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***A cosmogenic view of
erosion, relief generation,
and the age of faulting in
southern Africa***

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Featured Article

SCIENCE:

4 A cosmogenic view of erosion, relief generation, and the age of faulting in southern Africa

Paul R. Bierman, Ryan Coppersmith, Kathryn Hanson, Johann Neveling, Eric W. Portenga, and Dylan H. Rood

Cover: Iron-rich silcrete mantles beveled quartzite in south-central South Africa. Deep valleys dissect the landscape and steep hillslopes separate the valley bottoms from the flat, gently sloping pediments. Bierman et al. (this issue, p. 4–11) use measurements of ¹⁰Be to show that the pediment surfaces are exceptionally stable landforms. Considered along with cosmogenic analysis of fluvial sediments, they suggest that relief is growing over time as valleys incise ~10 times more quickly than the pediment surfaces erode.



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A cosmogenic view of erosion, relief generation, and the age of faulting in southern Africa

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ABSTRACT

Southernmost Africa, with extensive upland geomorphic surfaces, deep canyons, and numerous faults, has long interested geoscientists. A paucity of dates and low rates of background seismicity make it challenging to quantify the pace of landscape change and determine the likelihood and timing of fault movement that could raise and lower parts of the landscape and create associated geohazards.

To infer regional rates of denudation, we measured ^{10}Be in river sediment samples and found that south-central South Africa is eroding $\sim 5\text{ m m.y.}^{-1}$, a slow erosion rate consistent with those measured in other non-tectonically active areas, including much of southern Africa. To estimate the rate at which extensive, fossil, upland, silcrete-mantled pediment surfaces erode, we measured ^{10}Be and ^{26}Al in exposed quartzite samples. Undeformed upland surfaces are little changed since the Pliocene; some have minimum exposure ages exceeding 2.5 m.y. (median, 1.3 m.y.) and maximum erosion rates of $<0.2\text{ m m.y.}^{-1}$ (median, 0.34 m m.y.^{-1}), consistent with no Quaternary movement on faults that displace the underlying quartzite but not the silcrete cover.

We directly dated a recent displacement event on the only recognized Quaternary-active fault in South Africa, a fault that displaces both silcrete and the underlying quartzite. The concentrations of ^{10}Be in exposed fault scarp samples are consistent with a 1.5 m displacement occurring ca. 25 ka. Samples from this offset upland surface have lower minimum limiting exposure ages and

higher maximum erosion rates than those from undeformed pediment surfaces, consistent with Pleistocene earthquakes and deformation reducing overall landscape stability proximal to the fault zone.

Rates of landscape change on the extensive, stable, silcretized, upland pediment surfaces are an order of magnitude lower than basin-average erosion rates. As isostatic response to regional denudation uplifts the entire landscape at several meters per million years, valleys deepen, isolating stable upland surfaces and creating the spectacular relief for which the region is known.

INTRODUCTION

Southern Africa has long attracted the attention of geologists and geomorphologists (King, 1953; Partridge and Maud, 1987). This is a landscape of ancient rocks, some pervasively deformed, cropping out in what is now a cratonic setting (Brown et al., 2000). Some of the continental margin is bordered by steep escarpments separating broad, low-elevation coastal plains from higher elevation uplands. Fission track and cosmogenic isotope analysis both suggest the escarpments retreated quickly after rifting and are now stable forms eroding only slowly (Bierman and Caffee, 2001; Cockburn et al., 2000; Matmon et al., 2002; Tinker et al., 2008).

Large areas of southern Africa have been beveled by erosion, leaving low-gradient geomorphic surfaces (pediments) stretching in some places kilometers from the range front toward the center of wide valleys (King, 1953). Some geomorphologists have correlated these extensive fossil geomorphic surfaces in order to provide evidence for episodic uplift and denudation since rifting and the breakup of Gondwanaland (King, 1953; Partridge and Maud, 1987). Pediment surfaces are commonly incised by headward-eroding drainages (Fig. 1) and can become isolated from adjoining mountain fronts by stream incision.

Some pediment surfaces are capped by gravels that have in many places been cemented by pedogenic processes and are now lithified as silcretes, calcretes, and ferricretes (Summerfield, 1983). The age of these high gravels, which are mapped as the Grahamstown Formation (Tg), is not well constrained. Numerical ages are scarce (Partridge and Maud, 1987). Electron spin resonance analysis suggests a Miocene age (7.3 Ma and 9.4 Ma) for two silcrete caps on pediment remnants in the Little Karoo (Hagedorn, 1988) west of our field area.

There is limited seismic activity in South Africa although faults in rock are commonplace (Fig. 2). The age of fault offset is typically poorly constrained, making it difficult to estimate the likelihood, magnitude, duration, and aerial extent of seismic shaking. Most historical South African earthquakes have been small; there



Figure 1. Deeply dissected landscape. Near river sediment sample site TSP17, the Baviaanskloof River is incised >100 m into the gently sloping, dissected silcrete-capped pediment from which we collected surface samples (TSP15 and TSP16, right side of image). Location 33° 31' 8.4" S, 23° 38' 27.6" E (WGS 84). Field of view in front of image is ~3-km-wide, looking west (shown on Fig. 3A).

have been only a few moderate intensity quakes including the 1969 Ceres quake (M_w 6.2) in the Western Cape region and the 1920 and 1976 Koffiefontein M_w 6.2 and 5.8 quakes in central South Africa (Bommer et al., 2013).

Surface offsets are rare (Hill, 1988). The Kango Fault, which is the only recognized Quaternary-active fault in South Africa (Hill, 1988), is part of the continent-wide Ceres-Kango-Baviaanskloof-Coega and Kouga Fault system that extends >600 km from near Cape Town in the west to Port Elizabeth in the east (Fig. 2). There are surface fault scarps along as much as 84 km of the eastern half of the Kango Fault, and trenching investigations at two sites in the western part of this reactivated segment document the occurrence of two large-magnitude earthquakes within the past 10–15 k.y. (Bommer et al., 2013). The extent of the surface rupture during these earthquakes and the timing of the most recent surface rupturing event on the eastern part of the reactivated Kango Fault are not well constrained. Surface offsets recorded in high geomorphic surfaces capped by cemented gravels (Tg) demonstrate that there have been previous episodes of probable Quaternary faulting along this eastern part. Similar gravel-capped pediment surfaces

(which are not offset) locally extend across other faults within the fault system.

Cosmogenic isotopes produced in situ have been used in Africa to estimate rates of erosion (Bierman and Caffee, 2001; Chadwick et al., 2013; Scharf et al., 2013), exposure ages of rock surfaces (Shanahan and Zreda, 2000), and the near-surface burial and exposure history of rock, soil, and sediment (Erlanger et al., 2012). Measurements of paired isotopes with different half-lives (such as ^{26}Al and ^{10}Be) can be used to determine whether a sample was exposed and then buried before being re-exposed (Granger and Muzikar, 2001). Measurements of cosmogenic ^{21}Ne elsewhere in southern Africa demonstrate that gravels capping some ancient erosion surfaces are extremely old with some having Pliocene ages (Van der Wateren and Dunai, 2001).

In this paper, we present new isotopic data from semi-arid to sub-humid south-central South Africa, an area characterized by exposed bedrock, ephemeral streams, and hilly to mountainous terrain. Measurements of ^{10}Be and ^{26}Al support the antiquity (at least Pliocene age) of the widespread planar pediment surfaces and the young age (Late Pleistocene) of a fault scarp on the eastern part of the reactivated segment of the Kango Fault. We use this chronologic information to establish limits on the timing of offset on major, through-going regional faults. We show that the regional erosion rate, while low and consistent with a tectonically inactive cratonic setting, is still many times higher than the rate of pediment erosion; thus, local relief is growing over time.

SAMPLING SITES AND METHODS

We collected eight sand samples from river channels draining seven basins in south-central South Africa in order to estimate basin-average erosion rates and infer rates of isostatically driven rock uplift (Figs. 2, 3A, and 3B). Some of the larger streams and those sourced closer to the coast have perennial flow; others flow intermittently. In the Cape Fold Belt Mountains, ~75 km inland, we collected, from low-gradient, beveled quartzite pediment surfaces, loose surface cobbles and samples from outcropping boulders embedded in the meters-thick silcrete that completely covers bedrock (Figs. 3C, 3D, and 3E). The surfaces are vegetated with grass and shrubs and slope gently (at most several degrees) away from nearby mountain fronts. The silcrete surfaces overlying four bedrock faults are not offset by faulting (TSP12, 14, 16, 17); thus, they

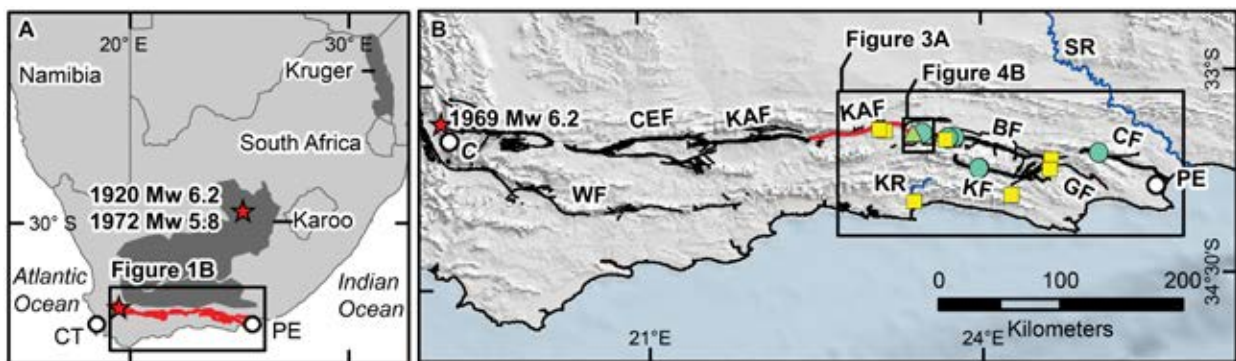


Figure 2. Location maps. (A) Regional context. (B) Sample sites and faults. Dark gray—Karoo and Kruger National Park; red line—Ceres-Kango-Baviaanskloof-Coega Fault System. Green circles—pediment samples; green triangle—fault scarp sample site; red stars—historical earthquakes; yellow squares—sediment samples. BF—Baviaanskloof Fault; C—Ceres; CEF—Ceres Fault; CF—Coega Fault; CT—Cape Town; GF—Gamtoos Fault; KAF—Kango Fault (Quaternary-reactivated segment shown in red); KF—Kouga Fault; KR—Keurbooms River; PE—Port Elizabeth; SR—Sundays River; WF—Worcester Fault.

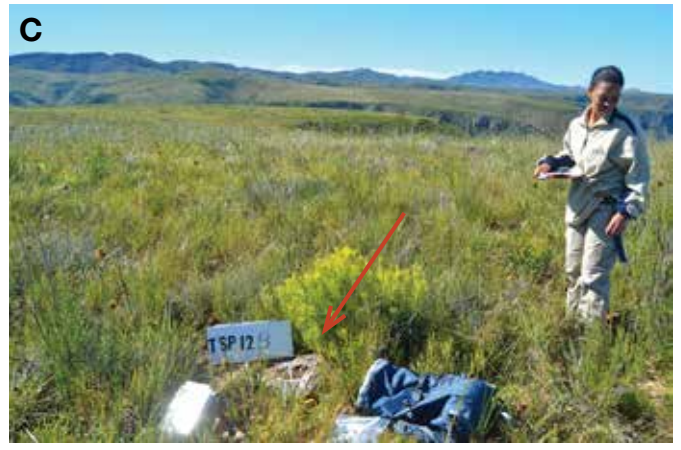
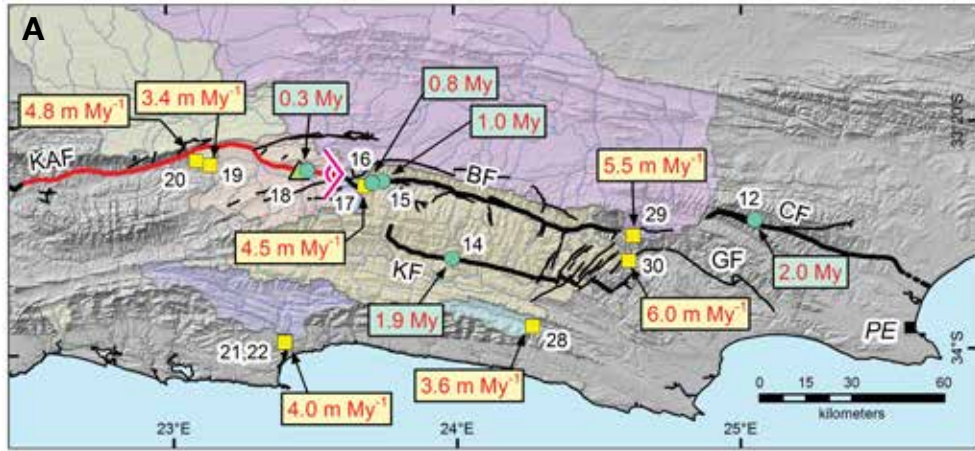


Figure 3. Sampling sites. (A) Sample location map with minimum limiting ages for pediment samples (green) and erosion rates for river samples (yellow). TSP sample sites identified by number; drainage basins shaded. BF—Bavianskloof Fault; CF—Coega Fault; GF—Gamtoos Fault; KAF—Kango Fault (Quaternary-reactivated segment shown in red); KF—Kouga Fault; PE—Port Elizabeth. (B) View down toward Traka River sample site TSP20 (basin area 3066 km²; erosion rate, 4.8 m m.y.⁻¹) showing an ephemeral river and alluvial valley. (C) Site TSP12B shown by arrow is a quartzite boulder embedded in and cropping out from vegetated silcrete surface (min. ¹⁰Be exposure age 1.8 m.y.). Min. total history considering ¹⁰Be and ²⁶Al: 3.0 m.y. (D) Loose clasts on the surface at TSP14; range of clast min. ¹⁰Be exposure ages is 1.3–1.8 m.y. (E) Sample site TSP18D, an outcropping quartzite boulder embedded in silcrete (min. exposure age: 0.36 m.y.). Arrows point to the main fault scarp bounding the graben on the hanging wall (see Fig. 4B).

provide a datum for determining a minimum limit for when the bedrock fault beneath last slipped. One pediment surface and its silcrete cover are offset by the trace of the Kango Fault (TSP18; Fig. 4A). Fault scarp samples (TSP18B) were collected from the hard, southward-facing silcrete face of the main fault scarp along the western edge of the pediment (Figs. 4B and 4C); one sample was collected from the flat-lying pediment surface just above the scarp face. Samples were processed at the University of Vermont, analyzed at Lawrence Livermore National Laboratory, and the CRONUS online calculator was used for age and erosion rate calculations. Detailed methods for sampling, sample preparation, and data analysis are provided in the online data repository along with data tables (Tables S1–S5; see GSA Supplemental Data¹).

PEDIMENT SURFACE MINIMUM LIMITING AGES

Outcropping boulders embedded in the silcrete and loose clasts from South African pediment surfaces (supplemental data Table S5 [see footnote 1]) contain exceptionally high concentrations of in situ–produced ¹⁰Be (up to 9.9×10^6 atoms g⁻¹) and ²⁶Al (up to 3.9×10^7 atoms g⁻¹). These ¹⁰Be concentrations can be interpreted as minimum durations of surface exposure (assuming rapid exposure and no burial or erosion since exposure) of 0.2–2.7 m.y. (median = 0.93 m.y.) or as maximum limiting erosion rates of 0.11–3.2 m m.y.⁻¹ (median = 0.54 m m.y.⁻¹), assuming steady erosion of at least several meters of material from the pediment surface. Field evidence does not allow us to differentiate between these two interpretations, but both are indicative of exceptional surface stability over time.

Sample TSP18A2, shielded from cosmic rays by several meters of silcrete, has low concentrations of both ²⁶Al (2.9×10^5 atoms g⁻¹) and ¹⁰Be (4.1×10^4 atoms g⁻¹) and has a ²⁶Al/¹⁰Be ratio (7.03 ± 0.65 , 1 σ analytical uncertainty) that is indistinguishable from the surface ²⁶Al/¹⁰Be production ratio. We interpret these data as indicating that most of the ¹⁰Be and ²⁶Al inherited from surface exposure before deposition on the pediment long ago has decayed away; thus, clasts now incorporated in the silcrete were deposited at least several ¹⁰Be half-lives ago (¹⁰Be half-life ~1.4 m.y.). Not only does the low nuclide concentration in TSP18A2 suggest that pediment-capping, silcretized gravels predate the Pleistocene, but the low concentration of ¹⁰Be in TSP18A2 indicates that the cosmogenic radionuclide concentrations measured in the surface clasts and outcrops we sampled reflect exposure on the pediment rather than in the mountainous source catchments.

