



1–4 Nov. GSA 2015 in historic Baltimore, Maryland, USA.

GSA TODAY

A PUBLICATION OF THE GEOLOGICAL SOCIETY OF AMERICA®

**Lithospheric
thinning
associated with
formation of a
metamorphic core
complex and
subsequent
formation of the
Iranian plateau**

GSA Member
Appreciation Issue

The Origin, Evolution, and Environmental Impact of Oceanic Large Igneous Provinces

Edited by Clive R. Neal, William W. Sager, Takashi Sano, and Elisabetta Erba

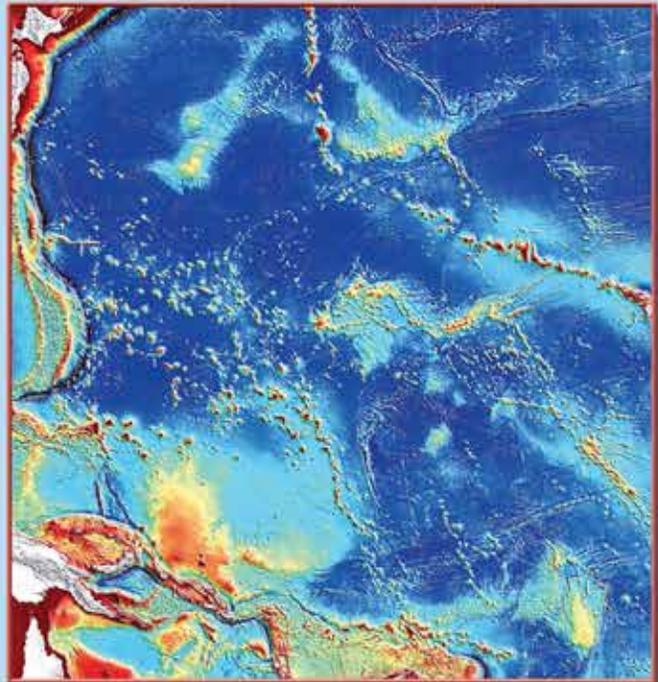
Member Price
\$56.00

The origin, evolution, and environmental impact of large igneous provinces (LIPs) represents a topic of high scientific importance because the magmatism associated with these features cannot be directly related to plate tectonics, and because the eruption of flood basalts may have global environmental consequences. Oceanic LIPs are even more poorly understood due to their relative inaccessibility. This volume takes a multidisciplinary approach to understanding LIP origin, evolution, and environmental impact in ocean basins. Papers that focus on plate tectonic reconstructions, petrologic and geophysical investigations of various LIPs, and sedimentological and micropaleontological evidence of syn-LIP sediments are presented. Precious materials and data from dredging cruises and scientific ocean drilling expeditions have made this volume possible.

SPE511, 17 chaps.
ISBN 9780813725116
\$80.00, member price \$56.00

The Origin, Evolution, and Environmental Impact of Oceanic Large Igneous Provinces

Edited by Clive R. Neal, William W. Sager, Takashi Sano, and Elisabetta Erba



THE GEOLOGICAL SOCIETY
OF AMERICA®

Special Paper 511

toll-free 1.888.443.4472
1.303.357.1000, option 3
gsaservice@geosociety.org

THE GEOLOGICAL SOCIETY
OF AMERICA®

Special Paper 511

Buy online at <http://rock.geosociety.org/store/>.

Featured Articles

GSA TODAY (ISSN 1052-5173 USPS 0456-530) prints news and information for more than 26,000 GSA member readers and subscribing libraries, with 11 monthly issues (March/April is a combined issue). *GSA TODAY* is published by The Geological Society of America® Inc. (GSA) with offices at 3300 Penrose Place, Boulder, Colorado, USA, and a mailing address of P.O. Box 9140, Boulder, CO 80301-9140, USA. GSA provides this and other forums for the presentation of diverse opinions and positions by scientists worldwide, regardless of race, citizenship, gender, sexual orientation, religion, or political viewpoint. Opinions presented in this publication do not reflect official positions of the Society.

© 2015 The Geological Society of America Inc. All rights reserved. Copyright not claimed on content prepared wholly by U.S. government employees within the scope of their employment. Individual scientists are hereby granted permission, without fees or request to GSA, to use a single figure, table, and/or brief paragraph of text in subsequent work and to make/print unlimited copies of items in *GSA TODAY* for noncommercial use in classrooms to further education and science. In addition, an author has the right to use his or her article or a portion of the article in a thesis or dissertation without requesting permission from GSA, provided the bibliographic citation and the GSA copyright credit line are given on the appropriate pages. For any other use, contact editing@geosociety.org.

Subscriptions: GSA members: Contact GSA Sales & Service, +1-888-443-4472; +1-303-357-1000 option 3; gsaservice@geosociety.org for information and/or to place a claim for non-receipt or damaged copies. **Nonmembers and institutions:** *GSA TODAY* is US\$88/yr; to subscribe, or for claims for non-receipt and damaged copies, contact gsaservice@geosociety.org. Claims are honored for one year; please allow sufficient delivery time for overseas copies. Periodicals postage paid at Boulder, Colorado, USA, and at additional mailing offices. Postmaster: Send address changes to GSA Sales & Service, P.O. Box 9140, Boulder, CO 80301-9140.

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.

Managing Editor: K.E.A. "Kea" Giles, kgiles@geosociety.org, gsatoday@geosociety.org

Graphics Production: Margo McGrew

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

GSA Online: www.geosociety.org

GSA TODAY: www.geosociety.org/gsatoday/

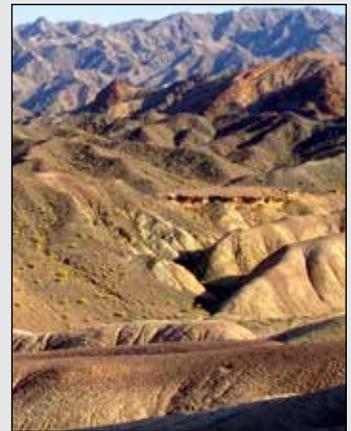
Printed in the USA using pure soy inks.



SCIENCE

- 4 **Lithospheric thinning associated with formation of a metamorphic core complex and subsequent formation of the Iranian plateau**
Fariba Kargaranbafghi and Franz Neubauer

Cover: Khosoumi Mountains in the southern part of the Chapedony metamorphic core complex of Central Iran. The high mountains in the back are represented by Eocene plutonic rocks of the footwall unit. Eocene volcanoclastic rocks in the foreground form the hanging-wall unit. See related article, p. 4–8.



GROUNDWORK

- 50 **A bird's-eye view of geology: The use of micro drones/UAVs in geologic fieldwork and education**
Benjamin R. Jordan

GSA News

- 9 **GSA 2015 Annual Meeting & Exposition**
12 **2015 GSA Medal & Award Recipients**
13 **2015 GSA Division Primary Awards**
14 **2015 GSA Fellows**
20 **GSA Celebrates New 50-Year Members for 2015**
21 **2015 GSA Research Grant Recipients**
28 **2015 GSA Division & Section Student Research Awards**
29 **2015 Cole Awards**
30 **GSA/ExxonMobil Field Camp Scholars Awards**
31 **Welcome New GSA Members!**
44 **In Memoriam**
45 **As Energy Use Changes, So Does GSA's Second Oldest Division**
45 **Call for Nominations & Applications**
46 **Meet Your Fiscal Year 2016 Officers & Councilors**
47 **2014–2015 GSA-USGS Congressional Science Fellow Report: A Keystone Recap**
48 **GSA Position Statements: Climate Change Position Statement Summary**
49 **Geoscience Jobs & Opportunities**
53 **GSA Foundation Update**

Lithospheric thinning associated with formation of a metamorphic core complex and subsequent formation of the Iranian plateau

Fariba Kargaranbafghi, Dept. Geography and Geology, University of Salzburg, Salzburg, Austria, and Dept. of Geology, University of Yazd, Yazd, Iran, fkargaran@yazd.ac.ir; and **Franz Neubauer**, Dept. Geography and Geology, University of Salzburg, Salzburg, Austria, Franz.Neubauer@sbg.ac.at

ABSTRACT

The formation of metamorphic core complexes is not well understood, which is why these large geological structures are still interesting subjects. They seem to have been formed by erosion of upper crustal rocks and exhumation of mid-crustal rocks. However, it is not clear how the lower crust and underlying mantle have responded. Many core complexes in the western United States are underlain by a flat Moho discontinuity, and some others possess a crustal root. Here, we present evidence of the Chapedony metamorphic core complex in the Central Iranian plateau. We show that the overall lithosphere and continental crust were thinned beneath regions of surface extension. The core complex is located within a continental rift and was exhumed at a rate of $\sim 0.75\text{--}1.3$ km/m.y. during the main phase of oceanic subduction of the Arabian plate beneath the Central Iranian block between ca. 49 and 30 Ma. The thinning of the underlying lithosphere appears to have been compensated by hot asthenosphere, as indicated by low seismic velocities in the Central Iranian block. We conclude that the development of the core complex involved lithospheric removal associated with extension and upwelling of hot asthenosphere, although we are aware of the fact that the structure could have been substantially modified by subsequent processes like slab break-off and associated uplift of the Central Iranian plateau.

INTRODUCTION

The Central Iranian plateau plays a key role in the study of the youngest continental collision on Earth, namely the oblique Arabia-Eurasia collision (Guest et al., 2007; Priestley et al., 2012). It provides, therefore, exciting opportunities to study large-scale orogenic processes that are overprinted and obscured in other, older parts of the Alpine-Zagros-Himalayan mountain chain. The combination of convergence with both shortening and extension is an interesting feature of the youngest continental collision. Understanding these complexities requires the recognition of important lateral variations in crustal and upper mantle structure (Wortel and Spakman, 2000). We describe, in a kinematic sense,

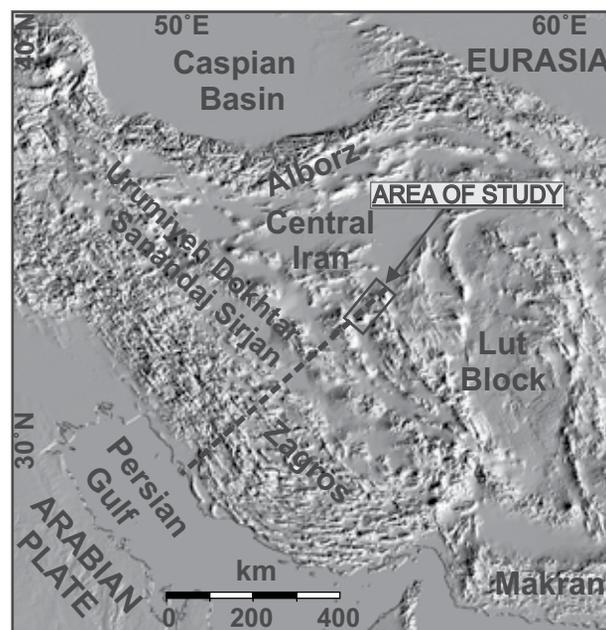


Figure 1. Digital elevation model of the Arabia-Eurasia convergence zone. Rectangle shows the position of the study area (Fig. 2); black dashed line shows the location of the lithospheric-scale cross section (Fig. 4) from the Arabian plate through the Central Iranian plateau.

the Zagros fold-thrust belt and Central Iranian block (Fig. 1) as part of the plate boundary zone, involving convergence and migrating subduction zones accompanied by extension and following collision. The overall surface structure of the Central Iranian plateau, which represents the uplifted part of the Central Iranian block at elevations of ~ 1.5 km, is characterized by large-wavelength folds with Cenozoic sedimentary basins and adjacent ridges with basement exposures (Guest et al., 2007; Kargaranbafghi et al., 2011; Morley et al., 2009). The development of the Central Iranian basin within the Central Iranian block probably began in a continental rift setting during Eocene to early Oligocene times (Jackson et al., 1990; Guest et al., 2007; Berberian and Berberian, 1981; Takin, 1972; Allen et al., 2003; Vincent et al., 2005), and the Central Iranian basin underwent inversion during the Early Miocene to Pliocene (Jackson et al., 1990; Guest et al., 2007; Morley et al., 2009; François et al., 2014a). The uplift of the Central Iranian plateau has been associated with slab break-off

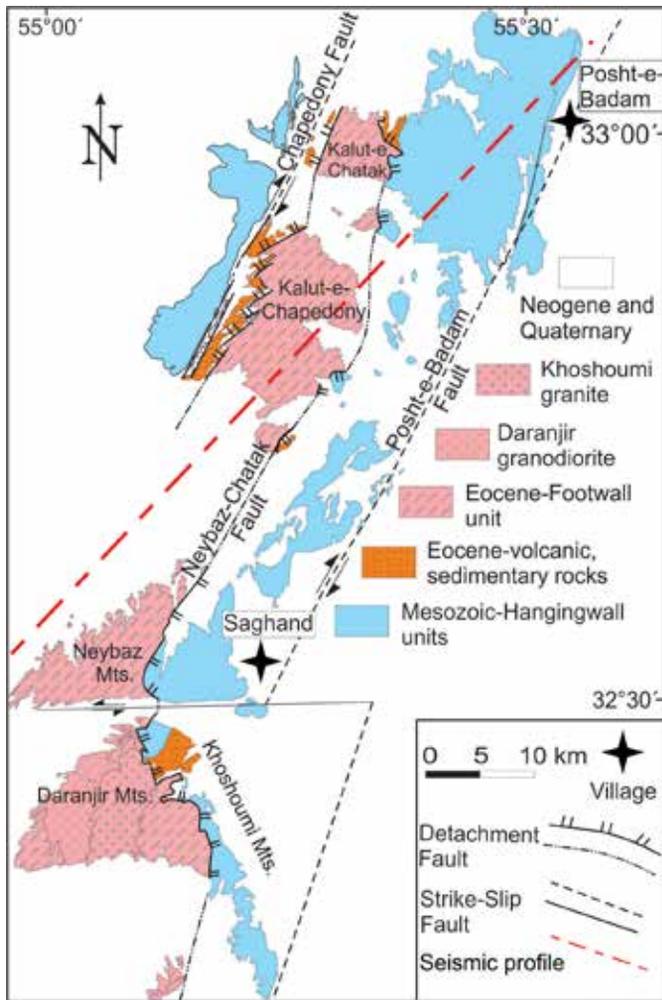


Figure 2. Simplified map of the footwall and hanging-wall of the metamorphic core complex.

and heating of the base of the lithosphere and its subsequent thinning (e.g., Hafkenscheid et al., 2006; Bottrill et al., 2012; Jimenez-Munt et al., 2012; Mohammadi et al., 2013; François et al., 2014b). Slab break-off was recently estimated to have occurred ca. 10 ± 5 Ma (Agard et al., 2011).

CHAPEDONY METAMORPHIC CORE COMPLEX

The Chapedony metamorphic core complex (CMCC) is located in the Saghand area in the southwestern Central Iranian block (Fig. 1). The CMCC has an ESE-WNW extent of ~20 km and a NNE-SSW extent of ~100 km (Fig. 2). It exposes migmatites and is intruded by granite and granodiorite with U-Pb zircon ages ranging from 47 to 44 Ma (Ramezani and Tucker, 2003). Along the Neybaz-Chatak fault, a ductile low-angle normal shear zone, rocks of the CMCC are juxtaposed to overlying Mesozoic metamorphic and sedimentary units in the hanging wall. Kinematics along the Neybaz-Chatak fault indicate to the NE transport during the Eocene (Kargaranbafghi et al., 2012b).

Kargaranbafghi et al. (2012a, 2012b) reported *P-T* estimates of peak metamorphic conditions of 4 kbar and 750 °C within the CMCC. New and existing (U-Th)/He ages of zircon and apatite indicate that the complex had cooled to <50 °C by 30 Ma

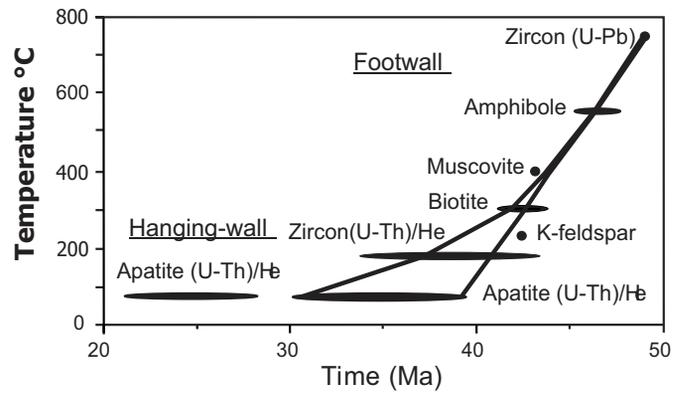


Figure 3. Chapedony Metamorphic Core Complex cooling path (modified from Kargaranbafghi et al., 2012a).

(Kargaranbafghi et al., 2012a). All geochronologic ages are consistent with a period of rapid cooling from 750 °C (migmatite formation, based on U-Pb zircon ages; Ramezani and Tucker, 2003) through ~300 °C ($^{40}\text{Ar}/^{39}\text{Ar}$ biotite ages; Verdel et al., 2007; Kargaranbafghi et al., 2012a, 2012b) to 50 °C by 30 Ma within <20 million years (Fig. 3). The data presuppose cooling at a rate of ~45–80 °C/m.y. Using the mentioned mineral thermobarometry (Kargaranbafghi et al., 2012a, 2012b) to constrain the initial depth (12 km), we calculated that the CMCC underwent tectonic unroofing and erosional exhumation at an average rate of ~0.75–1.3 km/m.y.

A seismic receiver function study indicates that the crustal thickness is ~45 km thick between the Persian Gulf coast and the High Zagros. After that, it thickens rapidly to ~70 km within a narrow zone beneath the Sanandaj-Sirjan Zone, before thinning to ~42 km beneath the Urumiyeh-Dokhtar volcanic magmatic arc. At the southern rim of Central Iran, the crust thins to 32–42 km beneath the CMCC (Kaviani, 2004; Kaviani et al., 2007; Paul et al., 2006; Priestley et al., 2012) (Fig. 4). These observations show that the CMCC is located above an area of crustal thinning. The average Moho upwarp is 7–17 km (Kaviani et al., 2007), close to the amount of upper crust tectonically removed over the CMCC in the period between 49 and 30 Ma (Fig. 4). An estimate of the

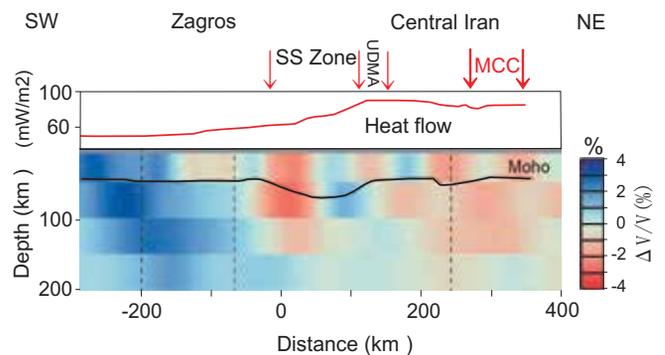


Figure 4. Depth cross section along the Arabian plate through the Central Iranian plateau (Kaviani et al., 2007). The profile in the 3-D model of P-wave velocity perturbations resulting from the inversion of residuals. Black solid line—Moho depth; red solid line—heat flow (Fernandez et al., 2003). MCC—metamorphic core complexes; UDMA—Urumiyeh-Dokhtar Magmatic Arc.

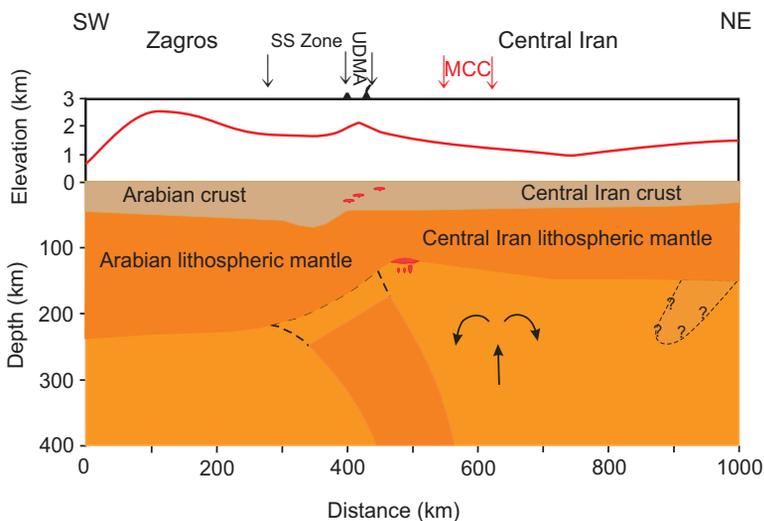


Figure 5. Model for the formation of the Iranian plateau. Interpretive cartoon cross section illustrating one possible scenario for the Central Iranian plateau. The subduction of lithosphere is tentatively inferred from seismic tomography images (Hafkenscheid et al., 2006) and confirmed by numerical modeling (Kaislaniemi et al., 2014). MCC—metamorphic core complexes; SS—Sanandaj-Sirja zone; UDMA—Urumiyeh-Dokhtar Magmatic Arc.

crustal and lithospheric thickness and heat flow before the exhumation of the CMCC can be made by adopting a thickness of 45–55 km and a temperature of 750 °C for the base of the crust before 49 Ma. These values are consistent with the metamorphic pressure-temperature-time studies on the CMCC (Kargaranbafghi et al., 2012a, 2012b) and with seismic estimates of the crustal thickness underneath the CMCC today (Kaviani et al., 2007; Paul et al., 2006).

CRUSTAL AND MANTLE LITHOSPHERIC STRUCTURE

The CMCC is located on a basement ridge within the region of crustal thinning and underwent surface uplift rather than subsidence. Mantle buoyancy isostatically supports regionally positive elevations in the Saghand region. The mantle decompression made this region susceptible to flow and further convective erosion of the mantle lithosphere beneath the CMCC. Priestley et al. (2012) and Lü et al. (2012) report a NE-trending fast direction of shear waves within the mantle lithosphere consistent with the Eocene NE-ward flow of crustal rocks within the CMCC (Kargaranbafghi et al., 2012b). Uplift continued forming topographic culminations reaching 1200–2100 m above sea level. The observed crustal thinning of ~7–17 km in the CMCC should produce 1.5–3 km of subsidence (Abers et al., 2002) that is isostatically balanced, because the mantle lithosphere thins in concert with the crust. The basin surrounding the CMCC is the surface expression of extension (Fig. 1). By the late-middle Miocene, ~3–4 km of post-Eocene evaporites, carbonates, and shales had accumulated in one of these successor basins (Jackson et al., 1990; Morley et al., 2009).

Variations in Moho depth beneath the CMCC explain variations in lower-crustal thickness through lower-crustal flow (Verdel et al., 2011). Furthermore, some flow of the lower crust may be needed to explain subsidence and the heat flow of the basins adjacent to the Saghand area. Heat-flow measurements across the Central Iranian block average ~85 mWm⁻² (Fernandez et al., 2003) (Fig. 4), likely indicating ongoing thermal erosion of the lithospheric base.

GEODYNAMIC REGIME

A significant change in the tectonic regime is typically marked by a change in the composition of the associated magmatism (Turner et

al., 1993). Before collision, subduction of the oceanic crust was accompanied by calc-alkaline arc magmatism in the Urumiyeh-Dokhtar Magmatic Arc, as is also the case in the high Himalaya (Turner et al., 1993). Crust-derived leucogranites were subsequently emplaced within the CMCC during the Eocene (Ramezani and Tucker, 2003) as a result of decompression associated with the onset of rapid exhumation. However, intense coeval volcanism occurred all over the Iranian plateau and is interpreted to represent a magmatic flare of crustal origin due to the remelting of crustal material (Verdel et al., 2011). A few scattered upper Oligocene to Quaternary volcanic rocks occur in the Central Iranian plateau (Berberian and Berberian, 1981; Milton, 1977) but not in the surroundings of the CMCC. The Oligo-Miocene regional plutonic activity of southwestern Central Iran cut through the Eocene-Oligocene volcanic rocks (Berberian and Berberian, 1981). The low ⁸⁷Sr/⁸⁶Sr initial ratio obtained for this complex (0.70524–0.70573) suggests an upper mantle or oceanic crust origin (Berberian and Berberian, 1981). The appearance of mantle-derived volcanism on the plateau marks a change in the tectonic regime and requires a thermal explanation. Young volcanism at the surface and high heat flow values in the region suggest that this zone of low velocities and high attenuation in the uppermost mantle represents asthenospheric material. We conclude that, in Central Iran, the only plausible means of attaining temperatures high enough for melting within the lithospheric mantle is by thinning, a mechanism consistent with recent seismic observations and modeling (e.g., Kaviani et al., 2009; Manaman et al., 2011; Zamani et al., 2013; Kaislaniemi et al., 2014). The surface uplift of the Central Iranian plateau is, therefore, likely associated with heating of the lithospheric base induced by break-off of the subducted lithosphere (François et al., 2014a, 2014b; Bottrill et al., 2012). Although no young volcanics are known in the surroundings of the CMCC, this process potentially could have slightly modified the lithospheric base of the area underneath the CMCC.

Although the geodynamic setting is entirely different, similarities exist between the CMCC in Central Iran and the metamorphic core complexes (MCCs) in Papua New Guinea, which may explain the juxtaposed thinning of crust and mantle lithosphere that is contrary in the MCCs of the western U.S. and the Aegean regions, which have relatively flat Mohos (Abers et al., 2002; Myers and Beck, 1994; Tirel et al., 2009).

CONCLUSIONS

The CMCC is a typical example of a metamorphic core complex formed by syn-orogenic extension: a contractional orogen, formed in Late Cretaceous to early Cenozoic times, which underwent rapid exhumation during the middle to late Eocene. The crust was probably thermally weakened before extension took place in the Eocene. Temperatures of 650–750 °C at depths equivalent to 3.5–4 kbar (~60 °C/km) would produce an unrealistic Moho temperature of >1200 °C for a conductive geotherm (Costa and Rey, 1995). Instead, advective heat transport probably occurred in the deeper parts of the continental crust to maintain the temperature of the lower crust between 750 and 1000 °C. The crustal root was partially melted, and the base of the mantle lithosphere was likely transformed into asthenosphere, either by thermal relaxation (Gaudemer et al., 1988) or by gravitational detachment (Houseman et al., 1981).

The geological evidence suggests that thinning, extension, and exhumation began in the middle Eocene (ca. 49 Ma), and extension continued through to earliest Oligocene (33 Ma). The final cooling (<50 °C) of the CMCC occurred earlier than in the hanging-wall unit (Kargaranbafghi et al., 2012a). This suggests that the hanging wall was exhumed during a second process after the main collision between the Arabian plate and the Central Iranian block. This took place during the late Oligocene and early Miocene, around the same time that the Red Sea started to open ca. 21–25 Ma (Omar and Steckler, 1995) and at the time of slab break-off (Hafkenscheid et al., 2006), although recent estimates suggest slab break-off at 10 ± 5 Ma (Agard et al., 2011). We propose a model for the Iranian plateau uplift subsequent to exhumation of the CMCC (Fig. 5) that is similar to the model for the northern Tibetan Plateau (Tilmann and Ni, 2003). We suggest that downwelling lithospheric material would inevitably drag neighboring asthenospheric material with it, a model recently confirmed through numerical modeling by Kaislaniemi et al. (2014). Tentative evidence for northeastward-directed subduction with associated downward convection along the northern margin of the Iranian plateau (Hafkenscheid et al., 2006) would have resulted in a deficit of asthenosphere. This must be counterbalanced by a focused upward-directed return flow. Such an upward flow would provide an explanation for the low-velocity body imaged by Kaviani et al. (2007) and provide a mechanism for heating the crust and gradual erosion of remaining mantle lithosphere beneath the Central Iranian plateau.

ACKNOWLEDGMENTS

We gratefully acknowledge the critical but constructive remarks of two anonymous reviewers and encouragement by the editor. This work was funded by the University of Salzburg, Austria. Fariba Kargaranbafghi acknowledges financial support from the Austria Academic Exchange Service. We thank Abdolrahim Houshmandzadeh for field and administrative assistance and support.

