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The geology of Cuba: A brief overview and synthesis

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Featured Article

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M.A. Iturralde-Vinent, A. García-Casco, Y. Rojas-Agramonte, J.A. Proenza, J.B. Murphy, and R.J. Stern

Cover: Valle de Viñales, Pinar del Río Province, western Cuba. Karstic relief on passive margin Upper Jurassic and Cretaceous limestones. The world-famous Cuban tobacco is grown in this valley. Photo by Antonio García Casco, 31 July 2014. See related article, p. 4–10.



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The geology of Cuba: A brief overview and synthesis

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ABSTRACT

Cuba is the largest island in the Greater Antilles, and its geology records three important episodes: (1) the Jurassic breakup of North and South America (Pangea) and associated passive margin and oceanic sedimentary and magmatic evolution; (2) the sedimentary, magmatic, and metamorphic evolution of an intra-oceanic Cretaceous–Paleogene ophiolite–arc complex; and (3) the Paleogene “soft collision” and transfer of the NW Caribbean plate (and Cuba) to the North American plate. Thick sequences of Jurassic–Cretaceous strata (conglomerates, sandstones, limestones, dolostones, shales) and interlayered basaltic rocks characterize passive margin sequences preserved in the Guaniguanico terrane (western Cuba, related to the Mayan passive margin and the Gulf of Mexico) and the Bahamas Platform borderlands (north of Cuba). Passive margin deposition ceased in latest Cretaceous time, when increasing relief of accreted (overriding) oceanic arc and ophiolite complexes shed coarse sediments (olistostrome and flysch), followed by carbonate deposition. Fragments of the intervening oceanic lithosphere (Proto-Caribbean, connected to the Central Atlantic) and fore- and back-arc oceanic lithosphere (Caribbean, of Pacific origin) occur as tectonic fragments detached from the ophiolitic units, including serpentinitized harzburgites and dunites, banded and isotropic gabbros, basalts (tholeiitic and fore-arc basalts, locally with boninites) and Late Jurassic (Tithonian) through Late Cretaceous (Coniacian and younger) oceanic sediments. Arc activity in the Cuban segment of the Greater Antilles produced sedimentary, volcanic, and plutonic rocks during Cretaceous times (ca. 135–70 Ma). A new arc developed in eastern Cuba during Paleocene–middle Eocene times. Cuban arc sequences include island-arc tholeiitic, calcalkaline, and alkaline bimodal suites of volcanic and plutonic rocks. Remnants of Proto-Caribbean oceanic lithosphere occur as exhumed mélange-bearing eclogite-, blueschist-, and garnet-amphibolite-facies tectonic blocks (oldest age ca. 120 Ma) within a serpentinite matrix intercalated with, or at the base of, the overthrust ophiolitic bodies. Cuban Cretaceous arc magmatic activity ended due

to the subduction of Proto-Caribbean passive margin sequences of the Caribbeana terrane, an offshore protuberance of Yucatan. This event formed strongly deformed high-pressure meta-sedimentary and metaigneous rocks at ca. 70 Ma, when the Caribbean plate began to collide with North America. The collision, which included overriding of the ophiolitic and arc units over both subducted and unsubducted passive margin sequences, also produced synorogenic basins and filled them, a process that continued until ca. 40 Ma. This foldbelt was succeeded by local uplift and subsidence to form late Eocene–Recent unconformable post-orogenic continental basins.

INTRODUCTION AND GEOLOGIC SETTING

Cuba has had a very interesting geologic evolution. The island is geographically very near the United States, but for political reasons, U.S. geoscientists have not been able to study it much. In this overview¹, we highlight the geology of Cuba. Useful publications on Cuban geology produced during the past quarter century can be found in Ceballos Izquierdo and Iturralde-Vinent (2016). We hope that the improving political situation will increase mutually beneficial interactions in the future. A few relevant geographic and demographic facts about Cuba are listed in Table 1.

Cuba is the largest island in the Greater Antilles and has been part of the North American plate (NOAM) since late Eocene time. It is separated from other Greater Antilles islands by the North

Table 1. Facts about Cuba

Size	109,884 km ² (about the size of U.S. state of Tennessee). The main island is 1250 km (780 mi) long. Cuba is the largest island in the Caribbean and the 17th largest island in the world.
Geography	Cuba consists of flat to rolling plains as well as low mountain chains with peaks between 600 and 1974 m (1968.5 and 6476 ft), surrounded by shallow platforms, keys, and islets, as well as deep depressions, such as the Bartlett trough (6810 m [−4.23 mi]).
Coastline	3740 km (2324 mi)
Highest point	Pico Turquino (1974 m [6476 ft])
Population (2014)	11,238,317
Political subdivisions	15 provinces and one special municipality: Isla de la Juventud.
Official language	Spanish
Geological resources	Cuba's most important mineral resource is nickel, with 21% of total exports in 2011. The output of Cuba's nickel mines that year was 71,000 tons, approaching 4% of world production. As of 2013, its reserves were estimated at 5.5 million tons, over 7% of the world total. Cuba is also a major producer of cobalt, a by-product of nickel mining operations. Oil exploration in 2005 by the USGS revealed that the North Cuba basin could produce ~4.6 billion barrels (730,000,000 m ³) to 9.3 billion barrels (1.48 × 10 ⁹ m ³) of oil.

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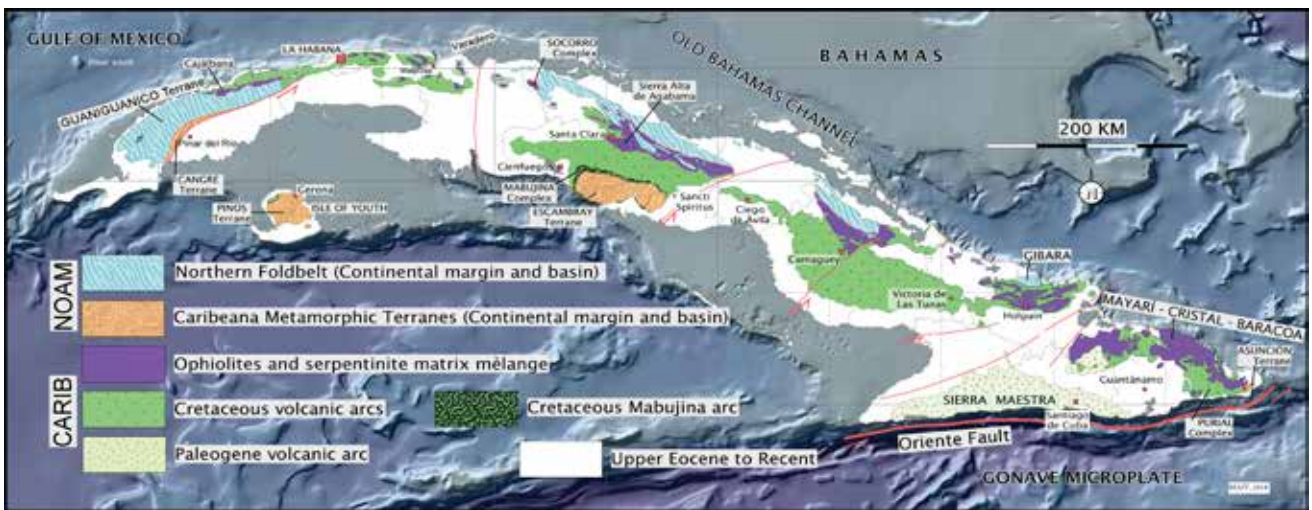


Figure 1. (Top) Tectonic map of the northern Caribbean region. (Bottom) Generalized geologic-tectonic map of Cuba modified from Iturralde-Vinent (2011).

Caribbean Transform Fault System (including the Oriente Fault), which defines the present North American–Caribbean (NOAM-CARIB) plate boundary south of Cuba (Fig. 1A).

The Greater Antilles Arc began to form ~135 m.y. ago, after the breakup of Pangea, along the leading edge of CARIB, due to SW-dipping subduction of NOAM beneath NW CARIB. The Cuban arc finally collided with Florida and the Bahamian platform in middle to late Eocene time (ca. 48–40 Ma). About this time, the Cayman spreading ridge and the Oriente transform formed to the south (Fig. 1A), resulting in a new NOAM-CARIB plate boundary zone (PBZ) along the new fault system (Burke et al., 1978). This plate reorganization also resulted in the formation of the small Gonave plate SE of Cuba (Fig. 1A). These events

transferred NW CARIB, including Cuba, to NOAM (Pindell and Kennan, 2009).

The geology of Cuba is dominated by three lithotectonic associations, which reflect its evolution as a Cretaceous–Paleogene convergent margin: (1) deformed (para)autochthonous NOAM Jurassic and Cretaceous continental margin and basin sections and Paleocene–Eocene synorogenic foredeep deposits; (2) oceanic lithosphere and associated sedimentary rocks that formed on CARIB, including ophiolite complexes and serpentinite mélanges. These oceanic crustal assemblages are associated with ca. 135–47 Ma magmatic activity and interbedded with or overlain by synorogenic basins; and (3) (neo)autochthonous late Eocene to Recent deposits that unconformably overlie the two older

units (Figs. 1B and 2; Iturralde-Vinent, 2011). Many of these units were partially subducted, metamorphosed, and exhumed. These lithotectonic associations are briefly summarized in the following sections.

NORTH AMERICAN (NOAM) ACCRETED DEPOSITS

North American igneous rocks and sediments originally formed along the Yucatan and Bahamas passive margins and elsewhere in the Proto-Caribbean basin. These units now crop out as juxtaposed fold-and-thrust belts of the Guaniguanico terrane, the Northern Foldbelt, and the metamorphic Caribeana terranes (Fig. 1B).

Guaniguanico Terrane

This terrane includes Early(?) Jurassic to latest Cretaceous passive margin siliciclastics, marine basalts, limestone, shale, and chert that record the origin and evolution of the Proto-Caribbean seaway (Fig. 2; Pszczółkowski, 1999; Iturralde-Vinent, 2011). These rocks are overlain by Paleocene to Lower Eocene synorogenic foredeep sedimentary rocks, including limestones, flysch, and olistostrome deposits. This ensemble was overthrust by ophiolitic and volcanic arc units (Bralower and Iturralde-Vinent, 1997).

Northern Foldbelt

This belt preserves the southern edge of the Mesozoic Florida-Bahamas platform deposits (Figs. 1B and 2; Meyerhoff and Hatten, 1974). The Northern Foldbelt and the Guaniguanico Terrane share similar Late Jurassic and Cretaceous Proto-Caribbean marine deposits. Between Paleocene and early Upper Eocene time, a forebulge and synorogenic foredeep developed with olistostrome, flysch, and carbonate deposition ahead of the leading edge of CARIB; extensive overthrusting also occurred

(Iturralde-Vinent, 2013; Iturralde-Vinent et al., 2008; van Hinsbergen et al., 2009).

Caribeana Metamorphic Terranes

These terranes comprise Proto-Caribbean Jurassic-Cretaceous passive margin and oceanic protoliths (Figs. 1B and 2) that were subducted and accreted to Cuba ~75–60 m.y. ago (García-Casco et al., 2008). Caribeana is represented in Cuba by (1) the Cangre glaucophane-bearing terrane; (2) the Pinos metamorphic terrane; (3) the Escambray greenschist to eclogite facies complex with inverted metamorphic structure; and (4) the Asunción lawsonite and glaucophane-bearing terrane (Figs. 1B and 2; Somin and Millán, 1981; García-Casco et al., 2008; Despaigne et al., 2016).

CARIBBEAN PLATE

CARIB allochthonous units are fragments of Pacific oceanic lithosphere that migrated into their present positions during Cretaceous time. An integrated geologic (Whattam and Stern, 2015) and geodynamic (Gerya et al., 2015) case has been made that Caribbean plate formation began when the Galapagos mantle plume head impinged on the Proto-Caribbean seaway in Early Cretaceous time. Alternatively, Pindell et al. (2012) proposed that onset of subduction at ca. 135 Ma occurred along an inter-American transform fault with no influence of plume head. The Greater Antilles subduction zone along the leading edge of the Caribbean plate was responsible for the subduction of at least 1500 km of Proto-Caribbean and NOAM lithosphere in a SW-dipping intra-oceanic subduction zone (Figs. 1B and 2). The following CARIB units can be distinguished in Cuba.

