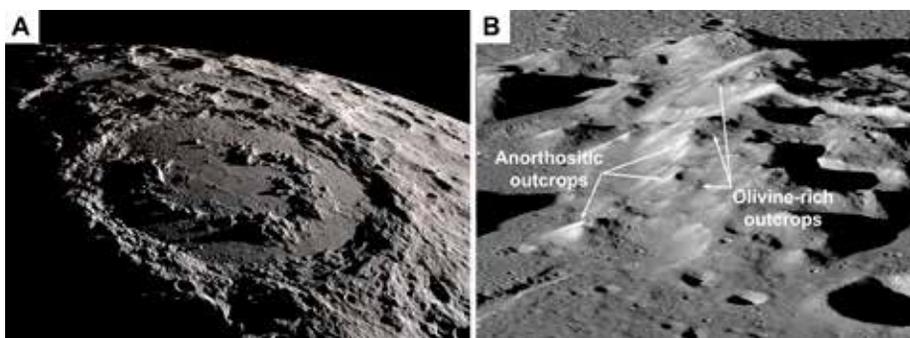


Figure 2. (A) The morphology of a peak ring is evident in this view of the ~320-km-diameter Schrödinger basin on the Moon, looking from the north toward the south pole. NASA's Scientific Visualization Studio. (B) A close-up view of a segment of the peak ring with rocks uplifted from mid- to lower-crustal levels by the impact event. The field of view is ~17 km wide through the center of the image. Lunar Reconnaissance Orbiter Camera image M1192453566.

steep cliffs and open chasms. Summit heights vary along the circumference of the peak ring. On the Moon, where the erosional processes familiar on Earth do not occur, that differential topography is a primary feature, caused by shear and fault displacement during the emplacement of the peak ring (Kring et al., 2016).

Spectral analyses of the lunar surface captured from the orbiting *Chandrayaan-1* spacecraft indicate the peak ring is composed of anorthositic, noritic, and olivine-bearing (e.g., troctolite or dunite) rocks from deep crustal or even upper mantle depths (Kramer et al., 2013). Those rock types occur in spectacular outcrops (Fig. 2B). Soon after *Apollo*, it was common to hear geologists lament that there are no outcrops on the Moon because the surface is covered with regolith. However, the rocks exposed in the peak ring constitute hectometer- to kilometer-size outcrops that are now recognized as high-priority sites

for future lunar sample return missions (Potts et al., 2015; Steenstra et al., 2016).

Geologic mapping of those rock types and numerical modeling of peak-ring emplacement (Kring et al., 2016) suggest the rocks in the peak ring were derived from mid- to lower-crustal depths on the Moon (e.g., ~15–26 km deep). During the impact event, those rocks rose above the lunar surface and, without the strength to maintain that elevation, collapsed outward to form nappe-like structures in a circumferential peak-ring. Pre-impact crustal strength seems to have affected that process. A gap in the peak ring occurs in the southeastern quadrant, which is an area in the target that had been previously weakened by the Amundsen-Ganswindt basin-forming event. There, the peak ring collapsed below the level filled by impact melts and impact breccias. Pre-impact crustal thickness also varied across the target area,

nearly doubling from 20 to 40 km from the east to the west and producing bilateral asymmetry in the peak ring (Fig. 3). As shown below, those types of morphological effects, visible at the surface on the Moon, are mirrored in the subsurface Chicxulub peak-ring basin on Earth.

CHICXULUB

The subsurface morphological character of the peak ring of the Chicxulub crater is similar to that of Schrödinger, although the topography on the upper surface of Chicxulub's peak ring is more subdued because of Earth's greater gravity. Thus, while Schrödinger's peak ring rises up to 2.5 km above the basin floor, seismic reflection data (Morgan et al., 2000) indicate Chicxulub's peak ring had ~400 m of relief before being buried. Additional seismic data suggest the peak ring varied in height circumferentially (Gulick et al., 2013), with reduced

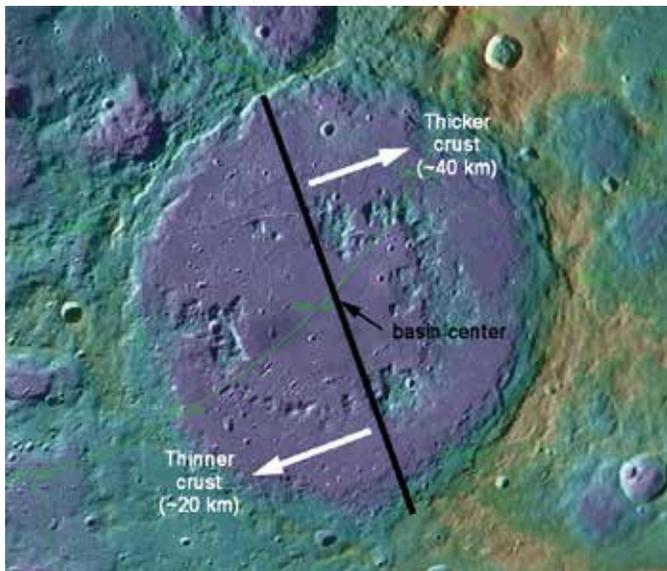


Figure 3. Pre-impact target conditions affected the formation of the peak ring in the ~320-km-diameter Schrödinger basin. In this view oriented with the south pole toward the top of the image, the peak ring collapsed below the level of the impact melt and breccia fill in the southeast quadrant. Also, differences in crustal thickness affected the morphology of the peak ring, producing bilateral asymmetry.

topography and thickening of the post-impact section in the northeast quadrant of the structure producing an anomalous gravity low (Fig. 1, inset). The offshore asymmetry in gravity data may be due to lateral variations in the continental shelf of the target which, in the northeast direction, is argued to have been thicker, topographically lower, and covered with deeper water at the time of impact (Gulick et al., 2008). Based in part on that assessment, Expedition 364 was designed to drill into the northwest quadrant (Morgan et al., 2016; Gulick et al., 2017), where seismic reflection data clearly image a high-relief peak ring that is relatively close to the surface (Morgan et al., 2011).

The borehole was drilled at Site M0077 (21.45° N, 89.95° W) a few kilometers north of the coastline in ~20 m water depth (Morgan et al., 2016). Those shallow water depths required the use of a leased jack-up platform or lift boat rather than one of the larger IODP ships (Gulick et al., 2017). The L/B *Myrtle* was anchored 5 April 2016 and drilling occurred from 7 April to 26 May 2016, followed by downhole logging and jack down of the platform on 30 May. Core recovery began at 505.7 mbsf and continued to 1334.7 mbsf with >99% recovery. The operator was able to maintain PQ3 core barrels from 701 m to the base of the borehole, producing ~83-mm-diameter core, which is wide for ocean drilling.

Because the platform was so small, only limited measurements and core descriptions could be undertaken before the core was placed into refrigerated storage and shipped to the Bremen Core Repository, Center for Marine Environmental Sciences (MARUM), University of Bremen, Germany. The science party convened in Bremen in September and October 2016 to split the core into two halves, perform a suite of standard IODP measurements, and log and sample the core.

Impactites consisting of melt-bearing breccias (suevites) and impact melt rock were encountered at 617.33 mbsf and formed an ~130-m-thick unit over granite and related basement rock types within the uplifted peak ring (Fig. 4). Thin, <1-m-thick melt horizons were logged within the granite. Also, ~4 m of melt and melt-bearing breccias were encountered at ~1000 mbsf, and ~58 m of melt and melt-bearing breccias occur in the lowest 100 m of core. The rock sequence encountered within the borehole is in accordance with prior interpretations of seismic reflection and refraction data (Morgan et al., 2000, 2011; Gulick et al., 2013), including correctly predicting (1) the depth to the top of

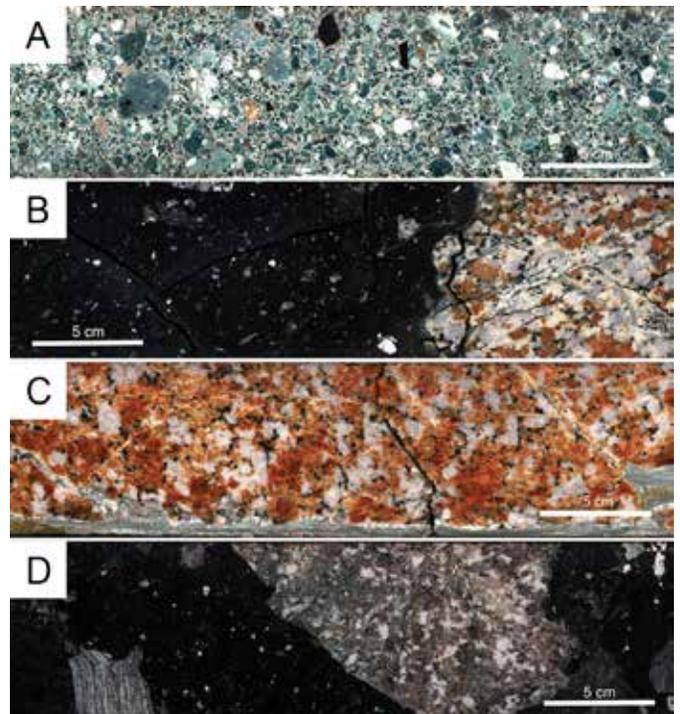


Figure 4. Representative core segments. (A) Suevite from ~645 mbsf contains fragments of impact melt, sedimentary target rocks, and igneous target rocks. (B) Melt rock from ~745 mbsf contains igneous clasts, dominated by granite. (C) Granite from ~814 mbsf with a gray-colored cataclastic vein. (D) Melt rock from ~1268 mbsf contains metamorphic and igneous clasts. The top of each core segment is located on the left.

the peak ring, (2) that the uppermost peak ring is formed from ~150 m of low-velocity impact breccia, and (3) that the peak-ring rocks comprised heavily fractured basement. The total thickness of the granite-dominated basement interval is 588 m and, based on seismic reflection data (Morgan et al., 2000; Gulick et al., 2013), is predicted to continue to depths of ~3 km at the site of the borehole.

The recovery of uplifted granitic rocks from the peak ring (Fig. 5) favors a dynamic collapse model for an over-heightened central uplift (Morgan et al., 2016), which is consistent with observations at other terrestrial craters (Grieve et al., 1981) and with an earlier set of numerical models of the Chicxulub-forming event (Collins et al., 2002; Ivanov, 2005; Collins et al., 2008). It is also similar to the processes inferred from geologic mapping and numerical modeling of the Schrödinger peak ring on the Moon (Kring et al., 2016). Shock metamorphism in the recovered Chicxulub peak-ring core samples indicates pressures of ~10–35 GPa, which are also consistent with a new, higher-fidelity numerical model of dynamic collapse at Chicxulub (Morgan et al., 2016).

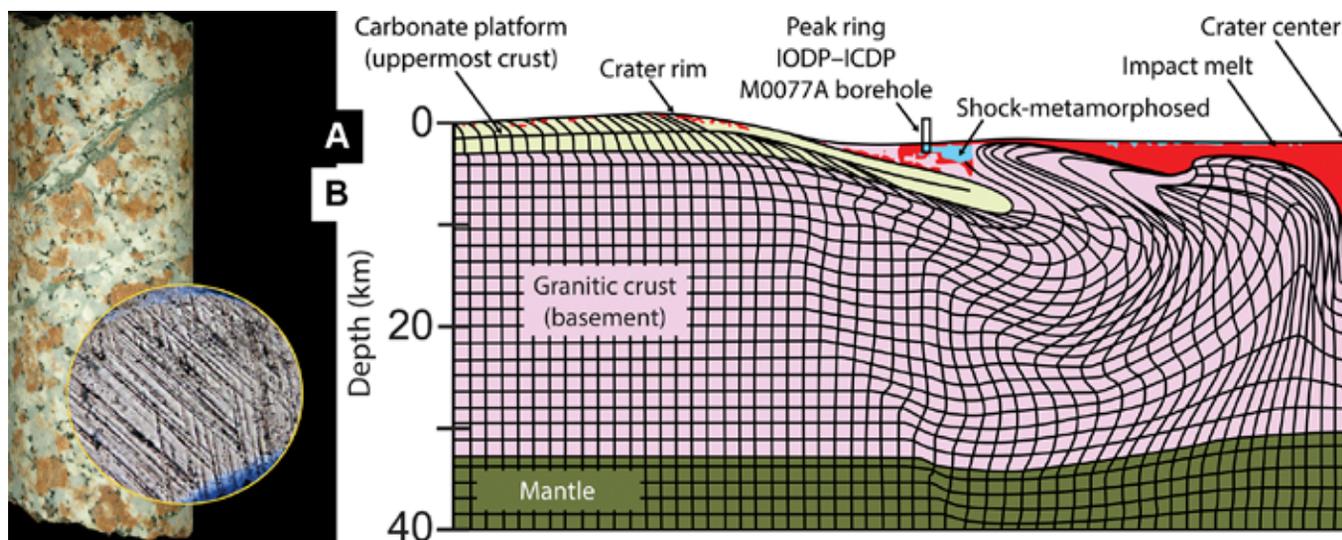


Figure 5. (A) The Chicxulub peak ring in 83-mm-diameter core is composed of granitic rocks, crosscut with cataclastic and hydrothermal veins, that have also been shock-metamorphosed, as illustrated with planar deformation features with ~5 micron spacing in quartz (inset, with field of view 245 microns wide). Photomicrograph of quartz by expedition scientist Ludovic Ferrière. (B) Granitic basement (pink) was uplifted and then collapsed outward over the pre-impact crust (yellow). The portion of the peak ring sampled in the core also contains shock-metamorphosed (blue) and melted (red) components, which are consistent with a numerical model of dynamic collapse of a central uplift during the crater-forming event (Morgan et al., 2016). While the numerical model treats the basement as a uniform unit of granite, which is the rock type that dominates the new IODP-ICDP core, the basement also contains metaquartzite, mica schist, granitic gneiss, gneiss, amphibolite, dolerite dikes, dacite, felsite, and granodiorite (Kring, 2005; Gulick et al., 2017).

Confidence in the dynamic collapse model, finally tested with core samples, has grown substantially.

The Chicxulub peak ring had an elevation below that of the crater rim. As inferred from analogy with the Schrödinger basin peak ring, and inferred from seismic reflection data, the peak ring had a topographically complex surface. There were highs subject to erosion and lows suitable for near-continuous sedimentation. Initial results suggest M0077A is located in a protected catchment with a rich post-impact sedimentary and paleontologic record. The expedition members are currently studying the sedimentation and biological processes that immediately followed the impact event, the nature of the sea that filled the basin, the chemical evolution of those waters as they were affected by a venting impact-generated hydrothermal system, and mixing with sea water from outside the basin, up to and including sediments associated with the Paleocene-Eocene Thermal Maximum. The underlying peak-ring basement samples of the Yucatán Peninsula will, in addition to our evaluation of impact, be useful for assessing the tectonic evolution of the Maya Block and its assembly along the margins of both the Caribbean and Gulf of Mexico basins. Measuring the ages of intrusive components within the core will better refine those processes.