REFERENCES CITED

- Abers, G.A., Ferris, A., Craig, M., Davies, H., Lerner-Lam, A.L., Mutter, J.S., and Taylor, B., 2002, Mantle compensation of active metamorphic core complexes at Woodlark rift in Papua New Guinea: *Nature*, v. 418, p. 862–865, doi: 10.1038/nature00990.
- Agard, P., Omrani, J., Jolivet, L., Whitchurch, H., Vrielynck, B., Spakman, W., Monie, P., Meyer, B., and Wortel, R., 2011, Zagros orogeny: A subduction-dominated process: *Geological Magazine*, v. 148, p. 692–725, doi: 10.1017/S001675681100046X.
- Allen, M., Ghassemi, M.R., Shahrabi, M., and Qorashi, M., 2003, Accommodation of late Cenozoic oblique shortening in the Alborz range, northern Iran: *Journal of Structural Geology*, v. 25, p. 659–672, doi: 10.1016/S0191-8141(02)00064-0.
- Berberian, F., and Berberian, M., 1981, Tectono-plutonic episodes in Iran, *in* Delany, F.M., ed., *Zagros-Hindu Kush-Himalaya Geodynamic Evolution*: American Geophysical Union Geodynamics Series, v. 3, p. 5–32.
- Bottrill, A.D., van Hunen, J., and Allen, M.B., 2012, Insight into collision zone dynamics from topography: Numerical modelling results and observations: *Solid Earth*, v. 3, p. 387–399, doi: 10.5194/se-3-387-2012.
- Costa, S., and Rey, P., 1995, Lower crustal rejuvenation and growth during post-thickening collapse: Insights from a crustal cross section through a Variscan metamorphic core complex: *Geology*, v. 23, p. 905–908, doi: 10.1130/0091-7613(1995)023<0905:LCRAGD>2.3.CO;2.
- Fernandez, M., Ayala, C., Skogseid, J., Vergés, J., Wheeler, W., and Karpuz, R., 2003, Crustal and lithospheric structure in the Zagros fold and thrust belt: A geological and geophysical approach, *in* Abstracts, AAPG International Conference, Barcelona, Spain, 21–24 September: abstract #90017@2003.
- François, T., Agard, P., Bernet, M., Meyer, B., Chung, S.-L., Zarrinkoub, M.H., Burov, E., and Monié, P., 2014a, Cenozoic exhumation of the internal Zagros: First constraints from low-temperature thermochronology and implications for the buildup of the Iranian plateau: *Lithos*, v. 206–207, p. 100–112, doi: 10.1016/j.lithos.2014.07.021.
- François, T., Burov, E., Agard, P., and Meyer, B., 2014b, Buildup of a dynamically supported orogenic plateau: Numerical modeling of the Zagros/Central Iran case study: *Geochemistry Geophysics Geosystems*, v. 15, no. 6, p. 2632–2654, doi: 10.1002/2013GC005223.
- Gaudemer, Y., Jaupart, C., and Tapponnier, P., 1988, Thermal control on post-orogenic extension in collision belts: *Earth and Planetary Science Letters*, v. 89, p. 48–62, doi: 10.1016/0012-821X(88)90032-5.
- Guest, B., Guest, A., and Axen, G., 2007, Late Tertiary tectonic evolution of northern Iran: A case for simple crustal folding: *Global and Planetary Change*, v. 58, p. 435–453, doi: 10.1016/j.gloplacha.2007.02.014.
- Hafkenscheid, E., Wortel, M.J.R., and Spakman, W., 2006, Subduction history of the Tethyan region derived from seismic tomography and tectonic reconstructions: *Journal of Geophysical Research*, v. 111, B08401, doi: 10.1029/2005JB003791.
- Houseman, G.A., McKenzie, D.P., and Molnar, P., 1981, Convective instability of a thickened boundary layer and its relevance for the thermal evolution of a continental convergent belt: *Journal of Geophysical Research*, v. 86, p. 6115–6132, doi: 10.1029/JB086iB07p06115.
- Jackson, M.P.A., Cornelius, R.R., Craig, C.H., Gansser, A., Stocklin, J., and Talbot, C.J., 1990, Salt diapirs of the Great Kavir, central Iran: *Geological Society of America Memoir* 177, 150 p., doi: 10.1130/MEM177-p1.
- Jiménez-Munt, I., Fernández, M., Saura, E., Vergés, J., and García-Castellanos, D., 2012, 3-D lithospheric structure and regional/residual Bouguer anomalies in the Arabia-Eurasia collision (Iran): *Geophysical Journal International*, v. 190, p. 1311–1324, doi: 10.1111/j.1365-246X.2012.05580.x.
- Kaislaniemi, L., van Hunen, J., Allen, M.B., and Neill, I., 2014, Sublithospheric small-scale convection—A mechanism for collision zone magmatism: *Geology*, v. 42, p. 291–294, doi: 10.1130/G35193.1.
- Kargaranbafghi, F., Neubauer, F., and Genser, J., 2011, Cenozoic kinematic evolution of southwestern Central Iran: Strain partitioning and accommodation of Arabia–Eurasia convergence: *Tectonophysics*, v. 502, p. 221–243, doi: 10.1016/j.tecto.2010.02.004.
- Kargaranbafghi, F., Foeken, J., Guest, B., and Stuart, F., 2012a, Cooling history of the Chapedony metamorphic core complex, Central Iran: Implications for the Eurasia–Arabia collision: *Tectonophysics*, v. 524–525, p. 100–107, doi: 10.1016/j.tecto.2011.12.022.
- Kargaranbafghi, F., Neubauer, F., and Genser, J., Faghhi, A., and Kusky, T., 2012b, Mesozoic to Eocene ductile deformation of western Central Iran: From Cimmerian collisional orogeny to Eocene exhumation: *Tectonophysics*, v. 564–565, p. 83–100, doi: 10.1016/j.tecto.2012.06.017.

- Kaviani, A., 2004, La chaîne de collision continentale du Zagros (Iran): Structure lithosphérique par analyse de données sismologiques [Ph.D. thesis]: Grenoble, France, Université Joseph Fourier, 238 p.
- Kaviani, A., Paul, A., Bourova, E., Hatzfeld, D., Pedersen, H., and Mokhtari, M., 2007, A strong seismic velocity contrast in the shallow mantle across the Zagros collision zone (Iran): *Geophysical Journal International*, v. 171, p. 399–410, doi: 10.1111/j.1365-246X.2007.03535.x.
- Kaviani, A., Hatzfeld, D., Paul, A., Tatar, M., and Priestley, K., 2009, A complex pattern of seismic anisotropy beneath the Arabia–Eurasia collision zone in Iran: *Earth and Planetary Science Letters*, v. 286, p. 371–378, doi: 10.1016/j.epsl.2009.07.003.
- Lü, Y., Liu, B., Pei, S., Youshun Sun, Y., Toksöz, M.N., and Zeng, X., 2012, *Pn* tomographic velocity and anisotropy beneath the Iran region: *Bulletin of the Seismological Society of America*, v. 102, p. 426–435, doi: 10.1785/0120100141.
- Manaman, N.S., Shomali, H., and Koyi, H., 2011, New constraints on upper-mantle S-velocity structure and crustal thickness of the Iranian plateau using partitioned waveform inversion: *Geophysical Journal International*, v. 184, p. 247–267, doi: 10.1111/j.1365-246X.2010.04822.x.
- Milton, D.J., 1977, Qal'eh hasan ali maars, central Iran: *Bulletin of Volcanology*, v. 40, p. 201–208, doi: 10.1007/BF02597000.
- Mohammadi, N., Sodoudi, F., Mohammadi, E., and Sadidkhouy, F., 2013, New constraints on lithospheric thickness of the Iranian plateau using converted waves: *Journal of Seismology*, v. 17, p. 883–895, doi: 10.1007/s10950-013-9359-2.
- Morley, C.K., Kongwung, B., Julapour, A.A., Abdolghafourian, M., Hajian, M., Waples, D., Warren, J., Otterdoom, H., Srisuriyon, K., and Kazemi, H., 2009, Structural development of a major late Cenozoic basin and transpressional belt in central Iran: *The Central Basin in the Qom-Saveh area: Geosphere*, v. 5, p. 325–362, doi: 10.1130/GES00223.1.
- Myers, S.C., and Beck, S.L., 1994, Evidence for local crustal root beneath the Santa Catalina metamorphic core complex, Arizona: *Geology*, v. 22, p. 223–226, doi: 10.1130/0091-7613(1994)022<0223:EFALCR>2.3.CO;2.
- Omar, G.I., and Steckler, M.S., 1995, Fission track evidence on the initial rifting of the Red Sea: Two pulses, no propagation: *Science*, v. 270, p. 1341–1344, doi: 10.1126/science.270.5240.1341.
- Paul, A., Kaviani, A., Hatzfeld, D., Vergne, J., and Mokhtari, M., 2006, Seismological evidence for crustal-scale thrusting in the Zagros mountain belt (Iran): *Geophysical Journal International*, v. 166, p. 227–237, doi: 10.1111/j.1365-246X.2006.02920.x.
- Priestley, K., McKenzie, D., Barron, J., Tatar, M., and Debayle, E., 2012, The Zagros core: Deformation of the continental lithospheric mantle: *Geochemistry Geophysics Geosystems*, v. 13, Q11014, doi: 10.1029/2012GC004435.
- Ramezani, J., and Tucker, R., 2003, The Saghand region, Central Iran: U-Pb geochronology, petrogenesis and implication for Gondwana tectonics: *American Journal of Science*, v. 303, p. 622–665, doi: 10.2475/ajs.303.7.622.
- Takin, M., 1972, Iranian geology and continental drift in the Middle East: *Nature*, v. 235, p. 147–150, doi: 10.1038/235147a0.
- Tilmann, F., and Ni, J., 2003, Seismic imaging of the downwelling Indian lithosphere beneath central Tibet: *Science*, v. 300, p. 1424–1427, doi: 10.1126/science.1082777.
- Tirel, C., Gautier, P., van Hinsbergen, D.J.J., and Wortel, M.J.R., 2009, Sequential development of interfering metamorphic core complexes: Numerical experiments and comparison with the Cyclades, Greece: *Geological Society [London] Special Publication 311*, p. 257–292, doi: 10.1144/SP311.10.
- Turner, S., Hawkesworth, C., Liu, J., Rogers, N., Kelley, S., and Calsteren, P.V., 1993, Timing of Tibetan uplift constrained by analysis of volcanic rocks: *Nature*, v. 364, p. 50–54, doi: 10.1038/364050a0.
- Verdel, C., Wernicke, B.P., Ramezani, J., Hassanzadeh, J., Renne, P.R., and Spell, T.L., 2007, Geology and thermochronology of Tertiary Cordilleran-style metamorphic core complexes in the Saghand region of central Iran: *GSA Bulletin*, v. 119, p. 961–977, doi: 10.1130/B26102.1.
- Verdel, C., Wernicke, B.P., Hassanzadeh, J., and Guest, B., 2011, A Paleogene extensional arc flare-up in Iran: *Tectonics*, v. 30, TC3008, doi: 10.1029/2010TC002809.
- Vincent, S.J., Allen, M.B., Ismail-Zadeh, A.D., Flecker, R., Foland, K.A., and Simmons, M.D., 2005, Insights from the Talysh of Azerbaijan into the Paleogene evolution of the South Caspian region: *GSA Bulletin*, v. 117, p. 1513–1533, doi: 10.1130/B25690.1.
- Wortel, M.J.R., and Spakman, W., 2000, Subduction and slab detachment in the Mediterranean-Carpathian region: *Science*, v. 290, p. 1910–1917, doi: 10.1126/science.290.5498.1910.
- Zamani, A., Samiee, J., and Kirby, J.F., 2013, Estimating the mechanical anisotropy of the Iranian lithosphere using the wavelet coherence method: *Tectonophysics*, v. 601, p. 139–147, doi: 10.1016/j.tecto.2013.05.005.

Manuscript received 25 Aug. 2014; accepted 6 Jan. 2015. ☼

CALL FOR PAPERS

GSA TODAY

The Geological Society of America's science & information magazine, *GSA Today*, is seeking science and Groundwork articles for publication in late 2015–early 2016.

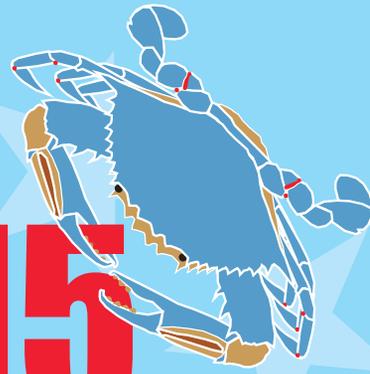
- **GET NOTICED:** *GSA Today* is open-access online (www.geosociety.org/gsatoday/) and has a circulation of ~25,000. Its science articles, with just one featured each month, are among the most widely read in earth science, and this consequently provides an unparalleled opportunity for disseminating the results of research projects to the widest possible audience.
- **MAKE AN IMPACT:** *GSA Today* is ranked twelfth in the world among geoscience journals in the latest report from SCImago Journal & Country Rank (www.scimagojr.com/journalrank.php?category=1907), which measures a journal's influence and prestige.

- **HIT THE GROUND RUNNING:** The time from receipt to acceptance averages 80 days; acceptance to publication for these articles averages 183 days, but for hot-topic papers, the turnaround time can be as short as a month (see the July 2008 science article).
- **TOP SCIENCE EDITORS:** Steven J. Whitmeyer of James Madison University and Gerald (Jerry) Dickens of Rice University.
- **GO HERE TO LEARN MORE:**
www.geosociety.org/pubs/gsatguid.htm.



1-4 NOVEMBER

GSA 2015

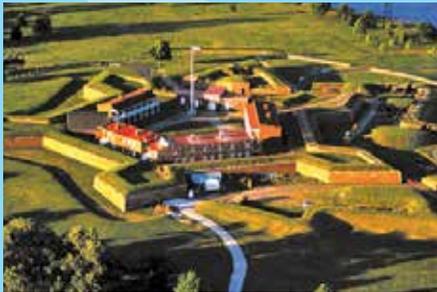


Baltimore, Maryland, USA

Don't miss out—*present your research at GSA 2015!*

“...it held the professionalism expected at a national level symposia,
yet still retained the level of friendliness
that made you feel at home with friends and colleagues.”

—First-time attendee at the GSA2014 Annual Meeting



Abstract Deadline: 11 August

Early Registration Deadline: 28 September



community.geosociety.org/gsa2015

Baltimore Sites Highlights



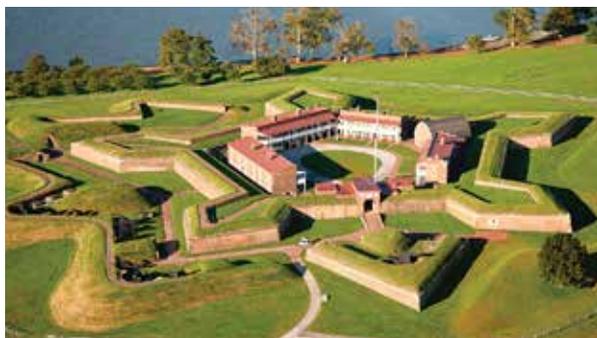
VISIT THE MARYLAND SCIENCE CENTER

Let your mind and senses wander as you explore the numerous hands-on activities at the Maryland Science Center. Featuring an IMAX theater, planetarium, and demo stage, it's sure to please all visitors.



GET CLOSE TO NATURE AT THE NATIONAL AQUARIUM

The National Aquarium houses sharks, dolphins, rays, and tropical fish among the more than 17,000 creatures in naturalistic exhibits, including a walk-through rain forest, an exciting live-action dolphin show, a 4-D Immersion Theater, and an Australia exhibit featuring a 35-foot waterfall. This spectacular aquarium is sure to be a hit with the kids (including the big ones!).



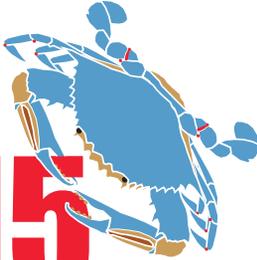
VISIT FORT McHENRY NATIONAL MONUMENT AND HISTORIC SHRINE

Just a water-taxi-ride from the Inner Harbor, Fort McHenry was built prior to the War of 1812 and is named for James McHenry, Secretary of War, 1796–1800. The fort played a central role during the Battle of Baltimore, 13–14 Sept. 1814 and inspired Francis Scott Key to write “The Star-Spangled Banner.”

Photos courtesy of Visit Baltimore.

<http://baltimore.org/article/baltimore-inner-harbor>

1-4 NOVEMBER
GSA 2015
Baltimore, Maryland, USA



EVENTS

THE PATHWAYS TO A SUCCESSFUL CAREER: BUILDING VALUE

Sat., 31 Oct., 1–4 p.m. Instructor: Patrick McAndless

GEOCAREERS IN INDUSTRY—CONNECTING STUDENTS AND INDUSTRY

Sun., 1 Nov., 9 a.m.–5:30 p.m.

GEOCAREERS IN INDUSTRY—RÉSUMÉ CLINIC

Sun., 1 Nov., 9 a.m.–5 p.m.

GEOCAREERS INTERVIEW SERVICE

(formerly the Employment Service Center)

Reserve your interview space at the meeting, for a small fee.

community.geosociety.org/gsa2015/science-careers



BE A PART OF THE MOVEMENT—ON TO THE FUTURE (OTF)

To date GSA has supported more than 240 diverse students to attend its Annual Meetings.

Support from members like you has been instrumental in shaping careers, changing lives, and diversifying our profession.

Join us as we look forward to another successful year by mentoring an OTF student at the meeting and/or donating to support a student.

community.geosociety.org/OTF



2015 GSA Medal & Award Recipients



**PRESIDENT'S MEDAL OF THE
GEOLOGICAL SOCIETY OF AMERICA**
Steven Squyres, Cornell University

PENROSE MEDAL
James W. Head, Brown University

ARTHUR L. DAY MEDAL
Jerry X. Mitrovica, Harvard University

YOUNG SCIENTIST AWARD (DONATH MEDAL)
Brandon Schmandt, University of New Mexico

GSA PUBLIC SERVICE AWARD
Naomi Oreskes, Harvard University

**RANDOLPH W. "BILL" AND CECILE T. BROMERY
AWARD FOR MINORITIES**
Dawn J. Wright, Environmental Research Systems Institute

GSA DISTINGUISHED SERVICE AWARD
John W. "Jack" Hess, Geological Society of America Foundation

**DORIS M. CURTIS OUTSTANDING
WOMAN IN SCIENCE AWARD**
Priya Ganguli, Woods Hole Oceanographic Institution

**GEOLOGIC MAPPING AWARD
IN HONOR OF FLORENCE BASCOM**
John M. Proffett, Independent Consulting Geologist

HONORARY FELLOWS
Manfred Strecker, Germany
Brian Fred Windley, United Kingdom

JOHN C. FRYE AWARD
*Investigation of Land Subsidence and Earth Fissures
in Cedar Valley, Iron County, Utah,*

by Tyler Knudsen, Paul Inkenbrandt, William Lund, Mike Lowe, and Steve Bowman

AGI MEDAL IN MEMORY OF IAN CAMPBELL

To be determined



Jonathan G. Price



Show your support
for our 2015 Awardees
by attending the
GSA Presidential Address
& Awards Ceremony
on 1 Nov. at the
2015 GSA Annual
Meeting & Exposition
in Baltimore, Maryland, USA.
At this year's combined event,
you will also have
the privilege of
hearing incoming
GSA President
Jonathan G. Price
give his
Presidential Address.



2015 GSA Division Primary Awards



RIP RAPP ARCHAEOLOGICAL GEOLOGY AWARD

Archaeological Geology Division

Francis (Frank) H. Brown, University of Utah

ISRAEL C. RUSSELL AWARD

Limnogeology Division

Andrew S. Cohen, The University of Arizona

GILBERT H. CADY AWARD

Energy Geology Division

Claus Diessel, University of Newcastle, Australia

DISTINGUISHED GEOLOGIC CAREER AWARD

Mineralogy, Geochemistry, Petrology, and Volcanology Division

David A. Clague, Monterey Bay Aquarium Research Institute

E.B. BURWELL, JR., AWARD

Engineering and Environmental Geology Division

George R. Priest, William H. Schulz, William L. Ellis, Jonathan A. Allan, Alan R. Niem, and Wendy A. Niem

for Landslide stability: Role of rainfall-induced, laterally propagating, pore-pressure waves:

Environmental & Engineering Geoscience, 2011,

v. XVII, no. 4, p. 315–335, doi: 10.2113/gseegeosci.17.4.315.

G.K. GILBERT AWARD

Planetary Geology Division

Matthew P. Golombek, NASA Jet Propulsion Laboratory

OUTSTANDING CONTRIBUTIONS AWARD

Geoinformatics Division

Lesley Wyborn, Australian National University

KIRK BRYAN AWARD FOR RESEARCH EXCELLENCE

Quaternary Geology and Geomorphology Division

Daniel R. Muhs, Kathleen R. Simmons, R. Randall Schumann, Lindsey T. Groves, Jerry X. Mitrovica, and DeAnna Laurel

for Sea-level history during the Last Interglacial complex on San Nicolas Island, California:

Implications for glacial isostatic adjustment processes, paleozoogeography and tectonics:

Quaternary Science Reviews, 2012,

v. 37, p. 1–25, doi: 10.1016/j.quascirev.2012.01.010.

GEORGE P. WOOLLARD AWARD

Geophysics Division

David Evans, Yale University

LAURENCE L. SLOSS AWARD

Sedimentary Geology Division

Jody Bourgeois, University of Washington

BIGGS AWARD FOR EXCELLENCE IN EARTH SCIENCE TEACHING

Geoscience Education Division

Kyle Gray, University of Northern Iowa

CAREER CONTRIBUTION AWARD

Structural Geology and Tectonics Division

Tanya Atwater, University of California, Santa Barbara

MARY C. RABBITT HISTORY OF GEOLOGY AWARD

History and Philosophy of Geology Division

Léo F. Laporte, University of California, Santa Cruz

O.E. MEINZER AWARD

Hydrogeology Division

Brian Berkowitz, Weizmann Institute of Science

2015 GSA Fellows



Society Fellowship is an honor bestowed on the best of our profession by election at the spring GSA Council meeting. GSA members are nominated by existing GSA Fellows in recognition of their distinguished contributions to the geosciences. Learn more at www.geosociety.org/members/fellow.htm. GSA's newly elected Fellows will be recognized at the GSA 2015 Annual Meeting Presidential Address & Awards Ceremony on 1 Nov. in Baltimore, Maryland, USA. *We invite you to read some of what their nominators had to say:*



Emmit Calvin Alexander Jr. (Univ. of Minnesota): Calvin Alexander has been an exemplary trainer of geologists and geologic researcher in his role of Morse-Alumni Professor at the University of Minnesota. He has won numerous teaching awards, and produced a prodigious number of students across a wide spectrum of subdisciplines who have distinguished themselves as researchers and trainers. —John Van Brahana



Yemane Asmerom (Univ. of New Mexico): For extensive research and publications applying isotopic studies to paleoclimate and to geomorphic evolution. —P. Jonathan Patchett



Greg Balco (Berkeley Geochronology Center): Elected to Fellowship as one of the QG&G Division's 2014 Kirk Bryan Award recipients.



Susan L. Beck (Univ. of Arizona): Susan Beck's research uses broadband seismology to understand mountain belts, earthquakes, and faulting. She is interested in the evolution of the North and South American Cordilleras, with much of her current research in the Andes. She also studies earthquakes and Earth structure associated with subduction zones and strike-slip plate boundaries. —George H. Davis



Alan I. Benimoff (College of Staten Island, CUNY): Alan Benimoff is a leader among earth scientists through innovative applied research of environmental and geological problems such

"He has increased public awareness of geology through his popular articles, field trip guidebooks, and talks to the general public."

as storm surges and cancer occurrence on Staten Island, New York. Alan produces a monthly television show, "Geology Forum," that has brought an awareness of important geological process to the island community. —William J. Fritz



Timothy J. Bralower (Pennsylvania State Univ.): Elected to Fellowship as a new GSA Councilor.



Don W. Byerly (Univ. of Tennessee–Knoxville): Outstanding teacher at UT–Knoxville, Byerly received the 1999 NAGT Neil Minor Award; active in K–12 teacher education; authority on impacts of sulfide oxidation and acid drainage; engineering geologist; and outreach efforts recognized. Non-technical book, *The Last Billion Years: A Geologic History of Tennessee* (Univ. of Tennessee Press, 2013). —Robert D. Hatcher Jr.



John F. Casey (Univ. of Houston): For outstanding contributions to our understanding of accretionary plate boundaries and the composition and structure of the ocean crust and shallow mantle. For building one of the great geoscience departments, and educating a generation of geoscientists. —Henry J.B. Dick



William W. Chadwick (CIMRS, Oregon State Univ.): We nominate Dr. William W. Chadwick Jr. for Fellow of the Geological Society of America for his seminal studies on volcanic deformation and eruption processes and in pioneering studies in the nascent field of submarine physical volcanology. —Robert W. Embley



Michelle L. Coombs (U.S. Geological Survey, Alaska Volcano Observatory): Michelle Coombs is cited for her geologic, petrologic, and geochemical studies of Alaskan and Hawaiian volcanoes, contributions to public safety through eruption response, and communication of geoscience to the public. —Charles R. Bacon



Kari M. Cooper (Univ. of California, Davis): Kari Cooper has made fundamental contributions to both the development of analytical techniques—most notably involving U-series nuclides—and the understanding of temporal and physical aspects of magma system histories. Her innovative work illuminates, among other key issues, how pre-eruption magma storage works: how long, and in what state? —Calvin F. Miller

Isaac J. Crumbly (Fort Valley State Univ.): Elected to Fellowship as the 2014 Bromery Award recipient.



Frederick D. Day-Lewis (U.S. Geological Survey): For seminal contributions toward fundamental advances in hydrogeophysics. —Roy Haggerty



John E. Ebel (Boston College): Nominated for seismological research, publications, and insight that have contributed much to our understanding of intra-plate earthquakes, their source mechanisms, and the potential hazards they create, particularly as applied to northeastern North America. Additionally, for the mentoring of students, geological administration, and outreach to the general public. —J. Christopher Hepburn



Yehouda Enzel (Institute of Earth Sciences, Hebrew Univ.): Dr. Yehouda Enzel is meritorious for GSA Fellow due to his trans-disciplinary, innovative, and sustained research record of 121 peer-reviewed papers (17 with GSA) focused on late Quaternary climate, landscape evolution, and surficial processes using sedimentologic, geochemical, and hydrological tools to decipher the geologic history of water and dust sources. —Stephen G. Wells



Sonia Esperanca (National Science Foundation): Dr. Esperanca's main contribution to our field has been leadership at the National Science Foundation. She has helped guide modern petrologic and high-temperature geochemical research in the twenty-first century, a time in which the field was revolutionized by technological and conceptual developments. —Dennis J. Geist



David A.D. Evans (Yale Univ.): Professor David Evans is nominated for GSA Fellowship for his outstanding contributions to the field of paleomagnetism, supercontinent evolution, and geodynamics. Major contributions include the identification of true polar wander (TPW) events, verification of the GAD hypothesis for the Precambrian, and linking supercontinent, superplume, and TPW events in global geodynamics. —Zheng-Xiang Li



Timothy G. Fisher (Univ. of Toledo): Fisher has made significant contributions to the understanding of Glacial Lake Agassiz, the Great Lakes, and associated environments. His fieldwork spans several Canadian Provinces and northern states and has led to publications that change the way we think about the history of some of the predominate landscapes of North America. —Harry M. Jol



Gillian R. Foulger (Univ. of Durham): Her insightful and ground-breaking research has led to a major rethinking of a key concept in global tectonics, the until recently widely held view that hotspots, regions of long-lived excess volcanism such as

FELLOWSHIP NOMINATIONS ARE SUBMITTED IN THE FOLLOWING CATEGORIES:

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

Iceland, Hawaii, or Yellowstone, result from plumes of hot material upwelling from great depth in the mantle. —Seth Stein



Tracy D. Frank (Univ. of Nebraska–Lincoln): Tracy Frank combines a background strength as a carbonate petrologist and sedimentologist with skills in stable isotope geochemistry and a superb knowledge of oceanographic processes to create a formidable partnership with which to explore ocean chemistry signals throughout geologic time. —Linda C. Kah



Henry Robert Frankel (Univ. of Missouri–Kansas City): Elected to Fellowship as the History and Philosophy of Geology Division's 2014 Mary C. Rabbitt Award recipient.



Frederick A. Frey (Massachusetts Institute of Technology): Elected to Fellowship as the MGPV Division's 2014 Distinguished Geologic Career Award recipient.



Anke Friedrich (Universität München): Elected to Fellowship as a new GSA Councilor.



G. Robert Ganis (G. Robert Ganis, Consulting Geologist): Dr. Ganis has been a major contributor to the industrial minerals industry in the eastern U.S., as well as within the associated professional organizations. He also has made major breakthroughs in deciphering the "Taconic Problem" in eastern Pennsylvania through his geologic mapping and biostratigraphic studies. —John E. Repetski

"Her science is typified by a non-egotistical generosity of effort."

2015 GSA Fellows

Laura A. Guertin (Penn State Brandywine): For her complete devotion to undergraduate education on the local and national stage, for her dedication to training the next set of geoscience teachers, for her cutting edge research involving technology in geoscience education, and for her leadership in the geoscience educational community. —Timothy J. Bralower



Gregory S. Hancock (College of William and Mary): Greg Hancock is an exceptionally strong and creative teacher who has influenced generations of geoscience and environmental science students. He has a remarkable record of mentoring undergraduate students in significant research projects, many of whom have presented their research at professional meetings. —Heather MacDonald



Charles F. Harvey (Massachusetts Institute of Technology): Elected to Fellowship as the Hydrogeology Division's 2014 Meinzer Award recipient.