Ophiolites and Ophiolitic Mélange

These rocks outcrop discontinuously for more than 1000 km along the northern margin of Cuba. They were obducted onto the

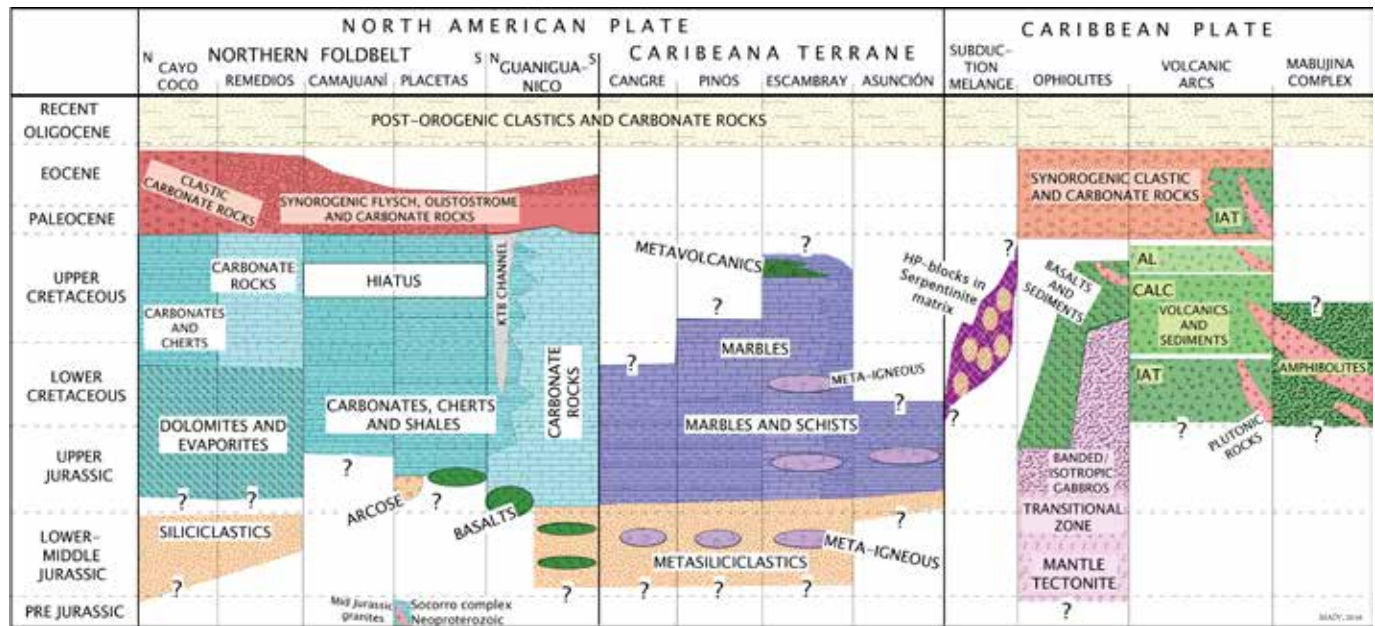


Figure 2. Generalized tectonic-stratigraphic chart of Cuba modified from Iturralde-Vinent (2011). Under “volcanic arcs,” abbreviations refer to island arc tholeiite (IAT), alkaline suites (AL), and calc-alkaline suites (CALC). KTB channel refers to a deep erosional channel cut due to the Cretaceous-Tertiary boundary mass flows from the platform margins due to the impact.

NOAM paleo-margin in latest Cretaceous to late Eocene times. Ophiolites include serpentinized harzburgites and dunites, banded and isotropic gabbros, basalts, and hyaloclastites (tholeiitic and fore-arc basalts, locally with boninitic compositions) overlain by Late Jurassic (Tithonian) through Late Cretaceous (Coniacian and younger) oceanic sediments. Sheeted dikes and isotropic gabbro are rare (Figs. 2 and 3C; Iturralde-Vinent, 1996). The available petrological, geochemical, and geochronological

data suggest that Cuban ophiolites include both mid-ocean-ridge and supra-subduction zone types (Kerr et al., 1999; Proenza et al., 2006; Marchesi et al., 2007; Lázaro et al., 2015). However, the widespread occurrence in the ophiolites of very refractory mantle peridotites as well as extrusive rocks with geochemical characteristics of island arcs indicate that the protoliths of most Cuban ophiolites formed above a subduction zone by both fore-arc and back-arc spreading. During subduction and obduction, the

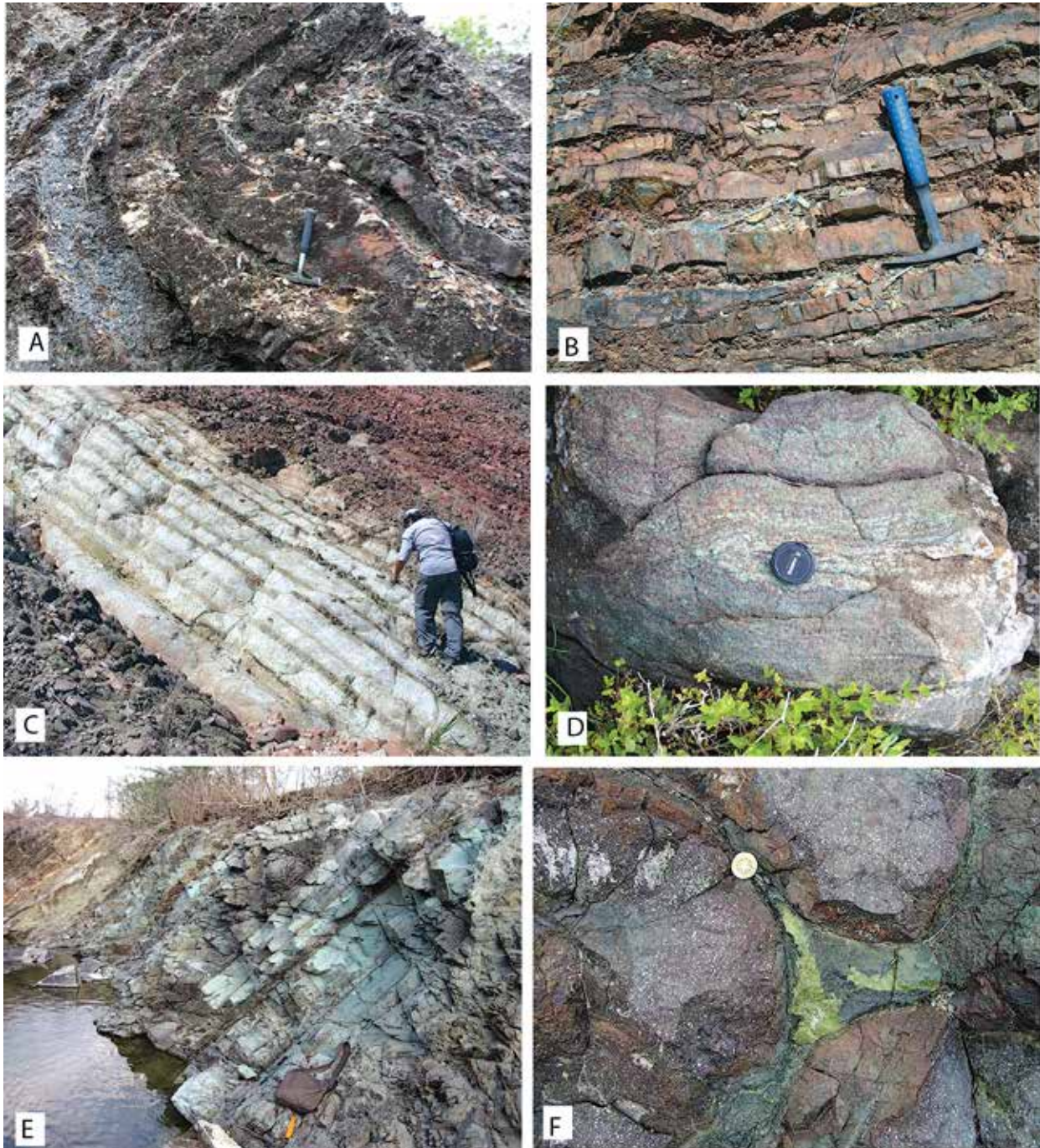


Figure 3. Outcrop photographs of some Cuban geologic units. (A) Recumbent fold in Jurassic continent-derived siliciclastics, Guaniguanico terrane, Alturas de Pizarra del Norte, Pinar del Río. (B) Aptian-Albian pelagic cherts of the Proto-Caribbean seafloor. Sierra de Rosario, Guaniguanico terrane, Pinar del Río. (C) Layered gabbros of the Moa-Baracoa Ophiolites, near Moa. (D) Block of mid-oceanic-ridge-basalt-derived epidote-Na-Ca amphibole eclogite in serpentinite mélangé (north of Santa Clara city, central Cuba). (E) Intercalated well-bedded fine-grained green tuff with conglomerate and sandstones of the Brujas Formation (Cretaceous volcanic arc) at Palmarito Dam, south of Santa Clara. (F) Eocene pillow basalts and green ribbon cherts of the Paleogene arc at Sierra Maestra.

ophiolites were dismembered, and exotic fault blocks from NOAM and the Cretaceous arcs were incorporated within the deformed ophiolitic bodies. Associated strips of subduction-related mélanges contain high-pressure (high-*P*) blocks (eclogite-, amphibolite-, blueschist-, and high-*P* greenschist-facies rocks and jadeite) in a serpentinite-matrix. These mélanges formed in a subduction zone from 120 Ma through latest Cretaceous (65 Ma; Fig. 3D); similar mélanges with high-*P* blocks occur as olistoliths within the foredeep basin and as tectonic slices within the Escambray complex (García-Casco et al., 2006; Blanco-Quintero et al., 2011; Cárdenas-Párraga et al., 2012).

Cretaceous Arc Complexes

Three stages of Cretaceous island arc volcano-sedimentary and plutonic rocks, separated by unconformities, are found in Cuba. Each arc sequence shows a distinct geochemical signature (Fig. 2). They are tectonically intercalated by thrust faulting with ophiolitic rocks and serpentinite mélanges and tectonically overlie the NOAM terranes (Figs. 1B and 2; Díaz de Villalvilla, 1997; Iturralde-Vinent and Lidiak, 2006; Marchesi, et al., 2007). In eastern Cuba (Purial complex) arc rocks metamorphosed in greenschist, and high-*P*, low-temperature blueschist-facies were partly subducted during the latest Cretaceous (García-Casco et al., 2008; Lázaro et al., 2015). Arc-related granitoid plutons range in age from ca. 89–83 Ma in the Santa Clara province (west-central Cuba) and 104–75 Ma in Camagüey province (east-central Cuba) (Hall et al., 2004; Rojas-Agramonte et al., 2011).

Mabujina Meta-Arc Complex

This complex structurally underlies the non-metamorphic arc rocks in Central Cuba (Figs. 1B and 2) and is composed of deformed gabbros, basalts, basaltic andesites, and pyroclastic rocks that were deformed and metamorphosed into the greenschist and amphibolite facies (Somin and Millán, 1981; Blein et al., 2003). Concordant and crosscutting granitic-gneissic rocks occur as pre-metamorphic (ca. 133 Ma), syn-metamorphic (ca. 93 Ma), and post-metamorphic intrusions/injections (ca. 89–83 Ma) (Grafe et al., 2001; Rojas-Agramonte et al., 2011). Several lines of evidence suggest that the Mabujina protoliths were detached from the Pacific margin of North America and accreted to the base of the Cuban Cretaceous arc complex at ca. 93–91 Ma (A. García-Casco and Y. Rojas-Agramonte, 2016, personal commun.).