Considering the ²⁶Al analyses along with the ¹⁰Be analyses suggests that most samples have experienced little if any burial since initial exposure (Fig. 5A); only one of the eight samples for which both nuclides were measured lies below the surface exposure region of the two-isotope plot when 2 σ uncertainties are considered. These data suggest that the pediment surfaces we sampled have simple histories that reflect long-term exposure and slow erosion with scant burial by soil or wind-blown sediment (cf. Nishiizumi et al., 1991). Considering both ¹⁰Be and ²⁶Al concentrations, minimum total histories of samples (initial exposure plus burial; Bierman et al., 1999) collected from the unfaulted surfaces range between 1.0 and 3.7 m.y. (Table S5 [see footnote 1]).

The two-isotope data provide a third line of evidence that some of these surfaces have been stable near Earth's surface since at least the Pliocene.

The oldest or most slowly eroding samples were taken from outcropping boulders embedded in silcrete (e.g., TSP12A, 2.7 m.y., 0.11 m m.y.⁻¹), and the mean exposure age of boulder samples (1.27 ± 0.84 m.y.) is higher than the mean exposure age of cobble samples (0.93 ± 0.54 m.y.); however, the populations of minimum limiting surface exposure ages for cobbles and outcropping boulders are not separable statistically (Student's *t*-Test); thus, we consider them together to estimate the minimum surface age and maximum erosion rate for each sampled surface.

The five sampled surfaces have different and in some cases statistically distinguishable minimum surface exposure ages and maximum erosion rates. An analysis of variance (Fig. 5B) shows that significant differences exist between the surfaces; eastern sites TSP12 and TSP14 have minimum surface exposure ages that are greater and maximum erosion rates that are less than those calculated for western sites TSP15 and TSP16. Site TSP18, cut by a fault scarp, has surface exposure ages significantly less than and erosion rates greater than that of all four other surfaces. Surface stability decreases to the west (Fig. 3A).

FAULT SCARP EXPOSURE AGE

Vertical offset on the Kango Fault is clearly visible for kilometers along strike both in rock and in overlying silcrete (Fig. 4A). At sample site TSP18, the pediment surface is offset vertically a total of 5–7 m by a series of en echelon faults (Fig. 4B). The most recent ruptures left a several-meter-high scarp in cemented silcrete; the bottom 1.5 m of the scarp are vertical, the silcrete is very hard, and the scarp appears well preserved, reflecting what we interpret to be movement during the last rupture event on this part of the reactivated fault (Fig. 4C). Above the 1.5 m scarp is a sub-horizontal surface of hard silcrete, part of the pediment.

The measured concentration of ¹⁰Be decreases exponentially down the scarp (Fig. 4D and Table S4 [see footnote 1]). In order to determine the age of faulting, we used the concentration of ¹⁰Be measured in sample TSP18B0, collected on the horizontal surface above the scarp face and the ¹⁰Be production rate at the site, to calculate the expected concentration of ¹⁰Be with depth below the surface had faulting not occurred (Fig. 4D and supplementary material). We then compared the calculated and measured concentrations of ¹⁰Be. All four fault plane samples (TSP18B3, 6, 9, and 12), independent of their depth below the surface, contained $1.15 \pm 0.11 \times 10^5$ atoms g⁻¹ more ¹⁰Be than predicted by the model. We interpret this uniform excess concentration as ¹⁰Be produced by cosmic rays striking the fault scarp directly after it was exposed by surface rupture during an earthquake (Fig. 4D).

Knowing the production rate of ¹⁰Be on the fault scarp allows us to calculate the age of the displacement using different assumptions about the stability of the silcrete edge that truncates the sampled scarp to the west (see supplementary material [footnote 1]). If we assume that the western edge of the silcrete (perpendicular to the scarp) is rapidly eroding and no ¹⁰Be was produced in our samples by neutrons penetrating from the west (Fig. 4C),

¹GSA supplemental data item 2014246, detailed methods and data tables, is online at www.geosociety.org/pubs/ft2014.htm. You can also request a copy from GSA Today, P.O. Box 9140, Boulder, CO 80301-9140, USA; gsatoday@geosociety.org.

the scarp was formed by an earthquake ca. 25.4 ± 2.6 ka (uncertainty represents 1σ of difference between observed and modeled ^{10}Be measured in TSP18B3, 6, 9, and 12). If we assume that the stability of the silcrete edge is similar to sample TSP18B0, then the scarp formed ca. 23.6 ± 2.6 ka.

The similarity of the model ages generated from samples TSP18-B3, 6, 9, and 12 (Table S4 [see footnote 1]) is most consistent with a single event scarp; there is no systematic change in the difference between the measured and modeled ^{10}Be concentration with depth below the surface (Fig. 4D). Nor is there any field or isotopic indication that colluvium near the base of the scarp has been recently eroded. If such erosion had occurred, we would observe less difference between the measured and modeled ^{10}Be concentrations at the base of the scarp than high on the scarp; this is not the case (Fig. 4D).

RIVER SEDIMENT, BASIN-AVERAGE EROSION RATES, AND EROSION-DRIVEN UPLIFT

Concentrations of ^{10}Be in eight river sand samples from south-central South African drainage basins of differing size are similar

and high ($0.84\text{--}1.53 \times 10^6$ atoms g^{-1} ; Table S3 [see footnote 1]). Two samples (TSP21 and TSP22), collected from sand bars ~450 m apart on the Keurbooms River, have the same ^{10}Be concentration within measurement uncertainty (1.03 and 1.04×10^6 atoms g^{-1} ; Table S2), indicating that ^{10}Be measurements of river sediment are reproducible and that sediment in the Keurbooms River is well mixed.

For the eight samples we collected, basin-average erosion rates range from 3.4 to 6.0 m.y.^{-1} . Not considering the two nested samples (TSP17 and TSP21 are upstream of TSP30 and TSP22, respectively), the area-weighted average erosion rate for the south-central coastal region of South Africa is 5.4 m.y.^{-1} ($n = 6$), indistinguishable from the median of 10 smaller catchments (5.2 m.y.^{-1}) nearby (Scharf et al., 2013). This erosion rate represents a spatial and temporal integration over the time it takes to remove several meters of rock from Earth's surface—in this case, several hundred thousand years.

Basin average erosion rates are not clearly related to watershed characteristics (Table S3 [see footnote 1]). There are no statistically significant relationships between basin average erosion rate

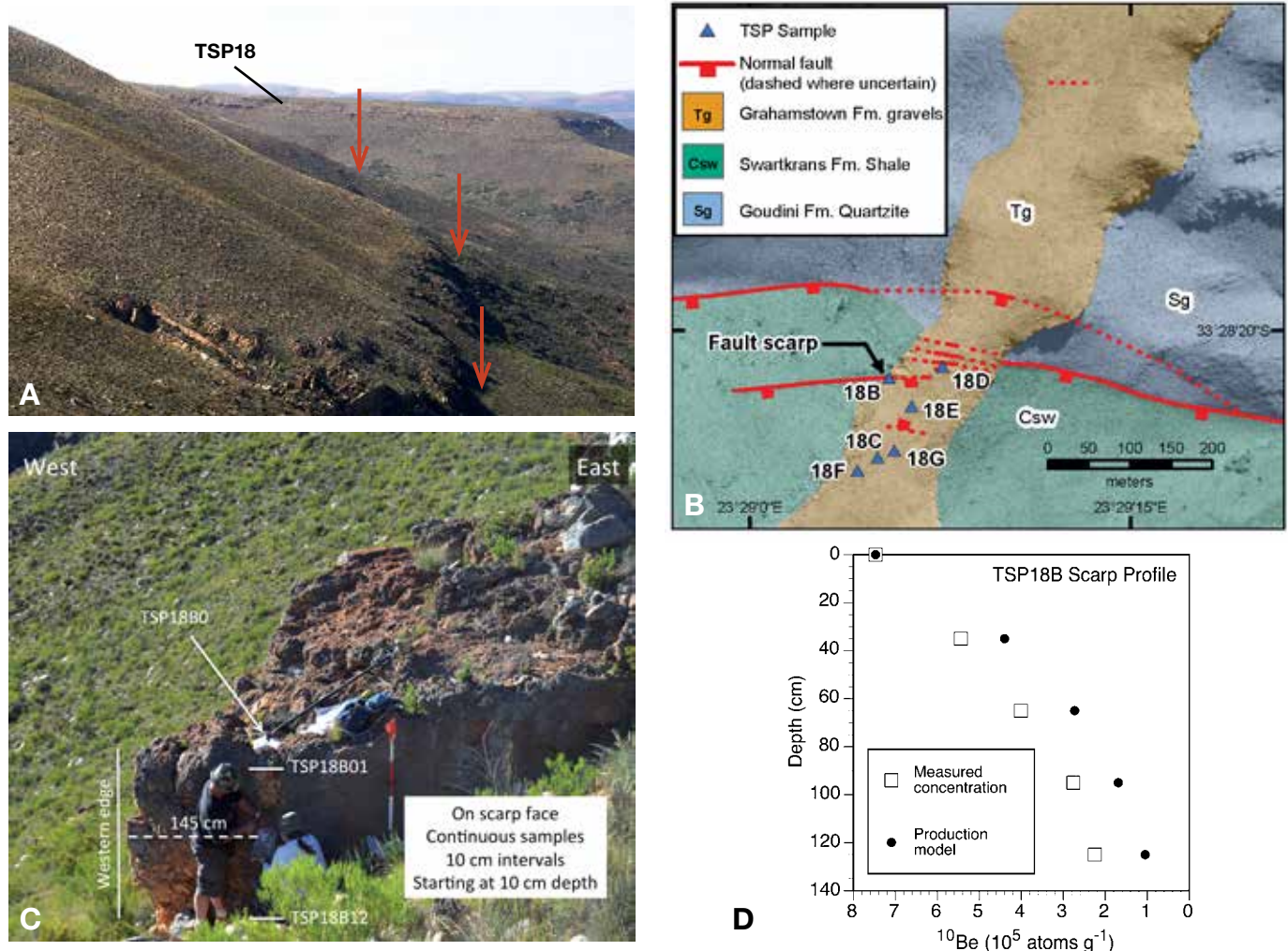


Figure 4. Fault scarp in silcrete. (A) Looking east along range front toward site TSP18; red arrows show fault scarp (photo by J. McCalpin). (B) Map of fault traces that disrupt Tg surface and sampled scarp locality at TSP18. (The Swartkrans Formation is equivalent to the Voorstehoek Formation, Ceres Group.) (C) Fault scarp sampling for cosmogenic nuclide analysis at site TSP18. View from the south. (D) ^{10}Be depth profile from fault scarp (exposed fault plane) showing measured concentration (open squares) and concentrations modeled assuming exponential decline in ^{10}Be production below surface sample TSP18B0. The concentration difference between the model and the measured value reflects nuclide production after faulting exposed the scarp.

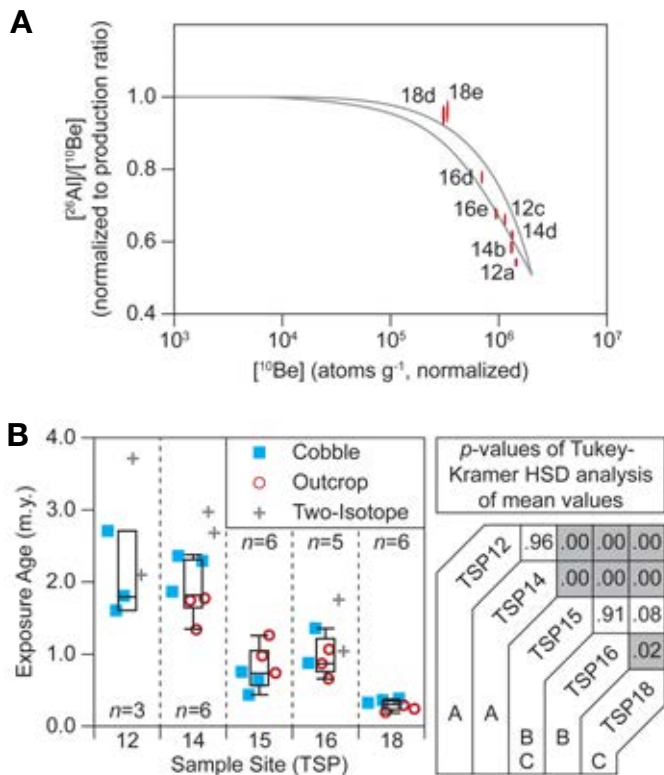


Figure 5. Pediment sample results. (A) Two-isotope plot for outcrop samples collected from the four pediment surfaces (TSP12, 14, 16, and 18); 1σ analytical uncertainties plotted. (B) Results of analysis of variance showing min. limiting surface exposure ages (^{10}Be) for cobble samples (blue squares) and outcropping boulder samples (red circles) collected from five pediment surfaces; two-isotope total histories for boulders are also shown (gray crosses). Bar and whisker plots of ^{10}Be data show median as horizontal line; box encloses second and third quartiles; whiskers show range of data (the remaining data points are outliers). Results from Tukey-Kramer HSD analysis show statistical similarity (same letter) or statistical difference (different letter) of means of sample populations ($p < 0.05$ [shaded gray boxes]).

and basin average slope ($R^2 = 0.01$; $p = 0.84$), mean basin elevation ($R^2 = 0.11$; $p = 0.51$), mean annual precipitation ($R^2 = 0.20$; $p = 0.38$), basin area ($R^2 = 0.29$; $p = 0.27$), or basin elevation range (a proxy for relief, $R^2 = 0.49$; $p = 0.12$).

DISCUSSION

Measurements of in situ-produced cosmogenic ^{10}Be and ^{26}Al place quantitative, geochronologic constraints on the history of land surfaces in south-central South Africa. The data constrain erosion rates in the field area, the minimum age of geomorphic surfaces, the Quaternary history of faults, and the rate at which rock uplift, in response to surface denudation, is likely occurring.

The central South African landscape is exceptionally stable. Pediment and basin-average erosion rates, when compared to the global compilation of Portenga and Bierman (2011), are among the slowest in the world (Fig. 6). The sampled drainage basins rank between 10th and 42nd out of 1,003 sites listed in Portenga and Bierman (2011), whereas the outcropping boulders and pediment surface clasts have erosion rates comparable to the lowest fifth of bedrock outcrop erosion rates, ranking fourth to 82nd out of 490 samples. Such stability is likely caused by the resistance to erosion of massive quartzite and the well-indurated silcrete that

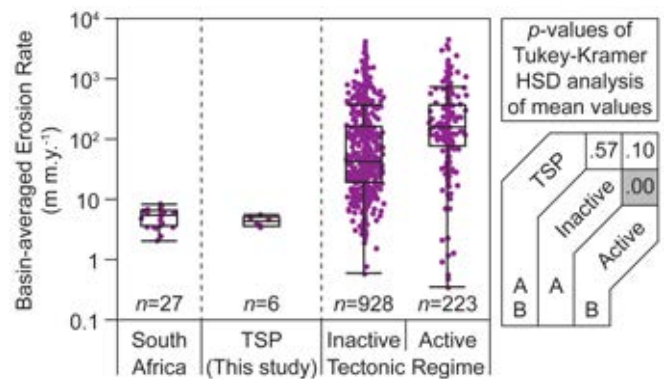


Figure 6. Erosion rate comparison. Semi-log bar and whisker plots showing global data set of basin-average erosion rates inferred from ^{10}Be in river sand (purple dots, Portenga and Bierman, 2011) compared to TSP data from this study and other measurements from South Africa (Scharf et al., 2013; Chadwick et al., 2013). Data from this study are consistent with data from areas defined as not tectonically active (peak ground acceleration $>2\%$ g with a 10% probability in 50 yr; Giardini et al., 1999) and are indistinguishable from other South African data.

caps the surfaces and encases cobbles (Bierman and Caffee, 2002; Scharf et al., 2013). Similarly low rates of erosion have been reported for outcrops of dolerite to the north in the Karoo (Decker et al., 2013).

Both the outcrop and basin-average erosion rates measured in south-central South Africa are most consistent with data from non-tectonically active areas along passive margins, including central and southern Australia (Bierman et al., 1998; Heimsath et al., 2001), Namibia (Bierman and Caffee, 2001), the Sri Lankan escarpment (Vanacker et al., 2007), and parts of the Appalachian Mountains (Duxbury et al., 2007). At a drainage basin scale, the landscape of south-central South Africa appears to be eroding at a rate similar to central Namibia (8 m.m.y.^{-1} ; Bierman et al., 2007) and Kruger National Park (5.5 m.m.y.^{-1} ; Chadwick et al., 2013) to the east but more slowly than other parts of eastern South Africa (27 m.m.y.^{-1} ; Erlanger, 2010).

Surface erosion and the consequent export of mass from the continent to the Indian Ocean triggers isostatic uplift because there is very little long-term sediment storage in the field area. Considering the low rates of erosion we measured at a basin scale (5.4 m.m.y.^{-1}) and the contrast between the density of mantle and continental rock (3.3 versus 2.7 g cm^{-3}), the long-term, average erosionally driven isostatic rock uplift rate in central southern Africa is 4.4 m.m.y.^{-1} . This is a lower rate of uplift than that inferred for the Sundays River area to the east ($9\text{--}16 \text{ m.m.y.}^{-1}$; Erlanger et al., 2012).