Frank C. Hawthorne (Univ. of Manitoba): For his seminal, visionary, and widespread contributions to the fields of mineralogy, crystallography, and solid-state chemistry by increasing our understanding of the mechanisms behind complex crystal chemistry, structural bonding topology, structural hierarchies, thermodynamics, and spectroscopy of minerals and solids in general. —Barbara L. Dutrow



Robert M. Hazen (Carnegie Institution of Washington): Hazen's unique, dramatically evolving research career pioneered studies of the temperature and pressure dependencies of crystal structures, a foundation of mineral physics, and of the role of temperature, pressure, and minerals in the origin of life. He founded the new field of mineral evolution and the worldwide Deep Carbon Observatory. —Craig M. Schiffrics



Brian T. Huber (National Museum of Natural History): Brian Huber is a renowned expert on Cretaceous and Cenozoic planktic foraminifera. His highly cited research in paleoceanography is characterized by its creative use of stable isotope paleoecology. This research includes studies of oceanic anoxic events and the K/Pg boundary from sections spanning the Antarctic to the deep-sea to Tanzania. —R. Mark Leckie

"He continues to be a goodwill ambassador for his profession and is still passionate about his love for geology."

Linda C. Ivany (Syracuse Univ.): Linda Ivany has compiled a highly distinguished research record, characterized by creativity, breadth, magnitude, and innovation. Beyond research, she has trained a new generation of young, productive paleobiologists. Professor Ivany's work is widely cited and continues to be at the forefront of the fields of paleobiology and paleoecology. —David E. Fastovsky



Anne E. Jennings (Univ. of Colorado): Anne Jennings has obtained an international reputation for her careful and insightful research on late Quaternary paleoclimate and glacial changes with a focus on the Arctic region and the deglacial histories of the Laurentide and Greenland Ice Sheets. —John T. Andrews



Cari L. Johnson (Univ. of Utah): Dr. Cari L. Johnson, Associate Professor, University of Utah, is a prolific geologic researcher whose science covers a broad cross section of geology, including tectonics and sedimentation, sequence stratigraphy, and applications to petroleum source rock and reservoir systems. She is an excellent mentor of students, having received numerous teaching awards. —Stephan A. Graham



Joe Kirschvink (California Institute of Technology): Elected to Fellowship as the Geophysics Division's 2014 Woollard Award recipient.



Stephen A. Leslie (James Madison Univ.): Stephen Leslie has been at the leading edge of conodont biostratigraphy research for 20 years. He has maintained a vigorous research program while serving as a very effective chair at two undergraduate-focused departments. Ultimately, his dedication to undergraduate research and education is the unifying thread that underpins his academic career. —Steven Whitmeyer



Julie C. Libarkin (Michigan State Univ.): Julie Libarkin is nominated for her many groundbreaking research contributions in geoscience education and geocognition, for her leadership in GSA, and for her contributions as Editor in Chief of the *Journal of Geoscience Education*. —Steven C. Semken



Rosalyn M.C. Lopes (Jet Propulsion Laboratory): Using instruments on unmanned spacecraft to investigate the geology of satellites in the outer Solar System, Rosalyn Lopes has made major significant contributions to understanding processes on the surface and interior of Io, a satellite of Jupiter, and on the surface of Titan, a satellite of Saturn. —Susan W. Kieffer

Michelle M. Lorah (U.S. Geological Survey): Michelle Lorah has made seminal contributions toward understanding the sources, transport, and reactions of organic chemicals in groundwater, surface water, wetlands, and soils. Her extensive research on the role of wetlands in the natural attenuation of chlorinated volatile hydrocarbons promises advances in the bioremediation of contaminated water. —Isabelle M. Cozzarelli



Francis A. Macdonald (Harvard Univ.): Elected to Fellowship as the 2014 Donath Medalist.



Franco Marcantonio (Texas A&M Univ.): Dr. Marcantonio has an extensive breadth as well as extraordinary depth in his geologic knowledge and application. He is the epitome of a top-drawer researcher who is well-respected for his application of He³ and the Th²³⁰ isotopes for understanding climate change. Dr. Franco Marcantonio is an excellent teacher and mentor. —John R. Giardino



Anthony Martin (Emory Univ.): Tony is an internationally recognized leader in undergraduate geoscience education and public outreach, in addition to having made outstanding contributions to the field of marginal marine and dinosaur ichnology. —Dan Deocampo



Bill McKinnon (Washington Univ. in St. Louis): Elected to Fellowship as the Planetary Geology Division's 2014 Gilbert Award recipient.



Charles E. Mitchell (SUNY-Buffalo): For his many contributions to the evolution of graptolites in the Paleozoic, how the evolution of life aids in chronostratigraphy, and for his teaching and mentoring of several generations of graduate and undergraduate students. —Brendan J. Murphy



Aberra Mogessie (Karl-Franzens-Universität Graz): Aberra Mogessie is nominated for his leadership in the African and international geological community as president of the Geological Society of Africa (2008–2016) and for his research on Cu-Ni-PGE and other ore deposits and petrologic problems in the Duluth Complex of Minnesota, Europe, Africa, and Argentina. —Suzanne M. Kay



Maureen A. Muldoon (Univ. of Wisconsin–Oshkosh): Dr. Muldoon has had an outstanding geologic career at the University of Wisconsin–Oshkosh and the Wisconsin Geological and Natural History Survey. She is an enthusiastic teacher of undergraduates and professionals who has made significant contributions to

understanding groundwater movement through carbonate rocks as well as significant service to the profession.

—Kenneth R. Bradbury



Jean-Philippe Nicot (Univ. of Texas): Dr. Nicot's publication record has an H index of 12 (ISI) or 16 (Google Scholar) including ~1,116 citations. His 2008 seminal paper on CO₂ storage is widely cited and is the foundation for research on greenhouse gases and climate change, energy security, and sustainability of water resources. —Bridget R. Scanlon



Suzanne O'Connell (Wesleyan Univ.): Dr. Suzanne O'Connell is an accomplished geoscientist who highly honors the traditions of research and scholarship in the geosciences, but also pays great attention to the societal well-being of the community, reflected by her service in professional societies, her work in policy, and her persistent and caring attention to students. —Marilyn J. Suiter



Yoshihide Ogasawara (Waseda Univ.): Prof. Yoshi Ogasawara was nominated because of his scientific contributions on the petrologic evolution of deeply subducted UHPM carbonates and the formation of metamorphic diamonds under fluid conditions, and his life-time dedication in teaching, research, and administration at the Waseda University, Japan. —John G. Liou



Charles G. Oviatt (Kansas State Univ.): Charles (Jack) Oviatt is cited for his many decades of exemplary published work on the stratigraphy, sedimentology, chronology, geomorphology, and paleolimnology of Lake Bonneville. —John F. Shroder Jr.



Jon D. Pelletier (Univ. of Arizona): For outstanding contributions to the geosciences, particularly in the form of published geological research advancing the understanding of landform and landscape evolution, at a variety of spatial and temporal scales, and employing the most advanced methods of mathematical modeling, digital-data analysis, and quantitative field measurements. —Victor R. Baker

“He is a person of great geological insight and understanding of serious and quiet reflection.”

2015 GSA Fellows

Stephen F. Personius (U.S. Geological Survey): Although rarely in the limelight, Steve has had a profound influence on paleoseismology and its application to earthquake hazards assessment in the western U.S. His exemplary mapping and publications have provided great positive direction to this field of research, and he has nurtured tomorrow's geologists with great skill and compassion. —Alan R. Nelson



Stephen J. Piercey (Memorial Univ. of Newfoundland): Stephen Piercey has made significant contributions to the field of economic geology, particularly the genesis and tectonic setting of volcanogenic massive sulfide deposits and associated magmatic rocks. His research has led to a much better understanding of the relationships between style and type of mineralization and tectono-magmatic processes globally. —John M. Hanchar



Jeffrey S. Pigati (U.S. Geological Survey): Jeffrey S. Pigati has made outstanding contributions to the geosciences: understanding the paleoclimatic significance of desert wetlands; developing new methods/materials for radiocarbon dating; and a leadership role in the investigations of the “Snowmastodon” fossil site in the Rocky Mountains of Colorado. This work has generated 35 publications (19 senior-authored). —Daniel R. Muhs



Geoffrey S. Plumlee (U.S. Geological Survey): Geoff Plumlee is internationally recognized for his contributions to environmental geochemistry and health in which he has applied his research to many societally compelling issues and enhanced the visibility of environmental geochemistry with the general public and with non-traditional collaborators in the public health, hazards, and social science disciplines. —Robert O. Rye



Robert J. Poreda (Univ. of Rochester): Dr. Robert J. Poreda is nominated as GSA Fellow for his research contributions on application of noble gases toward understanding the history of mantle dynamics, use of tritium-helium groundwater dating, ²¹Ne cosmogenic surface exposure age dating techniques, and environmental impacts of unconventional energy development on groundwater. —Anne E. Carey



Christopher J. Potter (U.S. Geological Survey at Rutgers Univ.): Dr. Christopher J. Potter is nominated as a Fellow of the Geological Society of America based on his publication record,

“Furthermore, each of her publications is a careful, valuable, and distinct contribution. It is not surprising that her work has already been cited almost 1,000 times.”

significance and impact of his research, his administrative service to geologic programs within the U.S. Geological Survey, and his continued participation in presenting original and innovative research to professional societies, governmental agencies, and to industry groups throughout his 40-plus-year-long career in the geosciences. —Warren C. Day



Jay Quade (Univ. of Arizona): Jay Quade's research addresses major events in Cenozoic paleoclimate, paleoecology, mountain-belt growth, and hominid evolution. He has carried out comprehensive calibration studies of diverse modern analog systems that are used in paleoclimate and paleoecology reconstructions to ground-truth the methods that he has developed and applied. —Carmala N. Garziona



Mark C. Quigley (Univ. of Canterbury): Elected to Fellowship as the 2014 GSA Public Service Award recipient.



Jahandar Ramezani (Massachusetts Institute of Technology): Jahandar Ramezani deserves recognition as a GSA Fellow for using high-precision U-Pb geochronology to solve problems in earth history and for the education of multiple generations of young scientists. Ramezani uses geochronology to frame and solve major issues associated with earth history and the evolution of life. —Samuel A. Bowring



Lothar Ratschbacher (Freiburg Univ.): Ratschbacher has an unmatched talent of making breakthrough discoveries in continental tectonics by combining cutting-edge analytical techniques, massive datasets, mechanical insights, and great geologic intuition. —Bradley R. Hacker



Loren A. Raymond (Appalachian State Univ.): Loren A. Raymond has been an inspirational teacher and an exemplary mentor for a generation of students. His dedication to motivating students to strive for their maximum potential as geologists serves as a hallmark for our profession, which has benefited especially from his masterful instruction in petrology and tectonics. —Fred Webb Jr.



Peter W. Reiners (Univ. of Arizona): Dr. Peter W. Reiners is elected to GSA Fellowship on the basis of his fundamental contributions in developing (U-Th)/He thermochronometry, and applying low-temperature thermochronology to both reconstruct the tectonic evolution of many different regions of the world and examine a broad array of petrologic, structural, geochemical, erosional, and geodynamic processes. —George E. Gehrels

John C. Ridge (Tufts Univ.): Elected to Fellowship as one of the QG&G Division's 2014 Kirk Bryan Award recipients.



Susan G. Stover (Kansas Geological Survey): Susan Stover has made public communication a priority in jobs at the Kansas Water Office and the Kansas Geological Survey. She has engaged the public and decision-makers in conversations about the Ogallala aquifer, and worked to increase awareness of the geosciences. She also chairs GSA's Geology and Public Policy Committee. —Rex C. Buchanan



Glenn B. Stracher (East Georgia State College): Glenn Stracher has excelled in building public awareness of the problem of coal fires. His efforts in outreach, editing and publishing, and training of geologists have supported this effort. He has inspired many of his colleagues to study coal fires and to present their findings to the general public. —James C. Hower



Douglas M. Thompson (Connecticut College): Thompson is nominated based on his publication of research relating to process and form in pool-riffle rivers, the implications of pool-riffle dynamics for river restoration, the history of instream manipulations for river restoration and critical examination of why many of these manipulations are unsuccessful, and enhancing public understanding of rivers. —Ellen Wohl



Robert M. Thorson (Univ. of Connecticut): Robert "Thor" Thorson has achieved great success as a scholar, educator, and communicator. His contributions to glacial-tectonic dynamics are significant. His award-winning books on New England stone walls, Henry David Thoreau, and Walden Pond, and his *Hartford Courant* opinion column, enable him to reach a wide audience with his writing. —Lisa E. Park Boush



Martyn Unsworth (Univ. of Alberta): Martyn has been a leader in electrical geophysics, especially magnetotellurics. He has applied these methods to solve a variety of tectonic, environmental, and resource problems. —Kevin L. Mickus



Avner Vengosh (Duke Univ.): Dr. Avner Vengosh is nominated as a GSA Fellow for his research contributions in isotope and environmental geochemistry, including seminal studies in the area of energy development and water quality. He has been an innovator in methodological development of boron isotope measurements and their use in solving hydrogeochemical and environmental problems. —W. Berry Lyons

Yang Wang (Florida State Univ.): I am nominating Professor Yang Wang to 2015 GSA Fellowship for her contributions to paleoenvironmental reconstructions, particularly by using stable isotopes in animal fossils and other materials to reconstruct Himalayan tectonic and climate history, and to understanding biogeochemical cycles of carbon, nutrients, and toxic metals in natural systems. —Xiahong Feng



Stephen R.H. Worthington (Worthington Groundwater): Steve Worthington is nominated for his extensive applied research and development on describing flow in carbonate aquifers using a new model that will contribute significantly to the understanding of these settings. His extensive publications on this work will help support a solid basis for their management and protection. —Gareth J. Davies



Shuhai Xiao (Virginia Polytechnic Institute): Over the past fifteen years, Shuhai Xiao has emerged as an international leader in paleontology and stratigraphy. His innovative and meticulous research, in particular on the Ediacaran Doushantuo Formation, has deeply informed our understanding of Neoproterozoic life and environments. —Andrew H. Knoll



R. Aileen Yingst (Planetary Science Institute): For significant research in planetary geology, leadership roles in multiple planetary missions, work in training the next generation of planetary geoscientists through a decade of leadership in NASA's Space Grant Program, and for her work in contributing to the public awareness of planetary geoscience. —Jayne C. Aubele

"She is a fine scholar, excellent mentor, and outstanding educator who is fully deserving of this honor."

Recent, Rare, and Out-of-Print Books

Geoscience Books; Paleontology Books and Fine Fossil Specimens; Ore Deposit Books, Mineral and Ore Specimens; USGS and USBM Publications



<http://booksgeology.com>

WE PURCHASE BOOKS, SPECIMENS, AND ENTIRE COLLECTIONS

MS Book and Mineral Company
MSBOOKS@BOOKSGEOLOGY.COM
P.O. Box 6774, Lake Charles, LA 70606-6774 USA

GSA Celebrates New **50-Year** Members for 2015



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

For a list of members who have *surpassed* the 50-year mark, please visit
<http://rock.geosociety.org/membership/50YearMembers.asp>;
the list of Fellows can be found at
<http://rock.geosociety.org/membership/50Yearfellows.asp>.

Asterisks (*) below indicate those members who have not yet been honored by election to
GSA Fellowship. **GSA Fellows:** You can help maintain a dynamic, vibrant cohort
by nominating these and other deserving geoscience colleagues for Fellowship.

Guidelines and nomination forms are online at

www.geosociety.org/members/fellow.htm.

If you have questions, please e-mail awards@geosociety.org.

Bruce D. Benson*	Kathryn H. Gray*	Edward O'Donnell*
Wallace A. Bothner	Priscilla Crowell Grew	John H. Peck
Carol S. Breed-McCauley	Gilbert N. Hanson	Alfred H. Pekarek*
Mont Jackson Bright Jr.*	Lincoln S. Hollister	Charles E. Sloan*
Nikolas I. Christensen	Richard Kesel*	John Suppe
Bruce R. Clark	William T. Kirchgasser*	Arthur G. Sylvester
H. Allen Curran	David Henry Krinsley	John J. Thomas*
Terrence J. Donovan	Jerry A. Lineback	Roger M. Waller
Louis A. Fernandez	Donald R. Lowe*	Isaac J. Winograd
George W. Fisher	Colin C. McAneny*	Sherwood W. Wise Jr.*
Paul D. Fullagar	Louis T. Mellinger*	Charles R. Wood*
Paul E. Gerdemann*	Harold E. Myers*	



Thank you for your membership!

2015 GSA Research Grant Recipients



The 2015 GSA Committee on Research Grants awarded US\$723,570 to 391 graduate students (nearly 50% of the 784 who applied), **with an average grant of US\$1,851**. The committee also selected 10 alternate candidates in the event that any grantees return all or part of their funds due to a change in their research project or receipt of funds from another source. The GSA Graduate Student Research Grant Program is funded by GSA, the GSA Foundation, GSA Divisions, and the National Science Foundation.

Committee members: Sarah Hayes (Chair), Olivier Bachmann, Maya Elrick, Stacia Gordon, Timothy W. Grover, Janet S. Herman, Christopher Holm-Denoma, Michael T. Hren, Micah J. Jessup, Elizabeth A. Johnson, Thomas C. Johnson, Todd A. LaMaskin, Andrew H. Manning, Sarah Penniston-Dorland, Jeffrey S. Pigati, Philip S. Prince, Richard W. Saltus, Jacob O. Sewall, Daniel M. Sturmer, James Vogl, Richard B. Waitt, Cheryl Waters-Tormey, Brent B. Wolfe, and Shuhai Xiao.

The following awards will be presented at the GSA 2015 Annual Meeting & Exposition in Baltimore, Maryland, USA.



2015 Outstanding Mentions

(proposals having exceptional merit in conception and presentation)

Levent Akinci, The Ohio State University

Saurabh Ghanekar, University of Wisconsin–Madison

Calvin Mako, Virginia Polytechnic Institute

Samuel Nath, University of Nebraska–Omaha

Simone Runyon, University of Arizona

Sarah Schmitt, University of North Carolina at Chapel Hill

Gaylen Sinclair, Oregon State University

Sarah Slotznick, California Institute of Technology

Kaydee West, University of South Florida

Brady Ziegler, Virginia Polytechnic Institute



2015 ExxonMobil/GSA Student Geoscience Grants

ExxonMobil has recognized 10 of the top 30 GSA student research grant proposals with grants of US\$7,500 each.

Alejandra Borunda, Columbia University

Ellen Chamberlin, Pennsylvania State University

Cody Colleps, University of Texas at Austin

Harrison Gray, University of Colorado Boulder

Gerhard Heij, University of Oklahoma

Katelyn Lehman, Cornell University

Demian Nelson, University of California, Santa Barbara

Marisa Repasch, University of New Mexico

Courtney Sprain, University of California, Berkeley

Theodore Them, Virginia Polytechnic Institute

2015 Specialized Awards



Sponsored by the GSA Foundation

MARLAND PRATT BILLINGS AND KATHARINE FOWLER-BILLINGS RESEARCH AWARD

Ryan Deasy, Indiana University

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

JOHN A. BLACK AWARD

Ryan Frazer, University of North Carolina at Chapel Hill

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

GRETCHEN L. BLECHSCHMIDT AWARD

Kimberly Lau, Stanford University

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

JOHN T. DILLON ALASKA RESEARCH AWARD

Nicholas Bill, Oregon State University

Emma Harrison, University of Pennsylvania

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

DIVERSITY AWARD

Brittany Huerta, California State University, Northridge

This award is presented to the top student(s) based on race/ethnicity status and the overall quality of the research.

ROBERT K. FAHNESTOCK AWARD

Charles Shobe, University of Colorado Boulder

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

ROBERT D. HATCHER RESEARCH AWARD

John Buchanan, Colorado School of Mines

This award supports an outstanding earth-science graduate student's field-based research and geologic mapping, either for that student's master's thesis or Ph.D. dissertation. Preference may be given to students working in the Appalachian orogeny, broadly construed, but is not restricted to this region.

JOHN W. HESS RESEARCH GRANT IN KARST RESEARCH STUDIES

Gerhard Maale, Texas A&M University at Galveston

This grant supports student research involving any aspect of cave and karst studies aimed at providing improved understanding of how caves and karst work, including how these resources can be better managed.

ROSCOE G. JACKSON II AWARD

Alexander Wilson, University of British Columbia

This award funds one recipient per year in the field of sedimentology.

LIPMAN RESEARCH AWARD

Katie Ardill, University of Southern California

Catherine Armstrong, University of British Columbia

Lauren Harrison, University of British Columbia

The fund for this award was established in 1993 and is supported by gifts from the Howard and Jean Lipman Foundation. Its purpose is to promote and support student research grants in volcanology and petrology. The president of the Lipman Foundation, Peter W. Lipman, was the recipient of a GSA research grant in 1965.

JOHN T. MCGILL AND CAROL G. AWARD

Jonathan Reeves, University of Massachusetts

This award, which is in the memory of John T. McGill, supports graduate student scholarships and research grants in engineering geology and geomorphology.

JOHN MONTAGNE AWARD

Jotautas Baronas, University of Southern California

This annual award supports research in the field of Quaternary geology/geomorphology.

BRUCE L. "BIFF" REED SCHOLARSHIP AWARD

Michael Eddy, Massachusetts Institute of Technology

This award was established to provide research grants to graduate students pursuing studies on the tectonic and magmatic evolution of Alaska primarily and also can fund other geologic research.

CHARLES A. & JUNE R.P. ROSS RESEARCH AWARD

Jeremy Caves, Stanford University

Allison Jacobel, Columbia University

Abagael West, Columbia University

This award supports research projects for graduate students, post-graduate students, and post-doctorate researchers in the fields of biostratigraphy (including, but not limited to, fossil age dating and the study of evolutionary faunal successions), stratigraphy and stratigraphic correlation, paleogeography and paleobiogeography, interpreting past environments of deposition and their biological significance, and the integration of these research areas into better global understanding of (1) past plate motions (plate tectonics and sea-floor spreading); (2) past sea-level events, including their identification and ages; and/or (3) climate changes and the effects of those climate changes on Earth's inhabitants through geologic time.

ALEXANDER SISSON RESEARCH AWARD

Michael O'Connor, University of Texas at Austin

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

PARKE D. SNAVELY, JR., CASCADIA RESEARCH AWARD

Sean LaHusen, University of Washington

This award provides support for field-oriented graduate-student research that contributes to the understanding of the geologic processes and history of the Pacific Northwest convergent margin or to the evaluation of its hazard or resource potential.

HAROLD T. STEARNS FELLOWSHIP AWARD

Soo Hyun Kim, University of Wisconsin

Dr. Stearns established this award in 1973 for student research on aspects of the geology of the Pacific Islands and the circum-Pacific region.

ALEXANDER & GERALDINE WANER FUND

Alec Gierzynski, Northern Illinois University

The Waner Fund was established in 2002 to support research dealing with coal and petroleum resources, mapping, and engineering geology, marine resources, petroleum economics, appraisal, and evaluation, and the geology of phosphate resources.

LAUREN A. WRIGHT & BENNIE W. TROXEL STUDENT RESEARCH AWARD

John Chesley, University of South Carolina

Louis Wersan, Indiana University

This award supports two graduate students in master's or Ph.D. programs conducting field-based research (1) in the region broadly centered on Death Valley National Park, or (2) in the western and southern Basin and Range Tectonic Province. This research grant is associated with GSA's Structural Geology and Tectonics Division.

FAROUK EL-BAZ STUDENT RESEARCH GRANTS

Abotalib Z.A. Farag, Western Michigan University

Tara N. Jonell, Louisiana State University

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

EAST ASIA GEOSCIENCE AND ENVIRONMENT RESEARCH (EAGER) AWARD

This award provides one-year grants to support the Ph.D. theses and post-doctoral research of East Asian scientists. It is open to scientists of the country hosting the annual CCOP conference. Past countries include Cambodia, China, Indonesia, Japan, Korea, Malaysia, Papua New Guinea, Thailand, and Vietnam. The 2015 recipient will be announced in October.

2015 GSA Research Grant Recipients



(listed in alphabetical order by university)

Appalachian State University

Mara Cloutier

Arizona State University

Chelsea Allison
Marina Foster
Amber Keske

Ball State University

Gilles Valdez Tagne Kamgue

Binghamton University

Ethan Spiegel

Boise State University

Amanda Drewicz
Josh Ekhoﬀ
Andrew Gase
Katherine Gibble
Travis Nielson
Darin Schwartz

Boston University

Sarah Foster

Bowling Green State University

Whitney Sims

Brigham Young University

Isaac Allred
Shane Dailey

Brown University

Leif Tokle

California Institute of Technology

Sarah Slotznick

California State University, Fullerton

Kylie Caesar

California State University, Long Beach

Maia Davis
Ryan Weller
Adam White

California State University, Northridge

Meghann Decker
Nathan Dickey
Brittany Huerta
Jeffery Joseph

Central Washington University

Megan Graubard
Andrew Raulerson

Colorado School of Mines

John Buchanan
Dante Huff
Ashley Quigley (Anderson)

Colorado State University

Katherine Lininger
Derek Schook
Bradley Sparks

Columbia University

Guleed Ali
Alejandra Borunda
Allison Jacobel
Sean Kinney
Abagael West

Cornell University

Brendan Anderson
Katherine Grant
Katelyn Lehman

Dalhousie University

Colin Bryden

Dartmouth College

Helen Doyle
Keith Kantack
Kristin Schild

Georgia College and State University

Taylor Upole

Harvard University

Sarah Hurley
Justin Strauss

Humboldt State University

Jessica Chu

Idaho State University

Harrison Colandrea
Stacy Schwabedissen

Illinois State University

Zachary Kisfalusi
Ellyn Rickels
Tamru Taye

Indiana University

Ryan Deasy
Joel Leonard
Louis Wersan

Indiana University Bloomington

Devon Colcord

Indiana University–Purdue University Indianapolis

James Harris

Iowa State University

Sergey Ishutov
Anna Nesterovich
Natalie Thompson
Alyssa Witt

Johns Hopkins University

Dana Brenner

Kansas State University

Annastacia Maynard
Michael Tummons

Laurentian University

Heather Carson

Loma Linda University

Colby Ford
Matthew McLain
Sandra Waresak

Louisiana State University

Tara Jonell
Abigail Maxwell

Massachusetts Institute of Technology

Michael Eddy
Benjamin Klein
Elena Steponaitis
Ning Zhao

Miami University

Stephanie Bosch
Masoomah Kousehlar
Kelly McHugh

Miami University Ohio

Eren Abus

Michigan State University

Brandon Chiasera
Sydney Ruhala

Michigan Technological University

Taya Flaherty

Missouri University of Science and Technology

Joseph Coons
Zachary Freeman
Chao Liu

New Mexico State University

Austin Hanson
Jenna Lente
Monica Mustain
Sidney Pinkerton

North Carolina State University

Stephen Challener
Audrianna Pollen

Northern Arizona University

Katherine Chapman
Suzanne Craddock
Michaela Kim
Tyler Schlieder
Douglas Steen
Casey Tierney
Karl Wagner
Sarah Weeks

Northern Illinois University

Tirzah Abbott
Joshua Ehlich
Alec Gierzynski
Matthew Mann
Justin Rosenblume
Joshua Zodarecky

Northwestern University

Jamie McFarlin

Ohio State University

Levent Akinci
Joshua DeVore
Deon Knights
Oliver Wigmore
Yue Zhang

Ohio University

Sarah Trubovitz

Oklahoma State University

Beth Vanden Berg

Oregon State University

Nicholas Bill
Na Hyung Choi
Nicholas Cohn

E. Michelle Neely

Susan Schnur
Gaylen Sinclair

Pennsylvania State University

Garett Brown
Ellen Chamberlin
Emily Doyle
Jennifer Estrada
Abby Kenigsberg
Arthur Minar
Yu Zhang

Plymouth State University

Melanie Perello

Portland State University

Justin Mccarley
Erik Shafer

Purdue University

Tanya Katzman
Darryl Reano

Queens College, City University of New York

Patrick Beaudry
James Muller

Rensselaer Polytechnic Institute

Megan Fung
Krystyna Kornecki

Rice University

Hehe Jiang

Richard Gilder Graduate School

Daniel Barta
Zachary Calamari

Rutgers University

Rachel Filo
Kevin Garrett
Guangyu Xu

Saint Louis University

Heather Robinson

San Francisco State University

Theresa Fritz-Endres

San Jose State University

Jane Manning

Simon Fraser University

Oliver Friesen

Stanford University

Chris Castillo
Jeremy Caves
Kimberly Lau

State University of New York, Buffalo

Dale Gump

Texas A&M University

Sakineh Arefi Fard
Pin Shuai
Anne Tamalavage

Texas A&M University at Galveston

Gerhard Maale

Texas Tech University

Matthew Garnett

Tulane University

Carl Swanson
Lizhu Yu

University at Buffalo

Alia Lesnek

University of Alabama

Christine Bassett
Gourab Bhattacharya
William Jackson
Kathleen Kingry
Hillary Sletten

University of Alaska–Fairbanks

Jacob Rosenthal

University of Alberta

Sasiri Bandara

University of Arizona

Marisa Earll
Daniel Favorito
Lucia Profeta
Carson Richardson
Simone Runyon
Andrea Stevens
Hector Zamora