CONCLUSIONS

New IODP-ICDP borehole data indicate that the peak-ring morphology of the Chicxulub crater was produced by the dynamic collapse of an uplifted central peak. Additional exciting expedition results are forthcoming. The impact generated an environmental calamity that extinguished life. It also induced a vast subsurface hydrothermal system that altered a portion of the Maya Block and serves as a proxy for much larger and more frequently generated hydrothermal systems during the Hadean, when bombardment rates were high. And, finally, the crater became an oasis for the recovery of life and allowed expansion into momentarily vacant niches that, when filled, defined the modern world.

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CALL FOR NOMINATIONS

2018 GSA Awards & Medals



Penrose Medal

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

Day Medal

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

Young Scientist Award (Donath Medal)

The Young Scientist Award was established in 1988 to be awarded to a young scientist (35 years or younger throughout the year in which the award is to be presented—for 2018, *only those candidates born on or after 1 Jan. 1983 are eligible*) for outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the sciences. The award consists of a gold medal (the Donath Medal) and an honorarium.

How to Nominate

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

1. **Nomination form:** Please go to <https://rock.geosociety.org/forms/Awardform.asp> to submit the form online.
2. **Supporting documents,** to be submitted as e-mail attachments or via post; for Penrose, Day, and Donath, the following supporting documents are required:
 - Curriculum vitae;
 - Summary (300 words or fewer) of the scientific contributions to geology that qualify the candidate for the award;
 - Selected bibliography of no more than 20 titles (for the Donath Medal, only 10 titles are required); and
 - Letters of support from each of five GSA Fellows or members *in addition* to the person making the nomination. **For the Day Medal only:** letters from five scientists with at least three of those being from GSA Fellows or members and up to two from fellows or members of the Mineralogical Society of America, Geochemical Society, or American Geophysical Union.



The deadline for receipt of all GSA medal, award, and recognition nominations is 1 Feb. 20178



CALL FOR NOMINATIONS

2018 GSA Awards & Medals



Geologic Mapping Award in Honor of Florence Bascom

The Geologic Mapping Award was established by GSA Council in 2013, to acknowledge contributions in published, high-quality geologic mapping that led the recipient to publish significant new scientific discoveries; to bring about greater understanding of fundamental geologic processes and concepts; and to contribute to the application of new knowledge to societal needs and opportunities in such areas as mineral resources, water resources, and the environment.

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

Selection criteria: (A) excellence of the nominee's published geologic maps; (B) clear record of a greater understanding of fundamental geologic processes and/or concepts, and high-quality publication of same, emerging directly from the meritorious quality of the geologic mapping; and (C) peer acclaim of the practical usefulness of the geologic mapping and the new discoveries that emerged from the mapping.

How to Nominate

- Nomination form:** Please go to <https://rock.geosociety.org/forms/Awardform.asp> to submit the form online.
- Supporting documents**, to be submitted as e-mail attachments or via post:
 - Curriculum vitae;
 - Letter of nomination (300 words or fewer) addressing the evaluation criteria;
 - Selected bibliography of geologic maps (20 titles or fewer);
 - Selected bibliography of peer-reviewed publications (20 titles or fewer);
 - PDFs or website links to several key geologic maps authored by the nominee; and
 - Letters of support from three scientists with at least two from GSA Fellows or members and one from a member of another professional geoscience organization. Diverse supporters (i.e., including individuals who are not currently/recently associated with the nominee's institution) are strongly encouraged.

Randolph W. "Bill" and Cecile T. Bromery Award for Minorities

The Bromery Award should be given to any minority, preferably African American, who qualifies under at least one of these two categories:

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

How to Nominate

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

The deadline for receipt of all GSA medal, award, and recognition nominations is 1 Feb. 2018.



CALL FOR NOMINATIONS

2018 GSA Awards & Medals



Doris M. Curtis Outstanding Woman in Science Award

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

How to Nominate

1. **Nomination form:** Please go to <https://rock.geosociety.org/forms/Awardform.asp> to submit the form online.
2. **Supporting documents**, to be submitted as e-mail attachments or via post:
 - Curriculum vitae including dissertation title and abstract;
 - Letter of nomination that clearly states how the Ph.D. research has impacted the geosciences in a major way;
 - Letters of support from three scientists with at least two from GSA Fellows or members and one from a member of another professional geoscience organization; and
 - Selected bibliography of no more than 10 titles.

GSA Distinguished Service Award

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

How to Nominate

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

GSA Public Service Award

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

- Authorship of education materials of high scientific quality that have enjoyed widespread use and acclaim among educators or the general public;
- Acclaimed presentations (books and other publications, mass and electronic media, or public presentations, including lectures) that have expanded public awareness of the earth sciences;
- Authorship of technical publications that have significantly advanced scientific concepts or techniques applicable to the resolution of earth-resource or environmental issues of public concern; and/or
- Other individual accomplishments that have advanced the earth sciences in the public interest.

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

How to Nominate

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

The deadline for receipt of all GSA medal, award, and recognition nominations is 1 Feb. 2018.



CALL FOR NOMINATIONS

2018 GSA Awards & Medals



Honorary Fellowship

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

GSA Fellowship

Fellowship is an honor that is bestowed on the best of our profession once per year at the spring GSA Council meeting and is recognized at GSA's Annual Meeting. GSA members are elected to Fellowship in recognition of distinguished contributions to the geosciences. A member can be nominated for Fellowship only by a Fellow of the Society who initiates the process by completing the nominating sponsor's form and identifying two other Fellows, or one Fellow and one member, who agree to support the nomination. A GSA Fellow may only support two nominees per election cycle and only one as a primary nominator.

How to Nominate

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

How to Nominate

The primary nominator:

1. Completes online nomination form at www.geosociety.org/FellowNoms;
2. Writes a letter of support;
3. Collects two (2) additional letters of support (one must be from a Fellow; both must be GSA members);
4. Obtains nominees current CV or résumé; and
5. Submits all documents in one packet to awards@geosociety.org. Questions? Email awards@geosociety.org

Award Notes

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

Forms and instructions are online at www.geosociety.org/awards/; they may also be obtained from GSA Grants and Awards, P.O. Box 9140, Boulder, CO 80301-9140, USA.

The deadline for receipt of all GSA medal, award, and recognition nominations is 1 Feb. 2018.

Notice of GSA Council Meetings

GSA Annual Meeting & Exposition Seattle, Washington, USA

- ▶ **Day 1:** Saturday, 21 Oct. 2017 (Willow Room*)
- ▶ **Day 2:** Wednesday, 25 Oct. 2017 (Ravenna Room*)

Council Meetings will be held from 8 a.m.–noon in the GSA Headquarters Hotel—Sheraton Seattle, 1400 6th Ave., Seattle, Washington 98101, USA.

All GSA members are invited to attend the open portions of these meetings.

**Meeting room is subject to change. Updates will be posted.*



CALL FOR NOMINATIONS

2018 GSA Awards & Medals



John C. Frye Environmental Geology Award

Deadline: 31 March 2018

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

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

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

Please send your nominations to GSA Grants and Awards, P.O. Box 9140, Boulder, CO 80301-9140, USA; awards@geosociety.org. For more information, please visit www.stategeologists.org/awards_honors.php.



CALL FOR NOMINATIONS

2018 AGI Awards

2018 National Awards

AGI Medal in Memory of Ian Campbell

The AGI Medal in Memory of Ian Campbell recognizes singular performance in and contribution to the profession of geology. Candidates are measured against the distinguished career of Ian Campbell, whose service to the profession touched virtually every facet of the geosciences. Campbell was a most uncommon man of remarkable accomplishment and widespread influence, and in his career as a geologist, educator, administrator, and public servant, he was noted for his candor and integrity.

In addition to awarding numerous medals and honors through its internal awards program, GSA encourages the nomination of deserving geoscientists for consideration in national science awards from a variety of scientific societies and organizations, including several that are open to members of AGI Member Societies.

Go to www.geosociety.org/awards/national.aspx for links to award information and nomination forms. If you know of an award not listed, please send the details to gsatoday@geosociety.org.

AGI Marcus Milling Legendary Geoscientist Medal

The Marcus Milling Legendary Geoscientist Medal is given to a recipient with consistent contributions of high-quality scientific achievements and service to the Earth sciences having lasting, historic value; who has been recognized for accomplishments in field(s) of expertise by professional societies, universities, or other organizations; and is a senior scientist nearing completion or has completed full-time regular employment. Prior to 2007, it was called the AGI Legendary Geoscientist Award.

To submit nominations for these and other awards, go to www.americangeosciences.org/awards.

GSA 2017 Registration and Information

You still have time to register for GSA 2017!

Space is available on some tours, ticketed events, field trips, and short courses. You can register online at community.geosociety.org/gsa2017/registration throughout the meeting, or visit the onsite registration desk in the Washington State Convention Center (WSCC).

BADGES must be worn and be visible at all times while you are in the WSCC. Badges will be available at the registration desk starting at 7 a.m. on Sat., 21 Oct. Staff at the registration desk can also reprint your lost or misplaced badge. Badge ribbons will be available at the GSA Information Desk in the WSCC during onsite registration hours. Eligible attendees should inquire there.

REGISTRATION FEES

	Standard/Onsite Registration
Prof Member—Full Meeting	US\$495
Prof Member—1 Day	US\$290
Prof Member—>70 Full Meeting	US\$375
Prof Member—>70 1 Day	US\$215
Prof Non-Member—Full Meeting	US\$680
Prof Non-Member—1 Day	US\$430
Early Career Professional—Full	US\$330
Early Career Professional—1 Day	US\$195
Student Member—Full Meeting	US\$165
Student Member—1 Day	US\$99
Student Non-Member—Full Meeting	US\$220
Student Non-Member—1 Day	US\$140
High School Student	US\$50
K–12 Professional—Full Meeting	US\$70
Field Trip or Short Course Only	US\$40
Guest or Spouse	US\$99
Low Income Country**	50%

Participants from countries classified as “Low or Lower Middle Income Economies” by the World Bank need only pay 50% of the category fee for full meeting or one day registration. Online registration is not available for “Low or Lower Middle Income Economy” registrants. Please come to the onsite registration desk to register. **Important: Fees for onsite registration will be collected in US\$ and credit card only.

GSA Section Travel Grants

Recipients of the Section Travel Grants will need to check in at the GSA Annual Meeting Office, WSCC Room 401, show identification, verify their address, and sign the check-in sheet to receive their check. Checks will be mailed to the recipient following the Annual Meeting. If you do not check in, you will not receive your grant.

Ticketed Events

Several GSA Divisions and Associated Societies hold ticketed events for breakfast, lunch, dinner, or reception awards presentations. Ticketed events are open to everyone; learn more at community.geosociety.org/gsa2017/ticketed. We recommend you **purchase your tickets in advance**. If you have already registered for the meeting and would like to add a ticketed event, please contact GSA Sales & Service at +1-888-443-4472. A minimal number of tickets will be available onsite in the registration area up to 48 hours prior to the event.

Hotels

Orchid Events (OE)/GSA Housing Bureau will continue to assist you with hotel reservations through 13 Oct. (group rates are not guaranteed). If rooms are not available at the hotels in the GSA block, OE will provide you with a list of hotels in the area that have availability. Learn more at community.geosociety.org/gsa2017/attendeeinfo/accommodations/reservations.

Critical Housing Dates

13 Oct.: All changes, cancellations, and name substitutions must be finalized through Orchid Events (OE) by this date.

14 Oct.: Beginning on this date, you must contact the hotel directly for all changes, cancellations, and new reservations.

Before You Arrive in Seattle

Review the arrival/departure dates on your hotel acknowledgment for accuracy. If you do not show up on the date of your scheduled arrival, the hotel will release your room AND you will be charged for one night’s room and tax. If you have travel delays and cannot arrive on your scheduled arrival date, contact the hotel directly to make them aware of your new arrival date.

Child Care

KiddieCorp is providing childcare services for GSA attendees Sat.–Wed., 7 a.m.–6 p.m. The program is open to children six months to 12 years old, and the cost is only US\$9 per hour per child (1 hour minimum). KiddieCorp must receive their registration form and payment in full to hold any advance reservations. You are also welcome to try to register on-site; however, there is no guarantee and it is not recommended. Learn more at community.geosociety.org/gsa2017/attendeeinfo/needs/family.

Convention Hotels & Rates

1. Sheraton Seattle Hotel - \$219
2. Crowne Plaza Hotel Seattle - \$169
3. Hilton Garden Inn Downtown Seattle - \$174
4. Hilton Seattle - \$189
5. Homewood Suites by Hilton Seattle - Convention Center - \$179
6. Paramount Seattle Hotel - \$185
7. Renaissance Seattle Hotel - \$182
8. The Roosevelt Hotel - \$185
9. Springhill Suites Seattle Downtown - \$184
10. The Westin Seattle - \$185



Annual Meeting & Exposition

22-25 October
Seattle, Washington, USA



The Geological Society of America®
GEOCAREERS

PRE-MEETING WEBINAR

Impress for Success at GSA's Annual Meeting

Wed., 11 Oct., 11 a.m. MDT

Presented by Patrick McAndless, P.Geo, FGC, this webinar is a guide to successfully navigating and getting the most out of your GSA Annual Meeting experience. Learn more at community.geosociety.org/impress. Register here: <http://bit.ly/2vBYgSI>.

Career Development Events for Students and Early Career Professionals

Geocareers Day

Sun., 22 Oct., 8 a.m.–1 p.m. All GeoCareers Day events will be held in Washington State Convention Center (WSCC) Ballroom 6B. All-inclusive fee: US\$25. Registration is required and space is limited.

8–9 a.m.: Career Workshop: Successfully prepare for a career in the industry and government sectors. The workshop will be divided into 20-minute power sessions: reviewing résumés for industry and USA Jobs, and Q&A.

9–11 a.m.: Career Information Session: This is your opportunity to ask questions and talk one-on-one with corporate and government representatives, learn about their unique work cultures, and types of careers available.

10–11:30 a.m.: Career Mentor Roundtables: Mentors from a variety of sectors will answer your career questions at table stations.

12–1 p.m.: Career Pathways Panel: Representatives from government and industry sectors will answer questions and offer advice in preparation for a career in these fields. Lunch provided.

The following GeoCareers Day events may be attended separately:

Career Pathways Panel: Lunch is included but limited to first-come, first-served. All-day participants receive priority.

Career Workshop: US\$10 fee if attending separately. Registration required. Sign-up on the registration form or contact GSA Sales & Service at +1-888-443-4472.

NETWORKING AND PANEL EVENTS

Women in Geology Career Pathways Reception

Sun., 22 Oct., 5:30–7 p.m., WSCC, Ballroom 6B

This informal gathering begins with remarks from key speakers who will address issues faced by women in geology. A roundtable mentoring session follows, providing time for networking, sharing ideas, and getting to know other women geoscientists.

Environmental and Engineering Geology Division's Student Mentoring Session

Sun., 22 Oct., 5:30 p.m.–6:30 p.m., WSCC, Room 612

A panel of experts will address a series of commonly asked questions from those emailed in advance of the meeting and the panelists will also address questions from the students in attendance. Time will be left at the end for one-on-one interactions with individual panelists. Mentors will be available at the EEGD Booth (#118) in the Exhibit Hall to further interact with students and address any outstanding questions.

Early Career Professionals Coffee

Mon., 23 Oct., 9–10 a.m., Sheraton Seattle, Cirrus Room

This informal gathering will have remarks from non-profits who have activities of interest to early career professionals. There will be time for networking and sharing ideas on how these organizations can best serve you.