Synorogenic Basins and Paleogene Arc

Late Campanian to late Eocene sedimentary strata unconformably overlie Cretaceous arc and ophiolite complexes (Fig. 2) with clastic deposits derived from the Cretaceous igneous substrate and interbedded carbonates (Iturralde-Vinent, 2015). In eastern Cuba, these deposits are interbedded laterally with Danian–middle Eocene arc lavas and volcanoclastics. Paleogene intraoceanic arc rocks are restricted to eastern Cuba (Fig. 2). Associated intermediate to felsic plutons are dated at 60.5 ± 2.2 to 46.9 ± 0.1 Ma (Cazañas et al., 1998; Iturralde-Vinent, 2011; Rojas-Agramonte et al., 2004, 2005). South of Sierra Maestra, the arc is truncated by the Oriente transform fault.

LATEST EOCENE TO RECENT DEPOSITS

Postorogenic latest Eocene to Recent basins and uplifted tectonic units formed above the strongly deformed foldbelt.

Deposits include interbedded coarse clastics and limestone, which in Cuba are mildly deformed and characterized by open folds, steeply dipping normal faults, and NE-SW strike-slip faults. These strata are strongly deformed only along the present E-W transform boundary between NOAM and CARIB in south-eastern Cuba, with recumbent folds and strike slip, reverse, and normal faults. Following establishment of modern sea level ~8000 years ago, Cuba attained roughly its present outline (Iturralde-Vinent, 2006).

RESEARCH OPPORTUNITIES

There is much that can we learn from future studies of Cuba, not only about the island itself but also about the tectonic evolution of the Caribbean region and other important tectonic processes of interest to the global geoscientific community. In the following sections, we briefly outline four promising research avenues: the Jurassic Caribbean, subduction initiation, intra-oceanic arc-trench systems, and collision tectonics.

Jurassic Caribbean

Better understanding of Cuban geology promises to provide important insights into the fit of Pangea and the origin of proto-Caribbean strata. Pre-Mesozoic clasts are found in Eocene, Cretaceous, and Jurassic conglomerates, but the sources of these and of the Jurassic siliciclastics are not well understood. For example, gneiss pebbles of ca. 400 Ma age (Millán and Somin, 1985) and 250–220 Ma (Somin et al., 2006) occur in the Eocene El Guayabo conglomerate of the Pinar del Río region of western Cuba. Focused studies should allow us to assign them to a source and provide a link between the Caribbean terrane and Central or South America. Furthermore, some poorly investigated meta-sedimentary blocks engulfed in the subduction mélange may sample early Atlantic–Proto-Caribbean oceanic sediments.

Subduction Initiation

It is important to understand how new subduction zones form. It has recently been suggested that emplacement of the Galapagos plume head formed most of the Caribbean plate, namely the (Caribbean Large Igneous Complex or “CLIP”), and that CLIP emplacement caused lithospheric collapse and formation of new subduction zones (Gerya et al., 2015), a process termed “plume-induced subduction initiation” (PISI). These subduction zones are argued to have formed around the plume head, perhaps first around the north at ca. 130 Ma, then around the southern, western, and northern margin at 85 ± 5 Ma. Alternatively, onset of subduction along the inter-American transform may have occurred with or without influence of the plume head. Studying the great Cuban ophiolite belt (Fig. 1B) provides a great opportunity to test and refine these hypotheses.

Intraoceanic Arc-Trench Systems

The Cuban arc is beautifully preserved and uplifted above sea level as a result of the soft-collision with NOAM. This gives us a 1000-km+ long arc section that may rival the classical arc crustal sections of California, Talkeetna, or Kohistan. The Mabujina Complex in particular promises important glimpses of arc crustal architecture and processes of arc crust formation. Examining potential correlations between CARIB early arc magmas and the evolution of the Mabujina arc and coeval magmatic rocks in the

eastern Pacific would enhance the understanding of the early evolution of the Caribbean Plate. The subducted section of the Cretaceous arc in eastern Cuba (Purial complex) also offers the opportunity to inspect forearc crustal structure. On the other hand, the well-exposed Cuban Paleogene magmatic arc and its prolongation into Hispaniola require detailed studies in order to improve models for the Cenozoic tectonic evolution of northern CARIB margin. These arc rocks are associated with unusual and poorly understood subhorizontal emplacement of ophiolite thrust sheets and high-*P* metamorphism of Cretaceous arc suites in eastern Cuba.

Collision Tectonics

Evidence of NOAM-CARIB collision is well preserved in the rocks of Cuba, and the sequence of plate reorganization events that followed this is mostly understood. The rapidity of the plate reorganization by forming the transform margin south of Cuba arrested collisional deformation at an early stage; this may be the best example of a “soft collision” available for study anywhere in the world. The range of deformation styles and sedimentary responses that occurred during the early stages of collision are well preserved and available for study.

CONCLUSIONS

In addition to the topics discussed here, Cuban geodiversity embraces natural resources, such as oil and gas, mineral and groundwaters, ore and industrial minerals, marbles and construction materials, and beautiful landscapes, including karst, wetlands, and coral reefs. The fact that we do not have space here to review these important features does not diminish their importance. Further reconstructing of the details of the older geologic framework, exploiting the economic potential, understanding the geomorphic evolution, and preserving the geobiological features are challenges and opportunities for the collective geoscientific community. We hope in the future to see more U.S.-Cuban collaborative studies of Cuban geology and NW Caribbean tectonic evolution.

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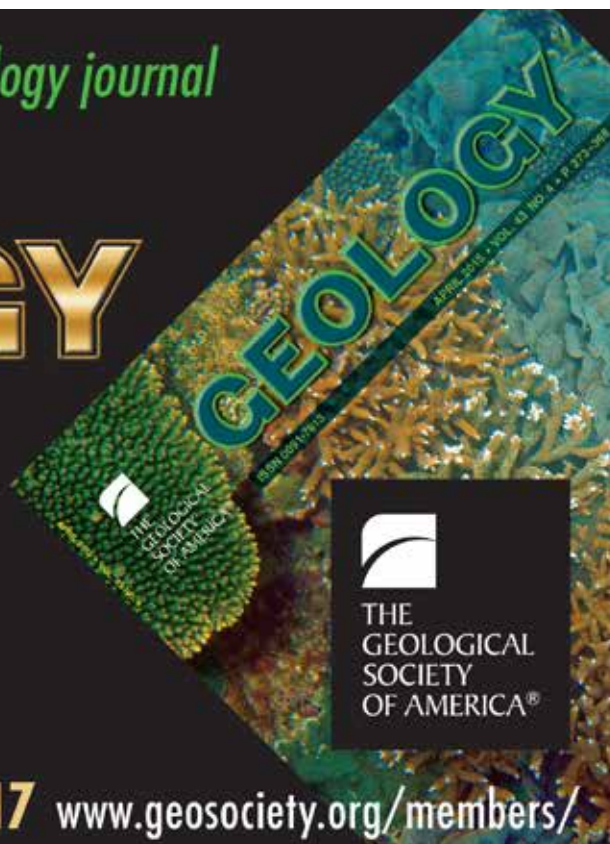
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Penrose Medal

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

Day Medal

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

Young Scientist Award (Donath Medal)

The Young Scientist Award was established in 1988 to be awarded to a young scientist (35 years or younger throughout the year in which the award is to be presented—for 2017, only those candidates born on or after 1 Jan. 1982 are eligible) for outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the earth sciences. The award consists of a gold medal (the Donath Medal) and an honorarium.

How to Nominate

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

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



The deadline for receipt of all GSA medal, award, and recognition nominations is 1 Feb. 2017.



CALL FOR NOMINATIONS

2017 GSA Awards & Medals



Geologic Mapping Award in Honor of Florence Bascom

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

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

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

How to Nominate

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

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

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

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

How to Nominate

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

The deadline for receipt of all GSA medal, award, and recognition nominations is 1 Feb. 2017.



CALL FOR NOMINATIONS

2017 GSA Awards & Medals



Doris M. Curtis Outstanding Woman in Science Award

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

How to Nominate

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

GSA Distinguished Service Award

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

How to Nominate

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

GSA Public Service Award

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

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

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

How to Nominate

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

The deadline for receipt of all GSA medal, award, and recognition nominations is 1 Feb. 2017.



CALL FOR NOMINATIONS

2017 GSA Awards & Medals



Honorary Fellowship

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

How to Nominate

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

GSA Fellowship

Fellowship is an honor that is bestowed on the best of our profession once per year at the spring GSA Council meeting and is recognized at GSA's Annual Meeting. GSA members are elected to Fellowship in recognition of distinguished contributions to the geosciences. A **GSA Fellow** may support *only two* nominees per election cycle and only **one** as a primary nominator. A **GSA member** who is not a Fellow may not be a *primary* nominator but may be a secondary nominator for no more than **two** nominees per election cycle.

The primary nominator is responsible for collecting the entire nomination packet (including letters of support) and must submit the nomination as one e-mail (with supporting documents as attachments). Letters of support sent separately will not be accepted.

How to Nominate

1. **Nomination form:** Please go to www.geosociety.org/members/fellow.htm to submit the form online.
2. **Supporting documents,** to be collected by the primary nominator and submitted as one package as e-mail attachments or via post:
 - Curriculum vitae;
 - Letter of nomination, including a summary of the nominee's significant contributions supporting the selected criteria for election (up to two pages);
 - Supporting letter of nomination from each of the secondary nominators—at least one should be from an organization other than that of the nominee.

Award Notes

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

All nomination forms and submission instructions can be found online at www.geosociety.org/awards/. Nomination forms and instructions may also be obtained from GSA Grants and Awards, P.O. Box 9140, 3300 Penrose Place, Boulder, CO 80301-9140, USA, awards@geosociety.org.

The deadline for receipt of all GSA medal, award, and recognition nominations is 1 Feb. 2017.



CALL FOR NOMINATIONS

2017 GSA Awards & Medals



John C. Frye Environmental Geology Award

Deadline: 31 March 2017

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

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

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

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



CALL FOR NOMINATIONS

2017 AGI Awards

2017 National Awards

AGI Medal in Memory of Ian Campbell

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

AGI Marcus Milling Legendary Geoscientist Medal

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

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

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

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



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Why GSA Membership is Important to Me



The things I value most about my GSA membership are the opportunities it provides for professional interaction with other geoscientists at the national and regional meetings. I work for a state government agency as their only geologist in a satellite office in a small town, several hundred miles from my home office, and separated from my colleagues by a couple of mountain ranges and a small desert. My job is very rewarding, but sometimes professionally isolating. I'm fortunate that my employer values participation at professional meetings, so I've been able to attend national and regional GSA meetings almost annually, and very often chair technical sessions at the national meeting. I continue to be surprised at how much I learn from attending these meetings, and not just from the technical sessions. Very often, I'll have extremely valuable exchanges of information simply from casual conversations in the corridors as I'm rushing from one talk to another.

Attending GSA meetings also provides me with opportunities to interact with students. Although I'm affiliated with a major state university, my position does not involve teaching, since all the students are on the other side of those mountains and deserts. I find the casual conversations I strike up with students during the poster sessions very stimulating. I have also taken advantage of the student mentor lunches that GSA hosts at their annual meetings, great fun (and free food). That kind of student-mentor interaction is something I rarely get anywhere else.

Lewis Land

*New Mexico Bureau of Geology and Mineral Resources
National Cave and Karst Research Institute
GSA member since 1992*

2017 GSA Section Meetings



Aerial overview of the Canyon Lake spillway of south-central Texas. Photo by Larry Walther.



JOINT MEETING

Pittsburgh skyline panorama at night.



Midlothian Mines. Photo used with permission from Richmond Region Tourism.



Waikiki view from Diamond Head.



Dinosaur Provincial Park. Photo by Jenni Scott.