University of Arkansas

Amie West

University of British Columbia

Catherine Armstrong
Lauren Harrison
Marie Turnbull
Alexander Wilson

University of Calgary

Elena Favaro

University of California, Berkeley

Emily Orzechowski
Courtney Sprain

University of California, Davis

Catherine Davis
Alexander Morelan
Allison Rubin
Kevin Schrecengost
Laura Tait
Trevor Waldien
Jan Weninger

University of California, Riverside

Mathew Knauss

University of California, Santa Barbara

Mary Fidler
Demian Nelson

University of Chicago

Miquela Ingalls
Madeline Marshall
Nadia Pierrehumbert

University of Cincinnati

Jeanette Arkle
Elizabeth Bullard
Elizabeth Orr
Jeff Osterhout
Sourav Saha
Alexander Wall
Allison Young

University of Colorado Boulder

Sarah Crump
Harrison Gray
Charles Shobe

University of Connecticut

James Beard
Juliet Hooten
Sarah Vitale

University of Florida

Jack Hutchings

University of Georgia

Douglas John
Jiaying Wu

University of Hawaii at Mānoa

Joseph Kennedy

University of Houston

Nicolas Bartschi

University of Idaho

Andrew Canada

University of Illinois

Kim Drager

**University of Illinois at
Urbana–Champaign**

Noah Jemison

University of Iowa

Jordan Foye
Tyler Hedeem
John Kissock
Christopher Waid

University of Kansas

Sarah Gibson
Jason Hallman
Brittany Hendrix
Robert Rader
Drew Schwab
Brian Sitek
Abdul Wahab

University of Kentucky

Carlene Gilewski
Patrick Whalen

University of Maine

Catherine Hamley
Amy Kireta

University of Massachusetts

Benjamin Keisling
Jonathan Reeves

University of Massachusetts Amherst

Jessica McBeck
Greg de Wet

University of Michigan

Timothy Gallagher
Kathryn Rico
Meghan Taylor
Alex Tye
Ian Winkelstern

University of Minnesota

David Birlenbach
Megan Korchinski
William Nachlas

University of Missouri

Ashraf Gafeer

University of Montana

Carson Macpherson-Krutzsky

University of Nebraska–Lincoln

Victoria Chraibi
Shashank Khatri

University of Nebraska–Omaha

Samuel Nath

University of Nevada Las Vegas

William Joseph
Michael Strange

University of Nevada Reno

Stephen Angster
Kerry Howard
Andrew Sadowski
Kirsten Sauer
Carolina Zamora

University of New Hampshire

Abigail D'Ambrosia
Sarah Widlansky

University of New Mexico

Rebecca Frus
Jennifer Muus
Marisa Repasch
David White

University of North Carolina

George Allen
Madeyn Percy

**University of North Carolina at
Chapel Hill**

Ryan Frazer
Jonathan Munnikhuis
Sarah Schmitt

University of North Carolina at Charlotte

Amanda Stone
Faye Visco

**University of North Carolina at
Wilmington**

Shannon Hammaker
Brandon Peach
John Russell

University of Notre Dame

Darren Cheah

University of Oklahoma

Gerhard Heij

University of Oregon

Corina Cerovski-Darriau
Madison Myers
Brennan O'Connell

University of Pennsylvania

Emma Harrison
Kara Ludwig
Rachel Valletta

University of Pittsburgh

Janine Krippner
Charles Krueger
Zhongjie Yu

University of Rochester

Sarah Austin
Lin Li

University of South Carolina

John Chesley

University of South Florida

Daniel Cleary
Matthew Hayes
Henok Kiflu
Catherine Smith
Kaydee West

University of Southern California

Katie Ardill
Snir Attia
Jotautas Baronas
Sean Hartman
Gen Li
Dylan Wilmeth

University of Tennessee

Joy Buongiorno
Forrest Driscoll
Rachel Kronyak

University of Texas at Austin

Khushboo Arora
Douglas Barber
Tomas Capaldi
Peter Carlson
Cody Colleps
Jeffrey Cullen
Natchanan Doungkaew
Sarah George
Michelle Gevedon
Peter Gold
Joshua Lively
Chelsea Mackaman-Lofland
Selva Marroquin
Edward Marshall
Michael O'Connor
Margaret Odum
Timothy Prather
Kelly Thomson
Anna Weiss
Erick Wright

University of Texas at El Paso

Joe Collins
Collin Gray
Allison Mast
Joshua McFarland
Anna Ortiz

University of Texas at San Antonio

Andrea Russie

University of Utah

Casey Duncan
Tyler Huth
Brendon Quirk
Grant Rea-Downing

University of Virginia

Alexander Morgan

University of Washington

Jonathan Beyeler
Jonathan Calede
Camilla Crifo
Carrie Garrison-Laney
Yan Hu
Julia Kelson
Matthew Koehler
Sean LaHusen
Sarah Schanz

University of West Florida

Mitchell McMillan

University of Wisconsin

Maureen Kahn
Soo Hyun Kim
Randolph Williams

University of Wisconsin–Madison

Hanna Bartram
Saurabh Ghanekar
Erik Haroldson
Jack Hoehn
Michael Johnson
Nicholas Levitt
Sharon McMullen
Nicolas Roberts
Frances Saylor
Allen Schaen
Jody Wycech

University of Wisconsin–Milwaukee

Levi Moxness

University of Wyoming

Ryan Richardson

Utah State University

Michael Channer
Colter Davis
Jace Koger
Robert McDermott
Katherine Paukert
Daphnee Tuzlak

Vanderbilt University

Tenley Banik

Virginia Polytechnic Institute

Natalia Bykova
William Cochran
Christopher Griffin
Tiffany Jebson
Matthew LeRoy
Pilar Madrigal
Calvin Mako
Sarah Mazza
Lowell Moore
Qing Tang
Theodore Them
Lisa Whalen
Brady Ziegler

Washington State University

Shawn Gagahan
Amber Haston

West Virginia University

Clyde Findlay
Benjamin Johnson

Western Michigan University

Abotalib Farag

Western Washington University

Olivia Anderson
Benjamin Carlson
Jaime Delano
Paige Granneman
Kristina Gustovich
Luan Heywood
Geoffrey Malick
Rebecca Morris
Kevin Quillan
Dirk Rasmussen

Yale University

Victoria McCoy

2015 GSA Division & Section Student Research Awards



Six GSA Divisions and three GSA Sections have recognized the following student research grant recipients who submitted proposals of exceptionally high merit in conception and presentation in their fields.

These students will be honored at the GSA 2015 Annual Meeting in Baltimore, Maryland, USA.

DIVISION GRADUATE RESEARCH AWARDS

Geophysics

Allan V. Cox Student Research Grant

Henok Kiflu, University of South Florida

Geophysics Student Research Grant Award

Abigail Maxwell, Louisiana State University

Bradley Sparks, Colorado State University

Hydrogeology

Hydrogeology Division Student Research Grant Awards

Alec Gierzynski, Northern Illinois University

Michael O'Connor, University of Texas at Austin

Madeyn Percy, University of North Carolina

Jonathan Reeves, University of Massachusetts

Brady Ziegler, Virginia Polytechnic Institute

Mineralogy, Geochemistry, Petrology, and Volcanology

MGPV Division Student Research Grant Awards

John Buchanan, Colorado School of Mines

Nicholas Levitt, University of Wisconsin

Chelsea MacKaman-Lofland, University of Texas at Austin

Madison Myers, University of Oregon

William Nachlas, University of Minnesota

Demian Nelson, University of California Santa Barbara

Quaternary Geology and Geomorphology

Arthur D. Howard Student Research Award

Mariah Richards, Colorado State University

J. Hoover Mackin Student Research Award

Marina Foster, Arizona State University

Marie Morisawa Research Award

Sarah Schanz, University of Washington

Sedimentary Geology

Sedimentary Geology Division Student Research Grant Award

John Chesley, University of South Carolina

Structural Geology and Tectonics

Structural Geology and Tectonics Division

Student Research Grant Awards

Cody Colleps, University of Texas at Austin

Michael Eddy, Massachusetts Institute of Technology

Brittany Huerta, California State University, Northridge

Calvin Mako, Virginia Polytechnic Institute

Louis Wersan, Indiana University



GSA SECTION RESEARCH AWARDS

Rocky Mountain Section Undergraduate Research Grants

Jacob Gardner, Montana State University

Hiroimi Ishiki, Universidad Nacional Autónoma de Mexico

Doug Nichols, Colorado Mesa University

Kevin Rafferty, Weber State University

Tom Ulizio, Montana State University

Wesley Weisbert, Missouri State University

*Northeastern Section Stephen G. Pollock Undergraduate
Student Research Grants*

Emily Artruc, Syracuse University

Michael Barber, Indiana University of Pennsylvania

Isabelle Bristol, Bucknell University

Grace Duke, University of Maryland

Ellen Gales, CUNY–Queens College

James Greene, Richard Stockton College

Daniel Lammie, University of Pittsburgh

Anna Lesko, Alleghany College

Noel Potter, Bates College

Emily Sosa, Lafayette College

Caleb Ward, University of Maine–Presque Isle

North-Central Section Undergraduate Research Grants

Emily Cigolle, University of Cincinnati

Jennifer Lemke, University of Wisconsin–Oshkosh

Kevin Parks, Ohio State University

Emily Salings, Missouri State University

2015 Cole Awards



The 2015 Gladys W. Cole and W. Storrs Cole Memorial Research Awards for postdoctoral research are funded by the GSA Foundation.

GLADYS W. COLE MEMORIAL RESEARCH AWARD

Lyman Persico, Mercyhurst University, will be awarded US\$8,000 from the *Gladys W. Cole Fund for research in geomorphology of semiarid and arid terrains* for his project, "The role of rock type and dust in the development of hillslopes in the Sandia Mountains, New Mexico." The award will be presented at the QG&G Awards Ceremony at the GSA 2015 Annual Meeting & Exposition in Baltimore, Maryland, USA, on Tues., 3 Nov.



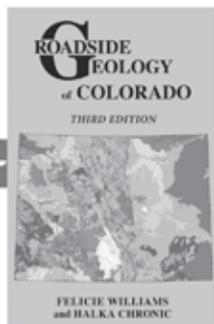
W. STORRS COLE MEMORIAL RESEARCH AWARD

Soma Baranwal, University of Tromsø, Norway, will be awarded US\$7,400 from the *W. Storrs Cole Fund for research in invertebrate micropaleontology* for her project, "Revisiting Arctic Pleistocene-Holocene (~2 Ma to present) from ODP 912A: A new record from the Arctic-Atlantic gateway." The award will be presented at the Cushman Foundation for Foraminiferal Research Awards Ceremony at the GSA 2015 Annual Meeting & Exposition in Baltimore, Maryland, USA, on Tues., 3 Nov.

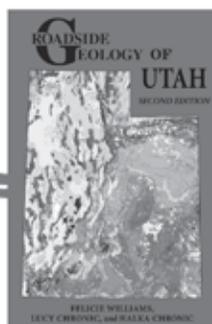


4 New Editions of our Popular Roadside Guides

IN FULL COLOR



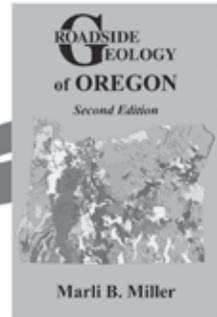
ROADSIDE GEOLOGY OF COLORADO
Third Edition
FELICIE WILLIAMS
AND HALKA CHRONIC
416 pages • 6x9
\$26.00, paper • Item #243



ROADSIDE GEOLOGY OF UTAH
Second Edition
FELICIE WILLIAMS,
LUCY CHRONIC,
AND HALKA CHRONIC
384 pages • 6x9
\$26.00, paper • Item #244



ROADSIDE GEOLOGY OF ALASKA
Second Edition
CATHY CONNOR
328 pages • 6x9
\$26.00, paper • Item #245



ROADSIDE GEOLOGY OF OREGON
Second Edition
MARLI B. MILLER
400 pages • 6x9
\$26.00, paper • Item #246

MP Mountain Press
PUBLISHING COMPANY
P.O. Box 2399 • Missoula, MT 59806 • 406-728-1900
800-234-5308 • info@mtnpublish.com
www.mountain-press.com

GSA/ExxonMobil Field Camp Scholars Awards



GSA/EXXONMOBIL FIELD CAMP EXCELLENCE AWARD

Paulo Hidalgo, Georgia State University Basic and Advanced Field Geology Field Camp

GSA/EXXONMOBIL FIELD CAMP SCHOLARS AWARD

Calvin Anderson, Cedarville University
Daniel Baisley, SUNY College at New Paltz
Laurel Blackman, Middle Tennessee State University
Michele Blundell, Wayne State University
Joe Booth, University of Georgia
Zachary Burton, Bowdoin College
Anna Clinger, University of Michigan–Ann Arbor
Elizabeth Da Silva, University of Oklahoma
Scott Eckley, University of Tennessee
Casey John, University of Arizona
Jennifer Kenyon, Louisiana State University
Zakia Keiyan Prinsloo, Georgia State University
Nicole Leach, SUNY University at Buffalo
Nathan Lentsch, University of Minnesota–Duluth
Alexis Lopez, University of the Pacific
Myriam Loving, University of Texas at San Antonio
Christina Penna, Southern Illinois University
Lukas Smith, Western Illinois University
Diana Snyder, Georgia State University
Kendra Walters, University of Oregon

GSA/EXXONMOBIL BIGHORN BASIN FIELD AWARD

Undergrads

Cheyne Aiken, SUNY Potsdam
Mariah Armenta, University of Arizona
Daniel Baisley, SUNY College at New Paltz
Lauren Bane, University of Wisconsin–Oshkosh
Emilie Bowman, University of Texas at Austin
Erin Conlon, University of Florida
Hamilton Goodner, University of Georgia
Mackenzie Kester, South Dakota School of Mines and Technology
Mary Layton, Southern Methodist University
David McLennan, Indiana State University
Jessica Rudd, University of Arizona
Lauren Schraeder, Wayne State University
Stephanie Sparks, Northern Virginia Community College
Wesley Weisberg, Missouri State University
Franklin Wolfe, Washington and Lee University

Grads

Ruoshi Cao, University of South Carolina
David Cross, University of New Orleans
Maia Davis, California State University, Long Beach
Bridget Kelly, University of North Carolina Wilmington
Thomas Neal, University of Kansas
Ming Wu, University of Tulsa

Professionals

Melissa Lombard, Georgia Southern University
Aisha Morris, UNAVCO
Matthew Powell, Juniata College
Jeffrey Simpson, Paradise Valley Community College



Welcome New GSA Members!

The following individuals submitted their applications for GSA membership between 11 Sept. 2014 and 16 Feb. 2015 and were approved by GSA Council at its April 2015 meeting.

Top Three Reasons Geoscientists Become GSA Members

1. Career Development
2. GSA Meetings
3. GSA Publications

PROFESSIONALS

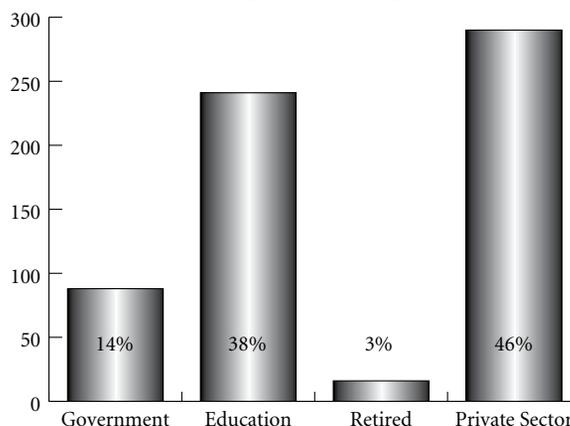
Mark Alan Adams
Ademuyiwa Adetunji
Werner Aeschbach-Hertig
Philippe Agard
Venkatesh Satya Akella
Asghar Ali
Alisa Ann Allen
Rivka Amit
Cory John Anderson
Kirk C. Anderson
Maria Antonia Andrews
Nelson da Franca Anjos
Tom Arnold
Andrew Arthur
Jorge Arzate
Dana M. Austin
Ryan M. Austin
Geoffrey Donellan Balfe
Soma Baranwal
Kyle Barker
David A. Barnett
John Macfadyen Barr
Behrooz Bashokooh
John Curtin Bedward
Andreas Beinlich
Chris Bendall
Caitlin M. Bernier
Angela Jeannine Berthold
Susan Bilek
Reginald Blake
Heather E. Blyth
James Blyth
Scott Bogue
David W. Bolton
Rosalba Bonaccorsi
Nelson Boniface
Stephan Anthony Bork
Thomas M. Bown

Matt Louis Boyce
Graham Boyd
Tonya Brami
Mitchell D. Brouman
Thomas E. Brown
Benjamin Brunner
Griffin Burke-Ruhl
Brendan Allen Buskirk
Liwen Cao
Rodolfo Carosi
Mark B. Carpenter
Mark Anthony Catanzano
Tzahi Cath
Sibille Irene Chalkley
Reynaldo Charrier
Bert Clever
Anthony Stephen Cohen
Teresa Cohn
Lisa A. Cole
Stacey A. Conley
Mark F. Coolbaugh
Sylvain Courrech du Pont
Robert John Creed Jr.
C. Cliff Creger
David S. Crotsley
William Crowe
Isaac J. Crumbly
Julius T. Csotonyi
Ellen Catherine Dailey
Michael Dale
Shahin Dashtgard
Amy Elizabeth Davey
(Kerckhoff)
Joel Degenstein
Evarado Delgado
Timothy Dellapenna
Sierra J. Derby
Michelle Dewolfe
Thomas Diggins

Eugene W. Domack
Jean-Pierre Dube
Richard Dyer
Carrie A. Eaton
Stephanie Evans
Holly A. Ewing
Frederick Felder
Steve Fellows
Karl Fennessey
Amelia João Fernandes
Ken Ferrier
Felipe Torres Figueiredo
Otto Figueroa
Joseph J. Filomena Jr.
Shawn Fiore
Nicholas E. Fischietto
Margaret W. Fisher
Ben Fitzhugh
John Fraser
Rinat Gabitov
Merab Gaprindashvili
Guillermo Garrido
Leticia Gaspar Ferrer
Kenneth C. Gass
Mussie G. Ghebreselassie
Jennifer Blanchard Glass
Scot Carl Gnewuch
Longlong Gou
Melissa Grasso
David Greenan
Roy Dale Greer
Gerald H. Grondin
Eugene Gerald Grosch
Eric E. Grossman
Ying Guo
Ronald Roger Gutierrez
Sergio Gutierrez
Carlos Guzman
Edgar Leo Haire
Lucien Halleux

Tark S. Hamilton
Linda M. Hand
John Robert Harris
Donald Harter
Nina T. Harun
Elisabeth Hausrath
Michael Benjamin Hay
Gary L. Henry
Jim Herbert
Gregory Charles Herman
Lee Hess
Astrid Hesse
Alan Heyvaert
Roger Higgs
Malcolm Hill
Frank Lloyd Hillemeier
Hitoshi Hirose
Leah Hogarth
Pike Lee Holman
Maurice L. Hooks
Casey Hubert
William P.C. Hudson
Imoukhuede Moses Idehai
Alessandro Ielpi
Richard William Inclima
Duncan I. Johannessen
Marjorie Jane Johns
Blair Geoffrey Jones
Carriayne Jones
Michael Lindsey Jones
Kevin Jordan
Kunio Kaiho
Pierre Karam
Anthony Kearsley
Paul Alexander Kenward
Jess King
Tom Kirkpatrick
Marcella A. Kolberg
Helena Kuikka
Redzhep N. Kurbanov Sr.

New Professional Members Employment Type



Carl Lamborg
 Christopher Laughton
 Dale Allen Leckie
 Eung Seok Lee
 Ben Leshchinsky
 Kristen Lewis
 Amanda Little
 Fulai Liu
 Richard A. Livingston
 David London
 Tom Loomis
 Gary C. Luce
 Timothy Macaluso
 Mary Maclaughlin
 Brian Marlowe
 Fred Marschak Jr.
 Katherine Marshall
 Sergio Martinez
 Andrea Marzoli
 Ryan Massey
 Steven Masterman
 Reginald Ebhin Mastro
 Andrew K. Matzen
 Nigel Howard Maund
 Farzin Mazhari
 John Scott McCartney
 Lindsay McClenaghan
 Kelli McCormick
 Eileen Marie McGowan
 Glenn McKenney
 Nigel Brey McMillion
 David Mencin
 Xiaohong Meng
 Miriam (Mia) Tamar Merin
 Diana Meza-Figueroa
 Kathleen A. Mihm
 Emily A. Miller
 Christoph Moder
 Pulin Mondal
 Mackenzie Morris
 Nan Mu
 Janet Rose Muhling
 Roderick John Muir
 Michelle Alyce Mullane
 Adam C. Mumford
 Breandan Murphy
 Hubert Mvondo
 Stefanie Julie Mysel
 Uri Nachshon
 Ranjeet M. Nagare
 Patricia Rose Newman
 Edwin Nissen
 Benjamin Kofi Nyarko
 Jonathan O'Neil
 Gordon Oakey
 David Obright
 Serge Occhietti
 Taylor Olson
 Richard A. Ortt Jr.
 Philip N. Owens
 Jeff Paddock

John E. Palmer
 Franklin Davis Patton
 Richard R. Pavey
 Daniele Pedretti
 Marlow G. Pellatt
 John Pernet-Fisher
 Dustin Lippman Perry
 Chad Petersmeyer
 Ellen Lesley Petticrew
 Federico Pezzotta
 Jaeson Woods Pieretti
 Luisa Pinto
 Janina Plach
 Jaime Poblete
 Evan F. Portier
 Simon Poulton
 Amelia Rainbow
 Darrell Robert Reed
 Jay Rehor
 Mark Alan Richards
 James Roberts
 Chance Marc Robinson
 Christopher S. Robinson
 Jenai Rohllf
 Kristin M. Rohr
 Nancy L. Ross
 Jamil A. Sader
 Matt Sakals
 Joshua Xavier Samuels
 Matthew Spencer Sanchez
 Deborah A. Sanderson
 Arnulf Schiller
 Maarten Schreuder
 Brad Scott
 Maria Seton
 Jesse Sexton
 Adam Shales
 Wei Shan
 Owen Sherwood
 Michael Anthony Sifuentes
 Danielle Jade Simon
 Scott W. Simpson
 Eric Jan Slavin
 Alan Mitchell Smith
 Janelle Therese Smith
 Vance Smith
 Katherine A. Smuk
 Clinton Smyth
 Thomas Smyth
 Rong Cai Song
 Ying Song
 Emerson Jacob Speyerer
 Kerri Spuller
 William H.J. Strosnider
 Min Sun
 Kimberly T. Tait
 Yuanzhi Tang
 Ralf Tappert
 Emily Taylor
 Charles Houston Terhune
 Sittampalam
 Thirugnanasampanthan

Adam Robert Travis
 Brian B. Turner
 Christiaan Van Westendorp
 Bruce Hickey Vaughn
 Juan-Tomas Vazquez
 Jeremy G. Venditti
 Javier Vilcaez
 Melissa Wade
 Abdullah Wahbi
 Ian James Walker
 Bo Wan
 Aijun Wang
 Nanping Wang
 Nicholas Andrew Way
 Melissa M. Weber
 Desiree Wentland
 A. Joshua West
 Thomas Mitchell Whitehurst
 Shelly K. Whitman
 Scott T. Wieman
 Harry Joseph Winters Jr.
 Yilin Xiao
 Changli Yao
 Jaehyung Yu
 Abdallah Sami Zaki
 Gonzalo Zamora Valcarce
 Min Zeng
 Wang Zheng

RECENT GRADUATES
 Matthew Clarke Aadland
 Clare Abercrombie
 Paul Ackermann
 Samuel Louis Adler
 Robert Lopez Aguirre
 Michael Ahrens
 Erik Alberts
 Genevieve Alexander
 Willemijn M. Appels
 Jordan Arey
 Emily Kalani Baer
 Amy Barfield
 Kelsey Barra
 Evan C. Becker
 Julie Antoinette Bergeron
 Katie Biggert
 Benjamin James Billings
 Chris Bishop
 Aaron Blair
 Meghan Rose Blodgett-Carrillo
 Esther-Jeanne Bordet
 Paul Boynton
 Jonah Quinn Bradley
 Michael Joseph Bradley
 Taryn Keiko Bye
 Roland Cardwell Campbell
 Felipe Castaneda
 R. Jeff Castro
 Mary Clark
 Simona Mercedes Clausnitzer

Taryn Contento
 Alexander Lynn Cook
 Amanda Cooke
 Jeremy Brandon Cooper
 Emma Coronado
 Pamela J. Daitch
 Elizabeth J. Davis
 Maria Monika Decker
 Zack Lee Delgrosso
 Mackenzie Dennis
 Dipa Desai
 Camila Didio
 Tessa Diem
 Alana Dingman
 Ursel Dion
 Alexandra M. Doran
 Taylor Christopher Dorn
 Conor Humphrey Duggan
 Caitlin Marie Dunne
 Bass Daniel Dye
 Matthew Carl Eberle
 Samuel Ecenia
 Travis Murray Erkenbrack
 Colin Etienne
 Temilola E. Famakinwa
 Ian Guthrie Faulds
 Marissa Fichera
 David William Randall Foster
 Sophie Lee Foster
 Lonia Rachael Friedlander
 Michael Paul Furman
 Cove John Fytpaa
 Matthew James Gerber
 Barbara Gordon
 Daniel Graybeal
 Joshua Greenberg
 Matthew Gregory
 Kelsey Gunvalson
 Richard P. Hale
 Scott Henderson
 Eric Hill
 Jered L. Hogansen
 Jason Alexander Holcomb
 Matthew Holland
 Breanne R. Huckabone
 Blaine Curry Hudson
 Rachael Elizabeth Hudson
 Benjamin Keilen Jackson
 David Jenkins
 Alberto Jimenez
 Benjamin Nephi Jones
 Muhammand Kamran
 Jered Andrew Karr
 David James Kelley
 Kara Kirkpatrick
 Robert Bradon Klopfer
 Bridget Kraynik
 Michael Andrew Kreiser
 Jason Michael Labrie
 Stephen Lagamba
 Jack Langree

Jia-Urnn Lee
 Melissa L. Lehman
 Vaughn Francis Leuppe
 Marrisa Lewis
 Brian J. Liesch
 Holly A. Lindberg
 Emily Anne Ljungman
 Leah Louis-Prescott
 Dolan Lucero
 Lauren Maceikis
 Nathalia Andrea Mantilla
 Caroline Mardock
 Sanita Maslovska
 Kelley E. Matthews
 Timothy Spence McColgan
 Isabel Huia McCrae
 Ned McElfresh
 James McFadden
 Brendan McGarity
 Callum McMillan
 Coulter T. McPhail
 Kristen Meisner
 Leslie P. Milliman
 Andrew Clark Mills
 Alexander J. Mitchell
 Bryce Akio Mitsunaga
 Tanner Morrill
 Kristian Mueller
 Brian Mulder
 Maia Murphy-Williams
 Kelsey Myhre
 Seth D. Nachimson
 James Nassif
 Conor Neal
 Edward William Nelles
 Riley S. Newman
 Vi Nguyen
 Nastassja Lee Noell
 Beth Martha O'Connell
 William O'Connell
 Martin O'Donnell
 Michael O'Keefe
 Dion Asher Obermeyer
 Alyssa Obester
 Brian N. Page
 Brandice Paranto
 Lillian Kennedy Pearson
 Christos Clifford Peter
 Thomas Pham
 Leanne N. Phelps
 Alissa Phillips
 Roger T.J. Phillips
 Laura Pianowski
 Kira D. Plaut
 Grace Postma
 Kusala Madhushani Premaratne
 Anthony Mitchell Quatrone
 Diana Rattanasith
 Ellen Ray
 Rosemary Read
 Stephannie Resendez

Hector Rivera
 Derek Thomas Rode
 Alfonso Luis Rodriguez Madrid
 Jason Rogers
 Donald James Rowe
 Amy Rudko
 Samuel John Rumel
 Devlin Rutherford
 Gephren R. Sadove
 Scott G. Saldivar
 Sydney Olivia Salley
 Sara Nan Santarelli
 Shane D. Schoepfer
 Marvin Scott Jr.
 Talia Sepiol
 Jeff Simpson
 Danielle Sims
 Jaime Smith
 Nathan Smith
 T'ara Antoinette Smith
 Samantha E. Snyder
 Sarah Stamps
 Blake Stone
 Peter Douglas Strand
 Aaron Szapa
 Ekrem Tamkan
 Sarah Lynn Thomas
 Michelle S. Trommelen
 Paul R. Trudell
 Brian Turley
 Jessica Uglesich
 Emily M. Usher
 Christina Valen
 Cordelia Anne Vargas
 Jeremy Vaughan
 Allison Vincent
 Damien Weaver
 Sarah Nicole Welter
 Sarah M. Wendlandt
 Jane Samantha Westfall
 Kristen Lee Whitbeck
 Kai Birch Whitehill
 Ben J. Wickham
 Edward Wiecek
 Maria Teresa Williams
 Jason Womer
 Hanson Wong
 Megan Wyllie
 Andrew Yahle

STUDENTS

(listed by professional interest)