Networking Reception

Mon., 23 Oct., 11:30 a.m.–1 p.m., Sheraton Seattle, Metropolitan Ballroom B

This reception provides students and early career professionals with an exciting opportunity to network with more than 40 geoscience professionals. The mentors will answer questions, offer advice about career plans, and comment on job opportunities within their fields.

The Paleontological Society Mentors in Paleontology Careers Luncheon

Mon., 23 Oct., noon–1:30 p.m., Tap House Grill

This student and early career professional luncheon features a panel of mentors representing a variety of colleges, universities, museums, and government agencies.

Hydrogeology Division Careers and Networking Event

Tues., 24 Oct., 2:30–4:30 p.m., WSCC, Ballroom 6B

In a relaxed and welcoming atmosphere, this gathering will begin with remarks from hydrogeologists in a variety of career fields, including government, industry, and academia. A roundtable mentoring session follows, providing time for individuals to network, share ideas, ask questions, and discuss careers in hydrogeology.

MORE WORKSHOPS

Publishing: "What's Your Problem; What's Your Point?"

Sun., 22 Oct., 11:30 a.m.–2 p.m., Sheraton Seattle Hotel, Issaquah

Experienced GSA science editors will explain the process of preparing your research for submission to scholarly journals. An application is required; find complete information at www.geosociety.org/GSA/Publications/GSA/Pubs/WritersResource.aspx.

Career Short Courses

Sat., 21 Oct.

- Preparing for a Career in the Geosciences
- Review and Preparation for the ASBOG Fundamentals of Geology Examination

EMPLOYMENT ASSISTANCE

Résumé Clinic

Sun., 22 Oct., 9 a.m.–5 p.m., WSCC, Ballroom 6B, Fee: US\$10 (cash only).

Bring a copy of your résumé and get valuable feedback. First-come, first-served; space is limited.

Geoscience Job Board

Check the online Geoscience Job Board at www.geosociety.org/jobs for employment, fellowship, and student opportunities.

Learn and explore a new topic.

Don't forget to sign up for a GSA Short Course!

Go to community.geosociety.org/gsa2017/attendeeinfo/registration to sign up. If you've already registered and want to add a course, please contact GSA Sales & Service, +1-888-443-4472.

Earn continuing education credits (CEUs)

All courses offer CEUs, and most are at low or no cost. For full course descriptions, go to community.geosociety.org/gsa2017/science-careers/courses.

Short Course questions?

Contact Jennifer Nocerino, jnocerino@geosociety.org.



Let's Celebrate Diversity!

On To the Future Events

GSA welcomes the new cohort of On To the Future (OTF) award recipients. The following events are open to OTF students and mentors. WSCC—Washington State Convention Center.

OTF Welcome: Sat., 21 Oct., 4:30 p.m., WSCC, Atrium Lobby (4th Floor)

OTF Group Photo: Sun., 22 Oct., 6:15 p.m., WSCC, Exhibits Hall, GSA Foundation

OTF Gatherings: Mon.–Wed., 23–25 Oct., 7:30 a.m., WSCC, Atrium Lobby (4th Floor)

Diversity and OTF Alumni Reception: Tues., 24 Oct., 5:30 p.m., Sheraton Seattle Hotel, Willow A

OTF Broadening Participation in the Geosciences through Effective Mentoring and Social Capital Development *Invite Only*

Wed., 25 Oct., 3–8 p.m., and Thurs., 26 Oct., 8 a.m.–noon, Sheraton Seattle Hotel, Ravenna

Celebrate Diversity at the Diversity and On To the Future Alumni Reception

Tues., 24 Oct., 5:30–7 p.m., Sheraton Seattle Hotel, Willow A
All are welcome to this reception to share ideas and celebrate diversity with the geoscience community. The 2017 On To the Future awardees will be recognized with a special keynote from the 2017 Bromery Awardee. Appetizers and a cash bar provided.

No Means No: How to Step Up and Stop Harassment

Mon., 23 Oct., noon–1:30 p.m., WSCC, Ballroom 6B

The damage done by harassers and bullies begins with those they target. It extends to those who witness or hear about it. And it poisons the atmosphere everywhere it happens—including in the workplace, in fieldwork settings, and at meetings and conferences. What can you do to stop harassment when you're the target? How can you step in to stop it when you see it? Learn how to recognize harassment for what it is and how to decide when to step up and step in, plus approaches and methods that work to stop harassing and bullying behavior. Presented by: Sherry A. Marts, Ph.D., S*Marts Consulting LLC.

GSA 2018 Indianapolis Meeting



4-7 November
Indianapolis, Indiana, USA

It's time to plan for our 2018 Annual Meeting in Indianapolis, Indiana, USA. Help ensure that your area of research and expertise is represented at next year's annual meeting. Any individual or geosciences organization is welcome to submit proposals.

Show the geology by leading a field trip.

Field Trip proposal deadline: 1 Dec. 2017

Trips can be anywhere from half a day to five days long. Field trip proposals may be submitted by any member of GSA, its affiliated societies, or other people interested in field geoscience. The proposal form is online at <https://gsa.confex.com/gsa/2018AM/fieldtrip/cfs.cgi>.

Exchange the geology by organizing and chairing a technical session.

Technical Session deadline: 1 Feb. 2018

Proposals are being taken for both Pardee Keynote and Topical Sessions. The proposal form is online at <https://gsa.confex.com/gsa/2018AM/cfs.cgi>.

Share the geology as an instructor through a Short Course.

Short Course proposal deadline: 1 Feb. 2018

Courses run the Friday and Saturday before the Annual Meeting and are typically half a day to two full days. The proposal form is online at <https://gsa.confex.com/gsa/2018AM/shortcourses/cfs.cgi>.



Photo courtesy of VisitIndy.com.

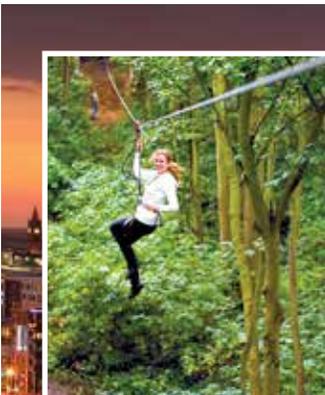


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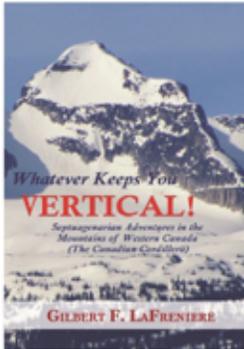
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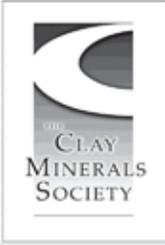
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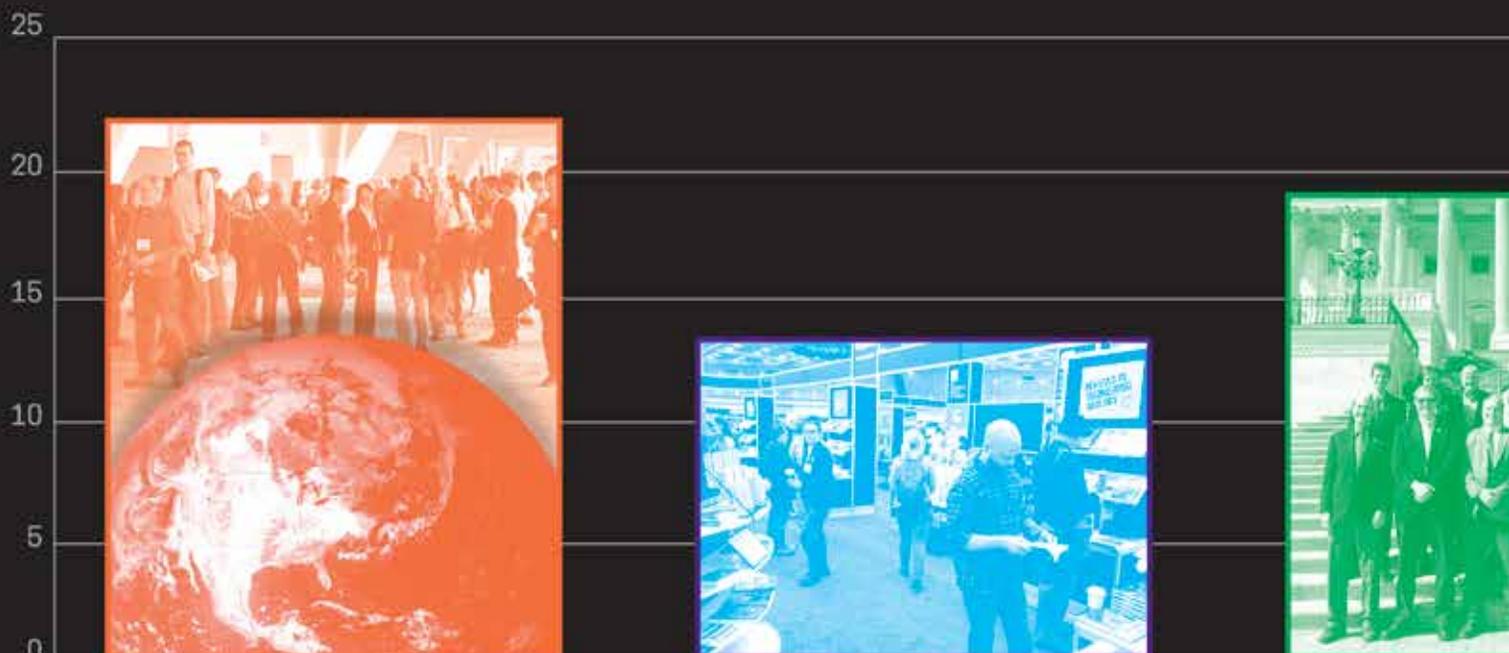
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Preliminary Announcement and Call for Papers

SOUTHEASTERN SECTION

67th Annual Meeting of the Southeastern
Section, GSA

Knoxville, Tennessee, USA
12–13 April 2018

www.geosociety.org/se-mtg

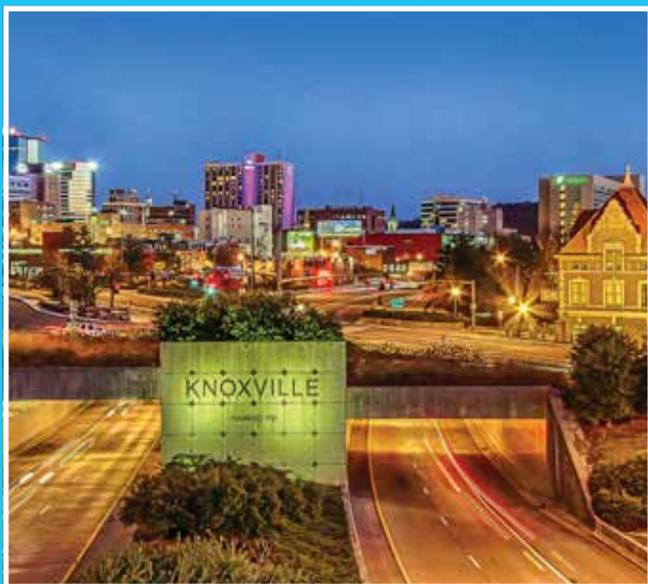


Photo by Bruce McCamish.

Geology at Every Scale

The 2018 Southeastern Sectional meeting of the Geological Society of America will be held in Knoxville, Tennessee, USA, and will explore geology at all scales, from isotopes and geomicrobiology to tectonics and other processes on the planetary scale. Surrounded by the natural beauty of the Appalachian Mountains, and situated on the banks of the Tennessee River, Knoxville has a lot to offer visitors. The downtown area offers live music, eclectic shopping, and highly acclaimed cuisine. Learn about the region's geologic setting and industries, or delve into its rich cultural history, from the first Native Americans to inhabit the Valley and Ridge, through the colonial and Civil War periods, at one of the several museums and historic homes within walking distance of the Knoxville Convention Center. Numerous other attractions are within easy driving distance, from the Knoxville Zoo and the Great Smoky Mountains National Park, to the family-friendly fun of Gatlinburg and Pigeon Forge. The University of Tennessee's Department of Earth and Planetary Sciences looks forward to hosting all of you in our new facilities this coming 12–13 April.

Keynote address: Robert Hazen, Carnegie Institute for Science.

CALL FOR PAPERS

Abstract deadline: 16 Jan. 2018

Submit abstracts online at www.geosociety.org/se-mtg. The submission fee is US\$18 for students and US\$30 for all others. If you cannot submit an abstract online, please contact Heather Clark, +1-303-357-1018, hclark@geosociety.org.

In addition to the following Symposium and Theme Sessions, we are soliciting abstracts for general discipline sessions.

SYMPOSIUM

S1. Longstanding Problems and New Ideas About the Structure and Tectonic Evolution of the Southern Appalachians and Other Mountain Belts: In Honor of the Career of Robert D. Hatcher Jr. Arthur J. Merschat, USGS, amerschat@usgs.gov; J. Ryan Thigpen, Univ. of Kentucky, ryan.thigpen@uky.edu; Elizabeth McClellan, Radford Univ., emcclellan@radford.edu; Mark W. Carter, USGS, mcarter@usgs.gov.

THEME SESSIONS

- T1. Seismic Hazards in the Eastern United States.** Christine Powell, Univ. of Memphis, capowell@memphis.edu; Chris Cramer, Univ. of Memphis, ccramer@memphis.edu; Martin Chapman, Virginia Polytechnic Institute and State Univ., mcc@vt.edu.
- T2. Recent Advances in Our Understanding of The Crust and Upper Mantle in the Southeastern United States.** Robert B. Hawman, Univ. of Georgia, hawman@uga.edu; James H. Knapp, Univ. of South Carolina, knapp@geol.sc.edu.
- T3. Geomorphic Anomalies and Underlying Geologic Controls Identified from Surficial and Bedrock Mapping, Southeastern United States.** Kathleen M. Farrell, North Carolina Geological Survey, kathleen.farrell@ncdenr.gov; Christopher S. Swezey, USGS, cswezey@usgs.gov.
- T4. Chemostratigraphy as a Tool for Reconstruction of Past Environments.** Linda C. Kah, Univ. of Tennessee, lckah@utk.edu; Miles A. Henderson, Univ. of Tennessee, mhende16@vols.utk.edu. *Cosponsored by GSA Sedimentary Geology Division.*
- T5. Environmental Problems and Solutions Associated with Appalachian Shale Plays and Coal Mining.** Anna Szynekiewicz, Univ. of Tennessee, aszynkie@utk.edu; Nathaniel Warner, Pennsylvania State Univ., nrw6@engr.psu.edu.
- T6. Karstology: Mechanisms and Case Studies in the Southeastern United States.** Terri Brown, Lincoln Memorial Univ., tbrown23@vols.utk.edu. *Cosponsored by GSA Hydrogeology Section.*
- T7. Linkages among Subterranean Ecosystems and Geological Events in the Eastern United States.** Nicholas S. Gladstone, Univ. of Tennessee, ngladsto@vols.utk.edu; Matthew L. Niemiller, Univ. of Alabama, cavemander17@gmail.com; Evin T. Carter, Univ. of Tennessee, ecarte19@vols.utk.edu; Michael L. McKinney, Univ. of Tennessee, mmckinne@utk.edu; Sarah W. Keenan, Univ. of Tennessee, skeenan1@vols.utk.edu.