South-Central Section

Location: San Antonio, Texas, USA

Dates: 13–14 March

Meeting Chair: Benjamin Surples, bsurples@trinity.edu

www.geosociety.org/Sections/sc/2017mtg/

Northeastern Section

(Joint with North-Central Section)

Location: Pittsburgh, Pennsylvania, USA

Dates: 19–21 March

Meeting Chair: Patrick Burkhart, patrick.burkhart@sru.edu

www.geosociety.org/Sections/ne/2017mtg/

North-Central Section

(Joint with Northeastern Section)

Location: Pittsburgh, Pennsylvania, USA

Dates: 19–21 March

Meeting Chair: Timothy G. Fisher,

timothy.fisher@utoledo.edu

www.geosociety.org/Sections/ne/2017mtg/

Southeastern Section

Location: Richmond, Virginia, USA

Dates: 30–31 March

Meeting Co-Chairs: David Spears, david.spears@dmme.virginia.gov; Karen Layou, klayou@reynolds.edu

www.geosociety.org/Sections/se/2017mtg/

Cordilleran Section

Location: Honolulu, Hawaii, USA

Dates: 23–25 May

Meeting Chair: Craig R. Glenn, glenn@soest.hawaii.edu

www.geosociety.org/Sections/cord/2017mtg/

Rocky Mountain Section

Location: Calgary, Alberta, Canada

Dates: 9–10 June

Meeting Chair: Katherine Boggs, kboggs@mtroyal.ca

www.geosociety.org/Sections/rm/2017mtg/

www.geosociety.org/sections

IN MEMORIAM



The Society notes with regret the deaths of the following members (notifications received between 10 May 2016 and 16 Aug. 2016).

M. Lee Allison

Tuscon, Arizona, USA
Date of death: 16 Aug. 2016

Curtis H. Elder

Evergreen, Colorado, USA
Date of death: 11 May 2016

Erwin Scheibner

Rylstone, New South Wales, Australia
Date of death: 14 June 2016

J. Kaspar Arbenz

Sandwich, Massachusetts, USA
Date of death: 7 June 2016

Jack V. Everett

Goodyear, Arizona, USA
Date of death: 12 Aug. 2013

Robert L. Smith

Fair Oaks, California, USA
Date of death: 17 June 2016

Paul J. Bateman

Deep River, Ontario, Canada
GSA notified: 10 June 2016

Elizabeth H. Gierlowski-Kordesch

Athens, Ohio, USA
Date of death: 17 May 2016

Gerald J. Wasserburg

Florence, Oregon, USA
Date of death: 13 June 2016

David Bedford

Menlo Park, California, USA
GSA notified: 7 June 2016

Jerlyn R. Gilmore

Glen Carbon, Illinois, USA
GSA notified: 13 June 2016

Robert Lee Wilson

Medford, Oregon, USA
Date of death: 19 May 2016

William J. Brennan

Geneseo, New York, USA
Date of death: 11 Apr. 2016

Kurt A. Grimm

Vancouver, British Columbia, Canada
Date of death: 10 Feb. 2016

Richard E. Byrd

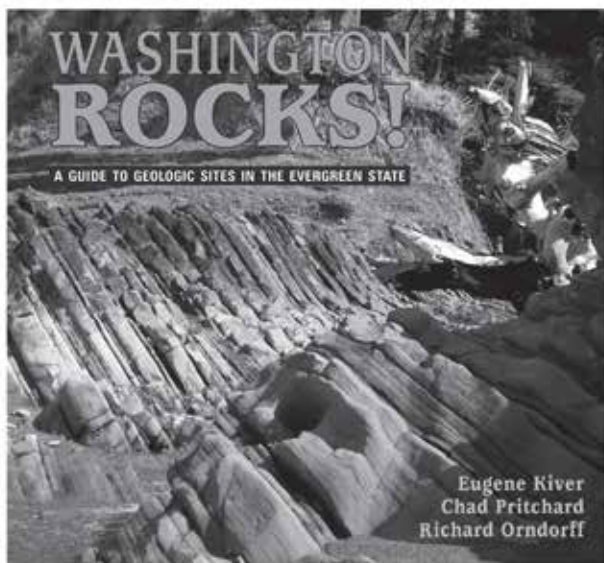
Houston, Texas, USA
Date of death: 26 Mar. 2016

James W. Mercer

Sterling, Virginia, USA
GSA notified: 10 June 2016

To honor a friend or colleague with a GSA memorial, please go to 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.

GEOLOGY ROCKS!



WASHINGTON ROCKS!

A Guide to Geologic Sites in the Evergreen State
EUGENE KIVER, CHAD PRITCHARD, AND RICHARD ORNDORFF

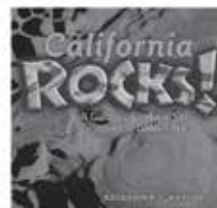
Our latest addition to the popular Geology Rocks! series, *Washington Rocks!*, introduces readers to amazing rocks and features such as limestone caves, petrified forests, mind-boggling waterfalls, channel scablands, and more.

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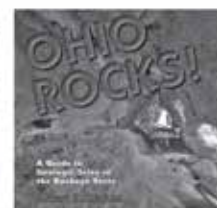
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Geoscience Jobs & Opportunities

Ads (or cancellations) must reach the GSA advertising office no later than the first of the month, one month prior to the issue in which they are to be published. Contact advertising@geosociety.org, +1.800.472.1988 ext. 1053, or +1.303.357.1053. All correspondence must include complete contact information, including e-mail and mailing addresses. Rates are in U.S. dollars.

Classification	Per Line for 1st month	Per line each addtl month (same ad)
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Fellowship Opportunities	\$9.20	\$8.95
Opportunities for Students		
First 25 lines	\$0.00	\$5.00
Additional lines	\$5.00	\$5.00

Positions Open

IMOGENE AND HAROLD HERNDON PROFESSORSHIP IN GEOSCIENCES TRINITY UNIVERSITY

The Department of Geosciences at Trinity University invites applications for the Imogene and Harold Herndon Professorship in Geosciences. Appointment to this endowed position is at the rank of Professor with tenure. A Ph.D. in Geosciences or a closely aligned field is required. The position includes a reduced teaching load and a yearly discretionary budget.

We seek candidates whose research program is widely recognized, externally funded, and provides opportunities for meaningful involvement of undergraduates. Demonstrated dedication to and success in undergraduate education are required. The successful candidate will teach introductory geosciences courses, at least one upper-level course related to environmental geoscience, and other contributions to department and university core curricula. We are open to a wide range of research specialties, including but not limited to hydrogeology, aqueous geochemistry, soil science, climate science, and oceanography.

Trinity University (<http://www.trinity.edu>), founded in 1869, is an independent, coeducational, selective, primarily undergraduate institution with high-quality science, liberal arts, and pre-professional programs. Trinity is among the national leaders in percentage of graduates who earn doctorates in the sciences. Undergraduate enrollment is about 2500, with students from all areas of the U.S. and many foreign countries. The attractive campus overlooks downtown San Antonio, the 7th largest city in the U.S., which is rich in heritage and ethnic diversity. The Geosciences Department is housed in the Center for Sciences and Innovation (<https://goo.gl/K6pSPP>). The department has granted degrees in the geosciences for over 50 years and is a member of the Keck Geology Consortium. Further information about the department and this search can be found at <http://www.trinity.edu/departments/geosciences/>.

Applications or letters of nomination should be sent to herndonsearch@trinity.edu. Complete applications must include a cover letter, curriculum vitae, a detailed statement of undergraduate teaching experience and philosophy, documentation and/or evaluations of teaching effectiveness, a description of research plans, and the names and contact information of four professional references. Review of completed applications will begin on December 1,

2016. Questions about the search can be directed to Dr. Glenn Kroeger [glkroeger@trinity.edu]. Minority and women candidates are strongly encouraged to apply. Trinity University is an Equal Opportunity Employer.

PALEONTOLOGY, DEPARTMENT OF GEOLOGY AND GEOPHYSICS AT TEXAS A&M UNIVERSITY

The Department of Geology and Geophysics at Texas A&M University invites applications for a tenure-track faculty position in paleontology. Areas of interest include marine micropaleontology, marine invertebrate paleontology, paleoecology, paleoclimatology and biostratigraphy. Successful applicants are expected to develop and maintain a vigorous, externally funded research program and demonstrate a commitment to exceptional undergraduate and graduate teaching through effective pedagogical techniques. We are a collaborative, broad-based Department within the College of Geosciences, which includes the Departments of Oceanography, Atmospheric Science, Geography, Texas Sea Grant, the Geochemical and Environmental Research Group (GERG), and the International Ocean Discovery Program. Opportunities for collaboration also exist within the Faculty of Ecology and Evolutionary Biology, which brings together faculty interested in Ecology and Evolutionary Biology from across the campus.

Interested candidates should submit electronic versions of a curriculum vita, statement of research interests and teaching philosophy, the names and addresses of at least three references and up to four reprints to <https://apply.interfolio.com/36752>. Screening of applications will begin October 1, 2016, and will continue until the position is filled. A Ph.D. is required at the time of employment.

Texas A&M University, a land-, sea-, and space-grant university, is located in a metropolitan area with a dynamic and international community of 255,000 people. Texas A&M University is an affirmative action/equal opportunity employer committed to excellence through the recruitment and retention of a diverse faculty and student body and compliance with the American with Disabilities Act. The University is dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment. We strongly encourage applications from women, underrepresented ethnic groups, veterans, and persons with disabilities. Texas A&M University also has a policy to address the needs of dual-career partners (<https://advance.tamu.edu/dual-career-program-information/>).

DIRECTOR OF THE BERG-HUGHES CENTER FOR PETROLEUM AND SEDIMENTARY SYSTEMS TEXAS A&M UNIVERSITY

The Department of Geology and Geophysics at Texas A&M University invites applications for the position of Director of the Berg-Hughes Center for Petroleum and Sedimentary Systems. The Berg-Hughes Center integrates geosciences, engineering and other disciplines to collaborate with industry and others to advance research and education in petroleum studies.

We seek dynamic, innovative, geoscientists with demonstrated experience in leading large, multi-disciplinary teams and in obtaining funding from both industry and government to become the Director of the Berg-Hughes Center (<http://berg-hughes.tamu.edu>). This is a senior-level faculty position (Professor, or Executive Professor) in sedimentary or petroleum geology.

We are seeking candidates with strong accomplishments in applying fundamental concepts in petroleum geosciences and engineering to grand challenges in energy and natural resource sciences, ranging from the pore to basin scale. Areas of expertise may include, but are not limited to, sedimentary processes, depositional environments, sequence stratigraphy, basin architecture, basin modeling, geologic modeling, and energy and natural resource science. The successful applicant will be expected to provide enlightened leadership, and effective management of the center activities. The Berg-Hughes Center Director must possess the ability to engage industry other colleges and government entities in initiatives that advance scientific and technical frontiers. The Director must have working knowledge of petroleum engineering and the ability to bridge geosciences with engineering disciplines. This position will also engage faculty and industrial leaders to ensure that students participating in center activities become tomorrow's leaders. The Director will be expected to establish a vigorous and externally funded research program in collaboration with faculty in the Department of Geology & Geophysics, other research units in the College of Geosciences, the Department of Petroleum Engineering, the Texas A&M Energy Institute and the petroleum industry. The successful candidate will also be expected to mentor junior faculty and graduate students and contribute to graduate teaching and research.

Interested candidates should submit electronic versions of a curriculum vita, statements of research interest and teaching philosophy, leadership philosophy, funding history, and the names and email addresses of at least three references, and up to four reprints at <https://apply.interfolio.com/36755>. Screening of applications will begin October 1, 2016 and will continue until the position is filled. A Ph.D. or a M.S. with greater than 20 years industry experience, or industry engagement is required at the time of employment.

The Berg-Hughes Center for Petroleum and Sedimentary Systems is a comprehensive program that integrates geosciences, engineering and related disciplines, including the Department of Geology and Geophysics and the Crisman Institute for Petroleum Research in the Harold Vance Department of Petroleum Engineering. The Department of Geology and Geophysics (geoweb.tamu.edu) is part of the College of Geosciences, which also includes the Departments of Atmospheric Sciences, Geography, Oceanography, as well as Sea Grant, the Geochemical and Environmental Research Group (GERG), and the Integrated Ocean Discovery Program (IODP).

Texas A&M University, a land-, sea-, and space-grant university is located in a metropolitan area with a dynamic and international community of 255,000 people. Texas A&M University is an affirmative action/equal opportunity employer

committed to excellence through the recruitment and retention of a diverse faculty and student body and compliance with the American with Disabilities Act. The University is dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment. We strongly encourage applications from women, underrepresented ethnic groups, veterans, and persons with disabilities. Texas A&M University also has a policy to address the needs of dual-career partners (<https://advance.tamu.edu/dual-career-program-information/>).