Samples collected from four unfaulted, silcrete-capped pediment surfaces, under which run the traces of the Kouga, Baviaanskloof, and Coega Faults, contain high concentrations of ^{10}Be in both outcropping boulders embedded in the silcrete and in loose clasts collected from the surfaces—in many cases, equivalent to at least millions of years of surface exposure. Because these pediment surfaces are so stable, if there had been any Pleistocene offset, fault scarps should be visible on the landscape. The absence of such scarps and the absence of offset on the basal silcrete/bedrock contact observed locally suggest that the Kouga, Baviaanskloof, and Coega Faults are not currently active and have not been active since deposition of the silcrete, most likely in the Miocene.

The lack of fault offset on the ancient surfaces constrains Quaternary fault motion to a restricted area (~100 km) on the western section of the Kango-Coega Fault system, where there is strong evidence for geologically recent surface rupture. The latest rupture at TSP18 appears to have occurred in the Late Pleistocene, between 20 and 25 ka. This offset is older than that documented in alluvial deposits at 60 and 75 km along strike to the west (Goedhart and Booth, 2009; Hanson et al., 2014). There, two surface-rupturing events in the past 10–15 k.y. were preceded by a long period of seismic quiescence (Bommer et al., 2013). The difference in displacement time along strike suggests that the Kango Fault ruptures in segments during at least some events.

Surface stability, as expressed by the concentration of cosmogenic nuclides in surface materials, increases away from the reactivated Kango Fault. The lowest surface exposure ages were measured on the faulted surface (TSP18), consistent with seismic activity (shaking and surface displacement), increasing the rate at which the surface erodes. The relatively low concentrations of cosmogenic nuclides measured in both outcropping boulders and surface clast samples at TSP18 suggest that faulting has affected the surface for at least several hundred thousand years—a sufficient duration to lower its long-term stability. Surfaces more distant from the active fault zone (TSP15 and TSP16) have minimum surface exposure ages that are lower by a factor of two than the most stable surfaces (TSP12 and TSP14), which are even farther away. If surface stability is related to faulting, then long-term fault activity and the likelihood of seismic shaking decreases from west to the east along the sampled area of the fault system.

Erosion of the central South African landscape is not spatially uniform. The aerially extensive pediment surfaces are eroding nearly an order of magnitude more slowly than the landscape as a whole—these are stable, nearly fossil uplands. The very low erosion rates of most pediment surfaces (decimeters per million years) have allowed them to persist for at least millions of years, almost certainly because they are underlain by hard, non-reactive quartzite and covered by silica-cemented quartzite gravels.

The disparity between the rate of pediment surface lowering (decimeters per million years) and the rate of landscape lowering (meters per million years) suggests that local relief is growing, albeit slowly, over time; however, the lack of a relationship between average drainage basin slope and erosion rate (Riebe et al., 2000) suggests that long-term, average base-level in the study area has not changed—an indication of tectonic stability (i.e., the lack of abrupt uplift between the sampled basins and the Indian Ocean, which provides the ultimate base-level for these drainages). We speculate that the incision of the erosion-resistant pediments results from ongoing isostatic adjustment (cratonic uplift) as mass is shifted off the craton and delivered to the Indian Ocean, allowing the cutting of deep, pediment-dissecting canyons. Although much of the isostatic adjustment is likely accomplished by crustal warping (Pazzaglia and Gardner, 1994), normal faults, such as the Kango fault system, are another mechanism by which the craton could be differentially uplifted locally in response to net mass removal by erosion and transport offshore.

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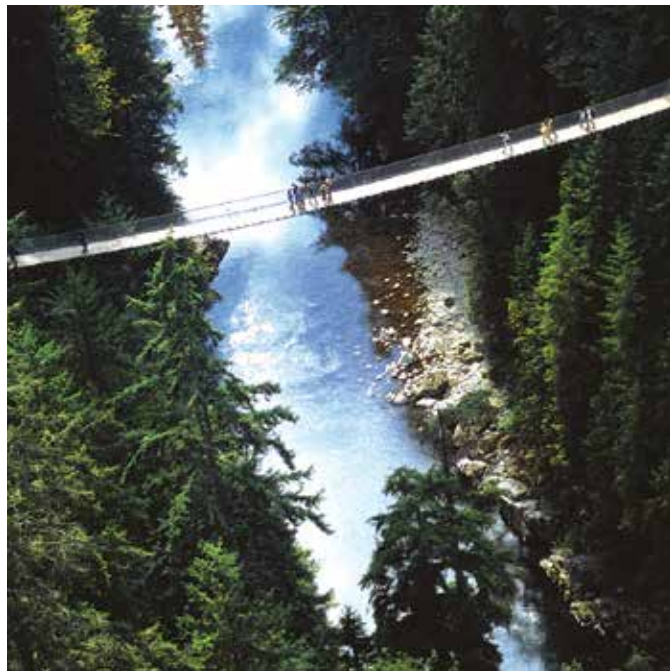
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Your responsibility is to arrive as scheduled. We advise you to double-check the arrival date on your hotel reservation one week prior to your arrival to make sure it is correct. If you do not show up on the date of your scheduled arrival, then the hotel will release your room and you will be charged for one night's room and tax. If you have travel delays and cannot arrive on your scheduled arrival date **contact the hotel directly** to let it know of the change.



CHILDCARE

The youngest attendees can enjoy the meeting while you are in sessions by participating in the KiddieCorp childcare program. The program is open to children six months to 12 years for only US\$7 per hour per child (two hour min.). Register via the GSA website.



REGISTRATION

Early registration deadline: 15 September

Cancellation deadline: 22 September

Fees (in U.S. dollars)

	EARLY		STANDARD*	
	Full Meeting	One Day	Full Meeting	One Day
Professional member	\$355	\$230	\$435	\$260
Professional member (70+)	\$260	\$160	\$345	\$185
Professional non-member	\$475	\$305	\$545	\$325
Student member/ recent graduate	\$115	\$75	\$150	\$85
Student non-member	\$155	\$100	\$190	\$110
High School Student	\$40		\$40	
K-12 Teacher	\$55		\$65	
Field Trip or Short Course Only	\$40		\$40	
Guest or Spouse	\$85		\$90	
Low-Income Country**	50%		50%	

*Fees for onsite registration will be collected in U.S. dollars and credit cards only (no checks).

**Participants from countries classified as “Low or Lower Middle Income Economies” by the World Bank need only pay 50% of the category fee for full meeting or one-day registration; however, online registration is not available. Please download and fill out a hard-copy registration form and mail it to GSA, 3300 Penrose Place, Boulder, CO 80301, USA.

Events Requiring Tickets/Advance Registration

Several GSA Divisions and Associated Societies will hold breakfasts, lunches, receptions, and awards presentations that require a ticket and/or advance registration. A complete list of ticketed events is available on the meeting website. Don't forget to purchase a ticket when you register for GSA 2014!

Student Volunteer Program

Students: Earn FREE meeting registration when you volunteer to work at the meeting for ten hours, PLUS a US\$25 stipend for every five hours worked, PLUS get an insider's view of the meeting! Sign up early online for the best selection of jobs, then register for the meeting as a student volunteer.

Special Requests

GSA strives to create a pleasant and rewarding experience for every attendee. Let us know in advance of the meeting if you have needs that require extra attention. Most dietary considerations can be met without any additional charge. Be sure to check the box when you register online and describe your need in the space provided.

Don't forget to:

- Register for tours, special events, field trips, and short courses;
- Purchase tickets for your Division and Associated Society functions;
- Apply for a Student Travel Grant by 15 September (after you register);
- Make your hotel reservation; and
- Book your travel.



Are you passport ready?



Lane

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GSA 2014



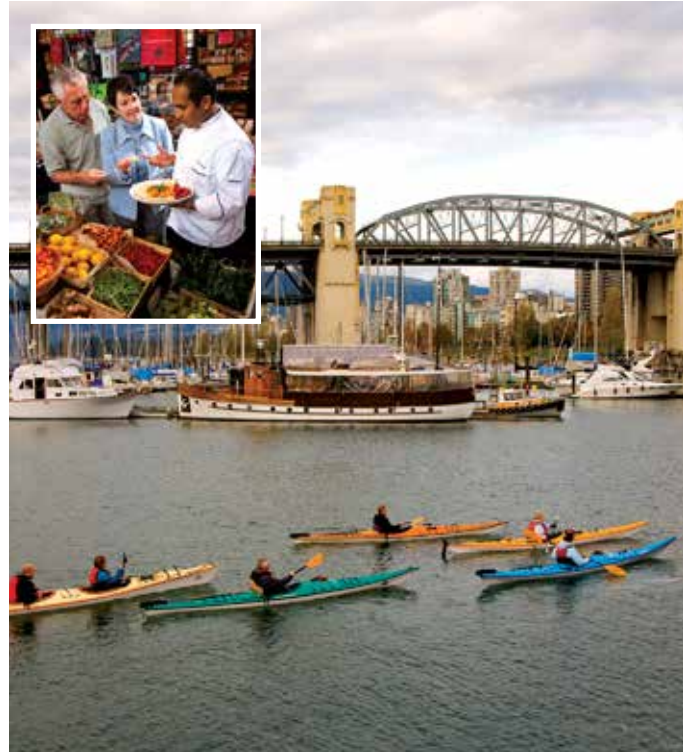
19-22 October | Vancouver, BC, Canada

Neighborhood SPOTLIGHTS

This is the third installment of our Vancouver spotlights series; see p. 12 of the July issue for the opening article.

GRANVILLE ISLAND

From <http://granvilleisland.com/discover-island/visitors-guide>: Imagine an island in the middle of a city. See? You are already curious. Now picture a place molded by a fascinating history, buzzing with a colorful artistic community. A living, breathing urban oasis filled with fine waterfront restaurants, theaters, galleries, studios, unique shops, cafes, and the most spectacular fresh food market you have ever seen. Add a vibrant and diverse mix of people and activities, and you have a destination so dynamic, no visit to the city is complete without spending at least a day here. Just think of Granville Island as Vancouver's Town Square—where locals and visitors come together to be inspired, to be entertained, or simply to breathe in some of its unique atmosphere.

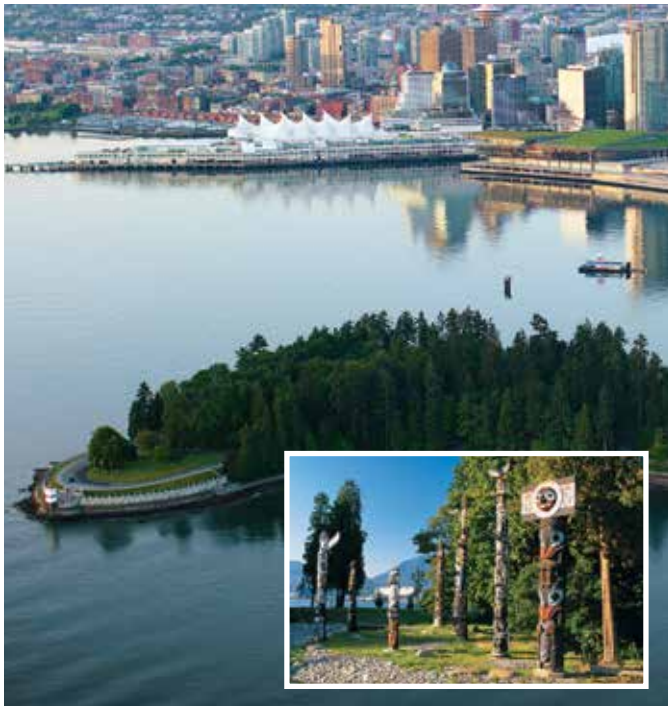


Granville Island Ecomarine Kayaking. Tourism Vancouver/Coast Mountain Photography. Inset: Edible Canada Chef tour. Tourism Vancouver/Coast Mountain Photography.

STANLEY PARK

From <http://www.tourismvancouver.com/do/explore/stanley-park-complete-guide/>: Ideally situated on a peninsula at the northwestern edge of downtown Vancouver, Stanley Park is one of the city's main tourist destinations, attracting approximately eight million visitors each year. Featuring numerous lovely beaches, miles of well-maintained paved and dirt trails, Canada's largest aquarium and an array of can't-miss kid-friendly spots (including a pool, water park, miniature railway, and more), this 1,000-acre haven is recognized as one of the greatest urban parks in the world.

As Vancouver's first park, with its ever-blooming gardens, pristine coastal areas and roughly 500,000 cedar, fir, and hemlock trees, Stanley Park has continued to live up to its "greenspace" designation for more than 120 years. For these reasons and more, this tranquil oasis is the perfect city escape.



Aerial view of Stanley Park. Tourism Vancouver/Albert Normandin. Inset: Story poles. Tourism Vancouver/Al Harvey.

Tourism Vancouver Official Map Downtown Vancouver



ACCOMMODATIONS

- 1 Best Western Plus Downtown Vancouver
- 2 Days Inn Vancouver Downtown
- 3 The Fairmont Hotel Vancouver
- 4 The Fairmont Waterfront
- 5 Four Seasons Hotel Vancouver
- 6 The Georgian Court Hotel
- 7 Hampton Inn & Suites by Hilton Downtown Vancouver
- 8 Hyatt Regency Vancouver
- 9 Pan Pacific Vancouver
- 10 Renaissance Vancouver Harbourside Hotel
- 11 Sheraton Vancouver Wall Centre Hotel
- 12 The Sutton Place Hotel
- 13 Vancouver Marriott Pinnacle Downtown

MAP HIGHLIGHTS

- Burrard Street is a major thoroughfare in Vancouver that will take you to the Vancouver Convention Centre – West.
- Robson Street has a large number of excellent restaurants and shopping — a lively street you don't want to miss!
- The Waterfront SkyTrain Station is just steps from the Vancouver Convention Centre and is the last stop of the Canada Line. The travel time from the Waterfront SkyTrain Station to the Vancouver International Airport is only 26 min.

SHOPPING CENTRES

- 1 Harbour Centre
- 2 Pacific Centre
- 3 Royal Centre Mall
- 4 Waterfront Centre



PARDEE Keynote Symposia

Pardee Keynote Symposia are named in honor of GSA Fellow and benefactor Joseph Thomas Pardee (1871–1960) via a bequest from Mary Pardee Kelly. Pardee was perhaps best known for his work on Glacial Lake Missoula. These symposia consist of invited presentations covering a broad range of topics. All symposia take place at the Vancouver Convention Centre–West, Ballroom A.

community.geosociety.org/gsa2014/science/sessions/pardee

19 SUNDAY

8 a.m.–noon

P1. **Apatites I Have Known: From Man to Mars.**
Conveners: Sarah W. Keenan and Lawrence A. Taylor.

1–5 p.m.

P2. **Mass Extinctions: Volcanism, Impacts, and Catastrophic Environmental Changes.** Conveners: David P.G. Bond, Gerta Keller, and Thierry Adatte.

20 MONDAY

8 a.m.–5 p.m.

P3. **Energy Resource Development and Groundwater: Looking Broader and Deeper.**
Conveners: Grant Ferguson and Andrew H. Manning.

21 TUESDAY

8 a.m.–5 p.m.

P4. **Great Earthquakes, the Cascadia Subduction Zone, and Society.**
Conveners: Andrew Meigs and Chris Goldfinger.

22 WEDNESDAY

8 a.m.–noon

P5. **The Cordilleran Ice Sheet: A Glacial Legacy in the Pacific Northwest.**
Conveners: Andrew J. Stumpf, John Clague, and Kathy Goetz Troost.

Association for Women Geoscientists Come Visit us at Booth 1134!

Easy membership sign-up or renewal!

Look for our upcoming events:

AWG at GSA

Women in Geology Mentoring

AWG Networking Breakfast

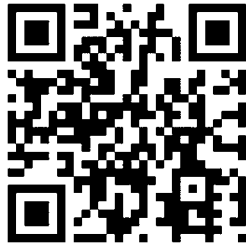


AWG Programs

AWG Foundation 501(c) Funds
AWG JobWeb • Web-based Mentors
AWG E-News • Field trips • Gaea newsletter
Online membership signup
Distinguished lecturers
Geoscientists-in-the Parks
Educator of the Year Award
Chrysalis Scholarship • Chapter Scholarships
Minority Scholarship • Brunton Award
Crawford Field Camp Scholarship
Takken Travel Award • Sand Travel Award
Student Awards for Geoscience Excellence (SAGE)
International Science and Engineering Fairs (ISEF)
Regional Science Fairs • Girl Scout Activities Funds

Encourage Exchange Enhance

MOBILE Meeting



Everything you need to know about the meeting (updated in real time) at your fingertips!

Native App Version Support:

- iOS version 5 and above and on iPad
- Android version 2.3.3 and above and on tablets 3.0 or higher

What You Can Do:

- **View the Entire Technical Program!**—Locate the talk you want to hear, and add it to your calendar;
- See who is exhibiting and find them on the floor plan;
- Select events to attend and add them to your phone's calendar; and
- Receive important alerts and reminders.

After you install the app, open it, and data will start downloading. The download time is affected by your reception, signal strength, and the type of mobile device. Once the app is installed on your phone it is native—so you can browse the information in airplane mode. The app will automatically download any new or changed data each time you re-open it. The calendar events are added to the device's calendar (access must be granted first in order to save events to your device's calendar). Don't have a smartphone or tablet? The web version of the app will run on your computer.