- T8. **Geomicrobiology of Microbes and Minerals: Influence across Ecosystem Scales.** Jill Mikucki, Univ. of Tennessee, jmikucki@utk.edu; Caleb Schuler, Univ. of Tennessee, cschuler@vols.utk.edu.
- T9. **Nutrient Hotspots through Time: Taphonomy in Modern and Fossil Ecosystems.** Sarah W. Keenan, Univ. of Tennessee, skeenan1@vols.utk.edu; Jennifer M. DeBruyn, Univ. of Tennessee, jdebruyn@utk.edu; Sean M. Schaeffer, Univ. of Tennessee, sschae5@utk.edu.
- T10. **Biogeochemical Cycling and Microbial Dynamics in Response to Pulse Events.** Sean Schaeffer, Univ. of Tennessee, sschae5@utk.edu; Jennifer DeBruyn, Univ. of Tennessee, jdebruyn@utk.edu.
- T11. **Morphology and Evolutionary Trends.** Bradley Deline, Univ. of West Georgia, bdeline@westga.edu; Maggie R. Limbeck, Univ. of Tennessee, mlimbeck@vols.utk.edu. *Cosponsored by the Paleontological Society.*
- T12. **Taphonomy: The Good, the Bad and the Ugly.** Rebecca Freeman, Univ. of Kentucky, rebecca.freeman@uky.edu; Linda McCall, Univ. of Texas at Austin, Indmccall02@yahoo.com; Simon Darroch, Vanderbilt Univ., simon.a.darroch@vanderbilt.edu. *Cosponsored by the Paleontological Society.*
- T13. **Neontological Approaches to Paleontological Questions.** Stephanie K. Drumheller, Univ. of Tennessee, sdrumhel@utk.edu; Matthew A. Tibbits, Broward College, matthew.a.tibbits@gmail.com.
- T14. **Geologic Mapping from the Appalachians to the Planets.** Robert Jacobsen, Univ. of Tennessee, rjacobse@vols.utk.edu; Keenan B. Golder, Univ. of Tennessee, kgolder@vols.utk.edu. *Cosponsored by GSA Planetary Division.*
- T15. **Planetary Surface Processes.** Devon M. Burr, Univ. of Tennessee, dburr1@utk.edu; Bradley J. Thomson, Univ. of Tennessee, bthomsol@utk.edu.
- T16. **Structure, Stratigraphy, and Tectonics of the Craton in the Southeastern United States.** Mark Abolins, Middle Tennessee State Univ., mark.abolins@mtsu.edu.
- T17. **Teaching Geosciences at the College Level—Resources and Projects for Community College Students.** Renee Mazurek, ABTech Community College, reneemazurek@abtech.edu.
- T18. **Undergraduate Research (Posters).** Lee Phillips, Univ. of North Carolina at Greensboro, plphilli@uncg.edu; Jeff Ryan, Univ. of South Florida, ryan@mail.usf.edu. *Cosponsored by the Council on Undergraduate Research.*

FIELD TRIPS

Pre-Meeting

Quaternary Faulting along the Dandridge-Vonore Fault Zone in the Eastern Tennessee Seismic Zone. Robert D. Hatcher, Jr., Univ. of Tennessee, bobmap@utk.edu; Randel Tom Cox, Univ. of Memphis, randycox@memphis.edu.

Hydrogeology of the Oak Ridge Reservation and its Impact on a Manhattan Project Legacy of Waste Disposal Practices over the Last 75 Years. Steve Stowe, sstow@aol.com; Richard Kettle, richard.kettle@ettp.doe.gov.

The Blue Ridge Basement Complex of the Eastern Great Smoky Mountains: New Insight into Old Rocks from New U-Pb Geochronology. Dave Moecher, Univ. of Kentucky, moker@uky.edu.

Post-Meeting

Nutrient Hotspots through Time: Taphonomy in Modern and Fossil Ecosystems. Sarah W. Keenan, Univ. of Tennessee, skeenan1@vols.utk.edu; Christopher Widga, East Tennessee State Univ., widgac@etsu.edu; Jennifer M. DeBruyn, Univ. of Tennessee, jdebruyn@utk.edu; Sean M. Schaeffer, Univ. of Tennessee, sschae5@utk.edu.

Hydrogeology and Structure of Tuckaleechee Cove and Vicinity. Ben Miller, USGS Nashville, caverben@yahoo.com; Terri Brown, Lincoln Memorial Univ., tbrown23@vols.utk.edu.

Steaming through the Ordovician. C. Howard Capito, Knoxville, Tennessee, chcapito@comcast.net; Stephanie K. Drumheller, Univ. of Tennessee, sdrumhel@utk.edu.

Revisiting the Flynn Creek Impact Structure, Jackson County Tennessee. Steven J. Jaret, Stony Brook Univ., sjjaret@yahoo.com; David T. King, Jr., Auburn Univ., kingdat@auburn.edu.

Mesoscale Structures, Macroscale Folds, and Inferred Cratonic Basement Structures, Nashville Dome, Central Tennessee. Mark Abolins, Middle Tennessee State Univ., mark.abolins@mtsu.edu.

Lessons from Limestone: How to Teach All Sciences with Limestone. Michael A. Gibson, Univ. of Tennessee at Martin, mgibson@utm.edu; Don Byerly, Univ. of Tennessee, donbyerly@comcast.net.

Blue Ridge–Inner Piedmont Geotraverse from the Great Smoky Thrust to the Inner Piedmont: Upper Crust to Upper Lower Crust, Terranes, Large Faults, and Sutures. Arthur J. Merschat, USGS, amerschat@usgs.gov; J. Ryan Thigpen, Univ. of Kentucky, ryan.thigpen@uky.edu; Elizabeth McClellan, Radford Univ., emccellan@radford.edu; Mark W. Carter, USGS, mccarter@usgs.gov; Robert D. Hatcher, Jr., Univ. of Tennessee–Knoxville, bobmap@utk.edu.

OPPORTUNITIES FOR STUDENTS AND EARLY CAREER PROFESSIONALS

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

Geoscience Career Workshops

For more information, contact Jennifer Nocerino at jnocerino@geosociety.org.

Part 1: Career Planning and Informational Interviewing. 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.

Part 2: Geoscience Career Exploration. 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 when possible, professionals in the field, will address these issues.

Part 3: Cover Letters, Résumés, and CVs. How do you prepare a cover letter? Does your résumé need a good edit? Learn how to prepare the best résumé possible, whether you are currently in the market for a job or not. You will review numerous examples to help you learn important résumé dos and don'ts.

REGISTRATION

Early registration deadline: 5 March 2018

Cancellation deadline: 12 March 2018

Online registration begins January 2018. For further information, or if you have special requirements, please contact the local committee chair, Colin D. Sumrall, csumrall@utk.edu.

ACCOMMODATIONS

Hotel registration deadline: 20 March 2018

Blocks of rooms have been reserved at the Hilton Knoxville, located at 501 West Church Ave., Knoxville, TN 37902, USA. The meeting will take place within the Knoxville Convention Center facilities. The meeting rate is US\$139 per night plus tax for single and double occupancy. To make your reservations, please call the Hilton Knoxville at +1-800-774-1500 and be sure to refer to the meeting code: GSA18.

LOCAL COMMITTEE

General Chair: Colin D. Sumrall, csumrall@utk.edu

Technical Program Co-Chairs: Linda C. Kah, lckah@utk.edu; Robert D. Hatcher, Jr., bobmap@utk.edu

Field Trip Co-Chairs: Annette S. Engel aengel1@utk.edu; Robert D. Hatcher, Jr., bobmap@utk.edu

Sponsorships Co-Chairs: Ed Perfect, eperfect@utk.edu; Larry D. McKay lmckay@utk.edu

Exhibits Chair: Bradley J. Thompson, bthom@utk.edu

Student Volunteer Chair: Christopher M. Fedo, cfedo@utk.edu



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Preliminary Announcement and Call for Papers

NORTH-CENTRAL SECTION

52nd Annual Meeting of North-Central
Section, GSA

Iowa State University in Ames, Iowa, USA
16–17 April 2018

www.geosociety.org/ne-mtg



View of the Campanile on the Iowa State University campus. Photograph by Bri Gerke.

Geoscience Returns to the Heartland

LOCATION

The 52nd Annual Meeting of GSA's North-Central Section returns to the location of its 30th Annual Meeting at the Iowa State University Conference Center in the Scheman Building, located on the campus of Iowa State University, in Ames, Iowa, USA. As a premier university-based convention and meeting location, Ames is centrally located in America's Heartland. Known for one of the most beautiful campuses in the nation, Iowa State University is easy to navigate, and the Conference Center offers easy access to community and campus amenities. Whether looking for unique dining options or distinctive shopping experiences, you'll enjoy the Midwestern hospitality in Ames. If you're driving, Ames is easily accessible from both I-35 and I-80. If you're flying, the Des Moines International Airport is served by all major airlines and is 45 minutes from Ames by car.

CALL FOR PAPERS

Abstract deadline: 16 Jan. 2018

Submit online at www.geosociety.org/nc-mtg. Abstract submission fee: US\$18 for students; US\$30 for all others. If you cannot submit an abstract online, please contact Heather Clark, +1-303-357-1018, hclark@geosociety.org.

In addition to Theme Sessions, we are soliciting abstracts for general discipline sessions. Please direct questions on these sessions to the technical program co-chairs: Neal Iverson, niverson@iastate.edu, and Kristie Franz, kfranz@iastate.edu.

Theme Sessions

- T1. **Ancient Life on Earth and Elsewhere: Evidence from Modern and Fossil Systems.** *Cosponsored by Paleontological Society; GSA Planetary Geology Division; GSA Geobiology & Geomicrobiology Division.* Andy Czaja, Univ. of Cincinnati, andrew.czaja@uc.edu; Jeff Havig, Univ. of Minnesota, jeffhavig@gmail.com; Trinity Hamilton, Univ. of Minnesota, hamil689@umn.edu; Andrew Gangidine, Univ. of Cincinnati, agangidine@gmail.com.
- T2. **Fossil Insights into Paleoclimatic and Paleoenvironmental Change.** *Cosponsored by GSA Sedimentary Geology Division.* Aaron R. Wood, Iowa State Univ., awood@iastate.edu; Natalie Thompson, Iowa State Univ., nst27@iastate.edu.
- T3. **Climate Reconstructions from Speleothems.** *Cosponsored by GSA Karst Division; GSA Quaternary Geology and Geomorphology Division.* Rhawn Denniston, Cornell College, rdenniston@cornellcollege.edu; Jeffrey Dorale, Univ. of Iowa, jeffrey-dorale@uiowa.edu.
- T4. **Landlocked but Not Left Out: Contributions to Oceanography by Mid-Continent Scientists.** *Cosponsored by GSA Sedimentary Geology Division; GSA Geobiology and Geomicrobiology Division; GSA Quaternary Geology and Geomorphology Division; GSA Environmental and Engineering Geology Division.* Beth E. Caissie, Iowa State Univ., bethc@iastate.edu; Sally Zellers, Univ. of Central Missouri, szellers@ucmo.edu; Anna Nesterovich, Iowa State Univ., annanest@iastate.edu; Nina Whitney, Iowa State Univ., nwhitney@iastate.edu.
- T5. **Potential Impact of Climate Change on Water Quality and Quantity.** *Cosponsored by GSA Hydrogeology Division; GSA Geology and Society Division.* Zelalem Bedaso, Univ. of Dayton, zbedasol@udayton.edu; Shuang-Ye Wu, Univ. of Dayton, swu001@udayton.edu; Mike Ekberg, Miami Conservancy District, mekberg@mcdwater.com.
- T6. **Assessing Groundwater in the Midwestern U.S.—How Much, How Good, and for How Long?** *Cosponsored by GSA Hydrogeology Division.* Bob Libra, blibra999@gmail.com; Michael Anderson, Iowa Department of Natural Resources, michael.anderson@dnr.iowa.gov.
- T7. **Agricultural Impacts on Hydrology and Water Quality in the Midwest.** *Cosponsored by GSA Hydrogeology Division; GSA Geology and Society Division.* William Simpkins, Iowa State Univ., bsimp@iastate.edu; Michael Burkart, USDA-ARS (retired), mburkart@iastate.edu; Nathan Young, Iowa State Univ., nlyoung@iastate.edu.
- T8. **Hydrology and Water Quality in Urban and Suburban Watersheds.** *Cosponsored by GSA Hydrogeology Division;*

GSA Environmental and Engineering Geology Division. Eric W. Peterson, Illinois State Univ., ewpeter@ilstu.edu; Walt Kelly, Illinois State Water Survey, wkelly@illinois.edu; Janette Thompson, Iowa State Univ., jrjt@iastate.edu.