Archaeological Geology

Matthew Christian Adams
 Luisa Aebersold
 Zak Henry Bartholomew
 Robert Bennett
 Claire Colwell
 Shawna R. Couplin

Alexandra Covert
 Kate Cushen
 Sarah Marie Franssen
 Jenna M. Hammond
 Louise Willemina Haven
 Forest Hoffman
 Sarah Kivisto
 Adam James Lang
 John Adam Lawrence
 Angelina Locker
 Luke Alan Lohrstorfer
 Michael Lukas
 Heather McGuire
 Sergio Arturo
 Molina-Maldonado
 Jacob Mosteller
 Madeline Dorothy Murdock
 Jennifer Kristine Muus
 Susannah Oettle
 Genevieve Violet Perdue
 Kelsey Lauren Salmon Schreck
 Nicholas Schmuck
 Cassie Elizabeth Simpson
 Stella Sheridan Sudekum
 Amy E. Thompson
 Dana Yakabowskas

Ashley Grupenhoff
 Eliane Helitzer
 Kyle Herbert
 Bryan William Hoff
 Megan Hudak
 Nicholas Hugo
 Sarah Hurley
 Kelsey M. Jenkins
 Abigail M. Johnson
 Tanya L. Katzman
 Matthew C. Koehler
 Laura J. Krajewski
 Michelle Levisch
 Logan MacLay
 Ana Martinez Fernandez
 Gabby McGann
 Nigel W. McKenzie
 Rebecca Miller
 Montana Jay Mraz
 Vincent O'Leary
 Ellen Elizabeth O'Neil
 Robyn R. Oster
 Nathaniel Evan Peters
 Susan K. Priest
 Kathryn Isabel Rico
 Leslie James Robbins

Top Five Reasons Students Become GSA Members

1. GSA Meetings
2. Career Development
3. GeoCorps™ America Program
4. Research Grants
5. Free Online Access to GSA Journals

Biogeosciences

Erin Adams
 Emily Austin
 Aisha Jane Balint
 Jotautas Jokubas Baronas
 Thomas James Barrasso
 Anna G. Bearman
 Laurel E. Blackman
 Jonathan Blanton
 Zena Cardman
 Mara Lee Cashay
 Beverly Chiu
 Kale M. Clauson
 Caitlin Colleary
 Caroline C. Craze
 Kristine Claire De Leon
 Maya Sheryl Desai
 Charles W. Diamond
 Kim Drager
 Margaret Esch
 Sarah Quinn Foster
 Shannon Kim Gaskell
 Devanita Ghosh
 Esther Anna Gies
 Micah Goris

Cameron Rossington
 Sofia Rudin
 Sarah Schmitt
 Stacy Gayle Schwabedissen
 Peng Shang
 Michael Shields
 Vincent Tambwe Somwe
 Patrick Marcel Sullivan
 Qing Tang
 Elizabeth Julia Tedder
 Sarah Turner
 Tyler Weiglein
 Sierra Cheyenne Wick
 Benjamin P. Wilkins
 James Wilson
 Lauryn Taylor Yevincy

Climatology/Meteorology

Tristan O. Amaral
 Jacob Arndt
 Jessica August
 Shannon Nichole Blair
 Braden Lee Bruning
 Daniel Frank Damico
 Ilian A. Decorte

Nadine Macmanus Doiron
Dylan J. Garcia
Michael Glotter
Devon Gorbey
Sophie E. Greene
Hannah Grist
Anna Gwendolyn Harris
Austin Hart
Kevin A. Heller
Marius Lothar Huber
Joseph Matthew Krenzelo
Nicholas Luchetti
Tiphonie Renee Meeks
Daniel Robert Miller
Kyle C. Rennell
Maria Gabrielle Romero
Sarah Anne Rydgren
Kristin Meredith Schild
Spencer Tangen
Tavo T. True-Alcala
Gifford J. Wong
Hannah Lynn Yates

Economic Geology

Elizabeth Aiello
Lisa Marie Arnold
Michael Paul Avila
Amber G. Brusak
Brett James Caldwell
Alex Camy
Heather J.E. Carson
Stephen Challener
Edward Cromwell
Shane Dailey
Rita Dubman
Andrew C. Ford
Zachary William Freeman
Justin Gilbow
Matthew L. Greenwood
Kyle Broggi Hahn
Eric Hanna
Thomas Graham Hatton
Brittany A. Hendrix
Harley Hoiles
Gretchen Ann Hough
Eliza Kane
Nicholas Karl
Drew Justin Kehoe
Alastair King
Dakota Kolb
Kari A. Lanphier
Morgan Brooke Lee
Erin Looby
Julia Marsh
Jeff Menke
Jo Miles
Nicholas Joseph Mitchell
Austin Moyers
Charles Nye
Laura Opall
Katherine Paukert

Laura E. Perry
Janel Kathryn Powers
Ashley Kaye Quigley
Patrick Owen Quigley
Jordan T. Ray
James Douglas Rogers
Mary Sabuda
Samuel H. Saltzman
Andrew Lloyd Sasso
Lydia Somers
Ethan B. Spiegel
Jack Robert Stearns
R. Craig Stewart
Lauren Wilson

Energy Geology

Karin Abrahamsson
Kimberly Nichole Aguilar
Moyo Ajayi
Rachel Anyi
Anthony Michael Armao Jr.
James Maxwell Barrett
Chelsea Beach
Jay Austin Bean
Olga Beketova
Eric Bergersen
Catherine G. Bert
Amanda Blackburn
Emma Bradford
Jacqueline Brewster
John Brotherton
Holden D. Butler
Brendan Patrick Carr
Lauren Carter
Ryan Chacon
Alexander King Cheney
Joseph John Christoff
Stewart C. Cory
Jethro Antonio Cantila David
Austin Deane
Keegan M. Donovan
Nathanan Doungkaew
Ty Michael Engler
Tim L. Faller
Esme Marie Faneuff
Robert S. Feit III
Rick E. Fewtrell
David Finney
Luke Hibbs Fisher
Sarah Elizabeth Flaherty
Josh Fox
Kyle C. Gabb
Tyler Peter Gabrielson
Carlos Javier Garcia
Gregory Vance Ginther II
Conan Ray Godfrey
Nancy Elizabeth Gostic
Shelby Guercio
Christina Lynn Hanson
Matthew Harder
Jesus Fernando Hermsillo

Hunter Herring
Jenna Hessert
Carolyn Hirshberg
Justin Hodges
Brittany Holt
Jing Hua
Zachary Aaron Taylor Hunt
Alexander Jay Hutcheson
Lara Louise Jaeckel
Zekai Jia
Scott A. Johnson
Kristin S. Kennedy
Chad M. Kerner
Brian Keyser
Nathanael Michael Kilburg
Sean Kincade
Mollie Kish
Jace Michael Koger
Sara James Labrum
Elliott Lancarte
Casey B. Langdon
Jordan James Larson
Luke Lepage
Eric J. Levitt
Will Ligon
Michael Lochner
Brendan M. Lomago
Michelle Abshire Lutiker
Moiria Nicole Lyons
Raina Mahanes
Derrell Mathis
Clinton A. McCrary
Brian McCray
Elisabeth G. McElwee
Daniel Meehan
Kyle Mehnert
Michelle Teresa Melosh
Taylor Michell
Matthew Morris
Martial Morrison
Joshua Mudge
Sourav Krishna Nandi
Stephen M. Nelson
Emily Nicholson
Anthony J. Nicolardi
Daniel Edward Niles
Sierra Ohrmundt
Olorunsola Gabriel Olorunsola
Raymond Thomas Olson
Laura Damis Pacheco
Paul R. Panehal
Benjamin R. Pflughoeft
Michael Powers
Richard Pratt
Joseph Elliott Precise
Asnoldo Prieto
Oliver Laurel Purcell
Rocky Rachell
Chance Michael Reece
Ashley Richardson
Claire Ricks

Nicole Marie Ritchie
Samantha Ritzer
James Rodney Rizzuto
Alexander Rogaski
Jacob Jerome Rogers
Roberta Rogers
Kenneth Ruff
Charles Brock Rust
Adrian Sanchez
Jordan Paul Scheuermann
Joseph Shigematsu
Bruno Shkembi
Brian Smith
Jared Roman Smith
Joel P. Spansel
Jack Cowan Steele
Hunter Harrison Stevens
Rachel N. Sturges
Nan Sun
Matthew J. Tello
Kaelyn Trapp
Layne R. Tucker
Michael A. Tummons
Roxanna Marie Vaught-Mijares
Michael Scott Vineyard
Cristian Virrueta
Audra Elizabeth Voldbakken
Cory Joe Walk
Lindsay Wasik
Victoria E. Watson
Brandon James Weidner
Andrea Carol White
Logan Robert Wieland
Nicholas Williams
Timothy Williams
Danielle Nicole Woodring
Angela Wu Li
Abdelsalam I. Yuonis
Hanyue Zheng
Dominique Zvorak

Engineering Geology

Preston P. Ballou
Kimberly N. Barfield
Ibrahim Labaran Bashar
Nathaniel Boehler
Christopher Glenn Bourne
Shana Lynn Boynton
Jessica Castellon
Charles Christopher
Jordyn Cloud
Katherine Jean Condon
Sara Constantine
Shenden Jeffrey Cromwell
Liam P. Dizio
Jeremy Driscoll
Chidinma Emili
Cameron Blair Evans
Daniel S. Flores
Ian Armand Gammarino
Tom Gerhardt

Jennifer Godbout
 Kameron Alexander Hansen
 Philip M. Hartman
 Jordan Leeann Haserot
 Alexander V. Hernandez
 Paul E. Hurley IV
 Spencer Grant Ingram
 Nicholas Jordan
 Alison Keppel
 Jenna D. Kooy
 Reni Hsu Kunkel
 Aubrey Anne Laplante
 Cameron Laundry
 Geoffrey Malick
 Pritchard Tinaye Mhere
 Stephanie A. Mitts
 Wen Nie
 Kirk James Pace II
 Hannah Peterson
 Andrew Poley
 Kathleen Preston
 Casandra Pritchard
 Daniel Ramos
 Julianne Robinson
 Jeremiah Rose
 Kevin Ross
 Sean L. Ross
 Elizabeth Salvaterra
 Catherine Amber Samson
 Carmia Schoeman
 Kyla Seereeram
 Coley Daniel Smith
 Madeline Rose Sovo
 Jacob Michael Stone
 Bobbi Strange
 Brandon Suchomel
 Justin Thomas
 Nathalia De Siqueira Vieira
 Alexander R. Walker
 Jenna Therese Ward
 Reinhard Weidlich
 Natasha Weninger
 Kevin James Woodard
 Jalise Wright
 Rakiyah Nadia Wright

Environmental Science

James Accordino
 Emmanuel Ajidahun
 Oliver Seth Allen
 Sarah Marie Allen
 Samuel R. Alter
 Laura E. Ames
 Nicole Jessica Armstrong
 Korey Ashton
 Gonzalo Astray Dopazo
 Madeline Ann Atkins
 Caitlin Marina Augustin
 Cameron J. Axberg
 Jessica R. Ayers
 Bea Baharier

Stephen Paul Balash
 Jessica Corey Baloga
 Colleen Marie Barbe
 Brianna M. Barber
 Sheila Barter
 Robert William Baskett
 Andrew Bean
 Emily Benayoun
 Raymond Bibla
 Kendra Bishop
 Alexander Stephen Black
 Megan Blankenship
 Valerie J. Blomgren
 Mckenze Booth
 Dane Boring
 Drake Andrew Bortolameolli
 Amanda Elizabeth Brackett
 Rosa Brandt
 Alex Braud
 Kelsey Brennan
 Morgan Charles Brown
 Hilary Brumberg
 Emilie Ann Burke
 Michael William Byrd
 John Michael Cala
 Caila Michelle Campbell
 Jared L. Carte
 Carley Cavanaugh
 Kyle Lane Chambers
 Hannah Elise Chambless
 Hampton Kent Childres
 Rachel E. Clemons
 Samuel William Cody
 Christina Cole
 Emily Collins
 Valerie A. Connelly
 Janelle Frances Cooley
 Emma Cooper
 Sam D. Cooper
 Anthony Crowe
 Elena Renee Crowley-Ornelas
 William George Crumppacker
 Ryan Thomas Cutler
 Paisley J. Dandenault
 Sean R. Davis
 Taylor E. Davis
 Emily Deacon
 Laurel Dean
 Marina A. Debiase
 Aislinn Deely
 Lemuel Alejandro Del Valle
 Laura Mary Demarco
 Dominique Dilandro
 Sarah E. Diringer
 Gregory C. Dixon
 Thomas Dobson
 Sam Donnelly
 Shannon Donohue
 Kelly Donovan
 Patrick Michael Donovan
 Daniel Eduardo Dores

Kajetan Zulu Drozd
 Dylan Scott Dudley
 Rebecca Dzombak
 Masha Elizabeth Edmondson
 Rachel Egan
 Brendan Elba
 Kimberly Frances Elsenbroek
 Alison Margaret Emmons
 Jennifer A. Estrada
 Alexandra Evans
 Tyler Ming Fan
 Nicholas A. Fisher
 Kaci N. Fitzgibbon
 Mauricio Eduardo Flores
 James Ford
 Samantha M. Foster
 Emily Freilich
 Carla H. Freund
 Rebecca Fuller
 Tabatha Gabay
 Katelynn Garrett
 Bradley John Gaskin
 Austin Harrison Gilly
 Matt Giordano
 Timothy Goodsell

Chelsea Rose Horton
 Gustava Hoskins
 William Houser
 Liam Hoy
 Justyn Kase Huckleberry
 Jesse G. Hufstedler
 Ryan Cronin Hughes
 Grace A. Iftner
 Angel L.M. Iverson
 Allison Jacobel
 Catherine Jaffe
 Griffin Johns
 Meredith Johnson
 Benjamin Andrew Jones
 Chelsea Jones
 Oude Maher Karadsheh
 Melissa Lynn Karban
 Jasmeet Kaur
 Jack Kellner
 Elizabeth Lee Kenny
 Edward Cody Kent
 Nicole K. Kern
 Krista Keski-Hynnla
 Manik Singh Khinda
 John Kirchner

GSA Graduate Student Research Grants

- Funded 391 out of 784 student member proposals (50%)
- US\$723,570 was disbursed to student members
- Range of grants awarded: US\$938–US\$7,500; average: US\$1,851
- Ten student members were awarded US\$7,500 each (sponsored by ExxonMobil)

Aimee E. Goodwin
 Julia Grabowski
 Ashley Grace
 Keegan Griffith
 Gerry Grimes
 Brooke Leigh Groff
 Aaron Gross
 Brittany Carol Grosskopf
 Thomas Gruszkos
 Kristina Gustovich
 Kristian Daniel Hajny
 Phoebe Haney
 Cordelia Hao
 Crystal A. Hardee
 Deirdre Haren
 Nydra L. Harvey-Costello
 Mejs Hasan
 Linnea Holden Hattery
 Patricia Haug
 Daniel Hauschild
 Emma Margaret Hauser
 Hamish Henderson
 Juan Manuel Hernandez Jr.
 Nathan Herzog
 Jason G. Hoffmann
 Makenna Hopwood

Savannah S. Kisling
 Masoomah Kousehlar
 Kestrel Ann Kunz
 Matthew Lane
 Emma P.C. Lannon
 Aaron O'Neal Latham
 Victor Law
 Eric Lawrence
 Charlotte Coleman Leadem
 Kathryn Leys
 Guo Li
 Samuel Evan Lillard
 Kymberlee Littleton
 Brian Joseph Litwin
 Christopher Dominic Lore
 Caleb O. Lucy
 Stephen Clark Lukas
 Jillian Luranc Sweeney
 Jonathan David Lykins
 Tesa Renee Madsen-McQueen
 Brian Magumcia
 Clare Ellen Maher
 Mckinnon Main
 Kyle Mangione
 Evan Marine
 Molly Markell

M. Kat Marquez
Serena Matt
Katie Mattern
Patrick Angelo Mazzone
Ashley D. McAvoy
Megan McCauley
Larkin McCormack
Lindsay Jean McFarland
Taylor McGinnis
Aaron Fredrick McNamara
Kelly J. Measom
Andrew Thomas Migliazzo
Rachel M. Miller
Roger D. Miller
Spencer Moran
Matthew David Morris
Anthony Moschera
Mallory Kae Mueller
Jennifer L. Murphy
Kelsy Erin Murphy
Monica Rose Mustain
Rebecca Belle Newman
Jarrett Ian Nguyen
Danielle Nichols
Alexander N. Nitsche
Jessica Nicole Noll
Katherine E. Norskog
Daniel James O’Crowley
Jonathan Ofiara
Amanda Dovinh Ong
Elijah Orland
Matthew J. Ormrod
Anna Cristina Ortiz
Michael Ortiz
Thomas A. O’Shea
Nick Osmonson
Jennifer Owen
Anne Paden
Valerie Palkovic
Anna Paltseva
Alexandra K. Parise
Shelby Paulseth
Ashley R. Pederson
Clarice Rachelle Perryman
Jacob Daniel Phipps
Michael Pleimling
Rinpoche Ruth Price-Huish
Sharon Primerano
Leah Puklin
Olin Paul Racine
Henintsoa Rakotoarisaona
Samantha Rose Ramsey
Kristy Ablin Rasmus
Mary Rath
Audra N. Reagan
Tess Reardon
Charlotte Reed
Christopher Wade Ridener Jr.
John Rinehart
Nicholas S. Riqueros
Benjamin Robb

Gamaliel Obed Rodriguez
Aaron J. Roppoli
Kelly Lynn Rose
Tanya Rose
Hannah Shay Rosenkrans
Gabriella Rossi
Jacob Alan Roush
Nicholas Rubin
Mikaela Renae Ruga
Andrea Lea Russie
Blake Russo-Nixon
Carolyn M. Ryan
Ashley L. Salazar
Diego Alberto Sanchez
Kelly M. Sanks
Emily A. Santos
Constance Renée Sartor
Augustus T. Schaefer
Zoe H. Schapira
Morgan Devon Scherer
Kea Mockus Schwarz
Larissa Severance
Molly Rebecca Sexton
Afshan Shaikh
Mark Henry Shelleman
Larry Shores
Anamika Shrivastava
Zachary Bruce Sigler
Supriya Singh
Julia C. Slusher
Kyle Edward Smart
Christopher R. Smith
Talia Elisa Smith
Adrienne B. Soder
Narain Spolia
Tiffany Spring
Perrin Stein
Mark Strayer
Kevin Sullivan
Molly Sullivan
Collin Sutton
Gilles Valdez Tagne Kamgue
Lindsey Taylor
Erin Thornton
Whitney Thornton
Alan Toczydlowski
Geneva Toland
Callie A. Tominsky
Margaret Mae Upton
Keren Valdez
Vito Valerio
Katherine Vanzytveld
Melissa Varela
Michelle Villagran
Alaina N. Walag
Olivia Nicole Walker
Ryan J. Walker
Daniel Rm Walters
Randy Lee Wamsley
Mark Wang
Caleb William Ward

Erin Wells
Zoe Wellschlager
Audrey Elaina White
Christopher W. Williams
Matthew Willis
Laura Jayne Wiltshire
Sean S. Winters
Christopher Andrew Wolf
Alexander John Wood
Kali Woodard
Barbara Elaine Wortham
Kevin Michael Wozniak
Maria Yasel
Benjamin C. York
Elizabeth Young
Zhongjie Yu
Ruxun Zhang
Fangning Zheng

Geography

Grace Aleman
Chelsea Augustine
Danielle Beaty
Jamie Elizabeth Boelstler
Ryan William Bradley
Michaela Branch
Holly M. Brown
Katherine Cann
Jacob Cassidy
Lauren Cater
Shea Barrett Darland
Mariama Dryak
Emily Durante
Sam Edwards
Christopher Ely
Kaitlin Ann Finan
Oscar Armando Gavidia
Catherine Maeve Grady
Maria Groves
Corey M. Gut
Nicholas Hager
Clayton Thomas Hamre
Alisa L. Hass
Mary Padgett Hawkins
Brett Michael Hiley
Kiersten Hudson
Henrik Løseth Jansen
Irene Klock
Ella Koeze
Allison Nicole Koski
Alison Sky Leiterman
David Leydet
Paul Lincoln
Rachel Luu
A. Rose McClain
Mara Moettus
Hunter Moore
Sean David Morthland
Patricia Muchowski
Paige Norman
Alana Marie Rader

Jacqueline Ratner
Karl Bernard Reinhardt
Daniel Rhoades
Collin John Riley
Morgan L. Ripp
Maegen Rochner
Melanie F. Rosenberg
Allison Roush
Joseph H. Rudolph
Jacob Saindon
Stephen Adam Salway
Savannah Sawyer
Thomas F. Silva
Carolyn R. Smillie
Daniel Z. Solomon
Bryce Stevenosky
Courtney Tyler
Lee B. Van Ardenne
Melinda Vickers
Frank Joseph Vocaturo Jr.
Manon Line von Kaenel
Nicholas Walding
Jessica L. Warren
Nicholas Wells
Schuyler Vincent Williams

Geoinformatics

Hawraa Ibrahim Al-Ajmi
Virginia Alonso de Linaje
de Nicolas
John A. Ciccone
Brian Michael Cortes
Mario J. Federis
Xiangyang Guan
Nlingilili Habana
Jason Hartley
Lauren Asenath Huffman Kahre
Gabe Joseph
Christopher J. Kelly
Eddy Liu
Hongyuan Liu
William Metcalf
Dylan L. Molnar
Seth Owen Nichols
Michael Preko Nkum
Rebecca Anne Schmitt
Brandon Gene Swihart

Geology and Health

Emely Mariele Alfaro
Olusola Afeez Aremu
Mitchell Philip Collins
Elinda Dehari
Rafael Andres Delfin
Stephen James Fabian
Eseoghene Idamarhare
Marie Y. Jimenez
Spencer T. Jones
Christopher Link
Jasmine Pham
Anayeli Picasso

Liesel Sue Robbins
Alec Sachleben
Louise Tsang
Stephen Maurice West

Geophysics/Tectonophysics

Juhi Aggarwal
Nosheen Akhtar
Andrea L. Alexander
Ali Hussain Alkhawaja
Christina Andry
Gabriella Arroyo
Michael Barber
Michael McCabe Bartholomew
Genna H. Batchelder
Cameron Baumgardner
Benjamin Belzer
Brianna Berg
Andrew Bergman
Gungor Beskardes
Brittany Alexandra Blood
Blaine Bockholt
Brandon Bolach
Scott Borchardt
Harold Salomon Campbell
Ruoshi Cao
Dominic Thomas Chaulk
Enrique Rodolfo Chon
Spencer E. Clark
Marie Cooper
Isabella G. Dantas
Justin Scott Davis
Michael Matthew Day
Christopher J. Degarmo
Kevin M. Denton
Kaitlan Quinn Elizondo
Jordan Engstrom
Brady Alexander Evans
Kelly M. Ferguson
Eliana Gomez-Hurtado
Ryan William Hackbarth
Louisa Hall
Mariah Danielle Heck
Erin Jessica Hightower
Lauren M. Hinch
Samuel Prescott Hughes
Hannah Elizabeth Huhman
Jacob Calister Jarvis
Chelsea Anne Jolley
Andrew C. Karlson
Ronald Adam Knoll
Robert J. Kupper
Murat Kuvanc
Julianna Leiva
Samuel Levy
Yunhua Liu
Ashley Marie Loogman
Amanda Grace Loveless
Mark Alan Lundine
Heide Macmahon
Angelo Bertolino Marney

Jacob Michael Martin
Joshua F. Martin
Mark McClernan
Kimberly McCormack
David James Miller
Joshua Miller
Reid Miller
Mohammad Mohshin
Daniel Michael Mullally Jr.
Rosa Nguyen
Nathaniel Mark Nimtz
Emmanuel Atem Njinju
Charles Nwosu
Elizabeth Nicole Orange
Katherine Peterson
John D. Platt
Samuel Pressman
Ayanna Noni Reed
Cory A. Reed
William Randell Ritz
Emily E. Rodriguez
Nikola Rogic
Garrett Schlag
Jonathan Preston Schmidt
Katarina S. Seymour
Nathaniel Patrick Shields
Bo Ra Song
Ting-Jui Song
Bradley Sparks
Hannah Carey Spiegel
Jonathan Michael Stine
Tianhaozhe Sun
Erik Tamre
Rachel Tiner
Diana Beatriz Tinoco
Jazmine Nicole Titular
Danielle Danae Torres
Cecilia Tran
Maxwell Tobias Tupper
Julie Unson
Mason William Villarreal
Dan Wang
Alexis Lea Wilson
Travis Dean Winter
Tabitha Wyckoff
Chivithaya Xiong
Shuoyu Yao
Youqiang Yu
Zoe Zeszut
Yang Zhang
Kyle A. Zulpo

Geoscience Education

Rachel Elizabeth Barrachina
Jacob P. Baynes
Marian J. Bechtel
Karson Rose Bizzell
Riley Scot Blanchard
Kelly Ann Brenner
Emma Ann Bromenschenkel
Nia M. Burnett

Mary Comfort
Kelsey Conger
Morgan L. Douglas
L. Ertolahti
Halle Feiring
Misty Marie Finley
Brianna Kaitlyn Fuller
Shelby Galvin
Ryan Gardner
Justin D. Gay
Caity Gindling
Mallorie Christina Gomez
Spencer F. Gould
Mitchell Eduard Herrmann
Peter James Holzberger
Matthew Alan Jackson
Stacia Ann Jeroulis
Jason Patrick Jones
Lucy Katherine Keehn
Daniel P. Kennedy
Devesh Khosla Sr.
Gregory T. Ladestro
Andrew Gabriel Lostetter
Carson C. Macpherson-Krutsky
Stephen Nicholas Marshall

Calif K. Tervo
Megan Thompson-Munson
Caylon Kingsley Vielehr
Tina Vo
Trevor Ziomek

Geothermal

Alexander Hudgins Black
Jesse Mason Frechione
John Earl Gorman
Dmitriy Lukashov
Sydney Olund
Geoffrey Peterson
Noah Randolph-Flagg
Garen Jan Thomas
Alex Zinck

History and Philosophy of Geology

Benjamin Nelson Broman
Martin Wilkinson

Hydrogeology/Hydrology

Kristopher Aadahl
Nur Ahmed

Top Fields of Interest

- Quaternary Geology/Geomorphology
- Structural Geology/Tectonics
- Stratigraphy/Sedimentology
- Geochemistry
- Paleoclimatology/Paleoceanography
- Hydrogeology/Hydrology

Kathrine Valdez Maxwell
Peggy Mansfield McNeal
Robert Thomas Meyer
Geoffrey Murimi Munyiri
Danette Whittle Murphy
Claire Juliet Nelson
Alisha Newton
Madeline Niles
Robert T. O'Flaherty
Onyinyechukwu Vivian
Oguadinma
Carl Peterson
Lisa Y. Puckett
Rebecca Jean Rice
Rebecca Ringler
Miles Rinne
Austin Connor Robertson
Alexander Rubenstein
Molly Magan Ryf
Rachel Leigh Salter
Raghida Sharif
Kevin Shrumm
Camille Rose Sicker
Ariana Jene Solis
Kyler B. Stanley
Jennifer Stephens

Karina Alfaro
Chelsea Ames
Sherry Andersen
Dean Jeffrey Anderson
Md. Annaduzzaman
Kaley Aposporos
Amy Lee Archuleta
Lauren Baader
Josephine Lisa Babuin
Mazlam Baftiri
Daniel Tucker Bagbey
Ransford Lewis Bailey Jr.
William B. Ballow
Herbert Pat Barron Jr.
Carly Beck
Jessamyn A. Benshoof
Lauren Marie Berrien
David John Binger
Michael J. Blonski
Philine Bogeholz
Alexander Boles
Evan Sylvester Bosinger
Kaylin Brodzki
Elizabeth Rae Brown
Katie Wurtzler Buchan
Erin Bulson

Darrik T. Burns
Ethan F. Burns
Ismena Bystron
Amanda C. Cabanillas
Jennifer E. Campbell
Olivija Cepaite
Matthew Chan
Katherine Anne Chapman
Chong Seok Choi
Catherine Anne Clerf
Julián Hiltbrand Consoli
Zachary Cope
Mackenzie Mae Cremeans
Jeff Wheeler Crompton
Edward William Czebator
Seth Davis
Dominic Decesaris
Benjamin Arden Degner
Chelsey Dewitt
Sonya Diaz
Emily Dorward
Annie Leigh Dufficy
Eric Dale Dunham
Caroline Dziak
Marisa Melody Earll
Younis M. Elmabrok
Kirstin Fairweather
Joshua Michael Feight
Anouk Laura Ferroud
Hope Fisher
Landon Gregory Doyle Fleeman
Michael Foust
Emily Fuller
Cady Gebhart
Matthew Geller
Elizabeth Gerrits
Sean Russell Gibbon
Alec Gierzynski
Christopher N. Gillotte
Patrick R. Goetz
Eli Eden Gonzalez
Michael Grocott
Eric Gultinan
Danielle Catherine Guzzardi
Alex J. Hafer
Patrick F. Haley
Rachel Hallnan
Matthew Jack Harmon
Jesse Hastings
Orion Mitchell Hatch
Justin Healey
Greyson H. Herdman
David G. Hibbard
Tyler Lee Hickok
Beth Hoagland
Elizabeth Hopper
Junhao Hu
Dante Huff
Silja Hund
Nicholas Ibanez
Max McCabe Irons