If You Prefer... Use Our Personal Scheduler

Simplify your time during the annual meeting by taking advantage of the free Personal Scheduler. The Personal Scheduler is designed so that you can easily browse all meeting events, create your own schedule, record notes, and download them to your computer and print out or add them to your mobile device for easy reference.

www.geosociety.org/mobilemeeting/



SPEAKER READY Room

Vancouver Convention Centre–West, Room 101/102

Hours of Operation

Sat., 18 Oct., 8 a.m.–8 p.m.

Sun.–Tues., 19–21 Oct., 6:30 a.m.–6:30 p.m.

Wed., 22 Oct., 6:30 a.m.–1:30 p.m.

We highly recommend that all speakers visit the speaker ready room for an opportunity to run through their presentations and get comfortable with the equipment. Highly qualified technicians will be on-hand to offer assistance.

To submit your presentation prior to the meeting (deadline: 11:59 p.m. EDT, 12 Oct.), please upload to the Conference Exchange website: <http://gsa.confex.com/gsa/extra.cgi>. You will need to know your abstract ID (see your abstract acceptance notification) and password. You can also withdraw your presentation via this site. Your abstract acceptance e-mail will also include the time and location of your presentation as well as whether you've been slated for a talk or a poster.

If you are unable to submit your presentation prior to the meeting, please do so in the speaker ready room *the day before* your presentation.

If your presentation is on	Upload no later than
Sun., 19 Oct.	8 p.m., Sat., 18 Oct.
Mon., 20 Oct.	6:30 p.m., Sun., 19 Oct.
Tues., 21 Oct.	6:30 p.m., Mon., 20 Oct.
Wed., 22 Oct.	6:30 p.m., Tues., 21 Oct.

If you have a Sunday presentation and are unable to get to the speaker ready room on Saturday, please take your presentation directly to your session room at least 30 minutes before the session is scheduled to begin.

Acceptable file types: PowerPoint (.ppt or .pps), Microsoft Word (.doc), or PDF (.pdf). If your graphics or video clips are not embedded in your presentation, please be sure that you bring them as well.

Mac users: We strongly recommend that you test your Mac-produced presentation on a Windows-based system *before* coming to the meeting. Make sure that the hyperlinks still function, and avoid using a rewritable CD (CD-RW), as we've encountered compatibility problems with them. If your presentation includes embedded video, your video will most likely NOT play automatically on the PC platform. You will need to either convert your .mov files to .avi format or create a link in your slide show to an external .mov file. If you choose the latter, your animation will play in a separate QuickTime window, outside of your PowerPoint presentation. If you are unable to run your Mac presentation from a PC, we *will* be able to accommodate you; please talk to the technicians in the Speaker Ready Room for more information.

GSA CAREER ENHANCEMENT Programs

(Previously called mentor programs)

At the 2014 Annual Meeting you may take advantage of our Geoscience Careers in Industry Program and/or attend Career Pathways Luncheons and Receptions.

SATURDAY

GEOSCIENCE CAREER WORKSHOP: LAUNCH YOUR JOB SEARCH

This workshop, which runs from 1 p.m. to 5 p.m., will help students successfully prepare for a career in the geosciences. It will cover constructing effective cover letters, résumés, and CVs. Professionals will meet with the group and offer tips and suggestions for navigating their company hiring process.

SUNDAY

GEOSCIENCE CAREERS IN INDUSTRY PROGRAM

This free program connects students and private sector industries in a day of progressive sessions aimed at building a stronger career pipeline. Students will gain important skills toward preparing to enter the workforce, receive career advice from industry professionals, and have the opportunity to present their research to industry representatives. Plan to attend some or all of the following events.

GEOSCIENCE CAREERS IN INDUSTRY: STUDENT RESEARCH HIGHLIGHT SESSION

This session, which runs from 9 a.m. to noon, provides students with an opportunity to showcase and discuss their research, begin dialogues, and get to know sponsoring industry representatives and hiring managers. Students who present their research in this session will be invited to the evening networking reception where they will have ample opportunities to continue to interact with industry representatives.

GEOLOGY IN INDUSTRY CAREER PATHWAYS LUNCHEON

This popular program, which runs from noon to 1:30 p.m., features a FREE lunch for undergraduate and graduate students with a panel of mentors representing various industries. These mentors will answer questions, offer advice about preparing for a career in industry, and comment on the prospects for current and future job opportunities with their companies.

GEOSCIENCE CAREERS IN INDUSTRY: PROFESSIONAL PRACTICE SESSION

The session, which runs from 1:30 to 4 p.m., offers students an opportunity to ask questions and talk one-on-one with corporate sponsors, learning about the unique cultures within their companies and the types of careers available. Students will have a chance to talk with hiring managers or geoscience recruiters and recent hires to answer questions about their jobs. Companies may have information about their work, sustainability initiatives, less-known projects in research, and other components of their positive contributions to communities.

GEOSCIENCE CAREERS IN INDUSTRY: EVENING RECEPTION

This informal mixer from 4:30 to 5:30 p.m. offers a networking opportunity for the Geoscience Careers in Industry's participating companies and students, as well as recent industry hires. This event is only open to students who presented their research at the Student Research Highlight Session, or to students who receive an invitation from companies (at the companies' discretion).

WOMEN IN GEOLOGY CAREER PATHWAYS RECEPTION

This informal gathering, from 5 p.m. to 6:30 p.m., begins with remarks from a few key women speakers who will address issues faced by women in geology. A reception follows, providing time for networking, sharing ideas, and getting to know other women geoscientists and geosciences educators. *Appetizers provided.*



MONDAY

GEOLOGY IN GOVERNMENT CAREER PATHWAYS LUNCHEON

Undergraduate and graduate students: Enjoy a FREE lunch from 11:30 a.m. to 1 p.m. in the company of a panel of mentors representing a variety of government agencies. These mentors will answer questions, offer advice about preparing for a career in government, and comment on the prospects for current and future job opportunities with their agencies. Also, come learn more about GSA's GeoCorps™ program!

TUESDAY

STUDENT NETWORKING LUNCHEON

This light lunch from 11:30 a.m. to 1 p.m. is sponsored by AGI, GSA, SEG and the SEG Foundation, and ConocoPhillips. The program provides undergraduate and graduate students with an exciting opportunity to network with more than 40 geoscience professionals. The mentors will answer questions, offer advice about career plans, and comment on job opportunities within their fields. Please pre-register (contact Jennifer Nocerino, jnocerino@geosociety.org, if you have questions).

JOHN MANN MENTORS IN APPLIED HYDROGEOLOGY PROGRAM

This program underwrites the cost for 25 students to attend the Hydrogeology Division Luncheon and Awards Presentation and meet some of geoscience's most distinguished hydrogeologists. Students eligible for this honor are those who have (1) indicated a professional interest in hydrology/hydrogeology on their GSA membership application, and (2) registered for the Annual Meeting by 15 September. The first 25 students who respond on 16 September to an e-mail invitation based on these criteria will receive FREE tickets for the luncheon.

CONTACT

Geoscience Careers in Industry Programs: Tahlia Bear, tbear@geosociety.org, community.geosociety.org/gsa2014/science/careers/careersprog.

Career Pathway and Mentor Programs: Jennifer Nocerino, jnocerino@geosociety.org, community.geosociety.org/gsa2014/science/careers/mentors.

Student Networking Luncheon: Heather Houlton, hrh@agiweb.org.

To sponsor one of these events, contact Debbie Marcinkowski, dmarcinkowski@geosociety.org.

GSA'S EMPLOYMENT SERVICE CENTER Meets All Your Employment Needs

For Employers:

Search hundreds of qualified geoscience professionals in the Employment Service Center (ESC) database for only US\$300!

The ESC offers employers:

- Access to the GSA job applicant database through 30 April 2015; and
- Scheduling and space for in-person interviews at the GSA Annual Meeting in Vancouver, British Columbia, Canada, 20–21 October 2014.

For Job Seekers:

FREE for all GSA members, post your profile and résumé in the ESC database. Potential employers will search qualified candidates for open positions and interview at GSA's Annual Meeting in October.

To access the applicant database or post your résumé online,

go to the ESC website.
Contact Tahlia Bear, tbear@geosociety.org, +1-303-357-1066, for additional information.

**[www.geosociety.org/
Employment_Service/](http://www.geosociety.org/Employment_Service/)**

Scientific **FIELD TRIPS**

Field-Trip Chairs: Brent Ward and Shahin Dashtgard; e-mail: gsatrips@sfu.ca

GSA Contact: Beth Engle, bengle@geosociety.org

Please contact trip leaders directly if you have questions; leader contact information and expanded trip descriptions are listed on the meeting website. All trips begin and end at the Vancouver Convention Centre–West unless otherwise indicated.

401. **Exploring the Linkages between Glaciation, Outburst Floods, and the Generation of Palouse Loess in Washington State.** Wed.–Fri., 15–17 Oct. **US\$385.** This trip begins in Kennewick, Washington, USA, and ends in Pasco, Washington, USA.
402. **Karst Lands of Central Vancouver Island.** Wed.–Sat., 15–18 Oct. **US\$621.** This trip begins and ends in Nanaimo, British Columbia, Canada.
403. **Channeled Scablands.** Wed.–Sat., 15–18 Oct. **US\$485.**
404. **Natural Channel Networks on Alluvial Fans in Pacific Northwest Coastal Forests.** Wed.–Sat., 15–18 Oct. **US\$373.** This trip begins and ends in Nanaimo, British Columbia, Canada.
405. **Okanagan Valley Geology, Terroir, and Wines.** Wed.–Sat., 15–18 Oct. **US\$613.** This trip begins in Kelowna, British Columbia, Canada, and ends in Vancouver, British Columbia, Canada.
406. **Southern British Columbia Porphyry Cu (-Au, Mo) Deposits and Their Host Rocks.** Thur.–Sat., 16–18 Oct. **US\$582.**
407. **Occurrence and Hazard of Post-Glacial Holocene Landslides from the Mount Meager Volcanic Complex, Cascade Volcanic Arc.** Thur.–Sat., 16–18 Oct. **US\$400.**
408. **Canadian Cascade Volcanism: Subglacial to Explosive Eruptions along the Sea to Sky Corridor, British Columbia.** Thur.–Sat., 16–18 Oct. **US\$372.**
409. **The Life and Times of the Cordilleran Ice Sheet around the Southern Fraser Plateau, B.C.** Thur.–Sat., 16–18 Oct. **US\$416.**
410. **Urban Geology and Geoheritage of Metro Vancouver, B.C.** Fri., 17 Oct. **US\$104.**
411. **The Cretaceous–Cenozoic Coast–Cascade Orogen Chilliwack Valley–Harrison Lake Connection.** Fri.–Sat., 17–18 Oct. **US\$269.**
412. **Glaciers, Isostasy, and Eustasy in the Fraser Lowland: Resolving Late-Pleistocene Glaciation across the International Border.** Fri.–Sat., 17–18 Oct. **US\$264.** This trip begins in Bellingham, Washington, USA, and ends in Vancouver, British Columbia, Canada.



Okanagan Highlands outcrop. Photo by Bruce Archibald.

413. **Mount Baker Lahars and Debris Flows, Ancient, Modern and Future.** Sat., 18 Oct. US\$96. This trip begins and ends in Bellingham, Washington, USA.
414. **Late Glacial and Holocene Sedimentation and Investigation of Fjord Tsunami Potential in Lower Howe Sound, British Columbia.** Sat., 18 Oct. US\$152.
415. **An Introduction to the Geology of the Vancouver Area.** Sat., 18 Oct. US\$111.
416. **Full Access to the Geology of the Sea-to-Sky Highway.** Sat., 18 Oct. US\$100 for professionals; US\$23 for students. Students: Contact info@theiagd.org to get your trip paid for!
417. **Applied Geomorphology along the North Slopes of Burrard Inlet in North and West Vancouver.** Sat., 18 Oct. US\$94.
418. **Landslides and Slope Stability Adjacent to the Lower Fraser River Valley East of Chilliwack and Hope, and along the Lower End of the Fraser River Canyon.** Sat., 18 Oct. US\$122.
419. **Sea-to-Sky Geotour for Teachers.** Sun., 19 Oct. US\$85.
420. **Tertiary Stratigraphy and Structure of the Eastern Flank of the Cascade Range, Washington.** Thur.–Sat., 23–25 Oct. US\$404. This trip begins at the Vancouver Railroad Station, and ends in Seattle, Washington, USA.
421. **Multiple Younger Dryas and Allerød Moraines (Sumas Stade) in the Fraser Lowland and Late Pleistocene Glaciomarine Drift (Everson Interstade).** Thurs., 23 Oct. US\$104. This trip begins and ends in Bellingham, Washington, USA.
422. **Abbotsford Aquifer: The Intricacies of a Long-Term, Transboundary Water Quality Issue.** Thur., 23 Oct. US\$95.
423. **Kirk Bryan Field Trip: Glacial History, Geomorphology, and Natural Hazards along the Sea-to-Sky Highway.** Thur., 23 Oct. US\$100.
424. **Flood History of the Fraser River.** Thur.–Fri., 23–24 Oct. US\$291.
425. **Victoria, Visit to Institute of Ocean Sciences, Pacific Geoscience Centre, Ocean Networks Canada.** Thur.–Fri., 23–24 Oct. US\$287.
426. **Hydrogeology of the Nanaimo Lowlands.** Thur.–Fri., 23–24 Oct. US\$388.
427. **Geoarchaeology of the Fraser Canyon and Sea to Sky Highway.** Thur.–Fri., 23–24 Oct. US\$215.
428. **Volcanism and Interglacial Interaction in the Wells Gray–Clearwater Volcanic Field, East Central British Columbia.** Thur.–Sat., 23–25 Oct. US\$375.

3rd International EarthCache Mega Event

Saturday, 11 Oct. 2014

Duncan (Vancouver Island), British Columbia, Canada

EarthCaching gets people out in the field to learn about their planet first-hand. Participants in this annual event will learn all about EarthCaching, interact with EarthCachers from around the globe, meet EarthCache developers and reviewers, find local EarthCaches, and engage in many other exciting and educational activities. The 2014 event takes place one week before the GSA Annual Meeting & Exposition (19–22 Oct.), so join us at the event, explore the great geology of British Columbia, then attend the Annual Meeting!



For details, go to

- www.3iee.com
- www.earthcache.org
- www.facebook.com/earthcache

or

contact Gary Lewis at glewis@geosociety.org.

Let the Earth be your teacher!

SHORT COURSES

Early registration deadline: 15 September

Registration after 15 September costs an additional US\$30

Cancellation deadline: 22 September

The following courses are open to everyone. Early registration is highly recommended to ensure that courses will run. Go to community.geosociety.org/gsa2014/science/courses or contact Jennifer Nocerino at jnocerino@geosociety.org for course abstracts and additional information.

Can I take a short course if I'm not registered for the meeting? YES! Just add a meeting nonregistrant fee (US\$40 by 15 Sept.) to your course enrollment cost. If you then decide to attend the meeting, your payment will be applied toward meeting registration.

GSA K–12 teacher members do not need to register for the meeting or pay the nonregistrant fee in order to sign up for short courses.

Will I get continuing education credits (CEUs)? Yes! After the meeting, contact Jennifer Nocerino at jnocerino@geosociety.org for a course evaluation form. After she receives the evaluation, she will send your CEU certificate via e-mail. Check each course description for the CEUs offered.

501. **Sequence Stratigraphy for Graduate Students.** Fri.–Sat., 17–18 Oct., 8 a.m.–5 p.m. **US\$25**; includes lunch. Limit: 55. CEU: 1.6. **Extra!** Upon completion of the course, participants will receive a US\$25 coupon redeemable at the onsite GSA bookstore. **Instructors:** Bret Dixon, Anadarko; Art Donovan, BP; Morgan Sullivan, Chevron; Bob Stewart, ExxonMobil; Kirt Campion, Marathon.
502. **Field Safety Leadership.** Fri.–Sat., 17–18 Oct., 8 a.m.–5 p.m. **US\$25**; includes continental breakfast and lunch. Limit: 24. CEU: 1.6. **Extra!** Upon completion of the course, participants will receive a US\$25 coupon redeemable at the onsite GSA bookstore. **Instructors:** Kevin Bohacs, ExxonMobil Upstream Research Co.; David Story, ExxonMobil Upstream Research Co.; Pam Collins, ExxonMobil Upstream Research Co.
503. **Introduction to Petroleum Structural Geology.** Fri.–Sat., 17–18 Oct., 8 a.m.–5 p.m. **US\$25**; includes continental breakfast and lunch. Limit: 30. CEU: 1.6. **Extra!** Upon completion of the course, participants will receive a US\$25 coupon redeemable at the onsite GSA bookstore. **Instructors:** J. Steve Davis, ExxonMobil Upstream Research Co.; Peter Hennings, ConocoPhillips.
504. **Structural and Stratigraphic Concepts Applied to Basin Exploration.** Fri.–Sat., 17–18 Oct., 8 a.m.–5 p.m. **US\$25**; includes continental breakfast and lunch. Limit: 30. CEU: 1.6. **Extra!** Upon completion of the course, participants will receive a US\$25 coupon redeemable at the onsite GSA bookstore. **Instructors:** Lori Summa, ExxonMobil Upstream Research Co.; Bob Stewart, ExxonMobil Exploration Co.; Renee Breedlovestrout, ExxonMobil Exploration Co.
505. **Siliciclastic Core-Logging for Graduate Students.** Fri.–Sat., 17–18 Oct., 9 a.m.–5 p.m. **US\$75**. Limit: 24. CEU: 1.4. **Instructors:** Shahin Dashtgard, Simon Fraser Univ.; James MacEachern, Simon Fraser Univ.
506. **Near-Surface Geophysics for Non-Geophysicists.** Sat., 18 Oct., 8 a.m.–5 p.m. **US\$105**; includes course materials. Limit: 30. CEU: 0.8. **Instructor:** Gregory Baker, Univ. of Tennessee.
507. **Introduction to Terrestrial Laser Scanning (Ground-Based LiDAR) for Earth Science Research.** Sat., 18 Oct., 8 a.m.–5 p.m. **US\$41**; includes lunch. Limit: 24. CEU: 0.8. **Instructors:** Christopher Crosby, UNAVCO; Marianne Okal, UNAVCO; Carlos Aiken, Univ. of Texas at Dallas.
508. **The Water-Energy Nexus: Earth-Science Research Questions.** Sat., 18 Oct., 8 a.m.–5 p.m. **US\$76**. Limit: 40. CEU: 0.8. **Instructors:** Richard Healy, USGS; Bridget Scanlon, Univ. of Texas at Austin; Mark Engle, USGS.