- T9. **Pathogens and Other Contaminants of Concern in the Environment.** *Cosponsored by GSA Hydrogeology Division; GSA Geology and Health Division; GSA Environmental and Engineering Geology Division.* Claire Hruby, Iowa Department of Natural Resources, claire.hruby@dnr.iowa.gov; Sarah Elliott, U.S. Geological Survey, selliot@usgs.gov.
- T10. **Natural Contaminants in Groundwater Drinking Water Sources: When Natural Doesn't Mean Healthy.** *Cosponsored by GSA Hydrogeology Division; GSA Geology and Health Division; GSA Geology and Society Division.* Melinda L. Erickson, USGS, merickso@usgs.gov; Paul Stackelberg, USGS, pestack@usgs.gov; Brandy Toner, Univ. of Minnesota, toner@umn.edu.
- T11. **Biogeochemistry of Water, Sediments, and Interfaces.** *Cosponsored by GSA Limnology Division; GSA Geobiology and Geomicrobiology Division; GSA Hydrogeology Division.* Elizabeth Swanner, Iowa State Univ., eswanner@iastate.edu; Chad Wittkop, Minnesota State Univ.–Mankato, chad.wittkop@mnsu.edu; Amy Myrbo, Univ. of Minnesota, LacCore, amyrb@umn.edu.
- T12. **Environmental Impacts of Urbanization.** *Cosponsored by GSA Environmental and Engineering Geology; GSA Hydrogeology Division.* Yuyu Zhou, Iowa State Univ., yuyuzhou@iastate.edu; Madeline Gotkowitz, Wisconsin Geological and Natural History Survey, mbgotkow@wisc.edu.
- T13. **Hydrogeology in Fractured Rock.** *Cosponsored by GSA Hydrogeology Division.* Michael Cardiff, Univ. of Wisconsin–Madison, cardiff@wisc.edu; Dave Hart, Wisconsin Geological and Natural History Survey, dave.hart@wgnhs.uwex.edu.
- T14. **Recent Advances in Midwestern Karst Hydrogeology.** *Cosponsored by GSA Hydrogeology Division.* Douglas Gouzie, Missouri State Univ., douglasgouzie@MissouriState.edu; Eric Peterson, Illinois State Univ., ewpeter@ilstu.edu.
- T15. **Watershed Modeling: Current Approaches and Future Directions.** *Cosponsored by GSA Hydrogeology Division; GSA Geology and Society Division.* Kristie J. Franz, Iowa State Univ., kfranz@iastate.edu; David Dziubanski, Iowa State Univ., dave470@iastate.edu; Angela Bowman, Iowa State Univ., albowman73@gmail.com.
- T16. **Applied Geology: Environmental, Engineering, Hydro, Geotechnical, and Exploration Geophysics.** *Cosponsored by GSA Engineering and Environmental Geology Division.* Terry R. West, Purdue Univ., trwest@purdue.edu.
- T17. **Critical Zone Science in the Midcontinent.** *Cosponsored by GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Quaternary Geology and Geomorphology Division; GSA Hydrogeology Division.* Alison Anders, Univ. of Illinois, amanders@illinois.edu; David Grimley, Univ. of Illinois, dgrimley@illinois.edu; Art Bettis, Univ. of Iowa, art-bettis@uiowa.edu.
- T18. **Soils in the Critical Zone: Health, Function, Losses, and Transformations.** *Cosponsored by GSA Soils and Soil Processes Interdisciplinary Interest Group.* Ashlee Dere, Univ. of Nebraska–Omaha, adere@unomah.edu; Marshall McDaniel, Iowa State Univ., marsh@iastate.edu; Lee Burras, Iowa State Univ., lburras@iastate.edu.
- T19. **Eolian Systems of the Midcontinent.** *Cosponsored by GSA Quaternary Geology and Geomorphology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group.* Joe Mason, Univ. of Wisconsin–Madison, mason@geography.wisc.edu; Paul Hanson, Univ. of Nebraska–Lincoln, phanson2@unl.edu; Peter Jacobs, Univ. of Wisconsin–Whitewater, jacobsp@uww.edu.
- T20. **Slope Stability in the Midwest.** *Cosponsored by GSA Quaternary Geology and Geomorphology Division; GSA Environmental and Engineering Geology Division.* Lucas Zoet, Univ. of Wisconsin–Madison, lzoet@wisc.edu; Carrie Jennings, The Freshwater Society, cjennings@freshwater.org.
- T21. **Sediments, Landforms, and Chronology of the Laurentide Ice Sheet: Analog or Anomaly?** *Cosponsored by GSA Quaternary Geology and Geomorphology Division.* Neal Iverson, Iowa State Univ., niverson@iastate.edu; Lucas Zoet, Univ. of Wisconsin–Madison, lzoet@wisc.edu; Carrie Jennings, The Freshwater Society, cjennings@freshwater.org.
- T22. **Reconstructing Glacial Lakes in the Midwest and Great Lakes Regions I: Environments.** *Cosponsored by GSA Quaternary Geology and Geomorphology Division.* Timothy G. Fisher, Univ. of Toledo, timothy.fisher@utoledo.edu; B. Brandon Curry, Illinois State Geological Survey, bcurry@illinois.edu.
- T23. **Reconstructing Glacial Lakes in the Midwest and Great Lakes Regions II: Chronology.** *Cosponsored by GSA Quaternary Geology and Geomorphology Division.* Kenneth E. Lepper, North Dakota State Univ., ken.lepper@ndsu.edu; Timothy G. Fisher, Univ. of Toledo, timothy.fisher@utoledo.edu.
- T24. **Geophysics in Glacial Landscapes: Methods, Applications, and Innovations.** *Cosponsored by GSA Quaternary Geology and Geomorphology Division.* Jason Thomason, Illinois State Geological Survey, jthomaso@illinois.edu; Luke Zoet, Univ. of Wisconsin–Madison, lzoet@wisc.edu.
- T25. **Digital Landscapes: Investigating Geomorphic Processes Using High-Resolution Topographic Data.** *Cosponsored by GSA Quaternary Geology and Geomorphology Division.* Andrew Wickert, Univ. of Minnesota–Twin Cities, awickert@umn.edu; Karen Gran, Univ. of Minnesota–Duluth, kgran@d.umn.edu; Fiona Clubb, Univ. of Edinburgh, f.clubb@ed.ac.uk; Andy Breckenridge, Univ. of Wisconsin–Superior, abrecken@uwsuper.edu; Stephen DeLong, USGS, sdelong@usgs.gov.
- T26. **GIS Applications and Analysis in the Geosciences.** Stephen Crabtree, Univ. of Minnesota–Morris, crabt012@morris.umn.edu; Chris Harding, Iowa State Univ., charding@iastate.edu.
- T27. **Revolutions in Remote Sensing: Applications of UAVs to Field Mapping and Surface Analytics.** Dylan Blumentritt, Winona State Univ., dblumentritt@winona.edu; Toby Dogwiler, Missouri State Univ., tdogwiler@missouristate.edu.
- T28. **Advances Using Digital Data Systems for Geology.** Doug Walker, Univ. of Kansas, jdwalker@ku.edu; Basil Tikoff, Univ. of Wisconsin–Madison, basil@geology.wisc.edu.

- T29. **Structural Geology and Tectonics in a Quantitative World.** *Cosponsored by GSA Structural Geology and Tectonics Division.* Jacqueline Reber, Iowa State Univ., jreber@iastate.edu; Sven Morgan, Central Michigan Univ., morgalss@cmich.edu.
- T30. **Compelling Cores from the North-Central Section: A Core-Poster Session.** *Cosponsored by GSA Sedimentary Geology Division.* Franciszek Hasiuk, Iowa State Univ., franek@iastate.edu; Ryan Clark, Iowa Geological Survey, ryan-j-clark@uiowa.edu.
- T31. **Economic Geology, Igneous and Metamorphic Petrology, Mineralogy.** *Cosponsored by GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division.* Paul G. Spry, Iowa State Univ., pgspry@iastate.edu; Kevin L. Shelton, Univ. of Missouri–Columbia, sheltonkl@missouri.edu.
- T32. **Geoscience in the Southeastern South Dakota, Southwestern Minnesota, Northeastern Nebraska, and Northwestern Iowa Area.** Sarah Chadima, South Dakota Geological Survey, sarah.chadima@usd.edu; George Shurr, GeoShurr Resources, georghshurr@gmail.com; Richard Hammond, Heine Electric & Irrigation, rhhhei@gmail.com.
- T33. **Collaborative Learning in Geoscience Classrooms and Labs: Examples, Demonstrations, Best Practices, and Assessment.** *Cosponsored by GSA Geoscience Education Division.* Cinzia Cervato, Iowa State Univ., cinzia@iastate.edu; Charles Kerton, Iowa State Univ., kerton@iastate.edu; Theresa Halligan, Iowa State Univ., theresah@iastate.edu.
- T34. **Integrating Technology and Geoscience Education: Innovations in the Classroom and the Field.** *Cosponsored by National Association of Geoscience Teachers Central Section; GSA Geoscience Education Division.* Beth Johnson, Univ. of Wisconsin–Fox Valley, beth.a.johnson@uwc.edu.
- T35. **Geoscience Outreach and Engagement.** *Cosponsored by Geological Outreach at Museums, Parks, & Surveys Group; GSA Geoscience Education Division.* Lisa Anderson, Michigan State Univ. Extension, andel874@msu.edu; Peter Voice, Western Michigan Univ., peter.voice@wmich.edu.
- T36. **Undergraduate Research Poster Session.** *Cosponsored by Geosciences Division–Council on Undergraduate Research.* Robert D. Shuster, Univ. of Nebraska, rshuster@unomaha.edu.
- T37. **Current Developments in Paleozoic and Early Mesozoic Conodont Biostratigraphy, Systematics, and Paleoecology: The 51st Pander Society Symposium.** James (Jed) Day, Illinois State Univ., jeday@ilstu.edu; Jeffrey Over, SUNY Geneseo, over@geneseo.edu.
- T38. **Twenty-First Century Aggregates.** Franciszek Hasiuk, Iowa State University, franek@iastate.edu; Ryan Clark, Iowa Geological Survey, ryan-j-clark@uiowa.edu.

WORKSHOPS/SHORT COURSES

For additional information, please contact the workshop/short course co-chairs: Chris Harding, charding@iastate.edu, and Yuyu Zhou, yuyuzhou@iastate.edu.

Geologic Mapping Using GIS. Sita Karki, Michigan Geological Survey, sita.karki@wmich.edu.

3D Printing of Terrain Models. Chris Harding, Iowa State University, charding@iastate.edu; Franciszek Hasiuk, Iowa State University, franek@iastate.edu.

Collecting Geological Field Data Using the StraboSpot Data System. Doug Walker, University of Kansas, jdwalker@ku.edu; Basil Tikoff, University of Wisconsin–Madison, basil@geology.wisc.edu.

Effective Science Communication Techniques for Geoscientists. Carol McCartney, Wisconsin Geological and Natural History Survey, carol.mccartney@wgnhs.uwex.edu; Michael Dahlstrom, Iowa State University, mfd@iastate.edu; Dara Wald, Iowa State University; dwald@iastate.edu.

NSF’s Portal to the Public: Partnering Researchers with Science Centers to Create Interactive Demonstrations to Bring Research to the Public. Renee Harmon, Science Center of Iowa, renee.harmon@sciowa.org.

FIELD TRIPS

For additional information, please contact the field trip co-chairs: Franciszek Hasiuk, franek@iastate.edu, and Aaron Wood, awood@iastate.edu.

Twenty-First Century Aggregates Field Trip. Franciszek Hasiuk, Iowa State University, franek@iastate.edu; Ryan Clark, Iowa Geological Survey, ryan-j-clark@uiowa.edu. Associated with Theme Session 38.

Cambrian-Ordovician Industrial Sand Resources and Stratigraphy of Iowa, Wisconsin, and Minnesota, USA. Jay Zambito, Wisconsin Geological Survey, jay.zambito@uwex.edu; Bob Libra, blibra999@gmail.com; Tony Runkel, Minnesota Geological Survey, runke001@umn.edu.

Geologic Controls on Surface and Groundwater Quality in the Cambrian-Ordovician Aquifer System of the “Driftless” Area of Southeastern Minnesota. *Cosponsored by GSA Hydrogeology Division; GSA Karst Division; GSA Environmental and Engineering Geology Division.* Robert Tipping, Minnesota Geological Survey, tippi001@umn.edu; Tony Runkel, Minnesota Geological Survey, runke001@umn.edu; Julia Steenberg, Minnesota Geological Survey, and01006@umn.edu; Andrew Retzler, Minnesota Geological Survey, aretzler@umn.edu.

Geology of the Upper Mississippi Valley Pb-Zn District. Martin Appold, University of Missouri, appoldm@missouri.edu.

Geomorphic Evolution of the Upper Mississippi Valley. *Cosponsored by GSA Quaternary Geology and Geomorphology Division.* Andrew Wickert, University of Minnesota–Twin Cities, awickert@umn.edu; Carrie Jennings, Freshwater Society, cjenning@freshwater.org; Karen Gran, University of Minnesota–Duluth, kgran@d.umn.edu; Brandon Curry, Illinois State Geological Survey, b-curry@illinois.edu.

Geosciences at the Science Center of Iowa. *Cosponsored by GSA Geoscience Education Division.* Renee Harmon, Science Center of Iowa, renee.harmon@sciowa.org.

Geoscience in Your Backyard: A Field Trip for Educators. *Cosponsored by GSA Geoscience Education Division.* Collin Reichert, Ames Community Schools, collin.reichert@ames.k12.ia.us.

Hydrogeology of the Ames Aquifer and Its Award-Winning Drinking Water. *Cosponsored by GSA Hydrogeology Division; GSA Geology and Society Division.* William Simpkins, Iowa State University, bsimp@iastate.edu; Lyle Hammes, Ames Water and Pollution Control Department, lhammes@cityofames.org.

Pennsylvanian Sandstones and Cyclothems of Central Iowa. *Cosponsored by GSA Sedimentary Geology Division.* Philip Heckel, University of Iowa, philip-heckel@uiowa.edu; Emily Finzel, University of Iowa, emily-finzel@uiowa.edu; John Paul Pope, Northwest Missouri State University, jppope@nwmissouri.edu.

Pipes, Pigs, and Peaks: Human and Animal Impacts on Hydrology, Water Quality, and Soils in Central Iowa. *Cosponsored by GSA Hydrogeology Division; GSA Geology and Society Division; GSA Soils and Soil Processes Interdisciplinary Interest Group.* William Simpkins, Iowa State University, bsimp@iastate.edu; Lee Burras, Iowa State University, lburras@iastate.edu; Kristie Franz, Iowa State University, kfranz@iastate.edu.

REGISTRATION

Meeting registration will open in January 2018. The deadline for early registration is 5 March 2018. Cancellation deadline: 12 Mar. 2018.

ACCOMMODATIONS

Rooms have been reserved at three hotel properties conveniently located adjacent to each other at the interchange of U.S. Highway 30 and University Blvd., just a short drive or walk from the conference center and the ISU campus. The Best Western Plus University Park Inn and Suites features great amenities, including a full hot breakfast that is included in the room rate of US\$109/night plus tax. For reservations, call +1-515-296-2500 and ask for the GSA conference rate.

OPPORTUNITIES FOR STUDENTS

Presentation Awards

Awards for the best student posters and papers are supported by the GSA North-Central Section and by the Great Lakes Section–SEPM (Society for Sedimentary Geology).

Mentor Programs

Cosponsored by the GSA Foundation. For more information, contact Jennifer Nocerino at jnocerino@geosociety.org.

Roy J. Shlemon Mentor Program in Applied Geoscience.

Students will have the opportunity to discuss career prospects and challenges with professional geoscientists from multiple disciplines over a FREE lunch. Learn more at www.geosociety.org/mentors.

John Mann Mentors in Applied Hydrogeology Program.

Students 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.

Geoscience Career Workshops

For more information, contact Jennifer Nocerino at jnocerino@geosociety.org.

Part 1: Career Planning and Informational Interviewing. 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.

Part 2: Geoscience Career Exploration. 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 when possible, professionals in the field, will address these issues.

Part 3: Cover Letters, Résumés, and CVs. How do you prepare a cover letter? Does your résumé need a good edit? Learn how to prepare the best résumé possible, whether you are currently in the market for a job or not. You will review numerous examples to help you learn important résumé dos and don'ts.

LOCAL COMMITTEE

General Chair: William Simpkins, bsimp@iastate.edu

Vice Chair and Sponsorship: Alan Wanamaker, adw@iastate.edu.

Technical Program Co-Chairs: Neal Iverson, niverson@iastate.edu, and Kristie Franz, kfranz@iastate.edu.

Short Course/Workshop Co-Chairs: Yuyu Zhou, yuyuzhou@iastate.edu, and Chris Harding, charding@iastate.edu.