**STRUCTURAL GEOLOGY/TECTONICS
CONOCOPHILLIPS SCHOOL OF
GEOLOGY AND GEOPHYSICS
MEWBOURNE COLLEGE OF
EARTH AND ENERGY
UNIVERSITY OF OKLAHOMA**

The University of Oklahoma invites applications and nominations for a tenure-track Assistant Professor faculty position in Structural Geology/Tectonics. Exceptional candidates at the Associate Professor level will also be considered. We seek a dynamic colleague who will teach and supervise students at all levels, while conducting an independent, externally funded research program in his/her field of expertise. The holder of this position is expected to (1) conduct research in structural analysis using any combination of theoretical, experimental, field and geophysical approaches; and (2) educate students in the area of structural concepts and techniques. The area of research experience and expertise is open. We expect the candidate to teach undergraduate Structural Geology and graduate courses in Advanced Structural Geology, and participate in the Introductory Field Geology course and Field camp.

The candidate must hold a Ph.D. at the time of appointment, have a research record, and an interest in teaching undergraduates and mentoring graduate students. Salary, benefits, and start-up funds will be competitive and commensurate with experience. The ConocoPhillips School of Geology and Geophysics has a large, vibrant faculty with a broad range of research activities, from fundamental to applied, and strong ties to the petroleum industry. The student body currently includes 180 undergraduates and 95 MS and PhD students.

Screening of applicants will begin in November 2016. Interviews will take place in January and February 2017. The position will be available at the beginning of 2017 academic year (Fall 2017 semester), and the search will remain open until the position is filled. Applicants are encouraged to apply at apply.interfolio.com/37030. Submissions should include a complete vita/resume, statement of research and teaching interests, and a list of three references (including names, phone numbers, e-mail addresses, and complete mailing addresses). Questions or requests for additional information may be addressed to Chair of the Structural Geology/Tectonics Search Committee, at (405) 325-3253, or oustructuresearchchair@ou.edu.

The University of Oklahoma is an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability

status, protected veteran status, or any other characteristic protected by law.

**TENURE-TRACK POSITION
IN SEDIMENTARY GEOLOGY AND
PALEOCLIMATOLOGY
UNIVERSITY OF MARY WASHINGTON**

The Department of Earth and Environmental Sciences at the University of Mary Washington seeks applications for a full-time, tenure-track position at the rank of Assistant Professor to begin Fall 2017. Candidates must have expertise in sedimentary geology and paleoclimatology. Additional expertise in estuarine/coastal processes, paleontology, or closely related fields is desirable. The successful candidate will teach classes in introductory geology and oceanography, upper-level undergraduate classes in sedimentation/stratigraphy and Earth's climate history, and other classes in their area of expertise. The successful candidate must also be able to mentor undergraduate research students and engage them in fieldwork. Candidates must possess the Ph.D. in an appropriate discipline at the time of appointment.

The University of Mary Washington is a primarily undergraduate, public, liberal arts institution that stresses teaching excellence and the engagement of students in research. The University is located in the Chesapeake Bay watershed on the margin between the Coastal Plain and Piedmont of Virginia, with nearby access to Washington, D.C. (including the Smithsonian Institute), the Chesapeake Bay, and Appalachian Mountains. The Department currently has expertise in GIS, structural geology, mineralogy/petrology, soil science, watershed analysis, aquatic ecology, hydrology, environmental geochemistry, and environmental policy, and is well equipped for sedimentological work, with sampling and coring equipment, sub-bottom profiling instrumentation, and a new 22-ft research boat. Faculty in the Department work closely with those in the Biology and Chemistry departments and have access to well-equipped, shared laboratories with instrumentation for the chemical analysis of water, soil, and sediment (e.g., variable-pressure SEM, ICP-AES, GC-MS, etc.).

To obtain additional information about the Department or University, please visit our websites at <https://cas.umw.edu/ees/> and <https://www.umw.edu>. Applications must be submitted online via the UMW Careers site at <https://careers.umw.edu>. Only applications submitted through the university site will be considered; faxed, mailed, or emailed applications or documentation will not be considered. A complete application package includes a completed online application form, letter of application, curriculum vitae, undergraduate and graduate transcripts, a brief statement of teaching philosophy, a brief statement of how undergraduate students would be engaged in research, and contact information for three references. The deadline for application submission is November 15, 2016. Send e-mail enquiries to jhayob@umw.edu.

The University of Mary Washington seeks to enrich its academic environment by continuing to provide equal educational and employment opportunities. We actively encourage women, minorities, individuals with disabilities, and veterans to apply. Employment offers are contingent upon the successful completion of criminal background checks.

**APPLIED GEOINFORMATICS
DARTMOUTH COLLEGE**

The Department of Earth Sciences at Dartmouth College invites applications for a junior rank tenure-track position in the area of geoinformatics with application to one or more of our core research areas including (i) ice and climate systems, (ii) water and environmental biogeochemistry, and (iii) planetary evolution and surface processes. We especially welcome applications from candidates who link traditional geologic approaches and state-of-the-art computational geoinformatics in their research. Particular attention will be given to candidates who combine a focus on understanding fundamental processes with laboratory and/or field research programs that complement and contribute to ongoing research activities in the Departments of Earth Sciences, Mathematics, and Computer Sciences, as well as the Thayer School of Engineering. The successful candidate will continue Dartmouth's strong traditions in graduate and undergraduate research and teaching. Teaching responsibilities consist of three courses spread over three of four ten-week terms.

The Department of Earth Sciences is home to 11 tenured and tenure-track faculty members in the School of Arts and Sciences, and enjoys strong Ph.D. and M.S. programs and outstanding undergraduate majors. To create an atmosphere supportive of research, Dartmouth College offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence, and flexible scheduling of teaching responsibilities.

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

Dartmouth, a member of the Ivy League, is located in Hanover, New Hampshire (on the Vermont border). Dartmouth has a beautiful, historic campus located in a scenic area on the Connecticut River. Recreational opportunities abound all year round.

To learn more about Dartmouth College and the Department of Earth Sciences, visit <http://www.dartmouth.edu/~earthsci>.

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

<http://apply.interfolio.com/20038>

Application review will begin November 1, 2016, and continue until the position is filled. The appointment will be effective July 1, 2017.

Dartmouth College is an equal opportunity/

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

**TENURE-TRACK FACULTY
POSITION, DEPT. OF GEOLOGY
WASHINGTON AND LEE UNIVERSITY**

The Geology Department at Washington and Lee University, Lexington, VA seeks applications for a tenure-track assistant professor in environmental geochemistry starting in fall 2017. PhD required at the time of appointment. Courses taught by the successful candidate will include hydrology, geochemistry, and environmental field methods at the majors level, and physical geology at the introductory level. We seek a dynamic, creative teacher/scholar, dedicated to diverse teaching approaches, enthusiastic about teaching intensive field-based geology courses, and able to develop a strong research program including collaboration with undergraduates. W&L and the Geology Department value excellence in scholarship, meaningful engagement in professional activities, sustainability, and the development of a campus climate that supports equality and diversity among its faculty, staff, and students. W&L is a nationally ranked, highly selective liberal arts college. The Department (geology.wlu.edu) has excellent facilities and resources, makes great use of the Appalachians in field courses and labs, and belongs to the Keck Geology Consortium. Applications should include curriculum vitae; teaching statement including teaching interests/experience; research statement; and contact information for 3 referees. Apply via email to wilsons@wlu.edu. Please address to Lisa Greer, Chair, Geology Department, Washington and Lee University. Initial review of applications will begin Sept. 1; we will be available to meet with potential candidates at the fall GSA meeting in Denver. Review will continue until the position is filled. The University is an Equal Opportunity Employer.

**WILLIAM E. WHITE POSTDOCTORAL
SCHOLARSHIP, GEOLOGICAL
SCIENCES AND GEOLOGICAL
ENGINEERING, FACULTY OF ARTS
AND SCIENCE AND FACULTY OF
ENGINEERING AND APPLIED SCIENCE,
QUEEN'S UNIVERSITY
KINGSTON, ONTARIO, CANADA**

One of Canada's leading universities, Queen's has a long-standing reputation for academic excellence, research, and a diverse and vibrant learning environment. With its strong tradition of public service, the University has helped to shape Canadian values and policies, educating notable political and cultural figures.

Queen's University is located in the heart of the community in historic Kingston, midpoint between Montreal, Toronto, and the nation's capital.

The Department of Geological Sciences and Geological Engineering of Queen's University, one of Canada's premier earth-science departments, invites applications for its William E. White Postdoctoral Scholarship, created from a fund endowed

 **Penn** Assistant Professor in the
Energy Cluster at the
University of Pennsylvania

As part of a larger investment to create the new Vagelos Institute for Energy Science and Technology, the School of Arts and Sciences at the University of Pennsylvania seeks to add faculty to our newly formed Energy Cluster spanning the natural sciences. We invite applications for a tenure-track assistant professor position in one of the following departments: Biology, Chemistry, Earth and Environmental Science, or Physics & Astronomy. Exceptional senior candidates will also be given consideration. The successful candidate will mount an innovative program of fundamental scientific research that impacts our societal energy challenges, broadly defined, and in doing so will forge collaborative links with other Penn scientists and engineers involved in energy research. Applicants must apply online at <http://facultysearches.provost.upenn.edu/postings/937>. Required application materials include: curriculum vitae with a list of publications, a research statement that includes the candidate's perspective on how she or he fits into one of the four departments and identifies potential collaborative links with other natural science departments, and a teaching statement. Applicants should also submit the names and contact information for three individuals who will provide letters of recommendation. Review of applications will start on October 15, 2016 and will continue until the position is filled. The School of Arts and Sciences is strongly committed to Penn's Action Plan for Faculty Diversity and Excellence and to establishing a more diverse faculty (for more information see: <http://www.upenn.edu/almanac/volumes/v58/n02/diversityplan.html>). The University of Pennsylvania is an equal opportunity employer. Minorities/Women/Individuals with disabilities/Protected Veterans are encouraged to apply.



GSA's Connected Community

Powered by You!

Photo by Bret Webster.

"What a great discussion." [Andrew Cullen]

Get Connected...

"Thank you for joining in. ... I believe this type of discussion is exactly what was intended by GSA for this open forum." [Michael Tarullo]

... In The Community

"I would like to add to this very interesting discussion." [Georges Pardo]



GSA Members:

Lend your voice to your community
community.geosociety.org

by the estate of William E. White. The award will be made for one year and may be renewed for a second year. The annual stipend will be no less than \$60,000.

The William E. White Postdoctoral Scholarship will be awarded to an outstanding scientist who has completed a Ph.D. degree, normally within the two-year period preceding the time of the appointment. The area of research is open, but the scholar's research must be complementary to that being pursued in the Department of Geological Sciences and Geological Engineering. The research program to be undertaken and the level of support of research costs and moving expenses will be negotiated with a faculty member at the time the award is made. Potential applicants may obtain an outline of current research interests on the Departmental website <http://www.queensu.ca/geol/home> and are required to initiate contact with a potential faculty supervisor in advance of applying. Fit with the research interests of the Department and the research excellence of the candidate will be the primary considerations in the selection process.

The Department invites applications from all qualified individuals. Queen's University is committed to employment equity and diversity in the workplace and welcomes applications from women, visible minorities, aboriginal people, persons with disabilities, and persons of any sexual orientation or gender identity.

Applicants should send curriculum vitae, a statement of research interests, and samples of research writing to the following address. Applicants should contact their referees and arrange for at least three confidential letters of reference to be sent to the address below. Review of complete applications will begin on October 15, 2016.

Professor D. Jean Hutchinson, Department Head, Department of Geological Sciences and Geological Engineering, Queen's University, Kingston, Ontario, Canada, K7L 3N6, Fax: 613-533-6592, hutchinj@queensu.ca and hyde@queensu.ca

TENURE-TRACK FACULTY ENERGY, NATURAL AND APPLIED SCIENCES, BENTLEY UNIVERSITY

Bentley University's Natural and Applied Sciences Department invites applications for a tenure-track faculty position in the broadly defined field of energy, with research and teaching interests that could include energy technologies and innovation, smart-grid technology, energy storage technology, renewable energy, energy efficiency, energy systems management, availability and distribution of energy resources, energy analytics, energy transformations in Earth systems, or energy resources in the context of business, public policy, and global climate change.