Glenn Jasechko
Chelsea Leia Jefferson
Mason Johnson
Sean Preston Johnson
Kayla B. Jones
Katelyn A. Kane
Sophie Mitsuko Kasahara
Aaron Charles Katz
Matthew Kaufman
Cody King Kazakoff
Emily Keller
Sierra Keller
Joseph J. Kennedy
Jamie Kincheloe
Kerry Leda Korpela
Natalie Joyce Kubik
Mckenzie Ann Kuhn
Kevin Jean Langlois
Matthew Larson
Brandon M. Lee
Joseph Albert Lee-Cullin
Jared Lehning
Sage Lincoln
Rochelle Linsenbigler
Stephanie Brynn Lucker
Rae-Ann Maclellan-Hurd
Fazilatun Nessa Mahmood
Victor Whitesel Major
Kyle Henderson Marchman
Michele Markowitz
Anna E. Marshall
Orieliz Yisset Martínez Román
Danielle Elizabeth Matl
William Alexander McBee II
Sheelagh May McCarthy
Marlena McConville
Porcha Keyanna McCurdy
Elizabeth Meister
Lanie Nicole Meridith
Scott Alan Merschman
Tara Metzger
Brittany Lynn Meucci
Faith Meyer
Matthew C. Michalski
Chad Mickschl
Mary Ann Middleton
Maggie Midkiff
Aaron Mohammed
Jonathan Frederick Muller
Gregory T. Myers
Leah Irene Nelson
Nora Claire Nelson
Travis Nielson
Yi Niu
Evan G. Norman
Melissa Noryk
Emily Oberhoffer
Colleen Mary O'Brien
Michael O'Connor
Ryan Ordnung
Roderick Loudon Owre

Eric Parker
Madelyn Percy
Christopher D. Philipps
Vincent Phothisene
Richard Pire
Charles John Porreca
Lucas Hunter Powell
Katie L. Pressley
Adam Price
Matthew Rebolini
Rosemary M. Records
Dillon Reio
Kimberly Anne Rhodes
Bryan Joseph Richmond
Sarah Rios
Heather Kristine Robinson
Schuyler Thomas Robinson
Angela Patricia Rodriguez
Julia M. Rosenblit
Keitasha Royal
Devon Connor Salley
Andrew Kyle Sanders
Frances Claire Saylor
Alexander Robert Scherer
Adam Paul Schreiner-McGraw
Alexander D. Schwartz
Katy L. Schwingamer
Michael Shaljian
Andrew Shannon
Lee-Ann Sills
Tyler Smith
Zackary Smith
Lauren L. Smitherman
Kelly Robin Sokolosky
Alicia Tara Solomon
Chelsea Lydeen Stephens
Richard Lane Storey
Kelli Maureen Straka
Robert John Stuetzle
Chloe Shayne Sutkowski
Kyle K. Sweeney
Brandon Edward Taft
Brandon Michael Taylor
Ann Sutton Teichmiller
Carmi Milagros Thompson
Jeffrey Scott Tinklepaugh
Manuel J. Torres
Morgan Alan Tranter
Brandon C. Tufano
Thanh Tuyet Vo
Josh Carl Voss
Samuel Wallace
Sarah Watson
Casey Watts
Jonathan M. Weatherford
Jon Weiner
Dalton Spencer Weinstein
Christina Welch
Bryan Sean White
Dustin White
Holly Wilkie

Luna K. Wilson
Alyssa N. Witt
Edward Putney Wright
Alysa Muir Yoder
Katherine Yu

Karst

Corey William Beale
Gerald Allen Buckman Jr.
Peter Eric Carlson
Allison Chase
Shannon Cirulnick
Chantelle Marie Fortier
Alexander Ralph George
Nancy Hale Lilly
Jonathan D. Mallory
Natalie Rose Packard
Samuel R. Ronca
Sasha Ryan
Robert Thomas Schaefer III
Jessica Marie Shields
Madison Nicole Spencer
Grant Spoering

Limnogeology

Claire Archer
Jordan Gibbons
Anna N. Gravina
Jemma Harrison
Shelley Ann Kielb
John Connor McNee
Anniya Preisberga
Christopher John Shea
Elena Anne Steponaitis
Abigail M. Williams

Mineralogy, Geochemistry, Petrology, and Volcanology

Ian Dwayne Ackman
Jenna Victoria Adams
Adriano Aguiar
Nicole J. Ahline
Ijaz Ahmad
Christopher Ariel Albarrán
Madison Allgaier
Nicholas Christian Allin
Camila Almeida de Albuquerque
Jennifer Lee Anderson
Molly Kassandra Anderson
Logan Antonio Andrews
Joel E. Atwood
William Lee Bailey
Jessica T. Barnes
Mike Bartkowiak
Timothy P. Bata
Patrick Claude Beaudry
Holland R. Beckens
Mary Alice K. Benson
Surjendu Bhattacharjee
Chelsea Morgan Blanton
Trenton Jay Bortz

Ahmad Boskabadi
Leah Brennan
Eloise Marie Bretagne
Jackie Brown
Colin Donald Bryden
Emma Marie Burkett
Heather Lynn Bushie
Christopher Cacciatore
Cortney Cameron
Jonathan Canon
Marjorie Cantine
Kate Carroll
Dylan Carter
Sarah Carter
Cole Joseph Ceciliani
Kevin Cherfane
Colleen Chernowsky
Konrad Chrzastowski
Colin Chupik
Michael Cloutier
Amanda Coelho
Shelby Coleman
Dylan P. Colon
Dan Conrad
Christopher Thomas Conwell
Christopher Cook
Natalie Cook
Jonathan D. Cragle
Riley Crockett
Jeffrey Todd Cullen
Nicolas Cuzzo
Jamie Cutts
Nargiz Dadashova
Jillian Theresa Mayo Daniels
Laura Thayer Davey
Anthony Davila
Clayton Scott Davis
Michael Marquise Davis
Nivea M. De Assis Magalhaes
William Dylan Degraw
Michael Thomas Delaney
Justin Miles Delgado
William Dennis-King
Meagan Elizabeth Depugh
Douglas Detraz
Sarah Marie Dillon
Jules Dim
Kyle David Dirks
Suzanna Yuhua Doak
Tyler Rose Donaldson
Thisiane Christine Dos Santos
Kalie McCabe Duccini
Colin J. Eaton
Alexander Edmonds
Laurie Eli
Laurie Mary Ellis
Justin Emberley
Margaret Engelbert
Logan Douglas Englert
Gabe Epstein
Christopher Dean Ferguson

Teo Fisher
Andrew Warner Fletcher
Neva Fowler-Gerace
Stacie K. Frew
Megan Carey Freyman
Chase A. Friedemann
Jocelyn Jane Fuentes
Ryan Vaughn Furlong
Ashraf Gafeer
Sacha Lloyd Gafinowitz
Rose Gallo
Janelle Anastassia Galster
Sasha Garcia
Andrew Cleveland Gase
Murat O. Gemici
Ashley Gerik
Anna Gerrits
Joseph Giunchigliani
Ryan Goldsby
Shantal Goldsmith
Julia Ferreira Goncalves
Rebecca L. Gonzales-Clayton
Brandon M. Governo
Natalie Gravelins
Daniel Gray
Jeremy Gray
Kayo Green
James T. Greene
Benedicte Danshoj Grøtner
Xin Gu
Michael Andrew Guido
Tural Gurbanov
Daniel Haber
Rebecca Mary Hahn
Lydia Harmon
Sharon Harris
Laura Hartman
Rachel Elspeth Haynes
David L. Healey
Corey M. Hedges II
Christen Elena Helou
Heather Herinckx
Katherine Herries
Brianna Hill
Sarah Catherine Hill
James L. Hodge
Alisia R. Holland
John Walter Hollingsworth
Ross Holter
Ashley Diane Horton
William L. Hoskins
Colby Ryan Howland
Huanting Hu
Ellyn Gestwick Huggins
John W. Huson
Aslyn Elise Hutson
Benjamin Hutter
Hunter S. Jackson
Hehe Jiang
Shiyun Jin
Cody M. Johnson

Rachel E. Jolly
Jennifer Jurnack
Christopher Kanter
Krystal Kay Kauffman
C. Brenhin Keller
Gary Kelner
Jessica Colleen Kinninger
Stephanie Rose Kitowski
Benjamin Klein
Sally Pamela Klein
Raleigh Koeberle
Donald Qualey Koepp
Charles W. Kosman
Karolina Kosminska
Kaylee Helena Kraft
Susanna Torrey Kreinik
Daniel Philip Lapikas
Jennifer Lemke
Madeline Janine Lewis
Gen Li
Charles M. Lindner
Jake Lindsey
Timothy John Litz

James Watson Mize
Nichole L. Moerhuis
James Molloy
Grant H. Montieth
Claudia Grace Moore
Savannah Layne Morales
Daniel C. Morris
Rebecca Anne Morris
Sydney Morrow
William Curley Moynihan
Andrea Mundl
Autumn Skye Murray
Allison Murrie
Morgan W. Nasholds
Joseph Natale
McKay Nelsen
Ross Nelson
Cina Leigh Noel
Ashley Norris
Victoria Grace Oberc
Elsie Ekene Okoye
Lauren Elizabeth Oldfield
Brandon Oliff

GSA GeoCorps™ America and National Park Service—GSA Mosaics in Science

- 180+ GeoCorps™ America geoscience opportunities filled
- 26 Mosaics in Science interdisciplinary science opportunities filled
- Projects on more than 50 National Parks, 15 BLM lands, and 10 U.S. Forest Service sites
- US\$850,000 in allowances to member participants, averaging US\$4,400

Brian Longstreth
James Loveland
Man Lu
Jordan E. Lubbers
Erica Lynn Maletic
Victoria Maneta
Patrick Avery Manselle
Leandra X. Marshall
Paola Macarena Martinez
Erica Massey
Donald Maute III
Ian C. McBride
Dalton Miles McCaffrey
Heather Jeanne McCarthy
Charles Zachary McCartney
Samantha M. McLaughlin
Kathleen A. Meierdiercks
Evan Martin Melquist
Casey Leigh Michalowski
Dejan Milidragovic
Brittany Miller
Kelly E. Miller
Kristoffer Miller
Martha L. Miller

Danielle Olsen
Ellen Kristine Olsen
Daniel L. Orazi
Sarah Andra Ostertag
Brenda Pack
Robert William Page
Fagalima L. Paleafei
Ryan Panasy
Matthew Paris
Mark Patterson
Justin Paydock
Kenneth James Peterman
Gardner Hart Pierson
John D. Pilewski Jr.
Sid Mathew Pinkerton
Erica Pitcavage
Aaron Kayne Prock
Claire Rabine
Margo Regier
Jessa Marie Rizzo
Courtney Robertson
Ulysses Cheyanne Rodriguez
Camilo Alejandro Romero
Avery Daniel Roney

Richard L. Rowland II
Deidra Marie Rowley
Bethany Ann Royce
Emily Elizabeth Salings
Rhett D. Schley
Tyler Schlieder
Kristin M. Schnalzer
Jessica Christine Scholz
Aaron D. Schwab
Benjamin Bertram Seiderman
Ann Taylor Shields
Isaac John-Peter Simon
Jonathan Smeltz
Ali Cait Smith
Cody Smith
Anthony Diego Naves Spanakis
Emma Sofia Sosa
Paul Graham Starr
Philippa Skiles Stoddard
Samantha Stone
Ashlyn K. Stromgren
Amy Sullivan
Matthew Gordon Sumner
David Robert Sutterfield
Vanessa Marie Swenton
Drew Daniel Syverson
Lindsey Alexandra Tallman
Joseph Connor Taylor
Tze Yi Teh
Holly Katherine Theobald
Alyson Ryan Thibault
Graham Thomas
Robin Haley Thomas
Nathan Scott Tripp
Adam Turner
David J. Turner
Hope Turner
Lauren K. Ulbricht
Oscar Valencia Jr.
Cole Valentino
Michael Scott Vandervert
Grace E. Vandervort
Mellissa Moniche Verkest
Jamie Vornlocher
Corey James Wall
Blake M. Wallrich
Emily Danielle Ware
Stephen N. Warta
Bryan A. Wathen
Jessica Welkey
Taylor L. Westlund
William Taylor Whalen
Matthew Ryan Williamson
Nicole Williamson
Alexander Michael Wilson
Jared William Wilson
Sam David Wolansky
Dan Woodell
Candace M. Wygel
Ying Xia
Yunan Xie

Kristie Lynn Yager
David O. Zakharov
Md. Mashrur Zaman
Bei Zhu

Oceanography/Marine Geology

Jasmine Allen
Emily Grace Artruc
Paulina Marissa Capar
Katherine Carruth
Amber Marie Carter
Samantha C. Carter
Adam Thomas Cooper
Samantha Lynne Cooper
Victoria Elizabeth Coraci
Risa Dalsing
Anna Degeorge
Hiram Dunn
Alexandra Figueroa
Erik Hartley Fleming
Sloane G. Garelick
Nicholas Robert-William
Giegerich
Nathan Henry Goldstein
Joe Gradone
Marshall L. Grossman
Steven Bryan Grune Jr.
Shannon Nicole Hammaker
Shannee Lee Harbaugh
Elyzabeth Hendricks
Meghan Caitlin Horgan
Herbert Daniel Hughes III
Kuo-Wei Hung
Robert J. Hunter
Emily Levin
Gerhard Maale
Andrew Rae Mahoney
George B. Marino IV
Riley Sparks Martin
Ian Joseph Matsko
Laura Rose Maust
Morgan McCarthy
Emma McCully
Giulia Margaret Morrone
Miles Neilson
Nicholas A. O'Mara
Nancy M. Padilla
Matthew Petroff
Paul Prevou
Kalpani Manurangi Ratnayake
Serginio Remmelzwaal
Monique Johanna Ruhl
Susan Schnur
Robert James-Henry Serino
Bethany Renee Shaffer
Justin Shawler
Myranda Lee Stark
Rachel B. Stearns
Lexie Stodden
Mary Margaret Stoll
Hui Tang

Kevin Jacob Vanmatre
Sheana Marie Walsh
Michael S. Weinzierl
Alexandra N. Wernlé
Cameron James Whitley
Joshua Williams
Martin J. Wolf
Nicky Wright

Paleo-Sciences

Heda Agic
Anna Agosta G'meiner
Daniel Eric Barta
Christine Bassett
Elizabeth Joanne Bauder
Brian J. Beaty
Elizabeth Kathlene Benyshek
Mireya Berrios
Jake Biewer
Thomas Howard Boag
Emily Louise Bogner
Alejandra Borunda
Allison Whitney Bronson
Robert Patrick Brothers
Elizabeth Bullard
Thomas Robert Buskuskie
Sara Marie Campkin
Jessica Chu
Terry Coyle
Peter Crockford
Reid Cummins
Lauren Curry
Anastasia Y. Danilova
Marissa Anne Davies
Catherine V. Davis
Kristin Deutsch
Casey D. Dooms
Chris Kenneth Driesbach
Grace Conover Duke
Caitlin Elverson
Mackenzie Connor Englund
Erica Evans
Seth Evans
Dina M. Fieman
Carolyn S. Fortney
Chelsea Frazer
Johnathan J. Freebern
Paige Funkhouser
Thomas Michael Gaetano
Ellen Gales
John Emerson Gallucci
Ian Garofalo
Bryan Gee
William Bernard Gelnow
Kate Gigstad
Aaron Michael Goodman
John Grady
Dulcinea V. Groff
Carla J. Harper
George William Mallory
Harrison IV

Michael Christopher Hawkins
Reilly F. Hayes
Steven Todd Hensel
Alexander D. Horaz Sr.
Carrie Elizabeth Huffman
Anna Jay
Heather Jewell
Scott Robert Johnston
Rachel Rose Jones
John C. Kearney
Benjamin Keisling
Jonathan Stanford Keller
Bridget T. Kelly
Hana Kiewicz-Schlansker
Sedona King
Logan Isaac Knowles
Alysia Korn
Chaz C. Kuhlman
Katherine Kuklewicz
Joshua Laird
Anne Leclair
Ruth Ellen Letson
Christopher Shady Scott Lewis II
Megan Litwinczyk
Vanessa Londono
Kelly Lubbers
Robert Courtland Lyle
Arjan Mann
Ryan Allen Manzuk
Alana McGillis
Katherine Chandler McLellan
Caitlin A. Meadows
Dalton Lee Meyer
Dylan J. Mills
Leslie Marie Montoya
Connor Moore
James Dustin Naquin
Julianne M. Nawiesniak
Samuel Harrison Neely
Anna Nesterovich
Willow Nguy
Connor Andrew Nitti
Jake Oakes
Danielle Oberg
Morgan Elizabeth Oldham
Jeff Osterhout
Alex Michael Palacio
Anthony Raymond Papaccio
Lauren Elizabeth Parry
Ravindra Pathare
Danielle Makana
Peltier-Thompson
Stephen E. Perdziola
Alexander Spence Peters
Trevor D. Pontius
Andrea S. Price
Jenny Rashall
Thornton Robert Raskevitz
Colter W. Reed Sr.
Katherine Jane Reuter
Reid Lanaghan Robinson

Angela Rooker
Xiomara Pearl Rosenblatt
Alexander Jon Ruger
Michael Rutana
Michelle Nicole Sabo
Sabeeha Safi
Erin Blake Schuster
Elliott Armour Smith
Eric Jason Smith
Laura Elizabeth Speir
Shawn Stabile
Cassandre Rose Stirpe
Michael Strange
Kyle Robert Strong
Jana Suchocka
Sergio Sudarsky
Colin B. Sweeney
Anne Elizabeth Tamalavage
Mikayla M. Thomas
Carolyn Thornton
Emily Dawn Thorpe
Christie E. Torres
Katherine Antonia Turk
Amy Elizabeth Wakefield
Alexander Forster Wall
Daryl Georjeanne Walters
Zander William Warren
Emily Weaver
Anna M. Weiss
Abagael R. West
Derrin Richard Whitehead
Sarah J. Widlansky
Shawn M. Woll
Arielle Woods
Benjamin Nate Zalneraitis
Ning Zhao

Planetary/Space Science

Teresa D. Avila
Brian Edgar Bales Jr.
Madison Mitchell Ball
Lindsey Boyle
Montague Delano Brantley III
Nathan L. Brown
Scott Russell Carmack
Julian Matthews Chesnutt
Christina Marie Comuso
Christine Conner
Aaron Coots
Kendell Cozart-Middleton
Samantha W. Eckes
Elizabeth Eddings
Brittney Emmons
Travis Saint James Gabriel
Ariel Clayton Delacruz Garong
Andrew Graber
Justine G. Grabiec
Anna Grau Galofre
Garth R. Groshans Jr.
Norland Raphael Hagen
Rachel Hampton

Julia Ann Heydenreich
Jennifer Humphreys
Jack Iseman
Katelyn Noel Kennedy
Lisa K. Korn
Sarah Nicole Lamm
Zac Yung-Chun Liu
Connor F. Lynch
Kimberly Louisa Maccini
Audra N. Mann
Deanna Lynn Mantooth
Craig Robert Martin
Ellie Leslie Masters
Anna Mittelholz
Minda J. Moe
Pedro Esteban Montalvo
Dustin Kurt Morris
Kathleen O'Connell Nahodyl
Leah Claire C. Newman
Richard Alexander Ng-Yow Jr.
Viranga Perera
Scott M. Perl
Kristyn Rodzinyak
Aaron Scheinberg
Hiruni C. Senarath Dassanayake
Joshua Smith
Justin Snook
Jonathan Cordel Stanfield
Vivian Zheng Sun
Allen Peter Tevyaw II
Nicholas Thiabult
Felix Thieme
Montanus Michael Trammell
Emily Robin Weddle
Danika Wellington
Macy Whitacre
Nathanael Wigton
Wesley Yates

Policy/Regulatory

Nell Bender
Karriem Harris
Rosa Lehman

Quaternary Geology and Geomorphology

Paul Alessio
Brendan A. Anzures
Abra Atwood
Rachel Louise Bain
Sasiri Bandara
Eric Barefoot
Jennifer Bloom
Nickolas Bradley
Austin Canty
Elizabeth Chamberlain
Christine Yifeng Chen
Kristin Chilton
Matthew Chad Chrnalogar
Rachel J. Comp
Megan Casey Corcoran

Christopher James Cornette
Amanda Lorraine Couch
Emily Crampe
April R. Dalton
Shyam Das-Toke
Emily Dektar
Amelia Elizabeth Deuell
Brendan Salvo Dilloughery
John Robert Dilworth
Laura Catherine Dorsch
Madison Douglas
Helen G. Doyle
Kristen Fauria
Ryan Filbin
Christopher G. French
Joseph Leo George
Daniel Gregory
Glenn Hall
Rebecca Hammer-Lester
Austin Miguel Hanson
Stephanie L. Heath
Lisa Hettrich
Tyler J. Hodder
Macy Howell
Jessie Robert Hughes
Alexis Iwasiw
Marc Jaffrey
Kaitlyn James
Jabari Coleman Jones
Keith McBride Kantack
Rachel E. Kinney
Kelly Kochanski
Alexander Koiter
Marcus James Langevin
Fei Ma
Erin Markey
Hannah Marshall
Hector A. Antonio Martinez de la Torre
Shannon Marie McCaffrey
Casey McGuire
Sasha McLaughlin
Grace Elizabeth Medley
Jordan R. Mertes
Nikolas Connor Midttun
Nathaniel Arthur Mitchell
Antoine Morissette
Claire Morris
Gregory Myers
Catherine Opalka
Elizabeth Orr
Jin-Si Rose Over
Ronald Wayne Peery III
Noel L. Potter
Brendon James Quirk
Matthew Renquist
Brenna Rodriguez
Bruno L. Rodriguez Jr.
Luc Rondeau
Deirdre D. Ryan
Sourav Saha

Christopher Sheehan
John D.B. Stephens
Michael Stanley Stone
Sondra Tanji
Jessy Van Horn
Faye Lynn Visco
Yiran Wang
Alfred John Ward
Logan Reed Wetherell
Will Wicherski
Qiang Yao
Nick Richard Yeiter
Lauren E. Yu Blythe
Yu Zhang

Seismology

Kelsey Stuart Berger
Kyle Joseph Bunte
Joshua Stephen Franck
Carrie Garrison-Laney
Jeffrey Kinney
Matthew C. O'Leary
Vipul Silwal
Austin Stout
Nicholas Voss
Dandan Zhang

Soil Science

Mari Lauren Fromstein
Emma Fulop
Katherine E. Grant
Laura Hoefler
Christina Rhea Judas
Gabriela Paz Leyton-Nolan
Xiaoyu Lu
Jane Manning
Leah M. Marko
Nicholas Ross Patton
Andrew Allen Poindexter
Linda M. Waters
Heather Watson

Stratigraphy/Sedimentology

Conner J. Adams
Fatimah T. Alasadi
Tadesse Berhanu Alemu
Viviana Aluia
Michiel Arts
Elizabeth Filiz Lindsay Atar
Sameer Baral
Joseph Prescott Barns
Tushar Bishnoi
Elizabeth Borucki
Emilie Elisabeth Bowman
Trevor Nulton Browning
Marie Busfield
Kristina Butler
Miranda Nichole Childress
Charlie Chou
Megan Clevenger
Preston Scott Cook

Benjamin Gordon Daniels
Kimber De Salvo
Nicole Desko
Rebecca Eiden
John Idoko Ejembi
Ahmed El Belasy
Jake Emmert
Rattanaporn Fongngern
James R. Foote
Clayton Ford
Matthew Fox
Oliver J. Friesen
Gabriel Gallegos
Kevin Gardner
Andrew Cameron Gibson
Brett Richard Gildner
Richard Goldberg
Donald R. Grover Jr.
Grégoire Guillet
Kyle Mathew Halat
Bolton John Howes
Tarig Ibrahim
Shakura Jahan
Robert N. James
Wei Ji
Chance Dylan Jones
Aaron Kahn
Joel David Kane
Matthew P. Kaplan
Nabeel Khan
Hayley Knouff
Alexander Robert Koch
Woong Mo Koo
Nicholas Joseph Krohe
Brian Shelby Lainhart
Bailey Anne Lathrop
Meagan Lenna
Anna Lesko
Dakota Raine Lindsey
David Arthur Little
Jose Raul Llaguno
Hayden Charles Malloch
Jennifer M. Marin
Weston Cameron Martin
Elizabeth McComb
Julia McIntosh
Mahmoud M. Mohamed
Bronwyn Moore
Carolina Morales
Sarah Munn
Frank Napkora
Amanda O'Connor
Soty Odoh
Amy Parker
Rayford Dean Parnell
Christopher Ryan Pate
Joseph Lee Perry
Michael J. Petro
Martin A. Pidel Sr.
Audrianna Pollen
Jillian Powers

Tammy Prescott-Fink
Felipe Aquiles Ramirez
Andrew Raulerson
Kyle William Rowinski
Alexandra Carranco Ruiz
Morgan Jane Sandritter
Tim Shaban
Shelby Elizabeth Shipley
Jesse Dean Scott Shumway
Fabio Simplicio
Kelsey Smestad
Bernard Jakob Smith
Curtis Smith
Jeffrey Snowden Jr.
Daniel T. Sochko
Stephanie Charlene Stewart
Jonathan Sulaica
Shanon Taylor
Philipp Tesch
Eric Timmer
Lilla Tokes
Siboney Trevino
Jake Hutchinson Turner
Trevor Tuttle
Thomas Robert Voigt
Christopher B. Waid
Jenna West
Chad Wood
Jeffrey Alan Woodall II
Yang Xu
Lizhu Yu
Xin Zhan

**Structural Geology and
Tectonics**

Ashley S. Ace
Remziye Akdo
Hafiz Umair Ali
Stephen Angster
Chad Arnhold
Jeremy Alan Ashburn
Christopher Barnes
Nicolas C. Bartschi
Olivia Beaulieu
Tessa Shea Begley
Gourab Bhattacharya
Alena Bibikava Jr.
Christopher James Blade
Katherine Boot
Anna Elizabeth Borch
Somiddho Bosu
Samantha Brickles
Lindsay Rose Caves
Guifan Chen
Jonathan Andrew Clark
Cody Lee Colleps
Kenton Crabtree
Benjamin L. Davis
Troy William Day
Brian Peter De Corte
Catherine Dunn

Andrew Evans
Alexa R. Everson
Athena E. Eyster
William Charles Farrell
Steven B. Felix
Paula Fleischmann
Helen D. Flynn
Daniel Joseph Foley
Blake Foreshee
Danny Wayne Fulton
Elizabeth Gant
Nicolas Garibaldi
Bridget Colleen Garnier
Becky Garriss
Michelle M. Gavel
Mark George
Saurabh Ghanekar
Sophia Gigliotti
Danielle Joanna Gorder
Jeremy Wade Greene
Michelle Harb
Rebecca Hardie
Xinran He
Robbie N. Helgason
Scott Hensel
Reina Hiramatsu
Devin Mikel Hobbs
Jack Ryan Hoehn
Brittany Huerta
Yirang Jang
Martyn Andrew Jaquez
Jonah Jordan
Arjun Kumar KC
Shashank Khatri
Kristin Koehler
Claire A. Kojaian
Rachael Kramer
Bailey Kudla-Williams
Robin Rae Kuharski
Bryce Lawrence Kujawa
Heunggi Lee
Joel S. Leonard
Angela J. Linder
Peter Edward Linton
Chao Liu
Eric Lunn
Amanda Lupardus
Chelsea Mackaman-Lofland
Melissa Anne Magno
Brian Nicholas Marion
Eric Kenneth McDonald
Lisa Anne Millar
Shawn Mines
Kelford Mitchel
Rachel L. Moran
Mahmud Muhammad
Caelan James Murphy
Rosa Elizabeth Murrieta
Erin A. Nebel
Jung Rae Noh
Savannah Leigh Norvell

Kathryn Nunez
Emmanuel Kwesi Nyantakyi
Margaret L. Odium
Nicholas Tyler Ogasa
Soledayo Samuel Olagbegi
Zac Olds
Ivan D. Ortiz Sr.
Graham Gear Oxman
Andrew Michael Parent
Michael Scott Parton
Julia Pickering
Deanna Lynn Pietkevich
Jordan Piper
Rosa Polanco Ferrer
Thomas Price
Allison Prizlow
Lynda L. Protzman
Ani Pytlewski
Brandon Rasaka
Matthew Douglas Raymond
Grant Rea-Downing
Katy Nicole Reminga
Ryan Morgan Revette
Rebekah Riemann
Nicolas M. Roberts
Davi Rodrigues Damasceno
Tristian Alexander Rojas
Celia Roth
Yanira Santiago Perez
Krista Lynn Sierra Sawchuk
Luke Schranz
Brian J. Schrottenboer
Drew R. Schwab
Christine Shiels
Ana Carolina Calderaro Silva
Eric Simpson
John R. Skoff
Hannah Marie Slover
Mabel M. Smebakken
Zachary P. Smith
Alison Spain
Shravya Srivastava
Andrew Jont Stevens
Amanda Dean Strickland
Nicole Whitfield Stubbs
Yanpeng Sun
Chase Nicolaus Svoboda
Laura Tait
Lucia Maria Theny
Janelle Kathryn Thumma
Leif Tokle
Richard Reid Trippe
Marvin Mark Turner
Haw Tzou
Tommy Walsh
Xuetong Wang
Alex C. Ward
Andrew K. Webb
Garic R. Williams
Christina Rose Woltz
Taylor Watson Woods