Field Trip Co-Chairs: Franciszek Hasiuk, franek@iastate.edu, and Aaron Wood, awood@iastate.edu

Budget/Logistics: DeAnn Frisk, dfrisk@iastate.edu

Exhibits: Betsy Swanner, eswanner@iastate.edu

Student Volunteers: Suzanne Ankerstjerne, ankerssm@iastate.edu

K–12 and Informal Education Co-Chairs: Beth Caissie, bethc@iastate.edu, and Aaron Wood, awood@iastate.edu

Activities Co-Chairs: Jacqueline Reber, jreber@iastate.edu, and Jane Dawson, jpdawson@iastate.edu

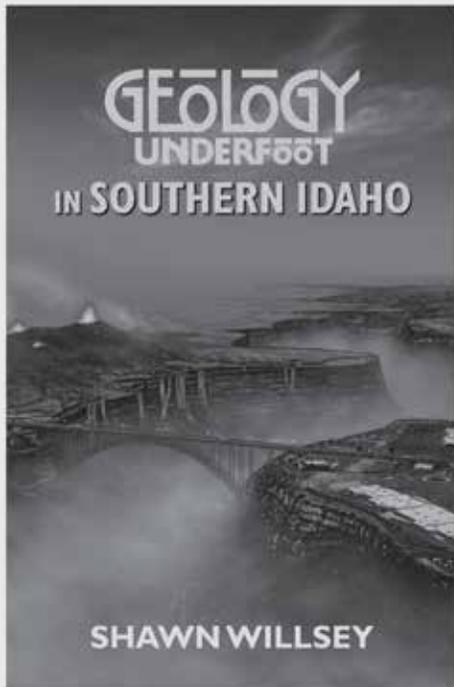
Student Judging: Paul Spry, pgspry@iastate.edu

IT Liaison: Mark Mathison, mathison@iastate.edu

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- Malm Gulch's Fossilized Forests
- Beaverhead Meteor Impact at Leaton Gulch
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Geoscience Jobs & Opportunities

Positions Open

FACULTY POSITION IN GEOCHEMISTRY YALE UNIVERSITY

The Dept. of Geology & Geophysics at Yale University invites applications for an open-rank faculty appointment in the broad area of geochemistry at the Assistant Professor, Associate Professor, or Professor level. Relevant fields include (but are not limited to) geochemical cycling, biogeochemistry, geomicrobiology, cosmology, planetary evolution, petrology, and Earth surface processes.

We seek candidates with outstanding prospects for research, scholarly leadership, and teaching excellence who will complement the existing strengths of the department. A successful applicant will develop and implement independent, externally-funded research programs, teach and advise students, and facilitate interdisciplinary research.

Applicants should submit a letter of application, a curriculum vitae including a full list of publications, a statement of research, a statement of teaching interests, and four confidential letters of reference. Applications should be submitted online at <http://apply.interfolio.com/44519>. Applications that arrive before Nov. 1, 2017, will receive full consideration. For information regarding Yale Geology and Geophysics, visit our web site at <http://earth.yale.edu>. Yale University is an Affirmative Action/Equal Opportunity employer. Yale values diversity among its students, staff, and faculty and strongly welcomes applications from women, persons with disabilities, protected veterans, and underrepresented minorities.

FACULTY POSITION IN CLIMATE SCIENCES YALE UNIVERSITY

The Dept. of Geology & Geophysics at Yale University invites applications for a tenure-track Assistant Professor appointment in the broad area of climate sciences. Relevant fields include (but are not limited to) the physics and chemistry of the atmosphere and ocean, climate change, paleoclimate, and the dynamics of planetary and exoplanetary atmospheres.

We seek candidates with outstanding prospects for research, scholarly leadership, and teaching excellence who will complement the existing strengths of the department. A successful applicant will develop and implement independent, externally-funded research programs, teach and advise students, and facilitate interdisciplinary research.

Applicants should submit a letter of application, a curriculum vitae including a full list of publications, a statement of research, a statement of teaching interests, and four confidential letters of reference. Applications should be submitted online at <http://apply.interfolio.com/44518>. Applications that arrive before Nov. 1, 2017, will receive full consideration. For information regarding Yale Geology and Geophysics, visit our web site at <http://earth.yale.edu>. Yale University is an Affirmative Action/Equal Opportunity employer. Yale values diversity among its students, staff, and faculty and strongly welcomes applications from

women, persons with disabilities, protected veterans, and underrepresented minorities.

TENURE-TRACK ASSISTANT PROFESSOR IN SEDIMENTARY GEOLOGY TEXAS TECH UNIVERSITY

The Dept. of Geosciences at Texas Tech University invites applications for a tenure-track Assistant Professor position in the broader field of sedimentary geology to begin in fall 2018. Applicants who demonstrate skills in carbonate sedimentology, paleoclimatology, basin analysis, or micropaleontology will be preferred. The ideal candidate will employ a combination of field, laboratory and/or computational techniques and be willing to participate in the development of petroleum-relevant research and teaching programs in the university. The department has a broad array of in-house analytical equipment; interested applicants should visit the department website www.geosciences.ttu.edu/geo.php.

The successful candidate is expected to establish an innovative, externally funded academic research program, teach and advise graduate and undergraduate students, and provide service to the department, college, university and the community. A PhD in Geology or a closely related field is required at the time of appointment.

Applicants must first visit the TTU employment website at <http://jobs.texastech.edu>. Once there, go to "Search Jobs," search for requisition number 11599BR, and provide the required information. Afterwards, applicants must submit a letter of application, curriculum vitae, a statement of teaching and research interests, names and contact information (including e-mail address) of at least three professional references. These documents must be uploaded to the employment website. Inquiries regarding the position should be sent to dustin.sweet@ttu.edu. Review of applications will begin Nov. 27, 2017, and will continue until the position is filled.

As an Equal Employment Opportunity/Affirmative Action employer, Texas Tech University is dedicated to the goal of building a culturally diverse faculty committed to teaching and working in a multicultural environment. We actively encourage applications from all those who can contribute, through their research, teaching, and/or service, to the diversity and excellence of the academic community at Texas Tech University. The university welcomes applications from minorities, women, protected veterans, persons with disabilities, and dual-career couples.

TENURE-TRACK, ASSISTANT PROFESSOR WILLIAMS COLLEGE

The Geosciences Dept. at Williams College invites applications for a tenure-track appointment in the broad field of climate science, at the rank of Assistant Professor, beginning 1 July 2018. We seek a colleague committed to excellence in undergraduate teaching, who will provide a balance of classroom, field, and laboratory experiences for our students, and develop a vibrant and productive research program that engages undergradu-

ates. We are particularly interested in candidates who take an interdisciplinary approach to climate science, and who will be likely to develop research and teaching collaborations across departmental boundaries.

The successful candidate will teach three courses per year (lectures plus labs). Teaching responsibilities are likely to include an introductory course in weather and climate, as well as higher-level courses based on the candidate's interests. Examples of such courses include, but are not limited to: climate system analysis and prediction; physical climatology; climate and society; hydroclimatology; applied climatology; climate engineering; climate dynamics; economics of climate change; statistical analysis of climatologic data; GIS/remote sensing; environmental management; climate and policy; cryosphere-climate interaction; or energy and the environment. Faculty have broad latitude in developing their own courses and we welcome ideas from candidates for ways in which they might develop courses that would cross traditional disciplinary lines and build dynamic intellectual bridges between Geosciences and other departments.

The Geosciences department www.williams.edu/Geoscience/ is committed to providing excellent training for future geoscientists, as well as teaching earth science as part of a balanced liberal arts education. Our department works closely with the Center for Environmental Studies ces.williams.edu/, and the successful candidate will be expected to mount courses that would be cross-listed with that program. The College is especially interested in candidates who can contribute to the growing diversity of the academic community through their teaching, scholarship and service. Enthusiasm for teaching, mentoring and advising a diverse population of students is essential.

Applicants should have a Ph.D. or dissertation completed by the time of appointment, demonstrated teaching experience, and a vigorous research program suitable for undergraduate student involvement. Deadline for applications is 30 Nov. 2017. We welcome applications from members of groups traditionally underrepresented in the field, and applicants are asked to state in their cover letter how they will enhance the diversity of offerings and educational experiences if hired. All offers of employment are contingent upon completion of a background check. Further information is available here: dean-faculty.williams.edu/prospective-faculty/background-check-policy/.

Candidates should apply via Interfolio (<http://apply.interfolio.com/43847>). The letter of application should include a cover letter, statements of teaching and research philosophy, curriculum vitae, and contact information for three references.

Williams College is a liberal arts institution located in the Berkshire Hills of western Massachusetts. The college has built its reputation on outstanding teaching and scholarship and on the academic excellence of its approximately 2,000 students. Please visit the Williams College website (www.williams.edu). Beyond meeting fully its legal obligations for non-discrimination, Williams College is committed to building a

diverse and inclusive community where members from all backgrounds can live, learn, and thrive.

ASSISTANT PROFESSOR OF STRUCTURAL GEOLOGY

CENTRAL MICHIGAN UNIVERSITY

Central Michigan University, Dept. of Earth and Atmospheric Sciences invites applications for a full time position in the broad field of structural geology at the Assistant Professor level beginning in Fall 2018. We seek a colleague whose research interests are focused on surficial or crustal level investigations with applications to regional or basin-scale tectonics; petroleum exploration; water resource development; reservoir/aquifer modeling and geomechanics; or subsurface fracturing and fluid flow. The ability to incorporate geophysical data and geographic information systems into their research is advantageous. S/he should be also be adept at employing and teaching surficial field methods that our B.S. geology majors need to successfully complete their capstone field camp course. The selected candidate will support the department's programs through engaging, student-centered teaching, develop an externally-funded research program that involves students, and actively contribute to service initiatives that advance the department, college, and university.

The Dept. of Earth and Atmospheric Sciences, housed in the College of Science and Engineering, offers B.S. degrees in Geology, Meteorology, and Environmental Science, and participates in an interdisciplinary Ph.D. program in Earth and Ecosystems Science. Further information about the department is available at www.eas.cmich.edu.

Candidates must hold a Ph.D. in structural geology or a related field. In addition, candidates must demonstrate (1) potential for outstanding teaching at the undergraduate and graduate levels, (2) potential to develop a vigorous research program that involves students and attracts external funding, (3) strong verbal and written communication skills, and (4) the ability to perform the essential functions of the job with or without reasonable accommodations. Preference will be given to candidates who have postdoctoral experience (academic or industry), a demonstrated record of receiving external funding, college-level instructional experience, and potential to collaborate with existing faculty.

Review of applications will begin October 30th, and continue until the position is filled. Applicants should submit a CV, cover letter, statement of research interests, statement of teaching philosophy, transcripts, and the names and contact information for three references through an online process at www.jobs.cmich.edu. **CMU faculty will attend the 2017 Seattle GSA Annual Meeting and can arrange to meet potential applicants and answer questions about the EAS department and this position.** Requests for further information may be sent to Dr. Lawrence Lemke at L.D.Lemke@cmich.edu.

The Carnegie Classification of Institutions of Higher Education identifies CMU as a doctoral university with higher research activity (R2) recognized for strong undergraduate education and a

range of focused graduate and research programs. CMU is a student-focused university with opportunities for leadership, internships, and off-campus volunteer programs. CMU is an AA/EO institution, providing equal opportunity to all persons, including minorities, females, veterans, and individuals with disabilities (see www.cmich.edu/ocrie).

ASSISTANT PROFESSOR OF PALEOBIOLOGY DEPARTMENT OF GEOSCIENCES BAYLOR UNIVERSITY

Baylor University is a private Christian university and a nationally-ranked research institution, consistently listed with highest honors among The Chronicle of Higher Education's "Great Colleges to Work For." The university is recruiting new faculty with a deep commitment to excellence in teaching, research and scholarship. Baylor seeks faculty who share in our aspiration to become a tier one research institution while strengthening our distinctive Christian mission as described in our strategic vision, Pro Futuris (www.baylor.edu/profuturis/). As the world's largest Baptist University, Baylor offers over 40 doctoral programs and has almost 17,000 students from all 50 states and more than 80 countries.

Baylor seeks to fill the following tenure track faculty position within the College of Arts and Sciences: Tenure-Track Assistant Professor, Paleobiology.

The Baylor University Dept. of Geosciences (www.baylor.edu/Geology/) seeks a dynamic scholar to fill this position beginning August, 2018. Candidates should have a Ph.D. in Paleobiology, Paleontology, Geology, Ecology and Evolutionary Biology, or a closely related discipline. We seek an individual with a research focus in aspects of biological paleontology such as invertebrate paleontology, vertebrate paleontology, ichnology, palynology, micropaleontology, paleoecology, paleogeography, molecular paleontology, taphonomy, phylogeny, systematics, macroevolution, functional morphology, and other biological and paleobiological processes and patterns. Regardless of research focus area, enthusiasm for interdisciplinary research and cultivation of new collaborations is essential to this position. The successful candidate will contribute to the undergraduate curriculum by teaching courses in historical geology and invertebrate paleontology and to the graduate programs (MS and PhD) in Geosciences by teaching graduate courses and seminars in his/her areas of specialization, establish and participate in externally-funded research, and successfully mentor M.S. and Ph.D. candidates to graduation. The department currently consists of 18 tenured and tenure-track geoscientists, and has considerable analytical and computing facilities with equipment including Stable Isotope, Gas Chromatograph, Nuclear Magnetic Resonance, FTIR, and Raman Spectrometers. Additionally, shared Mass Spectrometry, Molecular Biosciences, and Microscopy and Imaging Centers are available. Research space is available in the 500,000 ft² "state-of-the-art" Baylor Sciences Building.

The application package for this position should include a cover letter, current curriculum vitae,

official transcripts, reprints of three peer-reviewed publications, separate statements of your research plan and teaching philosophy, and the names and contact information of three references. The application package should be submitted electronically to: Dr. Daniel Peppe, Search Committee Chair, Dept. of Geosciences, One Bear Place #97354, Baylor University, Waco, TX 76798-7354 USA (Telephone: +1-254-710-2629; email: daniel_peppe@baylor.edu).

Salary is commensurate with experience and qualifications. We will be available to meet with candidates at the GSA meeting in Seattle. Please contact Daniel Peppe by email to set up a meeting. Applications will be reviewed beginning 11/01/2017 and will be accepted until the position is filled. To ensure full consideration, complete applications must be submitted by 11/17/2017.

To learn more, please visit these links: www.baylor.edu/geology/, www.baylor.edu/artsandsciences/, and www.baylor.edu/hr/facultypositions.

Baylor University is a private not-for-profit university affiliated with the Baptist General Convention of Texas. As an Affirmative Action/Equal Opportunity employer, Baylor is committed to compliance with all applicable anti-discrimination laws, including those regarding age, race, color, sex, national origin, marital status, pregnancy status, military service, genetic information, and disability. As a religious educational institution, Baylor is lawfully permitted to consider an applicant's religion as a selection criterion. Baylor encourages women, minorities, veterans and individuals with disabilities to apply.

EARTH AND ENVIRONMENTAL GEOSCIENCE INFORMATICS, DARTMOUTH COLLEGE

The Dept. of Earth Sciences at Dartmouth College invites applications for an assistant or associate rank tenure-track position in the area of earth and environmental geoscience informatics with specific application to one or more of our core research areas: ice and climate systems, watershed and soil processes, or environmental (bio)geochemistry. We are especially interested in candidates who combine a focus on understanding fundamental physical and/or geochemical processes in modern or ancient systems using innovative analyses of big and/or broad datasets and to candidates who provide synergy with ongoing research activities within the department and elsewhere at Dartmouth.

The Dept. of Earth Sciences is home to 11 tenured and tenure-track faculty members in the School of Arts and Sciences, and enjoys strong Ph.D. and M.S. programs as well as outstanding undergraduate majors. To create an atmosphere supportive of research, Dartmouth College offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence, and flexible scheduling of teaching responsibilities. We have strong traditions in graduate and undergraduate teaching, and the successful candidate will help develop curricular and research opportunities in the analysis of big and/or broad data. Teaching responsibilities consist of three courses per

year at both introductory and graduate-levels. To learn more about Dartmouth College and the Dept. of Earth Sciences, visit www.dartmouth.edu/~earthsci.