The successful candidate must have a Ph.D. in a relevant STEM field, including physics, engineering, Earth sciences, chemistry, physical geography, environmental science, or related discipline. She/he must be an outstanding teacher who can engage undergraduate students, most of whom are business majors, and perform innovative research in his/her fields of expertise. Bentley is an equal opportunity employer building strength through diversity. See the university website (www.bentley.edu) for information about the school, the Natural & Applied Sciences Department, its faculty, students, and programs.

All application materials should be submitted through Bentley's on-line employment site at <https://jobs.bentley.edu> (search jobs; department = Natural and Applied Sciences). Applications should include curriculum vitae, cover letter, separate statements of teaching philosophy and research plans, and contact information for three references. We will begin reviewing applications received by November 1, 2016, although applications will be accepted until the position is filled. Teaching and post-doctoral research or industry experience is preferred. Anticipated start date is July 1, 2017.

TENURE-TRACK ASSISTANT PROFESSOR GEOMICROBIOLOGY, DEPT. OF GEOSCIENCES, BAYLOR UNIVERSITY

Baylor University is a private Christian university and a nationally ranked research institution, consistently listed with highest honors among The Chronicle of Higher Education's "Great Colleges to Work For." Chartered in 1845 by the Republic of Texas through the efforts of Baptist pioneers, Baylor is the oldest continuously operating university in Texas. The university provides a vibrant campus community for over 15,000 students from all 50 states and more than 80 countries by blending interdisciplinary research with an international reputation for educational excellence and a faculty commitment to teaching and scholarship. Baylor is actively recruiting new faculty with a strong commitment to the classroom and an equally strong commitment to discovering new knowledge as we pursue our bold vision, Pro Futuris (www.baylor.edu/profuturis/).

The Baylor University Department of Geosciences (<http://www.baylor.edu/Geology/>) seeks a dynamic scholar to fill this position beginning August, 2017. Candidates should have a Ph.D. in Geology, Microbiology, or a closely related discipline with a strong emphasis on microbial mediation of biogeochemical and hydrological processes within the vadose and shallow saturated zones. Utilization of unique analytical techniques or conceptual modeling coupled with field-based measurements is desired. Research areas may range in scope from the Critical Zone to global biogeochemistry with relevance to hydrologic cycles. Regardless of research focus area, enthusiasm for interdisciplinary research and cultivation of new collaborations is essential to this position. The successful candidate may teach courses in geomicrobiology, soil hydrology, or biogeochemistry, establish and participate in externally-funded research, and successfully mentor M.S. and Ph.D. candidates to graduation. The Department currently consists of 17 tenured and tenure-track geoscientists, and supports the Baylor Center for Reservoir and Aquatic Systems Research (CRASR at <http://www.baylor.edu/crasr/> for further information). Research space is available in the 500,000 ft² "state-of-the-art" Baylor Sciences Building.

Applications for the position will be accepted until the position is filled. Please submit a letter of application, current curriculum vitae, official transcript showing highest degree conferred (if ABD), also send official transcript of completed Ph.D. hours, and a description of your research plan and teaching philosophy. Include names, addresses, and phone numbers of three individuals from whom you

have requested letters of recommendation to:

Dr. Steven G. Driese, Search Committee Chair, Department of Geosciences, One Bear Place #97354, Baylor University, Waco, TX 76798-7354 USA; +1-254-710-2194; please submit all applications electronically to Steven_Driese@baylor.edu.

Salary is commensurate with experience and qualifications. Applications will be reviewed beginning 11/01/2016 and will be accepted until the position is filled. To ensure full consideration, complete applications must be submitted by 11/15/2016.

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

ASSISTANT PROFESSOR EARTH AND ATMOSPHERIC SCIENCES (HYDROGEOLOGY/ GROUNDWATER MODELING) UNIVERSITY OF NEBRASKA-LINCOLN

Applications are invited for a tenure-track position as Assistant Professor in the Department of Earth and Atmospheric Sciences at the University of Nebraska-Lincoln. The successful candidate will be expected to participate in teaching and curricular development of undergraduate and graduate courses, to advise and direct graduate students, and to develop a rigorous research program that is supported by external funding. It is expected that the research program will focus on the responses of groundwater systems to climate change. Candidates must hold a Ph.D. in Geology, Hydrogeology, or a related field at the time of appointment. Ability to contribute to multidisciplinary water and climate research efforts within Department of Earth & Atmospheric Sciences and across the university will be considered as an advantage. The preferred candidate will also demonstrate strong potential for research and teaching.

The Department of Earth and Atmospheric Sciences offers B.S. degrees in Geology and Meteorology-Climatology, as well as M.S. and Ph.D. degrees in Earth and Atmospheric Sciences. Primary research areas within the geological sciences include sedimentary geology, paleontology and paleobiology, petroleum geosciences, hydrogeological sciences, and geobiology. Research in atmospheric sciences is focused on meteorological hazards, climate change, and remote sensing. Additional information about our department can be found on our web site: <http://eas.unl.edu>.

To apply, go to <http://employment.unl.edu/postings/51081> and complete the "faculty/administrative form". Applicants must attach a cover letter, curriculum vitae, statements of research and teaching interests, and names of at least three references via the above website. We will begin to review applications on November 23, but the position will remain open until it is filled.

The University of Nebraska-Lincoln is committed to a pluralistic campus community through affirmative action, equal opportunity, work-life balance, and dual careers. See <http://www.unl.edu/equity/notice-nondiscrimination>.

For further information, contact Dr. Richard Kettler, Search Committee Chair by email, phone, or mail at: rkettler1@unl.edu, 1-402-472-0882; Department of Earth & Atmospheric Sciences, University of Nebraska-Lincoln, 214 Bessey Hall, Lincoln NE 68588-0340.

**FACULTY POSITION IN
GEOENVIRONMENTAL ENGINEERING
AT THE UNIVERSITY OF
WISCONSIN-MADISON**

The University of Wisconsin-Madison is searching for a faculty member with expertise in Geoenvironmental Engineering to complement faculty in Civil and Environmental Engineering (<http://www.engr.wisc.edu/cee.html>) and the Geological Engineering Program (<http://gle.wisc.edu/>). Areas of interest include sustainability and resiliency, energy, waste management, materials and resource conservation, infrastructure, and environmental policy and regulation as related to geotechnical and geological engineering research and practice. This is a full-time tenure-track or tenured position and is open at the Assistant Professor rank.

Applicants for this position are expected to develop innovative and internationally recognized research programs, contribute to scholarly work in Civil and Environmental Engineering and Geological Engineering, undertake instruction in undergraduate and graduate classes, and engage in professional service. Successful candidates are expected to develop interactions with other faculty on the University of Wisconsin-Madison campus including those within the College of Engineering, and other colleges at the University of Wisconsin-Madison.

Applications should include a cover letter, curriculum vitae, research and teaching statements, and the names and contact information for three references all in one PDF Document.

The University of Wisconsin-Madison Madison is an equal opportunity/affirmative action employer that promotes excellence through diversity and encourages all qualified individuals to apply. Unless confidentiality is requested in writing, information regarding the applicants must be released upon request.

The application deadline is October 15, 2016, although applications may be considered until the position is filled. Applications for the position must be submitted electronically to www.aims.wisc.edu/jobapply.com. Additional information about the positions can be found here http://www.ohr.wisc.edu/Weblisting/External/PVLSummary.aspx?pv_num=87569.

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

The Department of Geological Sciences at California State University, Bakersfield (CSUB) invites applications for tenure-track Assistant Professor position beginning in Fall 2017. We seek a broadly trained Geologist with a preferred specialization in engineering geology, soil science, or hydrology/

Northwestern
WEINBERG COLLEGE OF ARTS & SCIENCES
Department of
Earth and Planetary Sciences

FACULTY POSITION IN GEODYNAMICS

The Department of Earth and Planetary Sciences at Northwestern University invites applications for a tenure-track Assistant Professorship in geodynamics, to begin fall 2017. Areas of specialization are open, but candidates whose expertise complements that of existing faculty in solid Earth geophysics, planetary science and habitability, natural hazards, seismology, and mineral physics are especially encouraged. A Ph.D. is required at the time of appointment. Review of applications will begin October 15th and continue until the position is filled. Applicants are encouraged to visit <http://www.earth.northwestern.edu> to apply.

AA/EOE. Northwestern University is an Equal Opportunity, Affirmative Action Employer of all protected classes including veterans and individuals with disabilities. Women and minorities are encouraged to apply. Hiring is contingent upon eligibility to work in the United States.

aqueous geochemistry. Review of applications will begin December 1, 2016 and continue until the position is filled. CSUB fosters and appreciates ethnic and cultural diversity among its faculty and students, and is committed to increasing the diversity of its faculty to reflect the diversity of the campus community. Applications from women, ethnic minorities, veterans, and individuals with disabilities are welcome. The full announcement and instructions on how to apply can be found at http://www.csu.edu/geology/_files/Geology-TT-Search-2016-position-announcement%20PDF.pdf.

**ASSOCIATE OR FULL PROFESSOR IN
ENVIRONMENTAL GEOSCIENCES, DEPT.
OF EARTH & ENVIRONMENTAL
SCIENCES, RENSSELAER
POLYTECHNIC INSTITUTE**

Troy, New York 12180-3590. The Department of Earth & Environmental Sciences at Rensselaer Polytechnic Institute in Troy, NY invites applications for the position of Associate or Full Professor in Environmental Geosciences, with emphasis on individuals with research interests in the areas of environmental geochemistry, hydrogeology, environmental remote or local sensing, global climate science/modeling (paleo or future), environmental data analysis, or environmental field-imaging visualization.

The successful candidate will have duties that include teaching graduate and undergraduate courses in the Department of Earth & Environmental Sciences, fulfilling the duties of the Director of the

Environmental Sciences undergraduate program, developing and maintaining robust programs of research and scholarship, and providing service to the department, the School of Science, and to Rensselaer.

Rensselaer has recently initiated several bold, new initiatives; the successful candidate should interface with one or more of these areas. Examples of these include the Rensselaer Institute for Data Exploration and Applications (IDEA; <http://idea.rpi.edu>), the Darrin Fresh Water Institute (DFWI), a comprehensive freshwater ecological field station and Institute-wide research effort that hosts The Jefferson Project at Lake George (<http://jeffersonproject.rpi.edu>). In addition, the Institute is conceptualizing a new, broader initiative that will bring together research and education activities in water, environment, ecology, and sustainability.

The successful candidate will have a Ph.D. or foreign degree equivalent in geoscience or related discipline, along with the ability to demonstrate, through accomplishments achieved over a post-graduate academic career of seven or more years, an international reputation and record of excellence in scholarship, along with a sustained level of high quality educational activities including teaching and advising, and a significant level of professional service.

To apply, applicants must submit as single pdf document a curriculum vitae, a statement of research accomplishments and goals, a description of teaching interests, and a list of four professional

references to: E&ES Faculty Search, Department of Earth and Environmental Sciences, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY 12180-3590; Email: spearf@rpi.edu (electronic submissions are preferred). Up to four select publications may be sent as separate files. Consideration of candidates will begin upon receipt of application. Applications are encouraged by midnight, December 24, 2016, and recruiting will continue until the position is filled. Preliminary interviews will be conducted at GSA and AGU in Fall 2016.

We welcome candidates who will bring diverse intellectual, geographical, gender, and ethnic perspectives to Rensselaer's work and campus communities. Rensselaer Polytechnic Institute is an Affirmative Action/Equal Opportunity, Race/Gender/Veterans/Disability Employer.