Two-Year College Faculty: Thanks to Subaru of America, Inc., 23 two-year college professors (at least half-time) who attend any one short course will be reimbursed US\$200! For more information see p. 40 or contact Davida Buehler at dbuehler@geosociety.org.



Tourism Vancouver/Capilano Suspension Bridge Park.

509. **Seismic Structural Interpretation for Academic Faculty.** Sat., 18 Oct., 8 a.m.–5 p.m. **US\$100.** Limit: 27. CEU: 0.8. **Instructors:** Bob Krantz, ConocoPhillips; Simon Kattenhorn, ConocoPhillips; Barbara Tewksbury, Hamilton College.
510. **Wet, Slimy Convecting Rockball: Geobiology, Earth/Life Coevolution, and the Ubiquity of Biofilms.** Sat., 18 Oct., 8 a.m.–5 p.m. **US\$88.** Limit: 40. CEU: 0.8. **Instructors:** Kurt Grimm, Univ. of British Columbia; Sean Crowe, Univ. of British Columbia.
511. **Apple iPad and iPhone as Tools for Field Use.** Sat., 18 Oct., 8 a.m.–4 p.m. **US\$137.** Limit: 15. CEU: 0.7. **Instructor:** Brian Saunders, White Raven Innovations Limited.
512. **Geobiodiversity Database and Quantitative Stratigraphy.** Sat., 18 Oct., 8:30 a.m.–5 p.m. **US\$20.** Limit: 40. CEU: 0.75. **Extra!** Upon completion of the course, participants will receive a US\$20 coupon redeemable at the onsite GSA bookstore. **Instructors:** Junxuan Fan, Nanjing Institute of Geology and Palaeontology; Peter Sadler, Univ. of California at Riverside; H. David Sheets, Canisius College; Shuang-ye Wu, Univ. of Dayton.
513. **Introductory Remote Sensing for Geoscientists.** Sat., 18 Oct., 9 a.m.–5 p.m. **US\$109.** Limit: 16. CEU: 0.7. **Instructor:** John Chadwick, College of Charleston.
514. **Deep Carbon through Deep Time.** Sat., 18 Oct., 9 a.m.–5 p.m. **US\$30;** includes lunch. Limit: 40. CEU: 0.7. **Instructor:** Robert Hazen, Carnegie Institution of Washington and Deep Carbon Observatory.
515. **Subaqueous Paleoseismology Methods.** Sat., 18 Oct., 9 a.m.–4 p.m. **US\$89;** includes lunch. Limit: 20. CEU: 0.6. **Instructors:** Chris Goldfinger, Oregon State Univ.; Randy Enkin, Geological Survey of Canada; Audrey Dallimore, Geological Survey of Canada.
516. **An Introduction to POGIL (Process Oriented Guided Inquiry Learning) Using Climate Change Activities.** Sat., 18 Oct., 9 a.m.–4 p.m. **US\$15;** includes lunch. Limit: 30. CEU: 0.6. **Instructor:** Daniel King, Drexel Univ.
- 517A. **Teaching Geoscience in Society: Building Relevance and Interest in the Geosciences by Adding InTeGrate Resources to Your Class.** Sat., 18 Oct., 8 a.m.–noon. **US\$50** for one course—*or get two-for-one!*—pay the same amount when you combine it with afternoon course 517C *or* 517D. Limit: 23. CEU: 0.4. **Instructors:** Anne Egger, Central Washington Univ.; David McConnell, North Carolina State Univ.
- 517B. **Improving Spatial Thinking in the Geological Sciences.** Sat., 18 Oct., 8 a.m.–noon. **US\$50** for one course—*or get*



Tourism Vancouver/ English Bay Inuksuk.

two-for-one!—pay the same amount when you combine it with afternoon course 517C *or* 517D. Limit: 23. CEU: 0.4. **Instructors:** Basil Tikoff, Univ. of Wisconsin–Madison; Tim Shipley, Temple Univ.

- 517C. **Student Learning Outcomes and Program Assessment.** Sat., 18 Oct., 1–5 p.m. **US\$50** for one course—*or get two-for-one!*—pay the same amount when you combine it with morning course 517A *or* 517B. Limit: 23. CEU: 0.4. **Instructors:** David Mogk, Montana State Univ.; Mary Savina, Carleton College.

- 517D. **Extreme Makeover Geosciences Style—Infusing Existing Curricula with the Spirit of the New Next Generation Science Standards (NGSS): Integrating Content, Scientific and Design Practices, and Cross-Cutting Themes.** Sat., 18 Oct., 1–5 p.m. **US\$50** for one course—*or get two-for-one!*—pay the same amount when you combine it with morning course 517A *or* 517B. Limit: 23. CEU: 0.4. **Instructors:** Aida Awad, Maine East High School; Susan Buhr, Univ. of Colorado; Sara Harris, Univ. of British Columbia.

- 518A. **Teaching Controversial Issues 1: Climate and Energy.** Sat., 18 Oct., 8 a.m.–noon. **US\$35** for one course—*or get two-for-one!*—pay the same amount when you combine it with afternoon course 518D, 518E, *or* 518F. Limit: 40. CEU: 0.4. **Instructors:** Don Duggan-Haas, Paleontological Research Institution/Museum of the Earth; Glenn Dolphin, Univ. of Calgary; Laura Guertin, Penn State–Brandywine; Scott Mandia, Suffolk County Community College; Robert Ross, Paleontological Research Institute/Museum of the Earth.

- 518B. **The Crunching of Cascadia: Discovering Deformation with Data.** Sat., 18 Oct., 8 a.m.–noon. **US\$35** for one course—*or get two-for-one!*—pay the same amount when you combine it with afternoon course 518D, 518E, *or* 518F. Limit: 18. CEU: 0.4. **Instructors:** Shelley Olds, UNAVCO; Nancy West, Quarter Dome Consulting; Vince Cronin, Baylor Univ.

SHORT COURSES

- 518C. **Crosscutting Earth Themes.** Sat., 18 Oct., 8 a.m.–noon. **US\$35** for one course—*or get two-for-one!*—pay the same amount when you combine it with afternoon course 518D, 518E, or 518F. Limit: 18. CEU: 0.4. **Instructor:** Susan Eriksson, Eriksson Associates.
- 518D. **Teaching Controversial Issues 2: Evolution of Life and Earth.** Sat., 18 Oct., 1–5 p.m. **US\$35** for one course—*or get two-for-one!*—pay the same amount when you combine it with morning course 518A, 518B, or 518C. Limit: 40. CEU: 0.4. **Instructors:** Don Duggan-Haas, Paleontological Research Institution/Museum of the Earth; Glenn Dolphin, Univ. of Calgary; Laura Guertin, Penn State–Brandywine; Scott Mandia, Suffolk County Community College; Robert Ross, Paleontological Research Institute/Museum of the Earth.
- 518E. **Yellowstone National Park as a Hotbed for Inquiry.** Sat., 18 Oct., 1–5 p.m. **US\$35** for one course—*or get two-for-one!*—pay the same amount when you combine it with morning course 518A, 518B, or 518C. Limit: 18. CEU: 0.4. **Instructors:** Shelley Olds, UNAVCO; Nancy West, Quarter Dome Consulting; Vince Cronin, Baylor Univ.
- 518F. **Introduction to Critical Zone Science and Observatories.** Sat., 18 Oct., 1–5 p.m. **US\$35** for one course—*or get two-for-one!*—pay the same amount when you combine it with morning course 518A, 518B, or 518C. Limit: 18. CEU: 0.4. **Instructor:** Timothy White, Penn State.
- 519A. **Digital Mapping and Data Collection for Field Environments.** Sat., 18 Oct., 8 a.m.–noon. **US\$50** for one course—*or get two-for-one!*—pay the same amount when you combine it with afternoon course 519C or 519D. Limit: 30. CEU: 0.4. **Instructors:** Steven Whitmeyer, James Madison Univ.; Terry Pavlis, Univ. of Texas–El Paso; Lawrence Malinconico, Lafayette College; Richard Langford, Univ. of Texas–El Paso.
- 519B. **GigaPan and GigaMacro for the Geosciences.** Sat., 18 Oct., 8 a.m.–noon. **US\$50** for one course—*or get two-for-one!*—pay the same amount when you combine it with afternoon course 519C or 519D. Limit: 30. CEU: 0.4. **Instructors:** Jennifer Piatek, Central Connecticut State Univ.; Bill Richards, North Idaho College; Ron Schott, Bakersfield College.
- 519C. **Google Maps Engine, Earth Engine, and Big GeoData.** Sat., 18 Oct., 1–5 p.m. **US\$50** for one course—*or get two-for-one!*—pay the same amount when you combine it with morning course 519A or 519B. Limit: 30. CEU: 0.4. **Instructors:** Jeffrey Ryan, Univ. of South Florida; Kristen St. John, James Madison Univ.
- 519D. **Using Google Earth to Teach Interpretation of Geologic Processes, Bedrock Structures, and Geologic History.** Sat., 18 Oct., 1–5 p.m. **US\$50** for one course—*or get two-for-one!*—pay the same amount when you combine it with morning course 519A or 519B. Limit: 30. CEU: 0.4. **Instructors:** Barbara Tewksbury, Hamilton College; Heather Almquist, Univ. of Montana.
520. **Optical Properties of Minerals in Thin Section: Quantitative Methods in Birefringence.** Sat., 18 Oct., 8 a.m.–noon. **US\$25.** Limit: 24. CEU: 0.4. **Instructor:** James Nicholls, Univ. of Calgary.
521. **Making Digital Geologic Maps with the NCGMP09 Database Schema.** Sat., 18 Oct., 8 a.m.–noon. **US\$78.** Limit: 31. CEU: 0.4. **Instructor:** Ralph Haugerud, USGS.
522. **Developing an Effective Broader Impacts Plan for Engaging Undergraduate Researchers.** Sat., 18 Oct., 8 a.m.–noon. **US\$40.** Limit: 28. CEU: 0.4. **Instructors:** Aisha Morris, UNAVCO; Donna Charlevoix, UNAVCO.
523. **Getting Started in Undergraduate Research for New, Future, and Current Faculty.** Sat., 18 Oct., 1–5 p.m. **US\$40.** Limit: 20. CEU: 0.4. **Instructor:** Lydia Fox, Univ. of the Pacific.
524. **Hands-On Experiences with Stable Isotopes in the Geosciences Curriculum.** Sat., 18 Oct., 1–5 p.m. **US\$25.** Limit: 24. CEU: 0.4. **Extra!** Upon completion of the course, participants will receive a US\$25 coupon redeemable at the onsite GSA bookstore. **Instructors:** Anne Jefferson, Kent State Univ.; Elizabeth Griffith, Univ. of Texas Arlington; Joseph Ortiz, Kent State Univ.; David Dees, Kent State Univ.
525. **Geoscience Career Workshop: Launch Your Job Search.** Sat., 18 Oct., 1–5 p.m. **US\$15.** Limit: 100. CEU: 0.4. **Extra!** Upon completion of the course, participants will receive a US\$15 coupon redeemable at the onsite GSA bookstore. **Instructor:** Tahlia Bear, GSA.
526. **Detrital Mineral U-Pb Geochronology and Hf Isotope Geochemistry: Theory, Methodology, and Applications to Northern Cordilleran Research.** Sat., 18 Oct., 9 a.m.–5 p.m. **US\$35.** Limit: 40. CEU: 0.7. **Instructor:** George Gehrels, University of Arizona.
527. **Earthscope Institute: Geochronology and the Earth Sciences.** Fri.–Sat., 17–18 Oct., 8:30 a.m.–5:30 p.m. **US\$50** (FREE for students); includes lunch. Limit: 70. CEU: 1.6. **Instructors:** Rebecca Flowers, Univ. of Colorado–Boulder; James Metcalf, Univ. of Colorado–Boulder; Ramon Arrowsmith, Arizona State Univ.; Blair Schoene, Princeton Univ.; Tammy Rittenour, Utah State Univ.

Campus CONNECTION

BRINGING STUDENTS AND SCHOOLS TOGETHER

GSA's Campus Connection (formerly Graduate School Information Forum) provides an excellent opportunity for students to meet face to face with representatives from top geoscience schools. This four-day event saves students time and travel expenses, giving the schools a chance to meet with some of the best student geoscientists in the world in a relaxed, informal setting. For a preliminary list of schools, see p. 47.

Campus Connection will be located in the Exhibit Hall with Poster Sessions on one side and The Quad on the other. A lounge especially designed for GSA's student participants; as on most campuses, this will be a gathering point for networking opportunities.



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GSA 2014

19-22 October | Vancouver, BC, Canada



528. SCIENCE COMMUNICATION WORKSHOP

HONE YOUR SKILLS

Hyatt Regency Vancouver, Sat., 18 Oct., 8 a.m.–noon.

Professionals: US\$35; students: US\$25. Includes continental breakfast.

Limit: 30. *Sign up when you register for the meeting.*

Instructors: Christa Stratton, Justin Samuel, and Kasey White of The Geological Society of America, and Beth Bartell of UNAVCO.

Scientist-communicators who can present messages clearly and foster respect between science and the lay public are essential for true public engagement with critical scientific issues, but traditional scientific training typically does not prepare scientists to be effective communicators. This workshop will give you guidance on how to hone your public communication and outreach skills as well as the opportunity to practice in a safe and comfortable setting.

You'll Learn

- How to create clear and concise messages that are targeted to your audience;
- How to stay on-message during a media interview;
- Best practices in social media communications;
- How to identify opportunities for interacting with the lay public in your community; and
- How to approach policy makers on scientific issues.

GSA Associated Society COURSES

SOCIETY OF ECONOMIC GEOLOGISTS

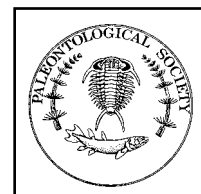
Applied Structural Geology in Exploration and Mining. Fri.–Sat., 17–18 Oct., 9 a.m.–5 p.m. Price: TBD. Limit: 40. **Instructors:** Julia Kramer Bernhard, SRK Consulting; Hubert Mvondo, SRK Consulting; Wayne Barnett, SRK Consulting; Findlay Craig, SRK Consulting. Questions? Contact Elizabeth Holley at elizabethholley@segweb.org.



Note: GSA does not handle registration for these courses. Please use the contact information provided online to learn more and to register.

PALEONTOLOGICAL SOCIETY

Reading and Writing of the Fossil Record: Preservational Pathways to Exceptional Fossilization. Sat., 18 Oct., 9 a.m.–6 p.m. FREE, with no registration needed and no course attendance limit. **Instructors:** Marc Laflamme, Univ. of Toronto; James D. Schiffbauer, Univ. of Missouri; and Simon Darroch, Yale Univ. Learn more at www.paleosoc.org.



LUNCHTIME Lectures

Join your colleagues for our annual Lunchtime Lectures, Sun.–Wed., 19–22 Oct., from noon–1 p.m., at the Vancouver Convention Centre–West, Ballroom B. Bring your lunch and listen and learn.



Hap McSween

SUNDAY

GSA Presidential Address: Mapping the Planets—Geology Stakes Its Claim

Plus: Updates from Jack Hess and Geoff Feiss

Please join us for GSA President Hap McSween's Presidential Address. Following the address, Jack Hess, GSA's Executive Director, will provide a presentation on the state of the Society, and Geoff Feiss, President of the GSA Foundation, will discuss the status of the Foundation and its efforts. No reservations, tickets, or meeting registration required.

MONDAY

Panel Discussion: Rails, Trucks, and Pipelines: What Are the Issues in Transporting Crude Oil?