Dartmouth College has undergraduate and graduate student populations that are diverse by many measures. We seek applicants with a record of successful teaching and mentoring of students from all backgrounds (including first-generation college students, low-income students, racial and ethnic minorities, women, LGBTQ, etc.). Dartmouth provides opportunities to participate in undergraduate diversity initiatives in STEM research, such as our Women in Science Program, E.E. Just STEM Scholars Program, and Academic Summer Undergraduate Research Experience (ASURE).

To submit an application, upload a cover letter, curriculum vitae, statements of teaching and research interests and objectives, reprints or pre-prints of up to three of your most significant publications, and the name, address (including street address), e-mail address and fax/phone numbers of at least three references to <http://apply.interfolio.com/43899>.

Application review will begin Nov. 1, 2017, and continue until the position is filled.

The appointment will be effective July 1, 2018.

Dartmouth College is an equal opportunity/affirmative action employer with a strong commitment to diversity. In that spirit, we are particularly interested in receiving applications from a broad spectrum of people, including women, minorities, and individuals with disabilities, veterans, or any other legally protected group.

TENURE-TRACK FACULTY POSITION IN HYDROGEOLOGY

UNIVERSITY OF ALASKA ANCHORAGE
The Dept. of Geological Sciences at the University of Alaska Anchorage (www.uaa.alaska.edu/geology/) seeks to hire a tenure-track faculty member at the Assistant Professor rank, broadly in the field of hydrogeology, to begin August 2018. Exceptional, experienced candidates may be considered for appointment at a higher rank. We aim to expand and complement existing areas of research expertise in the department which include geochemistry, structural geology, petrology, geochronology, stratigraphy, petroleum geology, geophysics, and planetary geology. We encourage applications from individuals with: 1) a commitment to teaching and research at the undergraduate and graduate level in a diverse campus community; 2) a strong background in geological sciences; and 3) expertise in one or more of the following areas: physical hydrogeology, groundwater and shallow subsurface flow in the vadose zone, fluid flow through fractured rocks, geothermal energy, fluid flow in cold climate environments and permafrost, contaminant transport, and environmental hydrogeology. The successful candidate is expected to: 1) develop a successful, externally funded research program that actively involves undergraduate and graduate students; 2) teach introductory geology courses as well as upper division and graduate courses in hydrogeology and related fields; and 3) help build and sustain partnerships between

the department and the environmental industry in Alaska.

The position requires a Ph.D. in geological sciences or a related field at the time of initial appointment, university teaching experience, and demonstration of research experience and future potential. Industry or post-doctoral experience will be considered favorably. Please submit a cover letter, curriculum vitae, a statement of teaching and research interests that includes how you will involve students in research opportunities, contact information for at least three references, and unofficial academic transcripts to Posting 506562 at careers.alaska.edu. **We will be available to meet with potential candidates at our graduate school booth at the GSA meeting in Seattle.** Review of applications will begin October 16, 2017 and will continue until the position has been filled.

UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: www.alaska.edu/titleIX/compliance/nondiscrimination. For more information, please contact search committee chair, Dr. Simon Kattenhorn: skattenhorn@alaska.edu.

ASSISTANT PROFESSORSHIP IN NATURAL HAZARDS SIMON FRASER UNIVERSITY

The Dept. of Earth Sciences at Simon Fraser University invites applications for a tenure track Assistant Professorship in Natural Hazards commencing as early as September 2018. A PhD is required, and post-doctoral research, teaching or industry experience is desirable. Qualified candidates will be considered for a Tier 2 Canada Research Chair (see below). The research activities of the successful candidate will complement the existing natural hazards research interests within the department, while contributing to the expertise of the department as a whole. Candidates with expertise in remote sensing, risk assessment and mitigation, field-based observation and/or laboratory-based studies examining natural hazards, in particular, geological hazards, are encouraged to apply.

The successful candidate will develop a strong, externally funded research program, and supervise both Master's and doctoral students. Teaching responsibilities will include undergraduate and graduate level courses, to support the environmental geoscience curriculum, for example, by teaching courses in Quaternary geology or environmental geoscience. The successful candidate is expected to eventually take on a leadership role in the Centre for Natural Hazards Research.

For additional information about this position, see www.sfu.ca/earth-sciences/

All qualified candidates are encouraged to apply; however, Canadian Citizens and Permanent Residents will be given priority. Simon Fraser University is committed to employment equity and encourages applications from all qualified women and men, including visible minorities, Aboriginal peoples, persons with disabilities, and LGBTQ persons. The University acknowledges the potential impact of career interruptions on a candidate's record of research productivity, and encourages qualified candidates to explain any impact career

interruptions may have had on their record of research achievements.

Applicants are requested to submit a curriculum vitae, a statement of research and teaching interests, and the names, addresses, phone numbers, and email addresses of three referees. Electronic applications are preferred. Review of applications will begin Nov. 1, 2017.

CRC Tier 2 Chairs:

- Tier 2 chairs are intended for exceptional emerging scholars (i.e., candidates must have been an active researcher in their field for fewer than 10 years at the time of nomination).
- Applicants who are more than 10 years from having earned their highest degree (and where career breaks exist, such as maternity, parental or extended sick leave, clinical training, etc.) may have their eligibility for a Tier 2 chair assessed through the program's Tier 2 justification process. Please contact the research grants office for more information.
- Please consult the Canada Research Chairs website for full program information, including further details on eligibility criteria. www.chairs-chaires.gc.ca/program-programme/nomination-mise_en_candidature-eng.aspx#s5.

Please note that under the authority of the University Act personal information that is required by the University for academic appointment competitions will be collected. For further details see: www.sfu.ca/vpacademic/Faculty_Openings/Collection_Notice.html.

Applications or requests for further information should be directed to: Dr. Brent Ward, Chair, Dept. of Earth Sciences, Simon Fraser University, 8888 University Drive, Burnaby, BC V5A 1S6, Phone: 778-782-4229, E-mail: eassec@sfu.ca.

TENURE TRACK, ASSISTANT PROFESSOR OF GEOLOGY, BELOIT COLLEGE

The Beloit College Dept. of Geology invites applicants for a tenure-track position in the area of Earth History and Climate (Paleoclimatology) to begin August 2018. The successful applicant will teach courses in climate and historical geology for geology majors and non-majors. Additional courses taught will reflect the applicant's area of specialty, and might include paleontology, sedimentology, geochemistry, and geoarchaeology. We seek candidates that can contribute to the departments' commitment to increasing access and opportunities for populations under-represented in the geosciences. The successful candidate will develop a research program that engages undergraduates, contribute to all-college programs such as first-year seminars, interdisciplinary studies, and international education, and serve in leadership roles in campus governance. An ability to contribute to an interdisciplinary Environmental Studies program is considered an asset.

Because equity and inclusion are central to our students' liberal education and vital to the thriving of all members of our residential learning community, Beloit College aspires to be an actively anti-racist institution. We recognize our aspiration as ongoing and institution-wide, involving collective commitment and accountability. We wel-

come employees who are committed to and will actively contribute to our efforts to celebrate our cultural and intellectual richness and be resolute in advancing inclusion and equity. We encourage all interested individuals meeting the criteria of the described position to apply.

Located in a diverse community close to Madison, Milwaukee, and Chicago, Beloit is a selective undergraduate liberal arts college that attracts students from across the United States and the world. The college emphasizes excellence in teaching, learning beyond the traditional classroom, international perspectives, and collaborative research among students and faculty. It is recognized as one of the Colleges That Change Lives.

Inquiries may be addressed to Susan Swanson, department chair (swansons@beloit.edu). Interested individuals may submit a letter of interest, curriculum vitae, statements of teaching and research interests, graduate transcripts, and contact information for three references to geologysearch17@beloit.edu. To ensure full consideration, please submit all materials by Nov. 15, 2017. The search will remain open until the position is filled.

**ASSISTANT OR ASSOCIATE PROFESSOR
OF ENVIRONMENTAL STUDIES
(CLIMATE SCIENCE),
HAMILTON COLLEGE**

The Environmental Studies Program at Hamilton College invites applications for a tenure track appointment at the Assistant or Associate Professor level in the general field of climate science starting July 1, 2018. We are seeking candidates who have earned a Ph.D. in an appropriate scientific field and who can demonstrate their experience in teaching or working with diverse student populations. Your cover letter should address ways in which you raise issues of diversity in your teaching, scholarship and/or service. Candidates will be expected to teach courses in global climate change and a gateway course in Environmental Studies. Areas of expertise could include (but are not limited to) one or more of the following: climatology, paleoclimatology, atmospheric science, climate modeling, climate and biodiversity, climate and energy systems, and the social, political, economic, and policy implications of climate change. Preference will be given to candidates who are conversant in both the scientific and societal aspects of climate change and who are dedicated to developing an active and productive research program involving undergraduate students. The normal teaching load is five courses per year. The successful candidate will be expected to advise and mentor senior projects in Environmental Studies and eventually assume directorship of the program.

Qualified candidates should submit: 1) a cover letter that addresses his/her qualifications for the position; 2) a statement describing his/her teaching philosophy; 3) a statement of research interests; 4) a curriculum vitae; and 5) letters from three professional references who know the candidate well and understand the expectations of a competitive liberal arts college. Candidates should submit these materials to Professor Todd Rayne

via Interfolio at <http://apply.interfolio.com/44185> by December 1, 2017.

Hamilton (www.hamilton.edu) is a residential liberal arts college located in upstate New York. Applicants with dual-career considerations can find other Hamilton and nearby academic job listings at www.upstatenyherc.org as well as additional information at www.hamilton.edu/dof/faculty-development/resources-for-prospective-or-new-faculty/opportunities-for-spouses-or-partners.

Hamilton College is an affirmative action, equal opportunity employer and is committed to diversity in all areas of the campus community. Hamilton provides domestic partner benefits. Candidates from underrepresented groups in higher education are especially encouraged to apply.

**STEPHEN F. AUSTIN
STATE UNIVERSITY
NACOGDOCHES, TEXAS**

PETROLEUM GEOLOGIST

The Department of Geology at Stephen F. Austin State University (SFA) invites applications for a tenure-track position at the assistant (or associate) professor level. Applicants must have a doctoral degree in geology or a related field with emphasis on petroleum geology, a strong commitment to excellence in teaching and a willingness to direct Master of Science geology graduate students in research. Preference will be given to candidates with petroleum industry and/or research experience. Teaching responsibilities will include introductory courses, upper-level and graduate courses in the applicant's specialty, and occasional weekend field trip courses. Other expectations include research, university service and continuing professional development.

Submit a letter of application, CV, Transcripts, Statement of Research Philosophy, Statement of Teaching Philosophy and contact information for three references to <https://careers.sfasu.edu> (posting 0605053).

Also mail official transcripts to: Dr. Wesley Brown, Search Committee Chair
Stephen F. Austin State University
Department of Geology
PO Box 13011 SFA Station
Nacogdoches, TX 75962-3011
(936) 468-3701

Review of applications will begin on November 3, 2017, and continue until the position is filled. SFA is an equal-opportunity employer. This is a security-sensitive position and will be subject to a criminal history check.



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Northwestern

Earth and Planetary Sciences

Call for Nominations Inaugural Nemmers Prize in Earth Sciences

The recipient will receive
\$200,000 in the academic year
2018-19.

Nominations accepted through
December 1, 2017.

Candidacy is open to those with
careers of outstanding
achievement in Earth Sciences.

Submission guidelines are
available at
www.earth.northwestern.edu.

This prize is made possible by a
generous gift to Northwestern University
by the late Erwin Esser Nemmers and the
late Frederic Esser Nemmers.



WISS POST-DOCTORAL RESEARCH FELLOWSHIP

The Department of Earth, Environmental and Planetary Sciences at Rice University is inviting applications for the Wiess Post-Doctoral Research Fellowship. We are seeking candidates with independent research interests that intersect with one or more faculty within our department. Applicants must have a Ph.D. awarded within three years of the time of appointment.

The research fellowship will be supported for two years, pending satisfactory progress during the first year. It covers an annual stipend of \$60,000 with a benefits package and an additional annual discretionary research allowance of \$3,500.

Applicants are requested to develop a proposal of research to be undertaken during the fellowship period. The principal selection criteria are scientific excellence, a clearly expressed research plan to address questions at the forefront of their field of study, and research synergies with at least one faculty. The proposed research should, however, encompass independent research ideas and explore new directions beyond the applicant's Ph.D. Preference will be given to applicants whose proposals demonstrate independence and originality, and also the potential for collaboration with one or more faculty in the Department of Earth, Environmental and Planetary Sciences.

Applicants are required to submit:

- (1) A cover letter
- (2) A research proposal of no more than 3 pages (single-spaced), including figures
- (3) A current CV, including a list of publications

All three documents should be submitted as a single PDF file to the chair of the fellowship search committee (esci-postdoc@rice.edu) by 10 November, 2017. In addition, letters of reference should be submitted by three referees to the same email address and by the same deadline.

The highest ranked applicants will be invited to visit Rice in early 2018. Following acceptance, the appointment may begin anytime before 1 January, 2019. For further information or questions contact the chair of the search committee at esci-postdoc@rice.edu.

Rice University is located in Houston, Texas, and is a private, coeducational, nonsectarian university that aspires to path-breaking research, unsurpassed teaching, and contributions to the betterment of our world. Rice fulfills this mission by cultivating a diverse community of learning and discovery that produces leaders across the spectrum of human endeavor.

Rice University is an Equal Opportunity Employer with commitment to diversity at all levels, and considers for employment qualified applicants without regard to race, color, religion, age, sex, sexual orientation, gender identity, national or ethnic origin, genetic information, disability or protected veteran status.

<https://earthscience.rice.edu/open-positions/>

SYRACUSE UNIVERSITY

Earth Sciences Department

Assistant Professor - Late-Quaternary Climate Science (073445)

Syracuse University Department of Earth Sciences seeks applicants for a tenure-track Assistant Professor's position in climate change science, who will hold the Thonis Family Endowed Professorship. Scientists with expertise in observational approaches to late-Quaternary paleoclimatology and with established links to the climate modeling community are strongly encouraged to apply. The department welcomes applicants with expertise collecting, characterizing and calibrating quantitative records of past temperature, sea level change, glacial dynamics, hydroclimate, and terrestrial responses to natural and anthropogenic forcing. The ideal candidate will collaborate across traditional disciplinary boundaries within the Department of Earth Sciences and the greater SU community, which includes expertise in energy, sustainability, and water resources. The successful applicant will arrive with or establish a strong, externally funded research program and develop a portfolio of excellence in teaching at the graduate and undergraduate levels. Active public engagement on issues of a changing climate is an essential part of the appointment. Applicants will teach a large, introductory-level class in Earth Science, contribute to existing courses in paleoclimatology and develop new undergraduate and graduate courses in the science of climate change.

A Ph.D. in earth sciences, geology, or a related field is expected at the time of appointment.

The Department of Earth Sciences at Syracuse University (<http://earthsciences.syr.edu>) currently has 15 full-time faculty with broad research strengths in the solid earth, geochronology, hydrology and paleoclimatology. The Department has an outstanding array of analytical facilities and recently renovated laboratories, and the University has an established track record of supporting research infrastructure. Applicants should submit a cover letter, curriculum vitae, statements of research and teaching interests, copies of three relevant publications, and the contact information for three referees to <http://www.sujobopps.com> (#073445), preferably by November 15, 2017. The search committee will be available to meet with candidates at the GSA and Fall AGU meetings; the search will remain open until the position is filled. Syracuse University is interested in candidates who have the communication skills and cross-cultural abilities to maximize their effectiveness with diverse groups of colleagues, students and community members. Women, military veterans, individuals with disabilities, and members of other traditionally underrepresented groups are encouraged to apply. Syracuse University is an equal opportunity employer, as well as a federal contractor required to take affirmative action on behalf of protected veterans.