**ASSISTANT PROFESSOR
HYDROGEOCHEMISTRY
GEOLOGICAL SCIENCES**

SAN DIEGO STATE UNIVERSITY

The Department of Geological Sciences at San Diego State University invites applications for a tenure-track faculty member at the Assistant Professor level in hydrogeology contributing to the Blue Gold, Mitigating Water Scarcity initiative at SDSU (<http://bluegold.sdsu.edu/>), with preference for expertise in geochemical, quantitative techniques and/or geophysical methods in assessing water fluxes and/or rock-water interactions. Candidates must have a PhD in Geological Sciences or a related field at the time of appointment. The full advertisement and directions for application are posted at (<https://apply.interfolio.com/36393>). The successful candidate is expected to establish an independent externally-funded research program and teach and supervise student research at graduate and undergraduate levels. Anticipated start date for the position is Fall 2017. Applications received by October 15, 2016 will receive full consideration. The position will remain open until filled. For additional information contact the co-Chairs of the Search Committee, Kathryn Thorbjarnarson, kthorbjarnarson@mail.sdsu.edu, and David Kimbrough, dkimbrough@mail.sdsu.edu.

SDSU is a Title IX, equal opportunity employer.

**ASSISTANT PROFESSOR
OF EARTH AND PLANETARY
SCIENCES, WASHINGTON
UNIVERSITY IN ST. LOUIS**

The Department of Earth and Planetary Sciences at Washington University in St. Louis invites applications for a tenure-track Assistant Professor position in the fields of climate, carbon cycling, or paleoclimatology. The ideal candidate will study climate or the effects of climate change in modern systems and/or over Cenozoic Earth history. Areas of interest include but are not limited to: paleoclimatology and records of consequent environmental change; elemental cycling and associated climate feedbacks; the response of terrestrial, marine, and/or freshwater systems to climate change. The candidate is expected to employ quantitative tools and ideally will integrate field observations with laboratory measurements.

The successful candidate is also expected to develop a vigorous, externally funded research

program, maintain a strong publication record, teach a range of undergraduate and graduate courses, advise students, and be active in university service. We are seeking candidates who will complement our research programs in biogeochemistry and environmental geology as well as foster collaboration with environmental scientists across the Washington University community.

Candidates must have a Ph.D. with a focus in environmental Earth science, or a related field, at the time of appointment, and should send a letter of application, curriculum vitae, statements of teaching and research interests, and names and contact information of at least four references as a single PDF to Alex Bradley, Climate Search Committee Chair, Department of Earth and Planetary Sciences, Washington University, Campus Box 1169, 1 Brookings Drive, St. Louis, MO 63130, or via e-mail: ClimateFacSearch@eps.wustl.edu. The Department seeks an exceptionally qualified and diverse faculty; women, minorities, protected veterans and candidates with disabilities are strongly encouraged to apply. Washington University in St. Louis is committed to the principles and practices of equal employment opportunity and affirmative action. It is the University's policy to recruit, hire, train, and promote persons in all job titles without regard to race, color, age, religion, gender, sexual orientation, gender identity or expression, national origin, veteran status, disability, or genetic information. Applications should be received by November 1, 2016, to ensure full consideration.

**TENURE-TRACK ASSISTANT
PROFESSOR POSITIONS
FACULTY CLUSTER HIRE IN
EARTH SURFACE PROCESSES
UNIVERSITY OF CALIFORNIA
SANTA BARBARA**

The University of California Santa Barbara announces a multidisciplinary cluster hire of four outstanding scientists, to further strengthen its world class Earth surface process teaching and research mission. We seek dynamic researchers who are at the forefront of advancing theory, measurements and understanding in terrestrial Earth Surface Processes from disciplines including climatology, geochemistry, geology, geomorphology, hydrology and soil science. The cluster hire will build on UC Santa Barbara's foundation strengths in physical geography and Earth and environmental sciences. Successful hires will contribute to improving our understanding of the characteristics and functioning of the entire planet, and especially its terrestrial surface through the study of the complex interactions among atmosphere, geosphere, hydrosphere, biosphere, cryosphere, including their alteration by, and impact on, human activity. We will give preference to candidates with demonstrated expertise in one or more quantitative techniques including field measurement, remote sensing, modeling, and theory and candidates who, based on research and teaching proficiency, would fit into one of the following: the Bren School of Environmental Science and Management, the Department of Earth Science, and the Department of Geography. Applications will be reviewed starting October 31, 2016, with expected appointments on July 1, 2017. Please see the following website for a more complete description of

the positions: <http://www.eri.ucsb.edu/escluster>. To be considered for one of the four available positions, apply electronically at <https://recruit.ap.ucsb.edu/>. Applications completed by October 31st, 2016, will receive fullest consideration, but each department will continue reviewing applicant files until that position is filled.

The school is especially interested in candidates who can contribute to the diversity and excellence of the academic community through research, teaching and service. The University of California is an Equal Opportunity/Affirmative Action Employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability status, protected veteran status, or any other characteristic protected by law.

**HYDROLOGY/HYDROGEOLOGY
DEPT. OF EARTH SCIENCES
UNIVERSITY OF MINNESOTA**

The Department of Earth Sciences in the College of Science and Engineering at the University of Minnesota - Twin Cities is soliciting applications for a tenure-track faculty position in hydrology/hydrogeology at the assistant professor level. Exceptional candidates at the associate professor level will also be considered. This position will carry with it additional resources from the Gibson Endowed Fund for research activities over the first five years of the appointment.

Areas of research for this position could include physical, chemical, and/or biological aspects of hydrology or hydrogeology. Frontier topics of interest in this field include, among others, research at non-traditional spatial scales, grand challenges in water resource sustainability and security, novel measurement techniques and datasets, and links between the study of hydrological systems and subsurface geology, other portions of the earth system, and/or other disciplines, as well as other topics. The successful candidate is expected to develop a vigorous research program, attract external funding, and contribute to the instruction, research, and service efforts of the department. A Ph.D. in earth sciences or a related field is required at the time of appointment.

The Department of Earth Sciences is a vibrant interdisciplinary department whose research ranges from geobiology to deep earth dynamics. Alongside our commitment to excellence in scholarship, we seek to further the University of Minnesota's land-grant mission through developing ties with industry and/or governmental agencies that benefit the needs of our students, the state of Minnesota, and the broader community. The Department is in the N.H. Winchell School of Earth Sciences (<http://www.esci.umn.edu/>), which also includes the Institute for Rock Magnetism, the Limnological Research Center/National Lacustrine Core Facility/Continental Scientific Drilling Coordination Office, the Minnesota Geological Survey, the National Center for Earth-surface Dynamics, and the Polar Geospatial Center. Other affiliated research units at the University include the Saint Anthony Falls Laboratory and the Institute on the Environment. The appointee will have access to large-scale computing facilities (Minnesota Supercomputer Institute,

Digital Technology Center) and the interdisciplinary Water Resources graduate program.

Materials Required:

- A one-page letter of intent;
- A CV with a list of publications;
- A statement of research and teaching interests; and
- Names and contact information of three referees who can address the candidate's research and teaching potential.

Applications must be completed online at <http://www1.umn.edu/ohr/employment/> —search for Job Opening ID: 311335.

The review of applications will begin October 14, 2016. Applications will continue to be accepted until the position is filled. Questions may be directed to Prof. Jake Bailey (baileyj@umn.edu).

The University of Minnesota provides equal access to and opportunity in its programs, facilities, and employment without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. The University supports the work-life balance of its faculty.

ASSISTANT PROFESSOR SKIDMORE COLLEGE

The Department of Geosciences invites applications for a tenure track position in solid earth geosciences at the level of Assistant Professor to begin Fall 2017. The Department seeks a candidate with strong teaching skills who will build and maintain an active research program with undergraduate students. The candidate's field of expertise will focus on solid earth processes and deep time, and should be distinct from existing departmental strengths in surface processes, hydrology, climatology, and oceanography. The successful candidate will teach introductory and advanced courses that support the mission of the department, and will also contribute to teaching the College's interdisciplinary, open-topic seminar courses for first year students. A Ph.D. in the geosciences or a related field is required and preference will be given to candidates with teaching experience.

For the complete job description and to apply for this position please visit us online at: <https://careers.skidmore.edu/applicants/Central?quickFind=57450>

TENURE-TRACK FACULTY POSITION, HYDROGEOLOGY AND WATER RESOURCES, UNIVERSITY OF WISCONSIN—EAU CLAIRE

The Dept. of Geology is seeking a person to teach water resources, physical hydrogeology, chemical hydrogeology, and introductory geology courses as needed starting Fall 2017. Applicant must also involve students in high-quality collaborative research projects. A Ph.D. in geology or a closely related discipline is required at the time of appointment. The department has modern facilities in hydrogeology (including on-campus well nests), geophysics, geochemistry, and sedimentology.

Only online applications are accepted; go to <http://uwec.ly/jobopenings> to apply. For priority consideration, all application materials must be submitted by October 28, 2016. For a complete position description, call +1-715-836-3732 or visit <http://www.uwec.edu/geology/index.htm>. UW-Eau Claire is an AA/EEO employer and encourages applications from women and minorities.



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or contact Becky Sundeen at
bsundeen@geosociety.org.



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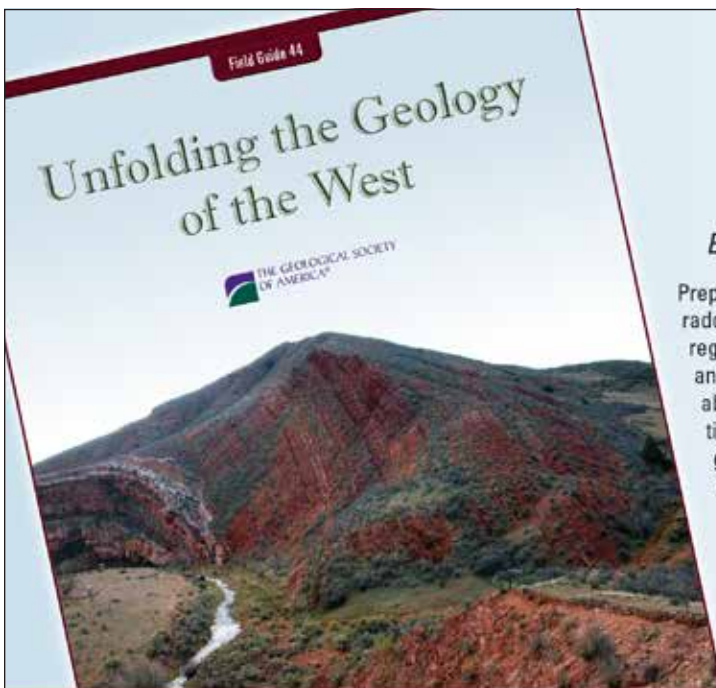


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FIELD GUIDE 44

Unfolding the Geology of the West

Edited by Stephen M. Keller and Matthew L. Morgan

Prepared in conjunction with the 2016 GSA Annual Meeting in Denver, Colorado, this volume contains sixteen guides to field trips in this rich geologic region. The four "Great Surveys" of the late 1800s ventured west to explore and document the region's unknown natural resources and collect valuable geologic information. Many of the field guides in this volume, aptly titled *Unfolding the Geology of the West*, will cover the same hallowed ground as the early geologic expeditions. Organized into four sections, this volume spans some of the major subdisciplines of geology: (1) stratigraphy, sedimentology, and paleontology; (2) structure and metamorphism; (3) Quaternary landscape evolution; and (4) engineering and environmental geology.

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Research Grants: Support from GSA Members Encourages Field Research and Mentorship

Since the Geological Society of America’s Graduate Student Research Grants began in the early 1930s, this notable program has generated the largest sum of research dollars available for geoscience graduate students. In its first year, the program awarded US\$47,600; in 2016, GSA presented more than \$741,000 in research grants to 359 graduate students. The average grant was \$2,038 this year, and about 50% of applicants received grants.

While early beneficiaries were professionals, the focus shifted to graduate-level recipients by 2001. Awardees are selected by GSA’s Committee on Research Grants. Funds are provided by GSA, the GSA Foundation, GSA Divisions, ExxonMobil, and the National Science Foundation, with a number of specialized awards supported by generous GSA members who created endowed funds with the GSA Foundation.

These specialized research awards support specific donor-designated purposes, and these funds significantly impact the work of recipients like Katie Ardill:

“Receiving a GSA research grant and the Lipman Research Award has enabled me to develop my skills as a field geologist, mapping magmatic structures at the regional and mineral scale, and has allowed me to learn a new analytical technique in the lab. It is a great honor to receive the Lipman Award, and for the scientific community to show their support and interest in my research in the early stages of my career.”