Victoria E. Worrell
Kou Yang
James Yelverton
Seungwan You
Darby E. Young
Erin Elisabeth Young-Dahl
Anne Zegers
Tina Zeidan
Huining Zhang
Weicheng Zhang
Vincent Zhao

Other Professional Interests

Naomi Rose Adler
Sean Michael Anderson
Ryan Bachynski
Jessica Anne Badgeley
Daniel R. Baisley
Anthony Banks
Seth A. Barot
Michael Barr
Eva Biedron
Micaela Mae Brevig
Joshua Brown
Abby Sarah Burlingame
Alejandra Cartagena Sierra
Christina Noel Cauley
Lacey Chalmers
Eric Chaney
Brandon Christy
Cassandra Cosans
James Crowell II
Abby Dennett
Emily Doyle
Mohammad Amjad El-Najjar
Hunter Ray Evans
Matt Aren Friduss
Goetz G. Galuba
Greta H. Garvey
Alexander Philip Hammond
Garrett Franklin Heath
Ella Ann Holme
Julianna Horgan
Grant Horner
Leah Marie Houser
Heath Aaron Hurst
Peter Illig
Jacqueline Marie Innella
Kevin Michael Jackson
Jeffery Joseph III
Keith William Kastama
Lakota Sage Keith
Abby Rose Kenigsberg
Alex Lausanne
Karen Linares
Jonathan Neil Luczak
Daniel Faber Manning
Manuel Martinez III
Tessa Anne Matthews
Megan Emily McEvers
Maya Midzik

Shelby Rae Mims
Erin Minuth
Justin Moore
Danielle Lauren Moran
Lukas Jakob Mosser
Soichiro Muta
Kevin Pham Nguyen
Stephanie Nichols
Morrison Robert Nolan
Kelly Nuccio
Kristina K. Okamoto
Benedict Romuald Pucilowski
Chelsea Raley
Jamie Recio
Michael Reed
Steven M. Richardson Jr.
Juan Francisco Rivera-Urdaz
Sophie Ninozcka Rodriguez
Mikah Schlesinger
Shon Shabari
Ryan Dean Shell
Hope Sisley
Julia Skrovan
Charlie Sliger
Zachary Smith
Sarah Sparhawk
Stephanie Ann Sparks
Natalia Tenorio
Kalyn Tew
Yael Toren
Seher Unlu
Meredith Chelsea Vaughn
Marissa Von Nessi
Janna Wale
Michael John Wallace Jr.
Amy Weaver
Ellen Weiner
Michael Weiss
Steve Wiesen
Alexandra Shirley
Winter-Billington
Sydney Alexa Workman
William Yeung
Adam C. Yoerg
Erica Zweifel

K-12 TEACHERS

Michael W. Baer
Britany Block
Ella F. Bowling
Wendy Bramlett
Briana Brown
Michelle L. Burton
Catherine T. Carpenter
Rita Chang
Gisele De La Cruz
Michael John Gay
Mahmoud Gharavizadeh
Martha Hoyt Goings
Victoria Gorman

Donna Governor
Eduard Remacha Grau
John H. Haley
Joseph M. Hartley
Jessica Jordan
Darren Kellerby
Tom Lyman
Greg Magnan
Brian Mcmichael
Denise Monte
Susan Niederberger
Heather Offen
Laura A. Orr
Mark J. Percy
Rob Radnich
Kelly Rash
Keni Rienks
Donya Stevenson Riles
Francisco Sanchez-Menendez
Jodi Sandler
Nicholas Andrew Soltis
Randell Eugene Taylor
Mark Allen Townley
Wendell H. Turner Jr.
Ilich Sebastian Villamizar Solano
Sue Walker Waber
James Werner
Lawrence R. Witt III
Tina Marie Wolfe
Frank F. Yulo
Debra L. Zolynsky

AFFILIATES

David Andersen
Michael F. Ballard
Kimberly Irene Batdorf
Veronica Bedoya
André Blair
Erik Boerboom
Melody S. Branch
Daniel Brendle-Moczuk
Philip J. Caldwell
John W. Carpenter
Michael Bennett Carson
Katie Colbert
Patricia Coleman
Ian M. Comings
Steve Cotterill
Miriam Grace Crespo
Kenneth M. Dymond
Nan Fischer
Monika Freyman
John Giziewicz
Tiffanie Glaze
Charles Berly Gorham
Daniel Guy Hernandez
Harold Hewitt
Edward Horton
Carol Ie

Thomas Infurna
Janell R. Kerr
Eric A. Kreuter
Nicholas Jan Kwiatkowski
Erik B. Lawson
Cynthia Fay Maher
Patricia Martínez-Alvarez
Osvaldo Meireles
Sarah Elizabeth Melton
Paul Monroe
Michael J. Moravan
Edward C. Robeck
Don Rosso
Rob Specter
Sandra B. St. Laurent
Adejuyigbe Olumide Sunday
Richard Turner
Stephen Wood



IN MEMORIAM



The Society notes with regret the deaths of the following members (notifications received between 27 Feb. and 30 Apr. 2015).

Thomas E. Ackart

Cedar City, Utah, USA
Date of death: 20 June 2014
GSA notified: 10 Mar. 2015

Robert L. Akright

Littleton, Colorado, USA
Date of death: 13 Nov. 2014
GSA notified: 16 Mar. 2015

Charles C. Almy Jr.

Greensboro, North Carolina, USA
Date of death: 9 Nov. 2014
GSA notified: 9 Mar. 2015

Robert A. Berner

North Haven, Connecticut, USA
Date of death: 10 Jan. 2015
GSA notified: 25 Apr. 2015

Albert V. Carozzi

Raleigh, North Carolina, USA
Date of death: 5 July 2014
GSA notified: 16 Mar. 2015

John K. Costain

Blacksburg, Virginia, USA
Date of death: 24 Mar. 2015
GSA notified: 30 Mar. 2015

Bernard J. Cunningham

Canyon, Texas, USA
Date of death: 21 Nov. 2014
GSA notified: 10 Mar. 2015

Weldon D. Frankforter

Wyoming, Michigan, USA
Date of death: 4 Nov. 2014
GSA notified: 16 Mar. 2015

Philip R. Grant Jr.

Colorado Springs, Colorado, USA
Date of death: 1 Dec. 2014
GSA notified: 16 Mar. 2015

Frederick R. Haeberle

Delaware, Ohio, USA
Date of death: 24 Mar. 2015
GSA notified: 3 Apr. 2015

Donald C. Haney

Richmond, Kentucky, USA
Date of death: 8 June 2014
GSA notified: 16 Mar. 2015

Robert B. Johnson

Fort Collins, Colorado, USA
Date of death: 28 Mar. 2015
GSA notified: 22 Apr. 2015

Charles F. Kahle

Bowling Green, Ohio, USA
Date of death: 7 Feb. 2015
GSA notified: 10 Mar. 2015

Ronald W. Kistler

Menlo Park, California, USA
Date of death: 30 Oct. 2014
GSA notified: 16 Mar. 2015

James E. Kline

Bedford, New Hampshire, USA
Date of death: 15 Mar. 2014
GSA notified: 11 Mar. 2015

John P. Pete Laux III

Denver, Colorado, USA
Date of death: 6 Feb. 2015
GSA notified: 22 Apr. 2015

Kenneth V. Luza

Norman, Oklahoma, USA
Date of death: 23 July 2014
GSA notified: 11 Mar. 2015

Robert H. Moench

Boulder, Colorado, USA
Date of death: 1 Oct. 2014
GSA notified: 11 Mar. 2015

George E. Moore

Ouray, Colorado, USA
Date of death: 31 Mar. 2014
GSA notified: 27 Feb. 2015

Richard J. O'Connell

Cambridge, Massachusetts, USA
Date of death: 2 Apr. 2015
GSA notified: 7 Apr. 2015

Franklin Howard Olmsted

Palo Alto, California, USA
Date of death: 14 Mar. 2015
GSA notified: 19 Mar. 2015

Donald B. Potter

Clinton, New York, USA
Date of death: 20 Jan. 2015
GSA notified: 12 Mar. 2015

Joseph J. Sample

Pangman, Saskatchewan, Canada
Date of death: 13 Feb. 2015
GSA notified: 1 Apr. 2015

John J. Schulte

Casper, Wyoming, USA
Date of death: 29 Oct. 2014
GSA notified: 17 Mar. 2015

Howard R. Shifflett

Huntington Beach, California, USA
Date of death: 24 May 2014
GSA notified: 17 Mar. 2015

William Spackman Jr.

Wilmington, North Carolina, USA
Date of death: 13 Mar. 2014
GSA notified: 11 Mar. 2015

Robert T. Terriere

Lakewood, Colorado, USA
Date of death: 20 Nov. 2014
GSA notified: 17 Mar. 2015

Thomas L. Thompson

Arvada, Colorado, USA
Date of death: 22 Jan. 2015
GSA notified: 13 Mar. 2015

John Thrailkill

Saint Augustine, Florida, USA
Date of death: 14 Feb. 2014
GSA notified: 13 Mar. 2015

J. Douglas Traxler

Pacific Palisades, California, USA
Date of death: 9 Feb. 2015
GSA notified: 11 Mar. 2015

John G. Weihaupt

Evergreen, Colorado, USA
Date of death: 15 Sept. 2014
GSA notified: 22 Apr. 2015

Robert J. Wright

Bethlehem, Pennsylvania, USA
Date of death: 17 Oct. 2014
GSA notified: 17 Mar. 2015

Dan Yaalon

Jerusalem, Israel
Date of death: 29 Jan. 2014
GSA notified: 30 Apr. 2015

Paul W. Zimmer

Boise, Idaho, USA
Date of death: 31 Dec. 2014
GSA notified: 27 Feb. 2015

To honor a friend or colleague
with a GSA memorial, please go to
[www.geosociety.org/pubs/
memorials/mmlGuid.htm](http://www.geosociety.org/pubs/memorials/mmlGuid.htm) to learn how.

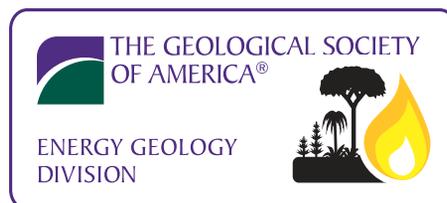
Contact the GSA Foundation,
www.gsafweb.org,
if you would like to contribute to the
Memorial Fund.

As Energy Use Changes, So Does GSA's Second Oldest Division

Lois Yoksoulian, *Division Secretary, University of Illinois at Champaign-Urbana*; and **Jen O'Keefe**, *Division Chair, Morehead State University*

The Coal Geology Division of The Geological Society of America is proud to be the second oldest Division within the Society. Since its inception in 1954, the primary focus of the Division has been North America's major energy resource: coal. However, as the nation's energy sources evolve, so too do the research interests of our members. The Division has been active in many aspects broadly defined as "energy geology" for a long time, as seen in the diversity of topics covered in past sponsored and cosponsored conference sessions, including mine fires, petroleum geology, black shale petrology, geologic carbon sequestration, and environmental issues related to fossil fuel use—in addition to more traditional coal topics. This move toward the Coal Geology

Division's recognition and inclusion of a more diverse energy research spectrum has been maturing since the late 1990s and has been punctuated by many lively discussions along the way. In 2014, we celebrated our 60th anniversary as a Division by looking forward: Members present at the annual business meeting voted to change the name of the Division to better reflect our members' diverse scientific practices and our likely direction of future growth. That direction, though, being so very interdisciplinary, made choosing the right name quite challenging! The division leadership voted among themselves and settled on the name **Energy Geology Division**. This name was put to a vote, and we are happy to announce that it was approved by 80% of the voting Coal Geology Division membership in late March of this year and was approved by GSA Council this past April. We look forward to another 60 years of supporting interdisciplinary energy research within and through The Geological Society of America. Please join us at 5:30 p.m. on Tues., 3 Nov., at the Annual Meeting in Baltimore to introduce yourself and celebrate our next step toward the future!



CALL FOR NOMINATIONS & APPLICATIONS

MINERALOGY, GEOCHEMISTRY, PETROLOGY, AND VOLCANOLOGY (MGPV)

Nominations due 15 July

Submit nominations to J. Alex Speer, Mineralogical Society of America, 3635 Concorde Pkwy, Suite 500, Chantilly, VA 20151-1110, USA; jaspeer@minsocam.org. For more information, go to www.geosociety.org/divisions/mgpv/awards.htm.

MGPV Distinguished Geologic Career Award

This award goes to an individual who, throughout his or her career, has made distinguished contributions in one or more of the following fields of research: mineralogy, geochemistry, petrology, volcanology, with emphasis on multidisciplinary, field-based contributions.

MGPV Early Career Award

This award will go to an individual near the beginning of his or her professional career who has made distinguished contributions in one or more of the following fields of research: mineralogy, geochemistry, petrology, and/or volcanology, with emphasis on multidisciplinary, field-based contributions. Nominations are restricted to those who are within eight years past the award of their final degree. Extensions of up to two years will be made for nominees who have taken career breaks for family reasons or because of serious illness.

KERRY KELTS AWARD

Application deadline: 31 July, midnight EST

Applications are invited for the Kerry Kelts Research Awards of the GSA Limnogeology Division. This year, one award of US\$1,000 for undergraduate or graduate student research related to limnogeology, limnology, or paleo-limnology is available.

Prepare your application as a PDF (or PDFs) with your last name in all file names. The application file should contain a research summary and a short CV (two pages max.). The research summary must include a description of the proposed research, its limnogeological significance, why the award funds are needed for the project, and a brief description of the student's other funding sources. Be sure to include a title. The maximum length for the summary is five pages, including figures and captions; the list of references cited is not included in this limit. Send your application to Division Chair Joop Varekamp, jvarekamp@wesleyan.edu. Please include "Kelts Award application" in the subject line.

GSA and the Limnogeology Division hope to increase the number of Kelts awards, named for visionary limnogeologist and inspiring teacher Kerry Kelts, in the future. If you can help support this award, please send your donation, labeled "Kerry Kelts Research Awards of the Limnogeology Division," to GSA at P.O. Box 9140, Boulder, CO 80301-9140, USA.

Meet Your Fiscal Year 2016 Officers & Councilors

GSA OFFICERS

Term: July 2015–June 2016



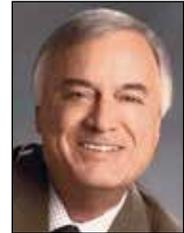
PRESIDENT
Jonathan G. Price
Jonathan G. Price LLC
Reno, Nevada, USA



**VICE PRESIDENT/
PRESIDENT-ELECT**
Claudia I. Mora
Los Alamos National Laboratory
Los Alamos, New Mexico, USA



TREASURER
Bruce R. Clark
The Leighton Group Inc.
Irvine, California, USA



PAST PRESIDENT
Harry (Hap) McSween
University of Tennessee–Knoxville
Knoxville, Tennessee, USA

GSA COUNCILORS

CURRENT GSA COUNCILORS

Term: July 2012–June 2016



Isabel P. Montanez
The University of California at Davis
Davis, California, USA

Term: July 2013–June 2017



Elizabeth J. Catlos
The University of Texas at Austin
Austin, Texas, USA

Term: July 2014–June 2018



Timothy J. Bralower
Pennsylvania State University
University Park, Pennsylvania, USA

NEWLY ELECTED GSA COUNCILORS

Term: July 2015–June 2019



Frank J. Pazzaglia
Lehigh University
Bethlehem, Pennsylvania, USA



Marilyn J. Suiter
Arlington, Virginia, USA



John J. Clague
Simon Fraser University
Burnaby, British Columbia, Canada



Anke Friedrich
Ludwig Maximilian University
of Munich
München, Germany



Christopher "Chuck" Bailey
College of William & Mary
Williamsburg, Virginia, USA



William W. Simpkins
Iowa State University
Ames, Iowa, USA



Neil Fishman
Hess Corporation
Houston, Texas, USA



Stephen G. Pollock
University of Southern Maine
Gorham, Maine, USA



Mary J. Kraus
University of Colorado
Boulder, Colorado, USA



Susanna Whitman Blair

A Keystone Recap

One of the largest pieces of legislation I have worked on was the Keystone XL Pipeline Approval Act, S.1., introduced in the Senate on 6 Jan. 2015. This bill would allow for the expansion of the Keystone Pipeline, transporting crude oil from Alberta, Canada, to Midwest and Texas refineries. The proposed pipeline could transport up to 830,000 barrels of oil per day. This is not the first pipeline to cross the U.S.-Canada border, but it has far and away garnered the most attention.

A quick aside—The Keystone XL bill was given the number S.1 in the Senate and H.R.3 in the House of Representatives. In both houses, the first 10 bills of a Congress are reserved for the majority party to use for legislation of high priority. In the House, bill numbers 11 through 20 are reserved for the minority party to use for their important pieces of legislation. These rules can be amended for each Congress. So, it is evident the Keystone XL legislation was high priority for the leadership in each chamber.

Very briefly, the opposing views of this legislation are as follows: Proponents say this pipeline would be a jobs creator, would contribute to the economy, reduce American dependence on foreign oil, and enhance trade relations with Canada. Additionally, oil distribution by pipeline is safer with regard to potential environmental and human health impacts, when compared to rail or truck, and it is more economical.¹ Opponents to the pipeline have concerns of pipeline leaks and the subsequent environmental impacts, citing the leak adjacent to the Kalamazoo River in 2010 as a prime example. The pipeline route would cross the Ogallala Aquifer, an important source for drinking water and for 30% of groundwater used for agriculture in the U.S.² Also called into question are the number of long-term jobs created and how much of the oil would be used domestically. Environmental groups argue this pipeline would create a conduit for increased mining of tar sands, which is a resource-intensive mining process requiring a lot of fuel and water and results in increased carbon emissions.

The Keystone XL Pipeline expansion was first proposed in 2008. Since then there have been extensive environmental impact assessments completed by the EPA, determinations of “national interest” and international permitting by the State Department,

rulings in Nebraska concerning the proposed route over the Sand Hills region, debate as to whether Congress has the power to ensure that the pipeline gets built, and votes in both chambers in the 112th and 113th Congresses. The more recent actions were the passage of this bill in the House, passage in the Senate by a 62 to 36 vote on 29 Jan., and veto by President Obama on 24 Feb. 2015.

What follows covers the amendment process, in which I was most involved. A total of 247 amendments were added to this bill. Forty-three were voted on and only four passed and were added to the final version of the bill. This whole process took three weeks of floor time, and by the end of it, this new 114th Congress took more votes than the whole of the 113th. My role during this process was to assist in tallying and reviewing all the submitted amendments. For each amendment, I helped draft vote recommendations for Senator Kirsten Gillibrand (D-NY), so she was prepared to make educated decisions. I really enjoyed this process, which did require reviewing all 247 amendments. Many of the proposed amendments did not seem to relate to the pipeline, but Senate rules did not require amendments to be “germane” or directly pertaining to the original bill’s language. For example, Senator Stabenow (D-MI) introduced a bill preventing cuts to the U.S. Postal Service. Another amendment introduced by Senator Moran (R-KS) would remove the threatened status of the lesser prairie chicken, a bird native to Midwestern prairies. While this seems fairly far flung for pipeline legislation, removing this status would lift the consideration of these threatened birds during EPA Environmental Impact Statements, potentially making it easier for allowable future natural resource mining and transportation.

My boss, Senator Gillibrand, introduced three amendments to this bill, and I want to briefly explain two of them. The first would amend the Safe Drinking Water Act as it relates to the regulation of underground injection activities. Under the Energy Policy Act of 2005 the definition of “underground injection” excludes the injection of fluids used for oil and gas hydraulic fracturing and the injection of natural gas for underground storage. What this effectively does is create a regulatory loophole for these activities so they do not have to comply with the Safe Drinking Water Act. This amendment would strike these exemptions. This was her only amendment that was voted on, and it failed by 35 to 63 (60 votes were needed for passage). The second amendment, cosponsored with Senator Menendez (D-NJ), would remove the liability cap for oil companies for offshore and onshore oil spills. Under the Oil Pollution Act of 1990, after an oil spill, responsible parties are required to pay up to US\$75 million for an offshore spill and US\$350 million for an onshore one. After this is met, the Oil Liability Trust Fund pays the remaining cost. (These only apply if the party was not accused of gross negligence, willful misconduct, or violation of Federal safety or regulation.) This amendment would hold companies fully responsible for spills if they are found negligent.

So, as of now the Keystone XL Pipeline expansion is on hold. Some may think that was a lot of time spent with little result; however, there were interesting outcomes. There were a number of

¹ United States Department of Transportation, Pipeline and Hazardous Materials Safety Administration. Safe Pipelines FAQs. Accessed 13 Apr. 2015.

² United States Department of Agriculture, Natural Resources Conservation Service. Ogallala Aquifer Initiative. Accessed 13 April 2015.

votes related to climate change, which forced Senators to make public their stance on the issue. Senators agreed that climate change is real, but are split 50-50 as to whether humans significantly contribute to it. There were a number of amendments designed to decrease the protection of public lands by placing more control with the states and opening them up for more economic opportunities, such as grazing and natural resource mining and production. Finally, I think this process was the necessary first step in a larger discussion of U.S. energy policy. Many of the issues related to energy efficiency, production, and security were put forth in amendments and will hopefully set the stage for further legislation.

The manuscript is submitted for publication by Susanna W. Blair, 2014–2015 GSA-USGS Congressional Science Fellow, with the understanding that the U.S. government is authorized to reproduce and distribute reprints for governmental use. The one-year fellowship is supported by GSA and the U.S. Geological Survey, Department of the Interior, under Assistance Award No. G13AP00095. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. government. Blair works in the office of Senator Kirsten Gillibrand (D-NY) and can be contacted by e-mail at Susanna_Blair@gillibrand.senate.gov.



GSA Position Statements

GSA Council approved revisions to the GSA Climate Change position statement at its April 2015 meeting. Full versions of all position statements are available online at www.geosociety.org/positions. GSA members are encouraged to use the statements as geoscience communication tools when interacting with policy makers, students, colleagues, and the general public.

Climate Change Position Statement Summary

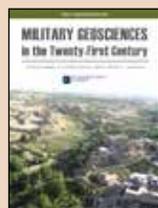
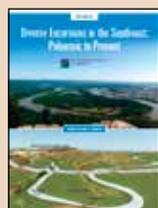
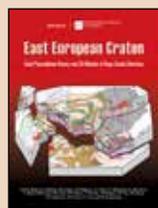
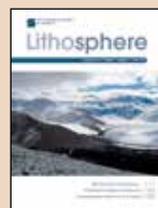
Decades of scientific research have shown that climate can change from both natural and anthropogenic causes. The Geological Society of America (GSA) concurs with assessments by the National Academies of Science (2005), the National Research Council (2011), the Intergovernmental Panel on Climate Change (IPCC, 2013) and the U.S. Global Change Research Program (Melillo et al., 2014) that global climate has warmed in response to increasing concentrations of carbon dioxide (CO₂) and other greenhouse gases. The concentrations of greenhouse gases in the atmosphere are now higher than they have been for many thousands of years. Human activities (mainly greenhouse-gas emissions) are the dominant cause of the rapid warming since the middle 1900s (IPCC, 2013). If the upward trend in greenhouse gas concentrations continues, the projected global climate change by the end of the twenty-first century will result in significant impacts on humans and other species. The tangible effects of climate change are already occurring. Addressing the challenges posed by climate change will require a combination of adaptation to the changes that are likely to occur and global reductions of CO₂ emissions from anthropogenic sources.



Browse GSA's Journals & Books at www.gsapubs.org.

Geology – GSA Bulletin – Geosphere – Lithosphere

Special Papers – Memoirs – Field Guides – Reviews in Engineering Geology



THE
GEOLOGICAL
SOCIETY
OF AMERICA®

Positions Open

PHYSICAL HYDROGEOLOGIST GEOLOGY, WEST VIRGINIA UNIVERSITY

Department of Geology & Geography invites applications for a tenure-track position in geology at the Assistant Professor level. This position, related to the stewardship of freshwater resources, is one of several university-wide, research-focused initiatives (<http://research.wvu.edu/about>). Research on freshwater is an area of growth across campus and includes a new interdisciplinary Water Center.

Applicants are expected to hold a Ph.D. or equivalent degree in geology or related field at the time of appointment. We seek applications from individuals with interests in basic and applied aspects of groundwater flow in the critical zone and/or deeper regimes. The successful applicant will possess demonstrable expertise in study of subsurface water flow and/or transport processes that may be applied to competitively-funded research problems. Specialties may include, but are not limited to, flow modeling in porous media; hyporheic or vadose zone processes; groundwater-surface water interaction; flow in fractured media; hydrogeology of energy-related activities; water supply and sustainability; contaminant and solute transport; and/or karst hydrogeology. The position will begin in January or August 2016.

Candidates will be evaluated on the basis of their potential to establish a vigorous externally-funded research program, publish scholarly work, mentor graduate students, and to teach at the undergraduate and graduate levels. Qualified applicants should submit the following items to hydrogeo@mail.wvu.edu: (1) a single PDF file including a statement of research interests, a statement of teaching philosophy, and curriculum vitae; and (2) pdf files of up to 4 publications. Please also arrange for three letters of reference to be sent to the same email address.

Review of applications will commence on September 15, 2015 and continue until a successful candidate is identified. For additional information, please see <http://pages.geo.wvu.edu/hydrogeo> or contact the search chair Dorothy J. Vesper at djvesper@mail.wvu.edu. WVU is an EEO/Affirmative Action Employer and welcomes applications from all qualified individuals, including minorities, females, individuals with disabilities, and veterans.

INSTRUCTOR DEPT. OF GEOLOGICAL SCIENCES FULL-TIME, ONE YEAR, TEMPORARY BRIDGEWATER STATE UNIVERSITY

The Department of Geological Sciences at Bridgewater State University invites applications for a one-year, benefited, full-time temporary position in Sedimentary Geology to begin September 2015, with the possibility of renewal for a second year.

The successful applicant will teach a comprehensive, upper-level undergraduate course in Sedimentary Geology that includes depositional environments, sedimentary petrology, and stratigraphy. Additionally, the individual will also teach an upper-level undergraduate course in Earth Systems History, as well as introductory-level geology courses to support the university-wide core curriculum. The candidate is also expected to develop and mentor undergraduate research activities and participate in department-led field trips.

Required Minimum Qualifications: A PhD in the geological sciences should be completed at the time of

appointment, but ABD candidates will be considered.

Preferred Qualifications: Previous teaching experience in the geological sciences.

Bridgewater State University is an affirmative action/equal opportunity employer which actively seeks to increase the diversity of its workforce.

Position is open until filled. Please apply online at <https://jobs.bridgew.edu>. E-mail questions to humes@bridgew.edu.

FACULTY POSITION EARTH AND PLANETARY SCIENCE DEPARTMENT OF EARTH SCIENCE RICE UNIVERSITY

We seek creative and promising candidates across the broad spectrum of earth and planetary science who complement the disciplines represented in our department.

Successful candidates are expected to direct an active research program, supervise graduate research, and teach courses for undergraduate and graduate students. Details about the department and its facilities can be found at <http://earthscience.rice.edu>.

Please send a CV, research and teaching statements, and names of four or more references to esci-search@rice.edu.

Equal Opportunity Employer — Females/Minorities/Veterans/Disabled/Sexual Orientation/Gender Identity.

AIPG EXECUTIVE DIRECTOR POSITION ANNOUNCEMENT

The American Institute of Professional Geologists is accepting applications for the position of Executive Director. The position is to be filled as soon as a qualified candidate is vetted. Applications will be accepted until the position is filled. Details can be found at www.aipg.org/ExecDirPosition.pdf.

CHAIR, DEPARTMENT OF EARTH AND ENVIRONMENTAL SCIENCES UNIVERSITY OF WATERLOO

The Department of Earth and Environmental Sciences, in the Faculty of Science at the University of Waterloo invites nominations and applications for the position of Chair of the department. Candidates must have a Ph.D. and are expected to have a distinguished record of teaching and research as well as demonstrated ability in leadership and administration. They should also be eligible for a faculty position, normally at the level of full professor. The successful candidate will lead the academic and research vision for the department, be responsible for the relationship between the department and the broader university academic community, and play a leading role in the academic planning and management process within the Faculty of Science.

The salary range for this position is \$140,000 to \$180,000. Negotiations beyond this salary range will be considered for exceptionally qualified candidates.