Hiring?

Post that open position on GSA's Job Board. Then make plans to visit with potential candidates while at the GSA 2017 Seattle meeting. Highlight the position announcement through the special section on the Geoscience Job Board (web).

Find those qualified geoscientists to fill vacancies. Use print issues of *GSA Today* and GSA's Geoscience Job Board (web). Bundle and save for best pricing options.

That unique candidate is waiting to be found.



GSA's Enduring History of Supporting Publication

While scientific publications have been a primary component of GSA's purpose since the Society's inception, some may be surprised to learn that funding to support publications was written into the very first Constitution and Bylaws of the Geological Society of America. As early as this 1889 document, lifetime membership invested sums were to be transferred into the Publication Fund upon the passing of members (*By-Laws*, CHAPTER I.—OF MEMBERSHIP. SEC 2.). It also allowed that anyone paying US\$1,000 to the Publication Fund of the Society may be elected Patron, one of three categories of membership at the time: "persons who have bestowed important favors upon the Society." With a later note that the fund consisted of publication payments from the general public, donations, and lifetime dues sums, in addition to the Patron recognition, we can deduce that the significance of publication support was established and communicated in GSA's earliest days.

Further along in the Society's history, an honorary named publication fund was established but proved challenging to sustain (late 1950s through the early 1970s). In 1980, however, a publishing endeavor took strong hold within GSA and its membership: In celebration of the Society's approaching 100th anniversary, the Decade of North American Geology project was an enormous effort resulting in a set of published volumes and maps

incorporating geology on a regional scale. The far-reaching project, spanning more than a decade, attracted a stunning \$3.8 million in contributed funds, which made it possible.

Today, as GSA moves into open access for its journals, we continue to see a strong culture of commitment to support publications. Aiming to assist authors who are unable to assume processing fees that allow for the open access model, a generous GSA member pledged US\$25,000, challenging editors to match the contribution and create an endowed fund. Having reached US\$50,000 in combined giving, we now pose a second match to an even larger group in hope of sending a message that GSA's editorial community supports the continued vitality of high-quality GSA publications from a wide range of authors.

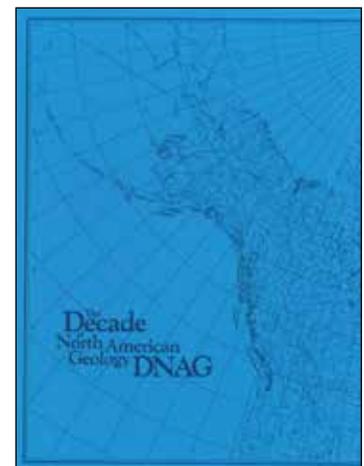
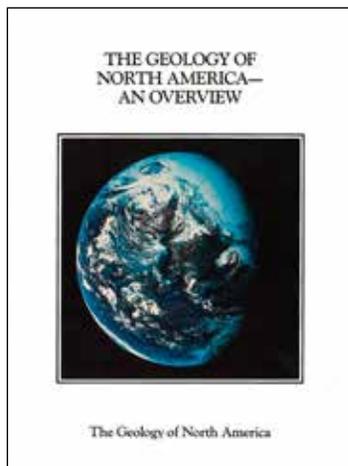
Our Society's history supports our bold, but essential, blueprint for the future. A number of leaders, such as GSA past president (2014) Hap McSween, helped guide the Society forward into this initiative, ensuring that high-quality editorial and review processes are retained: "Publications are at the core of GSA's research mission, and contributions help shore up their continuity and quality." We hope you will consider helping us carry on the tradition in which GSA was founded, transforming how we share our science. To learn about ways in which you can support these groundbreaking efforts, contact me directly at +1-303-357-1011 or jhess@geosociety.org.

Acknowledgment

Publication of this volume, one of the synthesis volumes of *The Decade of North American Geology Project* series, has been made possible by members and friends of The Geological Society of America, corporations, and government agencies through contributions to the Decade of North American Geology fund of the Geological Society of America Foundation.

Following is a list of individuals, corporations, and government agencies giving and/or pledging more than \$50,000 in support of the DNAG Project:

- | | |
|---|--|
| Amoco Production Company | Pennzoil Exploration and Production Company |
| ARCO Exploration Company | Phillips Petroleum Company |
| Chevron Corporation | Shell Oil Company |
| Cities Service Oil and Gas Company | Caswell Silver Corporation |
| Diamond Shamrock Exploration Company | Standard Oil Production Company |
| Exxon Production Research Company | Sun Exploration and Production Company |
| Getty Oil Company | Superior Oil Company |
| Gulf Oil Exploration and Production Company | Tenneco Oil Company |
| Paul V. Hoover | Texaco, Inc. |
| Kennecott Minerals Company | Union Oil Company of California |
| Kerr McGee Corporation | Union Pacific Corporation and its operating companies: |
| Marathon Oil Company | Union-Pacific Resources Company |
| Maxus Energy Corporation | Union Pacific Railroad Company |
| McMoran Oil and Gas Company | Upland Industries Corporation |
| Mobil Oil Corporation | U.S. Department of Energy |
| Occidental Petroleum Corporation | |



The Decade of North American Geology was a significant publishing effort in honor of GSA's 100th anniversary. A number of the companies listed gave US\$250,000 each in support of the project.



Harnessing an Effective Geoscience Curriculum for Students with Autism Spectrum Disorder

Dina Billig, Education Department, Touro College, New York, New York 10023, USA, dinatbillig@gmail.com; and *Howard R. Feldman*, Biology Department, Touro College, New York, New York 10023, USA, howard.feldman@touro.edu

INTRODUCTION

There is a growing awareness of the need to help individuals with autism survive the rigors of the classroom. On average, one in 68 students is diagnosed with autism spectrum disorder (ASD) annually (Autism Speaks: “Facts about Autism,” n.d.). ASD is a large spectrum, ranging from nonverbal individuals who respond minimally to intervention to individuals who “lose their diagnosis” (Sarris, 2016). A loss of diagnosis occurs when individuals are nearly indistinguishable from their peers; some individuals even use their savant-like qualities to compensate for their challenges (Winter-Messiers and Herr, 2007; Wisconsin Medical Society, 2016). ASD causes challenges with communication, knowledge of socially appropriate behaviors, and sensory regulation (Autism Speaks: “DSM-5 Diagnostic Criteria,” n.d.). Individuals with autism are said to attempt to cope by engaging in self-stimulatory behaviors. These are behaviors that provide sensory input, which include rocking, flapping hands, and rubbing hands. These challenges can be mitigated when building on the strengths of individuals with ASD, which can include science (Education Insider, 2015). One area of difficulty for students with autism is the *hidden curriculum*—the accepted attitudes and behaviors not part of the formal curriculum but necessary for social interactions (Myles and Simpson, 2001). Teachers can build on areas of strength while utilizing science to teach the hidden curriculum.

METHODOLOGIES

Effective teaching methodologies first must be in place before building beyond

the geoscience curriculum. The first step is to interest students in the natural world. Students with autism are often withdrawn and avoid new and unfamiliar experiences. However, we have found that a camera can be used to motivate students to voluntarily look for new experiences and become more involved and social. This can be incorporated into the curriculum by having them take photographs both on field trips and in man-made environments, such as at school and students’ homes. More challenged students can compare indoor and outdoor environments. If motivation is effective, a good geoscience curriculum will bring science to life; motivation may become self-generating. Many teachers disregard the essence of a well-rounded geoscience curriculum and design static lessons bound to PowerPoint presentations, worksheets, and online video curricula. However, students’ natural curiosity itself can be an effective motivator (Chalufour, 2010). Because science is about exploring, collecting, and organizing the rules that govern the natural and/or social world (Science Made Simple Inc., 2006), geoscience should be applied to students’ lives using hands-on activities and field trips (Chalufour, 2010; Berer, 2015). The science curriculum should be used to deepen students’ understanding of natural processes and to discover the beauty and symmetry around them (Teacher Vision, n.d.). Providing autistic students with an understanding and opportunity to interact with natural phenomena may decrease anxiety, as well as provide a sanctuary for when they become overwhelmed (Mind, 2013, p. 38).

When the geoscience curriculum becomes more abstract, teaching from the

bottom-up by beginning with basic details before moving to the more complicated, overarching concepts and skills is essential. Temple Grandin, a well-known autistic writer and lecturer, advocates the use of bottom-up teaching with many examples to provide context and generalization (Grandin, 2011). Bottom-up teaching could include beginning the year by defining the study of geoscience and its purpose in the classroom as a base for the other science units. It is also important to explain the concept of time to include thousands of years (Flammer, 2011). Flammer suggests using one dollar to represent one year and then having students imagine that some of the fossils’ years in dollar thickness would add up to the size of a football field. Students with autism will benefit from this visual method of explaining what would otherwise be esoteric concepts. Flammer also describes a possible class activity whereby students guess how long ago selected fossils lived, after which they place the fossils in chronological order (Flammer, 2011).

To reach all students, vary the mode of instruction to encompass visual, tactile, kinesthetic, musical, and artistic strengths (Virginia Dept. of Education, 2011, p. 11). Varying learning experiences can address sensory issues, motivate students, and improve application of the material (Virginia Dept. of Education, 2011, p. 94). Building on students’ strong curiosities, fixations, and strengths can be accomplished by providing choices in the topics covered, as well as letting students choose the modes of input and output of information. Student choice enables better learning, motivation, engagement, and classroom management to aid in developing

flexibility and problem-solving (National Science Teachers Association, n.d.). However, three choices should be the maximum provided to decrease the chance of being overwhelmed (Education Insider, 2015).

Cooperative learning should be used to build social skills (Virginia Dept. of Education, 2011, p. 19, 115). Because individual strengths are integral to the group, cooperative learning enables students with autism to utilize advanced skill sets. Emphasizing individual strengths within the group may help students carve a niche in the classroom hierarchy, and improve self-esteem and peer acceptance (Chalufour, 2010).

APPLICATIONS

Teachers could teach a scientific concept alongside an application into the hidden curriculum—that is, concepts not normally intended to be taught in lessons. Examples include social skills such as deceit, life skills, and flexibility to changes. To organize these concepts, students can use a double-entry journal to log the scientific area of study alongside its application.

Typically, children develop their understanding and application of concepts, such as determining sarcasm, innately, but many students with autism require specific instruction in this regard (National Science Teachers Association, n.d.). To help students understand deceit, they could research causes of falsified fossil records. Fossils have been falsified for attention, money, fame, religion, medicinal quackery, and to embarrass others (Monteith, 2012). Discussing the concepts of sarcasm, lies, and deception with examples may help students apply them to their own lives.

The fossil record can be used to explore the concept of change. The fossil record contains patterns of extreme and sudden change followed by long periods of stasis (punctuated equilibrium). Learning and exploring the concept of change, being able to name types of change, and seeing that there are times of stability can help prepare students with autism for life changes such as moving to middle or high school, or into adulthood. The teacher can point out that these periods of change are followed by periods of calm and equilibrium. Moreover, this lesson can be used as a springboard for calming strategies during periods of change. Students will then be better equipped to deal with expected changes because they can expect periods

of stasis as well. Even in an inclusive classroom, special-needs students may have difficulty relating to their peers and vice versa. However, learning about the differences between brachiopods and bivalves, for example, could demonstrate that differences do not preclude similarities. The class could be grouped and assigned questions to discover common interests.

One field trip technique that helps students with autism overcome defensive behaviors, such as repetitive self-stimulation, is a fossil-collecting trip. In the Hudson Valley, New York, USA, there are several shale outcrops from which it is easy to collect specimens of brachiopods, solitary corals, and bivalves. Students are given a handout and plastic bags and told to scour the outcrop to locate the fossils and place them in the bags. They work in pairs and become very enthusiastic and more curious and energetic as their collection grows. Ritual with the same pattern reduces fear of change; it is a task with order and routine. Finding the fossils and identifying the specimens could act as a distraction that makes some of them temporarily forget their defensive behaviors. It should be noted that in addition to collecting opportunities such as that mentioned in the Hudson Valley, numerous opportunities exist elsewhere and should be sought out.

CONCLUSIONS

The Common Core curriculum emphasizes reading, writing, and math more than science and history. However, this does not diminish the importance of science to every student, and especially to students with autism. Although most of these methodologies benefit students at the higher end of the ASD spectrum, geoscience can be utilized to encourage long-term growth socially and emotionally. Teachers can build on effective teaching methodologies to strengthen socio-emotional skills, develop self-confidence, and mitigate anxiety in students with autism.

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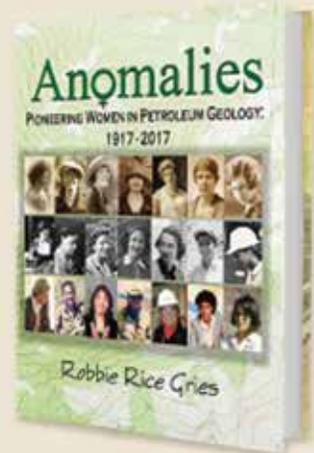
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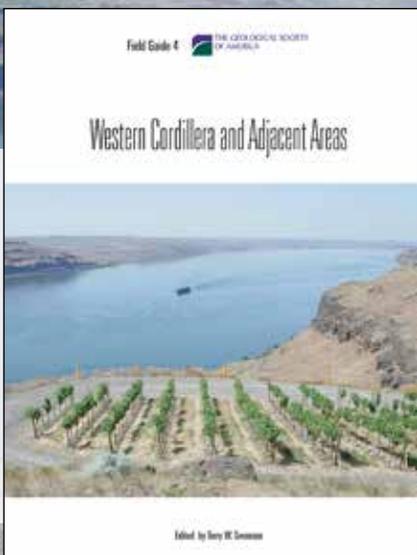
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GSA Section Meetings

8



South-Central Section

12–13 March
 Little Rock, Arkansas, USA
 Meeting Chair: Michael DeAngelis, mtdeangelis@ualr.edu
www.geosociety.org/sc-mtg
 Photo by Oliver Beland.

T



Northeastern Section

18–20 March
 Location: Burlington, Vermont, USA
 Meeting Chairs: Charlotte Mehrten, cmehrten@uvm.edu;
 Andrea Lini, alini@uvm.edu
www.geosociety.org/ne-mtg
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O



Southeastern Section

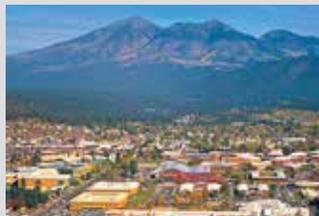
12–13 April
 Location: Knoxville, Tennessee, USA
 Meeting Chair: Colin D. Sumrall, csumrall@utk.edu
www.geosociety.org/se-mtg
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N



North-Central Section

16–17 April
 Ames, Iowa, USA
 Meeting Chair: William Simpkins, bsimp@iastate.edu
www.geosociety.org/nc-mtg
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Rocky Mountain/Cordilleran Joint Section Meeting

15–17 May
 Flagstaff, Arizona, USA
 Meeting Chair: Paul Umhoefer, paul.umhoefer@nau.edu
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