Rex Buchanan



Robert "Matt" Joeckel



Suzette Kimball

Moderator: Rex Buchanan, Interim Director, Kansas Geological Survey, University of Kansas

The transportation of hydrocarbons with the new energy boom is demanding a great deal of attention. Policy makers, agencies, and communities are evaluating the risks and economics of truck versus train versus pipelines in their decisions for routes, regulations, and rules. This expert panel will discuss the emerging issue, using science to inform our thinking on energy demands, sources, and distribution. Time will be given for questions from the audience.

Panelists include **Robert "Matt" Joeckel** of University of Nebraska and **Suzette Kimball**, Acting Director of the U.S. Geological Survey. Joeckel's research has focused on soils, paleosols, stratigraphy, and sedimentology. He has spoken at public forums on the science considerations with proposed Keystone XL pipeline through Nebraska. Suzette Kimball has been Acting Director of the USGS since January 2014, having previously served

as USGS Deputy Director, Eastern Regional Director, and Acting Associate Director for Geology. This panel discussion is sponsored by GSA's Geology and Public Policy Committee and GSA's Geology and Society Division.



Kevin Krajick

TUESDAY

2014 Michel T. Halbouty Lecture

Kevin Krajick, Lamont-Doherty Earth Observatory, Earth Institute, Columbia University

Kevin Krajick has been a journalist for more than 35 years, working in magazines, newspapers, books, and visual media. His articles on science and nature have appeared in *National Geographic*, *The New Yorker*, *Science*, *Smithsonian*, and many other publications. Among other honors, Krajick is two-time winner of the American Geophysical Union's Walter Sullivan Award for Excellence in Science Journalism, and he was a finalist for the American Society of Magazine Editors' National Magazine Award for Public Service. His book *Barren Lands* is the definitive account of one of modern history's great mineral strikes—the discovery of rich diamond deposits in far northern Canada. Field reporting has taken him to more than 20 countries and 48 U.S. states. Since 2007, he has led press relations and produced media for Columbia University's Earth Institute and its associated Lamont-Doherty Earth Observatory, where hundreds of researchers in geology, climate, oceanography, and other fields are working to understand the dynamics of the earth and their relationship to critical issues facing humankind.



Matt Golombek

WEDNESDAY

How to Select a Landing Site on Mars

Matt Golombek, Jet Propulsion Laboratory, California Institute of Technology

Matt Golombek is a Senior Research Scientist at the Jet Propulsion Laboratory (JPL), California Institute of Technology, the lead NASA center for planetary exploration and a veteran of space missions to Mars. Over the past 20 years, Golombek has led or been heavily involved in the selection of every successful Mars landing site in the modern era and is the JPL Mars Exploration Program Landing Site Scientist. He was the chief scientist for the Mars *Pathfinder* Mission, which successfully landed a spacecraft and the *Sojourner* rover on Mars in 1997. He is currently the Project Scientist of NASA's Mars Exploration Rover mission and is



Lunchtime Lectures continued

a science operations team chair for the *Opportunity* rover now exploring the red planet. Golombek is leading the landing site selection efforts for the *InSight* geophysical lander scheduled to launch in 2016 and the Mars 2020 rover scheduled to collect a cache of samples for eventual return to Earth. Golombek has published more than 150 papers in scientific journals, along with 470 abstracts.

VISIT THE GSA MEETINGS BULLETIN BOARD

Here you'll have a chance to meet other meeting attendees and talk about whatever you want, whenever you want. Meet new people, coordinate your schedules, and plan activities while in Vancouver. You can even save money by sharing travel and lodging expenses.

It's easy and it's free! To access the secure Bulletin Board, go to the meeting website (community.geosociety.org/gsa2014/) and click on "Community" and "Find a Roommate."

Start planning for Vancouver now.

See you there!



GSA PRESIDENTIAL ADDRESS ABSTRACT

Mapping the Planets—Geology Stakes Its Claim

Hap McSween

Beginning with the Moon, the transformation of the planets and their satellites from astronomical objects into geological worlds has taken place largely by geologic mapping via telescope and spacecraft imagery. Compositional data from orbital remote sensing, chronological information from crater densities, and the added dimension of petrology and geochemistry from surface rovers and laboratory analyses of samples have cemented geology's central place in planetary exploration. The present focus on characterizing planetary paleoenvironments and the search for life further buttresses geology's role in planetary exploration and serves as the next step in the expansion of our discipline beyond Earth. (See p. 32 for date and location.)



PRESIDENT'S MEDAL LECTURE

Prediction Problems of Earthquake System Science

Thomas H. Jordan

Mon., 20 Oct., 1–2 p.m.
Vancouver Convention Centre–West, Ballroom B
Speaker/Medalist: **Thomas H. Jordan**, Director, Southern California Earthquake Center, University of Southern California

System science seeks to explain phenomena that emerge from nature at the system scale, such as global climate change or earthquake activity in California or Alaska. The "system" is not a physical reality, but a hypothetical representation of nature, typically a numerical model or ensemble of models that replicates an emergent behavior and predicts its future course. In this presentation, Thomas Jordan will describe how system-level models of fault rupture and seismic wave propagation are improving our understanding of earthquake predictability by posing interesting problems of contingent predictability as physics questions in a system-specific context.

GSA GOLD MEDAL LECTURES

Mon., 20 Oct., 2–3:30 p.m.
Vancouver Convention Centre–West, Ballroom B

GSA continues the celebration with up-close and personal lectures by our three gold medalists: **Susan W. Kieffer**, Penrose Medal; **Lisa Tauxe**, Day Medal; and **Francis A. Macdonald**, Donath Medal. Each will present a 20-minute talk reflecting their scientific careers:

Kieffer: "Researching the Earth: Living It, Loving It, and Sharing It";

Tauxe: "Hunting the Magnetic Field"; and

Macdonald: "The Tectonic Context of Neoproterozoic and Early Paleozoic Environmental Change."

All are welcome; no reservations, tickets, or meeting registration required.



TOOLS FOR SCIENTISTS: Be Heard & Be Interesting

Substance and Style for Better Science Communication

The Geological Society of America's
Annual Meeting Workshop,
at the Hyatt Regency Vancouver, BC, Canada

Sat., 18 Oct., 8 a.m.–noon.

Professionals: US\$35; students US\$25. Includes continental breakfast

Limit: 30. Sign up on your meeting registration form
or call GSA Sales and Service, +1-800-443-4472 to add the workshop.

Are you considering doing outreach or joining a social media platform? Have you thought about what you would say if you met your Representative? Could you interest a non-scientist in your work and tell them why it's important in 30 seconds or less?

This interactive workshop will address how to create clear and concise messages that are targeted to your audience; how to stay on-message during a media interview; best practices in social media communications; how to approach policy makers on scientific issues; and more. You'll have the opportunity to practice your skills in a safe and comfortable setting.



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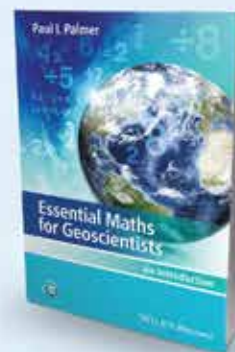
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STUDENT Events

STUDENTS AND RECENT GRADS

Students and recent university graduates: Check out these special events put together just for you. For information on how to earn free meeting registration and more, see p. 18.

STUDENT PUB CRAWL

Monday, 20 Oct., 6 p.m.

Get together with other students and make the round of pubs in the downtown Vancouver area. Some of the local area pubs have offered up great deals for students attending the meeting. Maps to these pubs and wristbands for this event can be picked up just outside the Student Volunteer Office (room 106 in the Vancouver Convention Centre–West), starting at noon on Monday and ending when the wristbands are gone. Don't miss out! Be prepared to show ID.

ANNUAL BEST STUDENT GEOLOGIC MAP COMPETITION

The U.S. Geological Survey (USGS) National Cooperative Geologic Mapping Program (NCGMP), in partnership with The Geological Society of America (GSA), GSA Foundation (GSAF), Association of American State Geologists (AASG), American Geosciences Institute (AGI), American Institute of Professional Geologists (AIPG), and the *Journal of Maps*, invites you to stop by to view the Best Student Geologic Map Competition.

This year marks the second annual Best Student Geologic Map Competition at the GSA Annual Meeting. The competition will highlight student research from around the world that utilizes field mapping and the creation of geologic maps as a major component.

The top three student geologic maps will be selected for recognition and awards at a special judging reception. Students will post their maps (Session Posters) on Tuesday, 21 Oct., as early as 9 a.m. and will be present from 5–6:30 p.m. in the Poster Hall for review and evaluation by the judges.

GEOLOGIZE AND SOCIALIZE: A RECEPTION FOR STUDENTS & RECENT GRADS

Tuesday, 21 Oct., 7–10 p.m. Fee: \$20, which includes one free drink ticket.

All undergraduate students, graduate students, and recent graduates are invited to enjoy live music and socializing at this event inside the Vancouver Convention Centre–West. *Light hors d'oeuvres and a cash bar will be provided.* This event is for students and recent grads only.



Twitter @geosociety
Follow the meeting at #GSA2014

ARE YOU A RECENT GRAD?

A Message from Hap McSween, GSA President, and Jack Hess, GSA Executive Director

GSA has many exciting opportunities for you to start or advance your new geoscience career.

- *Interested in the intersection of science and policy?* Then attend the Congressional Science Fellowship and Public Policy Reception on Monday evening.
- *Interested in upgrading your skills?* GSA offers many mentoring and career programs that provide advice on career pathways taken by leaders in their fields in government and industry.
- *Want to be a better communicator?* The Science Communications Workshop on Saturday may be for you.
- *Check out the GSA employment service* at www.geosociety.org/employment_service.
- *The GSA publications department* offers a free workshop on how to prepare research for publication and how to give back to the science through becoming an effective reviewer.

PRESIDENT'S Student Breakfast

Sunday, 19 Oct., 7–8:30 a.m.

Sponsored by

ExxonMobil

Hosted by GSA



GSA President Hap McSween invites all students registered for the meeting to attend a free breakfast buffet sponsored by ExxonMobil Corporation. Hap and members of GSA leadership will be on hand to answer questions and address student issues. ExxonMobil will also be presenting the GSA/ExxonMobil Field Camp Scholar and Bighorn Basin Field Awards.

Each student registered for the meeting will receive a complimentary ticket for the breakfast buffet. This is one of the most popular events at the meeting for students, and with good reason! Take this opportunity to network with fellow students and meet the officers of GSA at this casual event.

EDUCATOR Events

K-12 TEACHERS

Short Courses

This year we are offering several *two-for-one* Short Courses. Attend one course in the morning and your choice of afternoon course is free (see below).

Morning Courses (US\$35 each)

- 518A. Teaching Controversial Issues 1: Climate and Energy
- 518B. The Crunching of Cascadia: Discovering Deformation with Data
- 518C. Crosscutting Earth Themes

Afternoon Courses

- 518D. Teaching Controversial Issues 2: Evolution of Life and Earth
- 518E. Yellowstone National Park as a Hotbed for Inquiry
- 518F. Introduction to Critical Zone Science and Observatories

Field Trips

Don't miss out on this fantastic field trip: Field Trip 419: Sea-to-Sky Geotour for Teachers. It's a great way to learn about the geology of this area!

Geoscience Educators' Reception

Hyatt Regency Vancouver, Georgia A/B
Sun., 19 Oct., 7-9 p.m.

This fun and informal reception is a great way for you to network with educators from around the country. *Appetizers and a cash bar provided.*


Two-Year College Faculty Stipend

If you submitted paper work to Davida Buehler for the US\$200 stipend, don't forget to sign the attendance sheet that your short course leader will provide. Buehler will verify your attendance at the short course before she mails your stipend to you.

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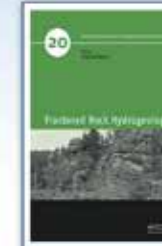
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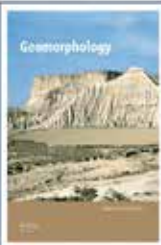
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Wake up in the morning with complimentary coffee (while it lasts) in the Vancouver Convention Centre (VCC).

Sun.: 9 a.m., VCC–West, Exhibit Hall C (Poster Sessions).

Mon.–Wed.: 9 a.m., VCC–West, Exhibit Halls A–C.

Coffee is also available for purchase at the Coal Harbour Café located off of the Thurlow Street Entrance, VCC–West, Level 1.

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Sun.: 5–7 p.m., Exhibits Opening Reception, Exhibit Halls A-B.

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101. **Vancouver's Cultural Mosaic:** Sun., 19 Oct., 9:30 a.m.–4:30 p.m. Cost: US\$130.
102. **Tastes of the Far East:** Mon., 20 Oct., 10 a.m.–2 p.m. Cost: US\$100.
103. **First Nations Heritage Tour:** Tues., 21 Oct., 1–5 p.m. Cost: US\$70.
104. **Coastal Rainforest Nature Walk:** Wed., 22 Oct., 8:30 a.m.–12:30 p.m. Cost: US\$80.
105. **Enchanting Victoria:** Thurs., 23 Oct., 8:30 a.m.–8:30 p.m. Cost: US\$172.

BLOG ROLL

Let everyone know about your meeting-related blog posts! Add your info to the Blog Roll at community.geosociety.org/gsa2014/socialbusiness/socialmedia. Also, check out GSA's blog, *Speaking of Geoscience*™, at <http://geosociety.wordpress.com>, and learn how YOU can add to the discussion.



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GSA is geosociety on Instagram. Submit your photos with meeting hashtag #GSA2014! Please note that meeting policy prohibits the use of cameras or sound-recording equipment at technical sessions and poster sessions.



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The *Annual Review of Earth and Planetary Sciences*, in publication since 1973, covers significant developments in all areas of Earth and planetary sciences, from climate, environment, and geological hazards to the formation of planets and the evolution of life.

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Volume 39, October 2014 • environ.annualreviews.org

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The *Annual Review of Environment and Resources*, in publication since 1976, provides authoritative reviews of significant topics within environmental science and engineering, including ecology and conservation science, water and energy resources, atmosphere, oceans, climate change, agriculture and living resources, and human dimensions of resource use and global change.

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Volume 45, November 2014 • ecolsys.annualreviews.org

Editor: **Douglas J. Futuyma**, *State University of New York, Stony Brook*

The *Annual Review of Ecology, Evolution, and Systematics*, in publication since 1970, covers significant developments in the fields of Ecology, Evolutionary Biology, and Systematics, as they apply to all life on Earth. Reviews cover topics ranging from phylogeny, speciation, and molecular evolution through behavior and evolutionary physiology to population dynamics, ecosystems processes, and applications in invasion biology, conservation, and environmental management.

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ON TO THE FUTURE

Congratulations to the 2014 On To the Future (OTF) Scholars! OTF Scholars are a select group of 125 students underrepresented in the geosciences, who have been chosen to receive a partial travel award to attend their first GSA Annual Meeting in Vancouver, British Columbia, Canada. OTF Scholars are chosen based on their commitment to pursuing a career in the geosciences, merit, and financial need.

Stop by the OTF table in the GSA Foundation booth at the Annual Meeting to meet an OTF Scholar or volunteer to mentor an OTF Scholar at the meeting. Check the OTF website (community.geosociety.org/OTF/annualmeetingprogram) for more information or contact Tahlia Bear at tbear@geosociety.org, +1-303-357-1066.

DIVERSITY IN THE GEOSCIENCES AND ON TO THE FUTURE ALUMNI RECEPTION

Tues., 21 Oct, 5:30–7 p.m.

The GSA Diversity in the Geosciences Committee invites you to attend a relaxing forum for socializing, sharing ideas, and meeting other geoscience community members interested in diversity issues. The 2014 On To the Future Scholars and Subaru Minority Scholarship Awardees will be recognized. *Appetizers and cash bar provided.*



Encounter your colleagues in



Photo by Bret Webster.

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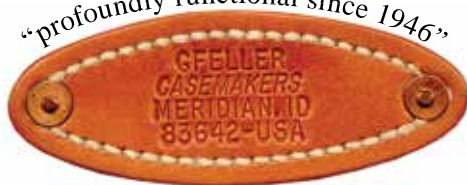
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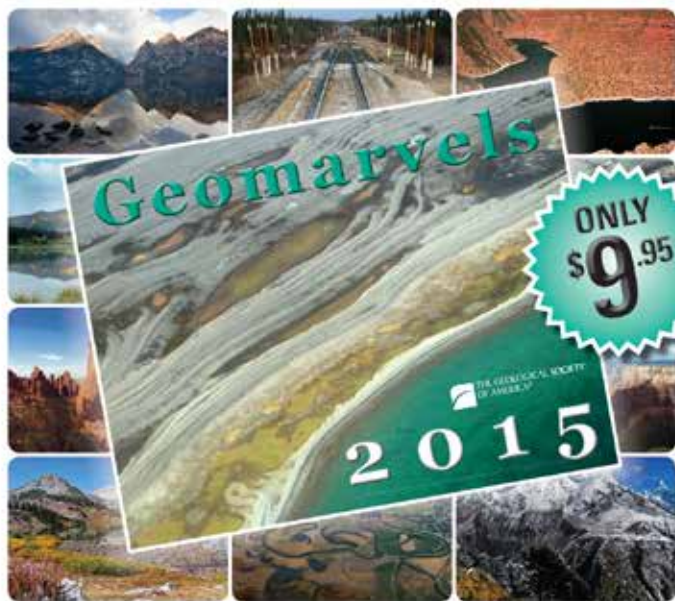
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Reconstruction of a Late Proterozoic to Devonian Continental Margin Sequence, Northern Alaska, Its Paleogeographic Significance, and Contained Base-Metal Sulfide Deposits

Edited by Julie A. Dumoulin and Alison B. Till

Reconstruction of a Late Proterozoic to Devonian Continental Margin Sequence, Northern Alaska, Its Paleogeographic Significance, and Contained Base-Metal Sulfide Deposits

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Preliminary Announcement and Call for Papers

SOUTH-CENTRAL SECTION

49th Annual Meeting
of the South-Central Section, GSA
Stillwater, Oklahoma, USA
19–20 March 2015

www.geosociety.org/sections/sc/2015mtg/



Byrds Mill Spring, the largest spring in Oklahoma, provides drinking water for the city of Ada, Oklahoma, USA. Photo by Kyle Spears.