The Lipman Research Fund, established in 1993, is supported by gifts from the Lipman Family Foundation. The fund promotes and supports student research grants in volcanology and petrology. The president of the Foundation, Peter W. Lipman, was the recipient of a GSA research grant in 1965.

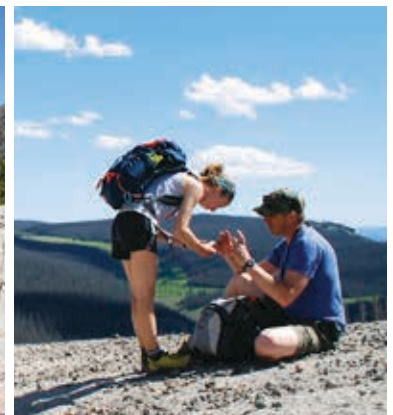
It is a clear path from receiving research support early in one’s career, to developing an important area of personal interest, and ultimately creating a mechanism to support emerging geologists in specific interest areas. Lipman writes,

“The GSA student research grants have long impressed me as uniquely worthy of support because no comparable source is available from any other earth-science organization. Such support, even at modest levels, can be exceptionally helpful at a critical point in a grad student’s development. Of great benefit to my own career, such a grant (50 years ago!) paid for ten chemical analyses of volcanic glass samples, at a time when such analyses were rare treasures, determinable only by specialized laborious wet-chemical methods. These analyses became key data for a major early research publication.”

Olivia Barbee, a Ph.D. student at Michigan Technological University, is another Lipman Research Award recipient. She says,

“The Lipman Research Award is providing me with a number of exciting research opportunities and is advancing my growth as a scientist and professional. The award facilitated my recent field work in the vast areas of Colorado that expose voluminous San Juan volcanic deposits and plutons. I was fortunate to work in the field alongside several other petrologists and volcanologists from around the world, including Peter Lipman himself. The research supported by this award will be an important step in my career, as it will not only allow me to build upon my knowledge of silicic volcanic rocks and advance current skills, but also explore and apply my skill sets to the plutonic realm of igneous petrology. In addition, the awarded research has given me the opportunity to mentor two women undergraduate students and their projects at Michigan Tech, both in the field and in labs. Working with these students on new research, learning new analytical techniques, and joining forces with new faces from the field will be important aspects of my budding career and are possible because of this award.”

Please consider contributing to GSA’s Graduate Student Research Grants Program and help hundreds of students each year continue their path to geoscience careers and research. Go to www.gsafweb.org/donate/#fund=geostar or contact Bill Tortorici at btortorici@geosociety.org, +1-303-357-1007.



Left: Research grant recipient Katie Ardill in the field. **Right:** Olivia Barbee and Chad Deering (her Ph.D. advisor) sampling ignimbrites in the Wheeler Geologic Area, La Garita Mountains, Colorado, USA.

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In 1896, **Florence Bascom** became the first woman to be employed by the U.S. Geological Survey.

In the 1920s, **J Harlen Bretz** revealed that the Channeled Scablands in eastern Washington were caused by massive flooding.

In 1935, **Charles Francis Richter** and **Beno Gutenberg** developed the Richter scale.

In the 1950s, **Marie Tharp**, **Bruce Heezen**, and **Maurice Ewing** mapped the ocean floor and confirmed the existence of a mid-Atlantic ridge; **Victor Vacquier** discovered magnetic striping on the seafloor; and **Clair Cameron Patterson** made the first reliable measurement of Earth's age.

In the 1960s, **Harry Hammond Hess**, **Robert S. Dietz**, and **J. Tuzo Wilson** proposed the concept of seafloor spreading, providing the framework for the theory of plate tectonics.

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Call For Field Trip, Short Course, and Technical Session Proposals



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GSA 2017 Seattle Meeting

Thank you to all the 2016 GSA Denver Annual Meeting attendees. We hope you enjoyed the geology, networking, and libations. It's time to plan for our 2017 Annual Meeting in Seattle, Washington, USA. GSA is excited to head back to the Pacific Northwest. Our 2009 meeting in Portland, Oregon, USA, attracted nearly 6,500 attendees from over 50 countries, so our 2017 meeting should be international, well attended, and full of excitement!

A highlight will be the Seattle-area geology: Glaciation, deposition, tectonics, crustal deformation, unconformities, erosion, bedrock structures, and drumlins. We challenge you to propose a field trip, short course, and/or technical session that will teach your colleagues and promote discussion about the incredible regional geology.

SHOW THE GEOLOGY BY LEADING A FIELD TRIP.

Field Trip proposal deadline: 1 Dec. 2016

Trips can be anywhere from a half day to 5 days long. Field trip proposals may be submitted by any member of GSA, its affiliated societies, or anyone else. The proposal form is online at <https://gsa.confex.com/gsa/2017AM/fieldtrip/cfs.cgi>.

EXCHANGE THE GEOLOGY BY ORGANIZING AND CHAIRING A TECHNICAL SESSION.

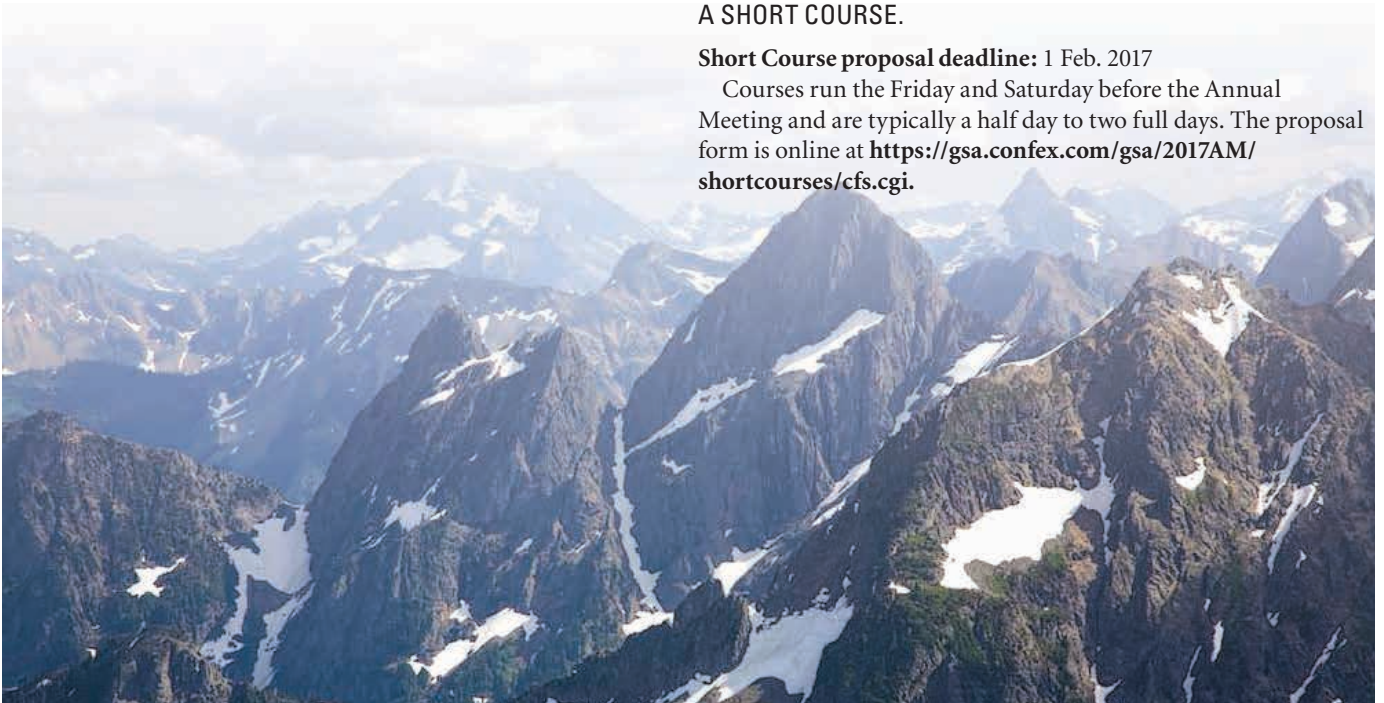
Technical Session deadline: 1 Feb. 2017

Proposals are being taken for both Pardee Keynote and Topical Sessions. The proposal form is online at <https://gsa.confex.com/gsa/2017AM/cfs.cgi>.

SHARE THE GEOLOGY AS AN INSTRUCTOR THROUGH A SHORT COURSE.

Short Course proposal deadline: 1 Feb. 2017

Courses run the Friday and Saturday before the Annual Meeting and are typically a half day to two full days. The proposal form is online at <https://gsa.confex.com/gsa/2017AM/shortcourses/cfs.cgi>.



Glaciated peaks of the North Cascades National Park, Washington. Photo by Marli Miller, Dept. of Geological Sciences, University of Oregon.

Belt Basin

Window to Mesoproterozoic Earth

Edited by John S. MacLean and James W. Sears



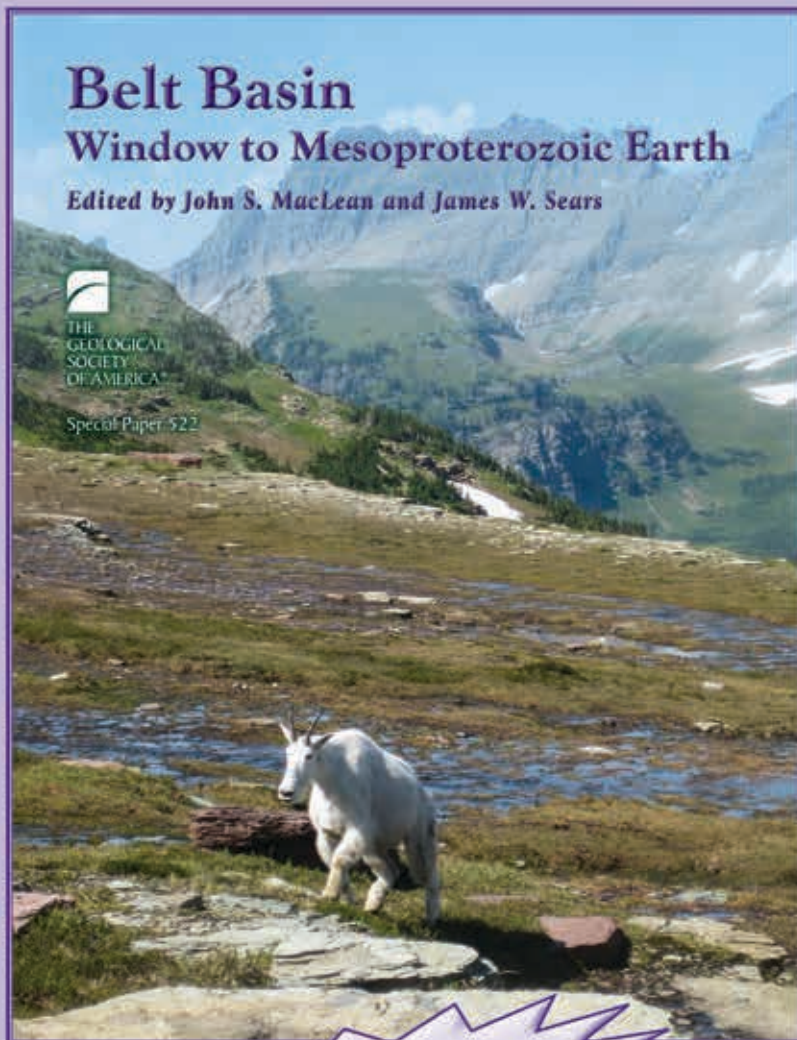
SPECIAL PAPER 522

With its thickness of more than 15 km of strata, covering some 200,000 km², the Belt Basin displays one of the planet's largest, best-exposed, most accessible, and best-preserved sequences of Mesoproterozoic sedimentary and igneous rocks. This volume focuses on research into this world-class province; kindles ideas about this critical era of Earth evolution; and covers aspects of the basin from its paleontology, mineralogy, sedimentology, and stratigraphy to its magmatism, ore deposits, geophysics, and structural geology.

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