The department has 21 full-time members of faculty, 4 research faculty members, 29 staff, approximately 100 graduate students, 25 post-doctoral fellows and research associates and over 250 Honours undergraduate students in Earth and Environmental Sciences related programs. In addition, the Geological Engineering program, with approximately 100 undergraduate students, is shared with the Department of Civil and Environmental Engineering. Undergraduate studies are available in both a Co-operative Education and Regular format. The department fosters a dynamic

and thriving research environment with over \$15 million in annual research, houses a CERC Chair and 2 CRC's (Tier 1) and initiated the Southern Ontario Water Consortium (>\$55 million) and the Canadian Water Network. The department attracts outstanding Canadian and international applicants to its graduate programs. Collaborative research programs that are global in scope are currently active with members of the Faculties of Science, Environment, Mathematics and Engineering and the Water Institute. The department is interested in strengthening these transdisciplinary initiatives and expanding ties within the national and international academic communities.

The University of Waterloo is located in the attractive and vibrant two-university community of Kitchener-Waterloo (population 500,000) in southwestern Ontario, about 100 km west of Toronto.

Applications and nominations should include a detailed resume, the names and contact information for three individuals willing to provide references, and a statement of capabilities and qualification. The closing date for applications is October 15, 2015. The anticipated start date is September 1, 2016. Send applications or nominations to: Professor Robert Lemieux, Dean, Faculty of Science, University of Waterloo, 200 University Avenue West, Waterloo, Ontario, Canada N2L 3G1. Phone: +1-519-888-4591; Fax: +1-519-746-2543, e-mail: lweber@uwaterloo.ca.

The University of Waterloo respects, appreciates and encourages diversity. We welcome applications from all qualified individuals including women, members of visible minorities, Aboriginal peoples and persons with disabilities. All qualified candidates are encouraged to apply; however, Canadian citizens and permanent residents will be given priority. Three reasons to apply: <https://uwaterloo.ca/watport/why-waterloo>.

Opportunity for Students

National Center for Earth-Surface Dynamics 2 (NCED2) Synthesis Post-doc program, University of Minnesota. Applications are now being accepted for the 2015–2016 National Center for Earth-Surface Dynamics 2 (NCED2) Synthesis post-doc program. This program aims to create a small, highly interactive community of post-docs and mentors who collaborate on a research theme in Earth-surface processes. The research theme for 2015–2016 is *Earthcasting: Case studies in predicting Earth-surface response to change*. Proposed research must directly address the current theme and each post-doc must have at least two advisor-mentors. NCED2 will provide 50% of post-doc salary support while advisor-mentors must provide the other 50% of support. The post-doc will network with other selected post-docs through workshops, webinars/web discussions, participation in the Summer Institute on Earth-Surface Dynamics (SIEDS), joint experimental work at the St. Anthony Falls Laboratory at the University of Minnesota, and field work at affiliated sites such as the Wax Lake Delta observatory. The post-doc must be based at a U.S. institution but is not required to be a U.S. citizen or permanent resident. Applications will be accepted and reviewed starting 1 July 2015 in the order in which they are submitted until all positions are full. Funding will commence in September 2015. Learn more and apply at www.nced.umn.edu/synthesis-post-doc-program.

A bird's-eye view of geology: The use of micro drones/UAVs in geologic fieldwork and education

Benjamin R. Jordan, Brigham Young University–Hawaii, 55-220 Kulanui Street, Bldg. 5, Laie, Hawaii 96762, USA

INTRODUCTION

The past few years have seen the rapid development and availability of unmanned aerial vehicles (UAV). Popularly called “drones,” they are remotely operated vehicles that can be fixed-wing aircraft or helicopters. UAVs are being developed for use in everything from product delivery (e.g., Albright, 2014) to farming (e.g., Papadopoulos et al., 2014).

Especially popular are micro UAV helicopters, which are usually in the form of small aerial platforms that have four or more propellers (Fig. 1). This configuration provides great maneuverability, stability, and control. Newer UAVs have built-in GPS systems that provide even greater control and make it easy for an inexperienced person to quickly learn the basics of flying. Their size also makes them easy to transport to even the most remote areas (Fig. 1). They require very little launch and recovery space, and the cost of a basic unit is such that even the total loss of a vehicle is not financially catastrophic (Carrivick et al., 2013). Their low cost also means that multiple UAVs can be used, providing for redundancy if one is lost or damaged.

USES OF MICRO UAVS IN GEOLOGIC RESEARCH AND TEACHING

Although smaller and limited in their instrumentation carrying capacity compared to larger UAVs, the potential use of micro UAVs in geologic research is great, while their small size and simplicity also make them valuable in educational settings. Aerial surveys, field mapping, and monitoring can be done in real time via telemetry, or the collected data can be rapidly downloaded at the end of a flight. In addition, with the ever-shrinking sizes of sensors, an ever-expanding range of instruments makes the potential uses of micro UAVs even greater.

UAVs provide access to areas that are hard to reach and/or dangerous, such as vertical or overhanging rock outcrops or gas-rich and unstable volcanic areas (Fig. 2) (e.g., Ohminato et al., 2011). They can be used to survey or map disaster areas during and after events, such as flooding or mass wasting (e.g., Delacourt et al., 2007; Niethammer et al., 2012). They have already been used for such things as bathymetric and topographic mapping of river channels (Lejot et al., 2007), 3-D mapping of geologic structures



Figure 1. An example of a micro UAV, a DJI Phantom 2. The drone has a GoPro camera mounted between the landing gear.

(Vasuki et al., 2014), generating paleoseismology models (Bemis et al., 2014), and surveying post-earthquake land changes (Gong et al., 2012). They can give a broad, aerial perspective of geoarchaeological sites (e.g., Eisenbeiss and Sauerbier, 2011) and be used in coastal and reef surveys. They have even been flown inside caves for karst research (McFarlane et al., 2013).

In educational settings, mapping exercises can be established during which students collect their own aerial images and then interpret them. Unlike Google Earth or regular aerial photos, structures imaged by UAVs provide greater detail at small scales (Helmke et al., 2007). Such exercises also provide students with experience in using technical instrumentation, data collection, data analysis, and interpretation—all critical career skills. The use of UAVs is also expanding in industry, making familiarity with them a résumé skill (e.g., Muttin, 2011; Morgenthal and Hallermann, 2014). Because of the ease of use and accessibility, they can be especially useful in undergraduate research.

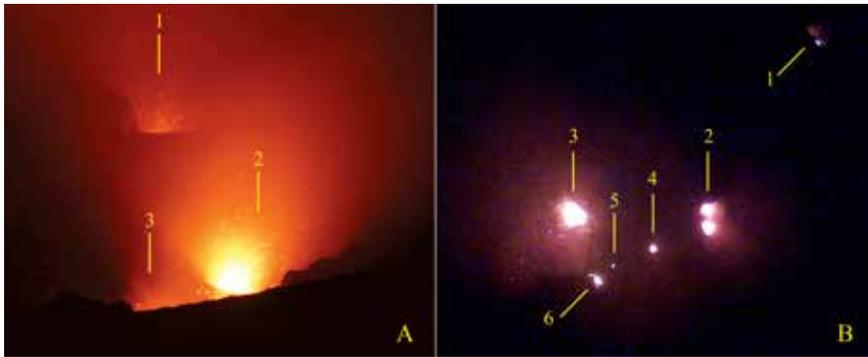


Figure 2. View of from crater rim of Mount Yasur Volcano. (A) From the rim, only three vents are visible. (B) From a micro-UAV image taken directly over the crater, six vents (1–6) are apparent (vents 1–3 correlate with the same numbered vents in [A]). It is also possible to see that vent 2 is obstructed.

One example of the benefits of using a micro UAV in the field comes from the 2014 field season at Mount Yasur Volcano on Tanna Island, Vanuatu. A UAV was flown directly over the active vents and within the gas plume of the volcano. Observations from the rim of the main crater found that there were three active vents emitting lava (Fig. 2). However, an analysis of the video and photographs collected from the UAV indicated that there were actually six active vents—three large vents and three smaller ones. It was also evident that the most active vent was partially obstructed. In addition, the ability of the UAV to fly directly into the gas plume makes it a safe and valuable platform for collecting samples of volcanic gas (cf. Shinohara, 2013).

CHALLENGES IN USING MICRO UAVS

The challenges in using micro UAVs can be divided into three categories:

1. Natural;
2. Technological; and
3. Legal.

In the first case, the biggest challenge to using micro UAVs concerns the weather. High winds (>30 km/h) can severely limit control or flight time, due to loss of battery power as the UAV tries to maintain its position. This was a significant issue at Mount Yasur. Strong winds can blow the UAV off course, into obstacles, and/or beyond areas of recovery and reduce fine control of the UAV. Current micro UAVs are not waterproof, which also limits their use in rainy conditions. Their small size also makes them difficult to see at great distances.

Technologically, UAV flight times are limited by their power source, which, given the size of the UAVs, are also small. High winds at Mount Yasur limited flight time to less than eight minutes. Many UAV cameras (such as a GoPro) use a fisheye lens that distorts the image. This can be solved by using a replacement camera model that does not have the distortion or by post-flight corrections (see James and Robson [2014] for one method). Another issue is determining the scale of view from the UAV images. The simplest way to solve this is to have a ground-based scale (e.g., measuring tape or an object of known size).

Finally, the ready availability and proliferation of micro UAVs has led to a sort of legal gray area in which governments are scrambling to try and regulate their use. Users of UAVs have been found, intentionally or otherwise, to aggravate wildlife (Robison, 2014), disturb natural features (Lowy, 2014), nearly collide with planes (Betelho, 2014), and cause privacy concerns (Flacy, 2014).

It is important for researchers and educators who use them to do so responsibly and train students in the ethics of their use.

THE FUTURE

Micro UAV use in geologic field work and teaching has enormous potential. The example cited in this article collected only visual data; however, micro UAVs can be potentially modified to collect many other forms of data, such as ambient weather data, thermal imaging, gas measurements, mapping and surveying data (including generation of 3-D models), long-term aerial monitoring, sample collection, vertical outcrop imaging for stratigraphic surveys, and countless other possibilities that have not been thought of yet.

REFERENCES CITED

- Albright, M.B., 2014, How drones will change the way you eat: The Plate, 7 Oct. 2014, National Geographic Society, <http://theplate.nationalgeographic.com/2014/07/23/how-drones-will-change-the-way-you-eat/> (last accessed 29 Jan. 2015).
- Bemis, S.P., Micklethwaite, S., Turner, D., James, M.R., Akciz, S., Thiele, S.T., and Bangash, H.A., Ground-based and UAV-based photogrammetry: A multi-scale, high-resolution mapping tool for structural geology and paleoseismology: *Journal of Structural Geology*, v. 69, p. 163–178, doi: 10.1016/j.jsg.2014.10.007.
- Betelho, B., 2014, FAA official: Drone, jetliner nearly collided over Florida: *CNN Travel*, 11 May 2014, CNN, <http://www.cnn.com/2014/05/09/travel/unmanned-drone-danger/> (last accessed 29 Jan. 2015).
- Carrivick, J.L., Smith, M.W., Quincey, D.J., and Carver, S.J., 2013, Developments in budget remote sensing for the geosciences: *Geology Today*, v. 29, no. 4, p. 138–143, doi: 10.1111/gto.12015.
- Delacourt, C., Allemand, P., Berthier, E., Raucoules, D., and Casson, B., 2007, Remote-sensing techniques for analysing landslide kinematics; a review: *Bulletin de la Société Géologique de France*, v. 178, no. 2, p. 89–100, doi: 10.2113/gssgfbull.178.2.89.
- Eisenbeiss, H., and Sauerbier, M., 2011, Investigation of UAV systems and flight modes for photogrammetric applications: *The Photogrammetric Record*, v. 26, p. 400–421, doi: 10.1111/j.1477-9730.2011.00657.x.
- Flacy, M., 2014, Man allegedly shoots down neighbor's drone with shotgun: *Digital Trends*, 1 Oct. 2014, <http://www.digitaltrends.com/cool-tech/new-jersey-man-allegedly-shoots-neighbors-drone/> (last accessed 29 Jan. 2015).
- Gong, J., Yue, Y., Zhu, J., Wen, Y., and Li, Y., 2012, Impacts of the Wenchuan Earthquake on the Chaping River upstream channel change: *International Journal of Remote Sensing*, v. 33, no. 12, p. 3907–3929, doi: 10.1080/01431161.2011.636767.
- Helmke, M.F., Coughlin, M.F., Potter, N., and Sevon, W.D., 2007, Hickory Run Boulder Field (2): Collecting high-resolution, low-altitude aerial photographs by UAV: *Geological Society of America Abstracts with Programs*, v. 39, no. 1, p. 43.

- James, M.R., and Robson, S., 2014, Mitigating error in topographic models derived from UAV and ground-based image networks: *Earth Surface Processes and Landforms*, v. 39, p. 1413–1420, doi: 10.1002/esp.3609.
- Lejot, J., Delacourt, C., Piegay, H., Fournier, T., and Tremelo, M.L., 2007, Very high spatial resolution imagery for channel bathymetry and topography from an unmanned mapping controlled platform: *Earth Surface Processes and Landforms*, v. 32, no. 11, p. 1705–1725, doi: 10.1002/esp.1595.
- Lowy, J., 2014, Government moves to ban drones in 400 National Parks: Associated Press (AP), 20 June 2014, <http://bigstory.ap.org/article/govt-moves-ban-drones-400-national-parks> (last accessed 29 Jan. 2015).
- McFarlane, D.A., Buchroithner, M., Lundberg, J., Petters, C., and Roberts, W., 2013, Integrated three-dimensional laser scanning and autonomous drone surface-photogrammetry at Gomantong Caves, Sebah, Malaysia: *Proceedings of the 16th International Congress of Speleology*, v. 2, p. 317.
- Morgenthal, G., and Hallermann, N., 2014, Quality of unmanned aerial vehicle (UAV) based visual inspection of structures: *Advances in Structural Engineering*, v. 17, no. 3, p. 289–302, doi: 10.1260/1369-4332.17.3.289.
- Muttin, F., 2011, Umbilical deployment modeling for tethered UAV detecting oil pollution from ship: *Applied Ocean Research*, v. 33, no. 4, p. 332–343, doi: 10.1016/j.apor.2011.06.004.
- Niethammer, U., James, M.R., Rothmund, S., Travelletti, J., and Joswig, M., 2012, UAV-based remote sensing of the Super-Sauze landslide: Evaluation and results: *Engineering Geology*, v. 128, p. 2–11, doi: 10.1016/j.enggeo.2011.03.012.
- Ohminato, T., Kaneko, T., Koyama, T., Watanabe, A., and Takeo, M., 2011, Upward migration of the explosion sources at Sakurajima volcano, Japan, revealed by a seismic network in the close vicinity of the summit crater: 2011 American Geophysical Union Fall Meeting, Abstract V41H–07.
- Papadopoulos, A., Iatrou, M., Papadopoulos, F., Metaxa, I., Theodoridou, S., Kalogeropoulos, K., and Kiparissi, S., 2014, Preliminary results for standardization of NDVI using soil nitrates in corn growing: *Fresenius Environmental Bulletin*, v. 23, no. 2, p. 348–354.
- Robison, K., 2014, Drone harasses bighorn sheep at Zion National Park: *St. George News*, 5 May 2014, <http://www.stgeorgeutah.com/news/archive/2014/05/05/kar-drone-harasses-bighorn-sheep-zion-national-park/#.VMqXV9LF-So> (last accessed 29 Jan. 2015).
- Shinohara, H., 2013, Composition of volcanic gases emitted during repeating Vulcanian eruption stage of Shinmoedake, Kirishima volcano, Japan: *Earth, Planets, and Space*, v. 65, no. 6, p. 667–675, doi: 10.5047/eps.2012.11.001.
- Vasuki, Y., Holden, E., Kovesi, P., and Micklethwaite, S., 2014, Semi-automatic mapping of geological structures using UAV-based photogrammetric data: An image analysis approach: *Computers & Geosciences*, v. 69, p. 22–32, doi: 10.1016/j.cageo.2014.04.012.

Manuscript received 10 Oct. 2014; accepted 25 Jan. 2015.

Penrose Conference—Snake River, Twin Falls, Idaho, USA, 9–13 September 2009. Photo by Ken Gilks.



March 2012 Penrose Conference location: Castelvetro, Piacenza, Italy.

The Next Step for Your Annual Meeting Science: PENROSE CONFERENCES and THOMPSON FIELD FORUMS

You'll be networking with 6,000+ colleagues in Baltimore, and this can be a great catalyst for generating intriguing scientific discussions and field study ideas. That's what GSA's Penrose Conferences and Thompson Field Forums are for.

Penrose Conferences have a long history of bringing together multi-disciplinary groups of geoscientists to facilitate open and frank discussions of ideas in an intimate, informal atmosphere and to inspire individual and collaborative research.

Thompson Field Forums are designed to capture the essence of exciting discoveries or controversial topics via forays into the field for on-the-spot discussions of a particular geologic feature or area. This is both an opportunity to get out into the field and to bring together experts on the topic at hand to exchange current knowledge, ideas, and theories.



THE
GEOLOGICAL
SOCIETY
OF AMERICA



THE
GEOLOGICAL
SOCIETY
OF AMERICA

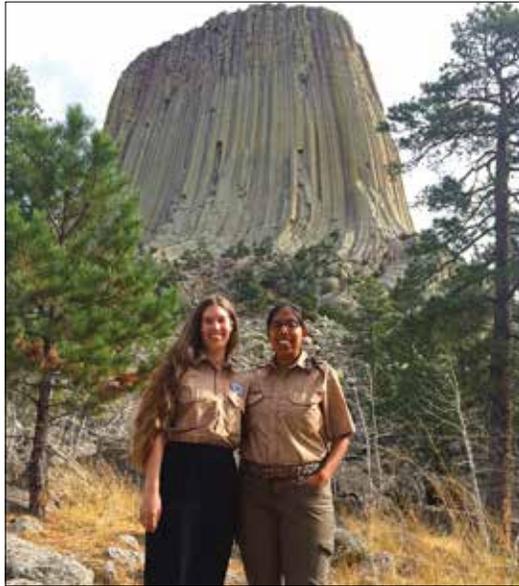
Learn more at:
[www.geosociety.org/meetings/
penrose-thompson.htm](http://www.geosociety.org/meetings/penrose-thompson.htm)
or contact Becky Sundeen at
bsundeen@geosociety.org.



THE
GEOLOGICAL
SOCIETY
OF AMERICA®



GeoCorps™ America Places One-Thousandth Geoscientist in the Field



GeoCorps participants 1,000: Claudia Velasco Campos (right) and 1,001: Piper Lewis (left) at Devil's Tower National Monument, Wyoming, USA.

GeoCorps™ America celebrated a milestone in 2014, achieving its one-thousandth placement since its inception in 1997. GeoCorps is a partnership between GSA and the Bureau of Land Management, the U.S. Forest Service, and the National Park Service. Agency partners provide scientifically rigorous projects, mentor contributions, and funding for participant and program expenses. GSA provides administrative support for the program, including coordinating position postings and the application process, providing customer service, and preparing program evaluations. GeoCorps participants apply their geoscience knowledge to fieldwork, interpretation, and rigorous research that benefit

agency programs. GeoCorps continues to grow and will place almost 200 geoscientists from among more than 2,000 applications in 2015.

The number of applications for GeoCorps positions is growing more rapidly than available positions. Donations from individuals help provide positions in addition to those supported through agency budgets. Your support of GeoCorps America when renewing your membership or by providing full or partial funding of a GeoCorps America position will enable GSA to provide more formative experiences to deserving geoscientists. In 2015, donor support was instrumental in providing several positions in Denali National Park and Devil's Tower National Monument.

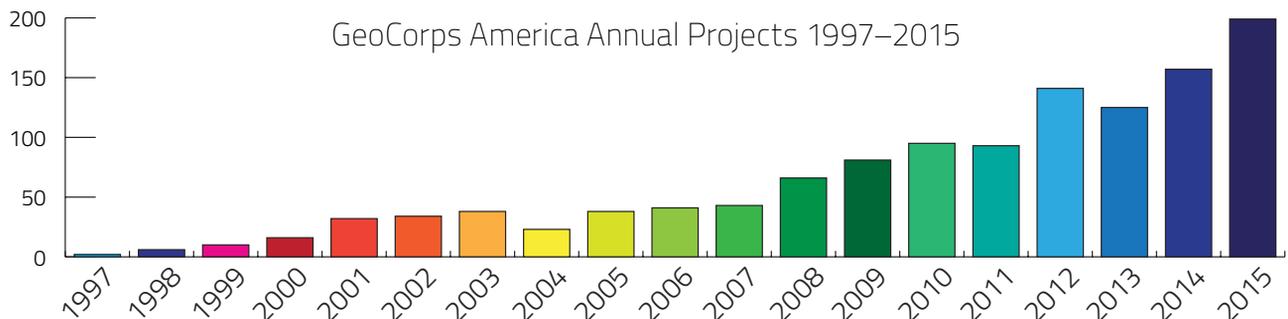
"The GeoCorps America program gave me valuable skills for my career while placing me in a beautiful area waiting to be explored, and I learned a little more about myself too."

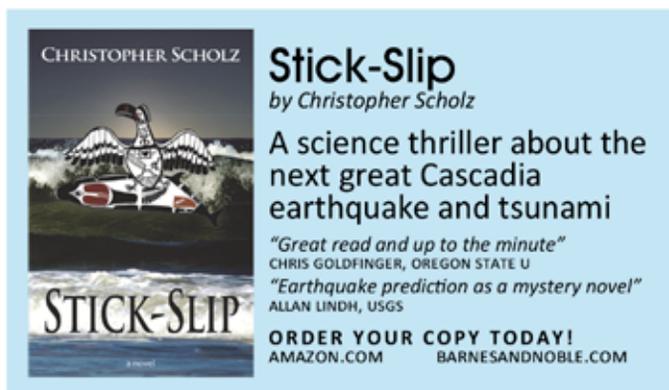
—Michael Stepowyj, GeoCorps/Geologist in the Park Participant, Delaware Water Gap National Recreation Area

Read the full 2014 GeoCorps™ America Annual Report at http://rock.geosociety.org/g_corps/documents/GeoCorps-AR_14-web.pdf.

To support GeoCorps™ America and other GSA programs, please contact Chris Tallackson, GSA Foundation Director of Development, at ctallackson@geosociety.org or +1-303-357-1007. You can also give online.

www.gsafweb.org





4th International EarthCache Event

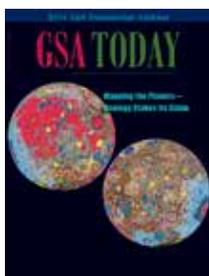
When: Sat., 19 Sept. 2015

Where: Rammelsberg World Heritage Museum and Visitor Mine, Goslar, Germany

EarthCaching gets people out in the field to learn about their planet first-hand. Participants in this annual event will learn all about EarthCaching, interact with EarthCachers from around the globe, meet EarthCache developers and reviewers, find local EarthCaches, and engage in many other exciting and educational activities. The 2015 event, in the beautiful Harz Mountains of north-central Germany, will be the first International EarthCache Event outside of North America. For details, go to www.earthcache.org, visit our Facebook page at www.facebook.com/earthcache, or contact Gary Lewis at glewis@geosociety.org.

GSA Today is Open Access Online

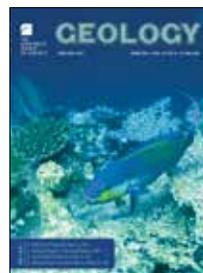
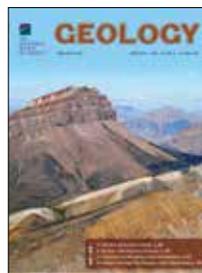
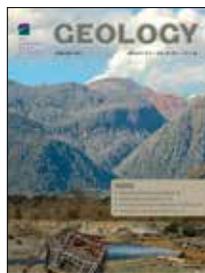
Go to www.geosociety.org/pubs/ and click on the *GSA Today* cover.



Follow the link on the *GSA Today* homepage to sign up for e-Alerts and be the first to know when a new issue comes online.

Let the Earth be Your Teacher!

GSA Publications Highlights



Free Access to *Geology's* Research Focus

Need perspective? See the forest along with the trees with *Geology's* Research Focus articles. These 1–2 page briefs discuss the significance of a particular research problem and demonstrate how an article in that issue of *Geology* contributes to a better or more holistic understanding of the problem.

The articles are designed to serve as a broad reference on major topics for both students and established researchers.

View the entire open-access collection at

<http://geology.gsapubs.org/cgi/collection/rfocus>.

2016 GSA Section Meetings



THE
GEOLOGICAL
SOCIETY
OF AMERICA®

SOUTH-CENTRAL

21–22 March

Hilton Baton Rouge Capitol Center,
Baton Rouge, Louisiana, USA

Chair:

Peter Clift, pclift@lsu.edu



NORTHEASTERN

21–23 March

Albany Convention Center,
Albany, New York, USA

Co-chairs:

Helen Mango, helen.mango@castleton.edu;
Tim Grover, tim.grover@castleton.edu



SOUTHEASTERN

31 March–1 April

Columbia Metropolitan Convention Center,
Columbia, South Carolina, USA

Chair:

Venkat Lakshmi, vlakshmi@geol.sc.edu



CORDILLERAN

4–6 April

Ontario Convention Center,
Ontario, California, USA

Chair:

Jade Star Lackey, jadestar.lackey@pomona.edu



NORTH-CENTRAL

18–19 April

I-Hotel and Conference Center,
Champaign, Illinois, USA

Chair:

Steve Brown, steebrow@illinois.edu



ROCKY MOUNTAIN

18–19 May

University of Idaho,
Moscow, Idaho, USA

Co-chairs:

Brian Yanites, byanites@uidaho.edu;
Leslie Baker, lbaker@uidaho.edu

EAST EUROPEAN CRATON: Early Precambrian History and 3D Models of Deep Crustal Structure

by Michael V. Mints et al., 2015

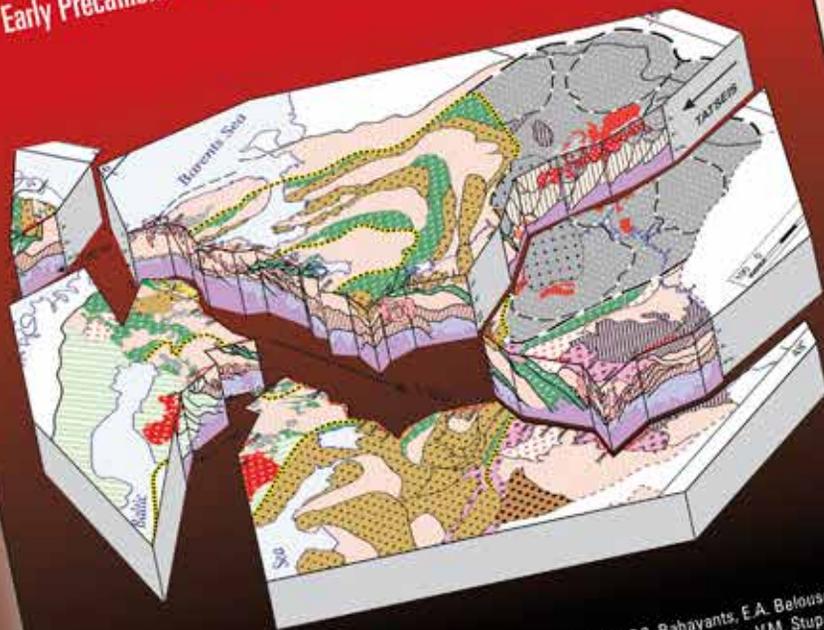
The results of regional geological study and geophysical surveying, including interpretation of common midpoint seismic geotraverses (1-EU, TATSEIS, and 4B in Russia; DOBRE in Ukraine; FIRE project in Finland), bear new information on 3D deep crustal structure and geological history of the early Precambrian East European craton. In addition, new geochemical, petrological, and geochronological data on the unique Mesoproterozoic-Neoproterozoic Belomorian eclogite province are presented. The authors conclude that regional granulite-gneiss belts are evidence for mantle plume activity in much the same way that large igneous provinces are. Oval intracontinental orogens (a new type of tectonic unit) were also formed under the influence of mantle plumes. The Archean tectonics of miniplates resembles the Phanerozoic plate tectonics more closely than the concept of Neoproterozoic-Paleoproterozoic supercontinents. Geological, tectonic, and petrophysical maps, and seismic cross sections covering more than 4000 km in total length, as well as their geological interpretations, are presented as appendices.

SPE510, 433 p. plus CD-ROM,
ISBN 9780813725109
list price \$85.00

\$60
MEMBER PRICE

East European Craton

Early Precambrian History and 3D Models of Deep Crustal Structure



By M.V. Mints, K.A. Dokukina, A.N. Konilov, I.B. Philippova, V.L. Zlobin, P.S. Babayants, E.A. Belousova, Y.I. Blokh, M.M. Bogina, W.A. Bush, P.A. Dokukin, T.V. Kaulina, L.M. Natapov, V.B. Pip, V.M. Stupak, A.K. Suleimanov, A.A. Trusov, K.V. Van, and N.G. Zamozhniaya

BUY ONLINE ► <http://rock.geosociety.org/store/>

toll-free 1.888.443.4472 | +1.303.357.1000, option 3 | gsaservice@geosociety.org



THE GEOLOGICAL SOCIETY
OF AMERICA®