Geosciences at the Crossroads of America: Integrating Geosciences to Address Complex Problems

LOCATION

The 49th Annual Meeting of GSA's South-Central Section will take place in Stillwater, Oklahoma, USA, at the Student Union of Oklahoma State University, which is located on the scenic shoreline of the Permian Sea, and currently sits at the crossroads of major U.S. highways and petroleum pipelines. The university has provided an intersection of geologic disciplines since the inception of the Boone Pickens School of Geology at OSU with a history in petroleum, water, and agriculture. The meeting will have a diverse program of workshops, technical sessions, and field trips that covers a spectrum of geologic disciplines. Our meeting is during the spring break for the campus, giving us the run of the largest student union in the world.

CALL FOR PAPERS

Abstract deadline: 16 December

Submit online at www.geosociety.org/sections/sc/2015mtg. Abstract submission fee: US\$10 for students and US\$15 for all others. If you cannot submit an abstract online, please contact Heather Clark, +1-303-357-1018, hclark@geosociety.org.

Symposia

- S1. **Mississippian Sedimentology and Sequence Stratigraphy of the Mid-Continent from Outcrop and Subsurface Studies.** Michael Grammer, Oklahoma State Univ., michael.grammer@okstate.edu; Jim Puckette, Oklahoma State Univ., jim.puckette@okstate.edu; Darwin Boardman, Oklahoma State Univ., darwin.boardman@okstate.edu; Jay Gregg, Oklahoma State Univ., jay.gregg@okstate.edu.
- S2. **Sequence Stratigraphy, and High Resolution Biostratigraphy of the Pennsylvanian Subsystem.** Darwin Boardman, Oklahoma State Univ., darwin.boardman@okstate.edu; John Pope, Northwest Missouri State Univ., jppope@nwmissouri.edu; W. Lynn Watney, Kansas Geological Survey, lwatney@kgs.ku.edu; Jim Puckette, Oklahoma State Univ., jim.puckette@okstate.edu.

Theme Sessions

- T1. **East African Rift, Southern Oklahoma Aulacogen, Rio Grande Rift, and other Continental Rifts: A Tribute to the Career of G. Randy Keller.** Mohamed Abdelsalam, Oklahoma State Univ., mohamed.abdel_salam@okstate.edu; Estella Atekwana, Oklahoma State Univ., estella.atekwana@okstate.edu; Asish Basu, Univ. of Texas at Arlington, abasu@uta.edu; Kevin Mickus, Missouri State Univ., kevinmickus@missouristate.edu; Robert Stern, Univ. of Texas at Dallas, rjstern@utdallas.edu.
- T2. **Geological Carbon Sequestration: Understanding Physical, Chemical, and Biological Processes.** Jack Pashin, Oklahoma State Univ., jack.pashin@okstate.edu; Matt Kirk, Kansas State Univ., mfkirk@k-state.edu.
- T3. **New Insights on the Architecture of the Gulf Coast Margin.** Raphael Gottardi, Univ. of Louisiana at Lafayette, rxg0121@louisiana.edu; and Gary Kinsland, Univ. of Louisiana at Lafayette, gkinsland@louisiana.edu.
- T4. **Evaporite Karst in the Greater Permian Basin of Texas, New Mexico, Oklahoma, Kansas, and Colorado.** Kenneth Johnson, Oklahoma Geological Survey, ksjohnson@ou.edu.
- T5. **Recent Advances in the Geological Evolution of the Southern Oklahoma Aulacogen.** Matthew Brueseke, Kansas State Univ., brueseke@ksu.edu; Jonathan Price, Midwestern State Univ., jonathan.price@mwsu.edu; Richard Hanson, Texas Christian Univ., r.hanson@tcu.edu.
- T6. **Geochemical Characterization of Dynamic Sedimentary Systems.** Tracy Quan, Oklahoma State Univ., tracy.quan@okstate.edu; Natascha Riedinger, Univ. of California–Riverside and Oklahoma State Univ., natascha.riedinger@ucr.edu; Eliot Atekwana, Oklahoma State Univ., eliot.atekwana@okstate.edu.
- T7. **Subsurface Fluids and Induced Seismicity.** Katie Keranen, Cornell Univ., kmk299@cornell.edu.

- T8. **Ouachita-Marathon Fold-Thrust Belt and Foreland Basins: Their Tectonics, Structural Geology, Sedimentology and Hydrocarbon Potential.** Ibrahim Çemen, Univ. of Alabama, icemen@as.ua.edu; Jim Puckette, jim.puckette@okstate.edu, Oklahoma State Univ.; Darwin Boardman, Oklahoma State Univ., darwin.boardman@okstate.edu.
- T9. **Karst Hydrogeology.** Joe Myre, Univ. of Arkansas, joemyre@gmail.com; Katherine Kneirim, Univ. of Arkansas, katherine.kneirim@gmail.com.
- T10. **Energy-Water Nexus.** Kyle Murray, Oklahoma Geological Survey, kyle.murray@ou.edu.

FIELD TRIPS

Look for full trip details online in December. Field Trip Chair: Darwin Boardman, darwin.boardman@okstate.edu.

High Resolution Sequence Stratigraphy of the Pennsylvanian of the North American Midcontinent. 14–17 Mar. Darwin Boardman, Oklahoma State Univ., darwin.boardman@okstate.edu; John Pope, Northwest Missouri State Univ., jppope@nwmissouri.edu; W. Lynn Watney, Kansas Geological Survey, lwatney@kgs.ku.edu; Jim Puckette, Oklahoma State Univ., jim.puckette@okstate.edu.

Geology of the Wichita Mountains. 18 Mar. Charles Gilbert, Univ. of Oklahoma (emeritus).

Hydrogeology of the Arbuckle Simpson Aquifer and EPA Tour/ Hydrodays. 20–21 Mar., Todd Halihan, Oklahoma State Univ., todd.halihan@okstate.edu; Randall Ross, U.S. Environmental Protection Agency, ross.randall@epamail.epa.gov; Jona Tucker, The Nature Conservancy, jtucker@tnc.org.

Meramecian and Chesterian (Visean) of Northeastern Oklahoma: Conodont Biostratigraphy and Revised Regional Stratigraphic Framework. 21–22 Mar. Cory Godwin, Oklahoma State Univ., cory.godwin@okstate.edu; Darwin Boardman, Oklahoma State Univ., darwin.boardman@okstate.edu; Michael Grammer, Oklahoma State Univ., michael.grammer@okstate.edu; Jim Puckette, Oklahoma State Univ., jim.puckette@okstate.edu.

SHORT COURSES

Short courses will be offered on Wed., 18 March, and Sat., 21 March. Watch for more information online.

Pre-Meeting

Mid-Continent Conventional and Unconventional Reservoirs—Core Workshop. Michael Grammer, Oklahoma State Univ., michael.grammer@okstate.edu; Jack Pashin, Oklahoma State Univ., jack.pashin@okstate.edu; Jim Puckette, Oklahoma State Univ., jim.puckette@okstate.edu; Darwin Boardman, Oklahoma State Univ., darwin.boardman@okstate.edu; Jay Gregg, Oklahoma State Univ., jay.gregg@okstate.edu.

A Holistic Approach to Groundwater Resource Development and Management. James Roberts, Professional Engineering Consultants, james.roberts@pec1.com; Michael Thornhill, Thornhill Group, mthornhill@tgi-water.com; Stanley Paxton, USGS, spaxton@usgs.gov; Todd Halihan, Oklahoma State Univ., todd.halihan@okstate.edu.

IHS Petra Training. Larry Gerken, IHS Energy–The Americas, larry.gerken@ihs.com

Post-Meeting

Introduction to Carbonate Diagenesis. Jay Gregg, Oklahoma State Univ., jay.gregg@okstate.edu.

STUDENT OPPORTUNITIES

Mentor Programs

The Roy J. Shlemon Mentor Program in Applied Geoscience. Students will have the opportunity to discuss career prospects and challenges with professional geoscientists from multiple disciplines over a FREE lunch. Learn more at www.geosociety.org/mentors/shlemon.htm.

The John Mann Mentors in Applied Hydrogeology Program. Students interested in applied hydrogeology or hydrology as a career will have the opportunity to network with professionals in these fields over a FREE lunch. Learn more at www.geosociety.org/mentors/mann.htm.

On To the Future (OTF): Stop by the GSA Foundation booth at the Welcome Reception to ask an onsite representative about applying to OTF, which provides travel support to students underrepresented in the geosciences to attend their first GSA Annual Meeting (the next one is 1–4 Nov. 2015 in Baltimore, Maryland, USA). Learn more at community.geosociety.org/OTF/home/.

ACCOMMODATIONS

A block of rooms has been reserved at the Best Western Plus Cimarron Hotel, 315 N. Husband Street, Stillwater, OK 74075, USA. Rate: US\$77 plus tax. To make your reservation, please call +1-405-372-2878. An additional block of rooms has been reserved at the Fairfield Inn and Suites Stillwater, 418 E. Hall of Fame Ave., Stillwater, OK 74075, USA. Rate: US\$99.99 plus tax. To make your reservation, please call +1-405-372-6300. Be sure to mention that you are attending the GSA South-Central Meeting.

LOCAL COMMITTEE

General Chair: Todd Halihan, todd.halihan@okstate.edu

Technical Program Chair: Jack Pashin, jack.pashin@okstate.edu

Field Trip Chair: Darwin Boardman, darwin.boardman@okstate.edu

Student Volunteer Coordinator: Tracy Quan, tracy.quan@okstate.edu

Judging Coordinator: Joseph Donoghue, joseph.donoghue@okstate.edu

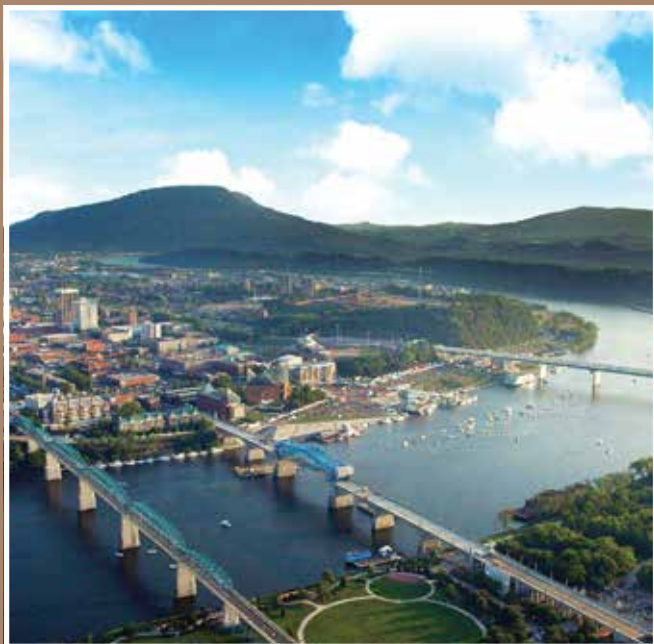
Industry Liaison: Anna Cruse, acruse@sampson.com

Preliminary Announcement and Call for Papers

SOUTHEASTERN SECTION

64th Annual Meeting
of the Southeastern Section, GSA
Chattanooga, Tennessee, USA
19–20 March 2015

www.geosociety.org/Sections/se/2015mtg/



The waterfront and downtown Chattanooga along the Tennessee River with Lookout Mountain in the background. Photo courtesy of the Chattanooga Convention & Visitors Bureau.

LOCATION

Widely known as “The Scenic City,” Chattanooga owes this distinction to its geologic setting. The city lies along the Tennessee River, among the valleys and ridges of the southern Appalachian fold-and-thrust belt, and within view of the Cumberland Plateau and Blue Ridge. Its name derives from “cató,” the Muskogean word for “rock,” giving due emphasis to the geology of the area and the ideal setting it provides for this meeting.

CALL FOR PAPERS

Abstract deadline: 9 December

Please submit your abstract online at www.geosociety.org/Sections/se/2015mtg/. An abstract submission fee of US\$10 for students and US\$15 for professionals is required. If you cannot submit an abstract online, please contact Nancy Wright, +1-303-357-1061.

Symposia

- S1. **Paleozoic Paleontology of the Southeast.** Principal Organizer: Bradley Deline, Univ. of West Georgia, bdeline@westga.edu. Co-Organizer: Katherine Bulinski, Bellarmine Univ., kbulinski@bellarmine.edu.
- S2. **In Honor of Hugh H. Mills: Geomorphology and Earth Surface Processes in the Southern Appalachians: Landscape Evolution and Practical Applications.** Principal Organizer: Richard M. Wooten, North Carolina Geological Survey, Rick.Wooten@ncdenr.gov. Co-Organizers: L. Scott Eaton, James Madison Univ., eatonls@jmu.edu; Kathleen Farrell, North Carolina Geological Survey, kathleen.farrell@ncmail.net
- S3. **John Dennison Memorial Symposium: Appalachian Geology and Paleozoic Glacio-Eustasy.** Principal Organizer: Rick Diecchio, George Mason Univ., rdiecchi@gmu.edu; Co-Organizer: Katharine Lee Avary, West Virginia Geological and Economic Survey (retired), avarygeo@gmail.com.

Theme Sessions

- T1. **Geology Careers for New Geology Graduates.** Principal Organizer: Ronald Wallace, Georgia Dept. of Natural Resources, ronald.wallace@dnr.state.ga.us. Co-organizer: Todd McFarland, AMEC Environment and Infrastructure, todd.mcfarland@amec.com.
- T2. **Kinematic Evolution of Faults and Shear Zones in the Appalachians.** Principal Organizer: Jackie Langille, Univ. of North Carolina–Asheville, jangill@unca.edu. Co-organizer: Jamie Levine, Appalachian State Univ., levinejs@appstate.edu.
- T3. **The Science behind Water and Land Management Practices.** Principal Organizer: Kristan Cockerill, Appalachian State Univ., cockerillkm@appstate.edu. Co-Organizer: Chuanhui Gu, Appalachian State Univ., guc@appstate.edu.
- T4. **Gas Shale and Oil Sands Resources of the Southeastern United States.** Co-Organizers: Ibrahim Çemen, The Univ. of Alabama, icemen@as.ua.edu; Denise Hills, Alabama Geological Survey, dhills@gsa.state.al.us.
- T5. **Undergraduate Research (Posters).** Principal Organizer: Lee Phillips, Univ. of North Carolina at Greensboro, plphilli@uncg.edu. Co-Organizers: Jeffrey Ryan, Univ. of South Florida, ryan@usf.edu; Weston Dripps, Furman Univ., weston.dripps@furman.edu; Amy Brock-Hon, Univ. of Tennessee at Chattanooga, amy-brock-hon@utc.edu.
- T6. **Traces Then and Now: One Ichnology.** Principal Organizer: Anthony J. Martin, Emory Univ., geoam@emory.edu. Co-Organizer: Andrew K. Rindsberg, Univ. of West Alabama, arindsberg@uwa.edu.
- T7. **Ordovician Tectonics of the Appalachians: New Ideas on an Ancient Orogen.** Principal Organizer: Clinton Barineau, Columbus State Univ., barineau_clinton@columbusstate.edu. Co-Organizers: James Tull, Florida State Univ., jtull@fsu.edu; Christopher Holm-Denoma, USGS, cholm-denoma@usgs.gov.
- T8. **Metamorphism from Zeolite Facies to UHP and UHT with Emphasis on Models for Predicting Metamorphic Mineral Stability.** Co-Organizers: Harold Stowell, Univ. of Alabama,

hstowell@geo.ua.edu; Douglas Tinkham, Laurentian Univ., Sudbury, ON, Canada, dtinkham@laurentian.ca; Mark Caddick, Virginia Tech, caddick@vt.edu.

- T9. **Wetlands in the Southeast: Hydrology, Soils, and Environmental Change.** Co-Organizers: Benjamin Tanner, Western Carolina Univ., btanner@email.wcu.edu; Jeffrey Wilcox, Univ. of North Carolina–Asheville, jwilcox@unca.edu.
- T10. **Crushed Stone, Dimension Stone, Landscape Stone, and Industrial Mineral Resources of the Southeastern United States.** Principal Organizer: Robert S. Fousek, FMR Inc., bobf32046@aol.com. Co-Organizer: Russ Patterson, Patterson Exploration Services, russ@pattersonexploration.com.
- T11. **Eastern Tennessee Seismic Zone and Paleoseismology in the Southeastern United States.** Principal Organizer: Christine Powell, Center for Earthquake Research and Information, The Univ. of Memphis, capowell@memphis.edu. Co-Organizers: Robert Hatcher, Jr., Univ. of Tennessee at Knoxville, bobmap@utk.edu; Randy Cox, The Univ. of Memphis, randycox@memphis.edu.
- T12. **Teaching Evolution in the Southeast.** Principal Organizer: Patricia Kelley, Univ. of North Carolina Wilmington, kelley@uncw.edu. Co-Organizer: Christy Visaggi, Georgia State Univ., cvisaggi@gsu.edu.
- T13. **Sinkholes, Swallets, and Subsidence: Karst Investigations in the Southeast.** Principal Organizer: Terri Brown, Univ. of Tennessee at Knoxville, tbrown23@vols.utk.edu.
- T14. **Geologic Maps, Geophysical Maps, Digital Geologic Maps, and Derivatives from Geologic and Geophysical Maps.** Principal Organizer: Michael W. Higgins, The Geologic Mapping Institute, mhiggins@mindspring.com. Co-Organizer: Ralph F. Crawford, The Geologic Mapping Institute, crawford@sprintmail.com.

FIELD TRIPS

Descriptions for the following field trips are online; trip registration opens in December. For additional information, please contact the Field Trip Chair, Ann Holmes, ann-holmes@utc.edu.

Pre-Meeting

Exploring the Origins of Modern Topographic Relief in the Southern Appalachians: An Excursion through the Transient Landscape of the Cullasaja River Basin, North Carolina. Principal Organizer: Sean Gallen, Univ. of Michigan, Ann Arbor, sfgallen@umich.edu. Co-Organizer: Karl W. Wegmann, North Carolina State Univ., karl_wegmann@ncsu.edu. Length: 1 day.

Former Volunteer Army Ammunition Plant and Chattanooga Creek—Characterization, Remediation, and Redevelopment. Principal Organizers: Larry McKay, Univ. of Tennessee at Knoxville, lmckay@utk.edu; Frank Bogle, Tetra Tech Inc., frank.bogle@tetrattech.com. Co-Organizer: Vijay Vulava, College of Charleston, vulavav@cofc.edu. Length: 1 day.

Structural Geology and Paleozoic Tectonics of the Nashville Dome, Tennessee. Principal Organizer: Mark Abolins, Middle Tennessee State Univ., mark.abolins@mtsu.edu. Length: 1 day.

Post-Meeting

The Gray Fossil Site: A Unique Late Miocene/Early Pliocene Forest Refugium from the Appalachians of Tennessee.

Principal Organizer: Steven C. Wallace, East Tennessee State Univ. and ETSU Museum of Natural History, wallaces@mail.etsu.edu. Length: half-day.

Coal Mining Impacts and Remediation in the Chattanooga Region.

Principal Organizer: Gregory Brodie, Univ. of Tennessee at Chattanooga, gregory-brodie@utc.edu. Length: 1 day.

Evolution and the Evidence around Dayton, Tennessee.

Principal Organizer: William Witherspoon, billspoon1@gmail.com. Co-Organizers: Michael Gibson, Univ. of Tennessee at Martin, mgibson@utm.edu; and Don Byerly, Univ. of Tennessee at Knoxville, donbyerly@comcast.net. Length: 1 day.

Geology and Water Use History atop the Cumberland Plateau.

Principal Organizers: Martin Knoll, Univ. of the South, mknoll@sewanee.edu; Bran Potter, Univ. of the South, bpotter@sewanee.edu. Length: 1 day.

Sedimentary Architecture of Basinal Fort Payne (Mississippian) Deposits: Mixed Carbonate-Clastic Channels and Waulsortian-Like Mounds.

Co-organizers: Larry Knox, Tennessee Technological Univ., lknox@tntech.edu; Jeannette Wolak, Tennessee Technological Univ., jwolak@tntech.edu. Length: 1 day.

A Laurentian Margin Back-Arc: The Ordovician Wedowee-Emuckfaw-Dahlonega Basin.

Principal Organizer: Clinton Barineau, Columbus State Univ., barineau_clinton@columbusstate.edu. Co-organizers: James F. Tull, Florida State Univ., jtull@fsu.edu; and Christopher Holm-Denoma, USGS, cholm-denoma@usgs.gov. Length: 2 days.

Sequence Stratigraphy, Invertebrate Fauna and Ichnofacies of the Silurian Red Mountain Formation, Birmingham, Alabama, to Chattanooga, Tennessee.

Principal Organizer: Tim Chowns, Univ. of West Georgia, tchowns@westga.edu. Co-organizers: Andrew Rindsberg, Univ. of West Alabama, arindsberg@uwa.edu; Ann Holmes, Univ. of Tennessee at Chattanooga, ann-holmes@utc.edu. Length: 2 days.

Geology and Tectonic Development of Sequatchie Valley, Tennessee.

Principal Organizers: Bob Hatcher, Univ. of Tennessee–Knoxville, bobmap@utk.edu; Bob Milici, USGS emeritus, rmilici@usgs.gov.



Our logo features the Market Street Bridge morphed into folded and faulted carbonate stratigraphy, the distinctive roofline of the Tennessee Aquarium, and the profile of Lookout Mountain.

Southeastern Section continued on p. 54

STUDENT OPPORTUNITIES

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The John Mann Mentors in Applied Hydrogeology Program. Students interested in applied hydrogeology or hydrology as a career will have the opportunity to network with professionals in these fields over a FREE lunch. Learn more at www.geosociety.org/mentors/mann.htm.

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ACCOMMODATIONS

Hotel registration deadline: 25 February 2015

A block of rooms has been reserved at the Chattanooga Hotel and Conference Center, 1201 Broad Street, Chattanooga, TN, USA 37402, www.chattanooga.com. Room rates start at US\$129 plus tax. To make your reservation, please call the Chattanooga at +1-800-619-0018 and mention that you are attending the GSA Southeastern Meeting to get the meeting rate.

LOCAL COMMITTEE

General Chair: Jon Mies, jonathan-mies@utc.edu

Technical Program Chair: Amy Brock-Hon, amy-brock-hon@utc.edu

Technical Program Co-Chair: Mark Steltenpohl, steltmg@auburn.edu

Field Trip Chair: Ann Holmes, ann-holmes@utc.edu

Field Trip Co-Chairs: Michael Gibson, mgibson@utm.edu; Chuck Trupe, chtrupe@GeorgiaSouthern.edu

Exhibits Coordinator: Kevin Hon, khon@smeinc.com

Student Volunteer Coordinator: Claire Landis, claire-landis@utc.edu

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



March 2012 Penrose Conference location: Castelvecchio Pascoli, Lucca, Italy.

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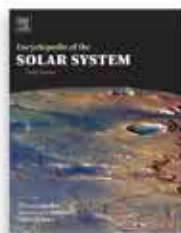
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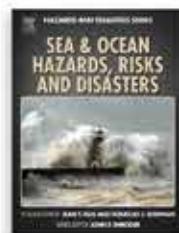
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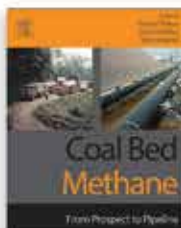
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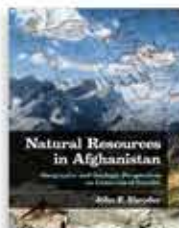
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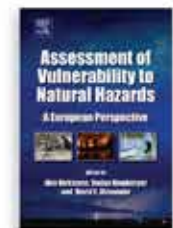
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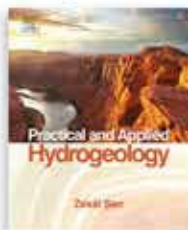
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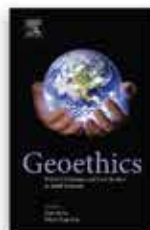
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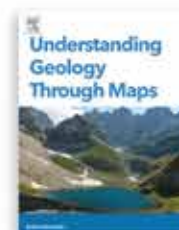
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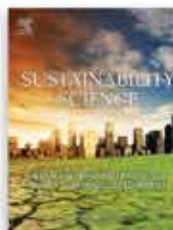
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Preliminary Announcement and Call for Papers

NORTHEASTERN SECTION

50th Annual Meeting
of the Northeastern Section, GSA
Bretton Woods, New Hampshire, USA
23–25 March 2015

www.geosociety.org/Sections/ne/2015mtg/



LOCATION

The GSA Northeastern Section is celebrating its *Golden Anniversary* in 2015, and to do so it is returning to The Omni-Mount Washington Resort “by popular demand.” The resort’s graceful atmosphere, magnificent scenery, and cordial staff will again furnish an extraordinary venue in which to share this special occasion. As those who attended the section meeting in 2013 already know, the venue is unlike any other, and with this, the 2015 meeting is again shaping up to be an informative, unusual, and not-to-be-missed occasion for professionals and students alike. Check the meeting’s website often for updated information on technical programming, the *50th Anniversary Gala Event*, special room reservation opportunities, and housing bargains for students.

CALL FOR PAPERS

Abstract deadline: 9 December

Please submit your abstract online at www.geosociety.org/Sections/ne/2015mtg/. A fee of US\$10 for students and US\$15 for professionals is required. If you cannot submit online, contact Heather Clark at +1-303-357-1018, hclark@geosociety.org.

Symposia

- S1. **Contributions to New England Stratigraphy & Structure: In Honor of Robert Moench and Douglas Rankin.** Greg Walsh, USGS, gwalsh@usgs.gov; Wally Bothner, Univ. of New Hampshire, wally.bothner@unh.edu; Mark Van Baalen, Harvard Univ., mvb@harvard.edu.
- S2. **Coastal and Glacial Processes from Alaska to New England: In Honor of John Boothroyd.** Bryan Oakley, Eastern Connecticut State Univ., oakleyb@easternct.edu; Mark Borrelli, Center for Coastal Studies, mborrelli@coastalstudies.org.
- S3. **Climate Change in Space & Time: An Update.** P. Thompson Davis, Bentley Univ., pdavis@bentley.edu; Jeremy Skakun, Boston College, jeremy.shakun@bc.edu.
- S4. **Contributions of Cosmogenic-Nuclide Geochronology to Glacial Geology and Geochronology in Northeastern North America—and Vice Versa.** Greg Balco, Berkeley Geochronology Center, balcs@bgc.org; John Gosse, Dalhousie Geochronology Centre, john.gosse@dal.ca.

Theme Sessions

- T1. **Updating the Orogen: Along-Strike Tectonic Correlations and Comparisons in the Northeastern Appalachians.** Jon Kim, Vermont Geological Survey, geojon710@msn.com; Craig Dietsch, Univ. of Cincinnati, dietscc@ucmail.uc.edu.
- T2. **Northeastern North American Volcanic Successions and Their Tectonic Context.** Sheila Seaman, Univ. of Massachusetts, sjs@geo.umass.edu; Christopher Koteas, Norwich Univ., gakoteas@norwich.edu.
- T3. **Terrain Forensics—Where Did They Come From and Which Are Related?** Sandra Barr, Acadia Univ., sandra.barr@acadiau.ca; Scott Sampson, Syracuse Univ., scott.sampson@syracuse.edu.
- T4. **Ages and Origins of Intrusive Rocks in the New England Appalachians.** Dyk Eusden, Bates College, deusden@bates.edu; Dwight Bradley, USGS, dbradley@usgs.gov.
- T5. **The Role of Interacting Processes in Deformation.** Jeff Marsh, Queens College, jhmarsh@gmail.com; Chris Gerbi, Univ. of Maine, christopher.gerbi@maine.edu; Scott Johnson, Univ. of Maine, scott.johnson@maine.edu.
- T6. **Retracing the Steps of Northeastern United States Geologists in the Past 50 Years.** Jeri Jones, Jones Geological Services, jonesgeo@comcast.net.
- T7. **Hartford Basin through Time.** Stephen Nathan, Eastern Connecticut State Univ., nathans@easternct.edu; Peter Drzewiecki, Eastern Connecticut State Univ., drzewieckip@easternct.edu.
- T8. **Advances in Pleistocene Geology: Northeastern U.S. and Eastern Canada.** Serge Occhietti, Université du Québec à Montréal, occhietti.serge@uqam.ca; George Springston, Norwich Univ., gsprings@norwich.edu; Woodrow Thompson, Maine Geological Survey, woodrow.b.thompson@maine.gov.
- T9. **New Perspectives on Paleoclimate from Advances in Glacial Geology.** Meredith Kelly, Dartmouth College, meredith.kelly@dartmouth.edu; Alice Doughty, Dartmouth College, alice.doughty@dartmouth.edu; Margaret Jackson, Dartmouth College, margaret.jackson@dartmouth.edu.

- T10. **Holocene Paleoclimate Perspectives on Present-Day Arctic Change.** Erich Osterberg, Dartmouth College, erich.osterberg@dartmouth.edu; Karl Kreutz, Univ. of Maine, karl.kreutz@maine.edu; Lisa Doner, Plymouth State Univ., ladoner@plymouth.edu.
- T11. **Limnological Records in Past, Present, and Future Climates.** Lisa Doner, Plymouth State Univ., ladoner@plymouth.edu; Julia Daly, Univ. of Maine, julia.daly@maine.edu; Bradford Hubeny, Salem State Univ., bhubeny@salemstate.edu.
- T12. **Pleistocene to Anthropocene Landscape Evolution in the Northeastern U.S.** Will Ouimet, Univ. of Connecticut, william.ouimet@uconn.edu; Noah Snyder, Boston College, noah.snyder@bc.edu.
- T13. **Using Ground-Penetrating Radar to Investigate Near-Surface Geology and Sedimentary Records of Environmental Change.** Steven Arcone, U.S. Army Cold Regions Research & Engineering Laboratory, steven.a.arcone@erdc.dren.mil; James Hyatt, Eastern Connecticut State Univ., hyatt@easternct.edu.
- T14. **Archeological Advances in the Northeastern U.S. and Adjacent Canada.** Steve Pollock, Univ. of Southern Maine, pollock@usm.maine.edu.
- T15. **Applied Geology in New England: Case Histories of Problems Solved.** Richard Lane, New Hampshire Dept. of Transportation, lanetrisbr@hotmail.com; Krystle Pelham, New Hampshire Dept. of Transportation, kpelham@dot.state.nh.us.
- T16. **Coastal and Nearshore Environments of the Northeast.** Dan Belknap, Univ. of Maine, belknap@maine.edu; Joe Kelly, Univ. of Maine, jtkelly@maine.edu.
- T17. **Ecohydrology Science and Sustainability.** Sean Smith, Univ. of Maine, ssmith@maine.edu; Andrew Reeve, Univ. of Maine, asreeve@maine.edu; Ciaran Harman, Johns Hopkins Univ., charman@hu.edu.
- T18. **Fossils in New England: Recent Discoveries and Reinterpretations.** William Clyde, Univ. of New Hampshire, will.clyde@unh.edu.
- T19. **The New England Continental Shelf.** Larry Ward, Univ. of New Hampshire, lgward@ccom.unh.edu.
- T20. **Evolution of Minerals in Diverse Environments: Geobiological and Geochemical Aspects.** Dawn Cardace, Univ. of Rhode Island, dawn.cardace@gmail.com; Amanda Olsen, Univ. of Maine, amanda.a.olsen@maine.edu.
- T21. **Life Cycle of Produced Water from Hydraulic Fracturing of Marcellus and Utica Shales.** Devon Renock, Dartmouth College, devon.j.renock@dartmouth.edu; Nathaniel Warner, Dartmouth College, nathaniel.r.warner@dartmouth.edu.
- T22. **State and Fate of Urban Watersheds in the Northeast.** Jonathan Gourley, Trinity College, jonathan.gourley@tincoll.edu; Suzanne O'Connell, Wesleyan Univ., soconnell@wesleyan.edu.
- T23. **Morphological and Hydrological Responses of Salt Marshes to Anthropogenic and Natural Stressors.** Beverly Johnson, Bates College, bjohnson@bates.edu; Kristin Wilson, National Estuarine Research Reserve, krwills@gmail.com.
- T24. **Groundwater in the Shallow Coastal Aquifers of the Northeast.** Denis LeBlanc, USGS, dleblanc@usgs.gov.
- T25. **River Restoration in New England.** Frank Magilligan, Dartmouth College, magilligan@dartmouth.edu; Carl Renshaw, Dartmouth College, rensaw@dartmouth.edu; Anne Lightbody, Univ. of New Hampshire, anne.lightbody@unh.edu.
- T26. **Advances in Topobathymetric Mapping, Models, and Applications.** John Brock, USGS, brock@usgs.gov; C. Wayne Wright, USGS, wwright@usgs.gov.
- T27. **Potential for Geothermal Energy in New England.** Matt Davis, Univ. of New Hampshire, mdavis@unh.edu; Rick Chormann, New Hampshire State Geologist, frederick.chormann@des.nh.gov; Steve Mabee, Massachusetts State Geologist, sbmabee@geo.umass.edu.
- T28. **Disruptive Technology and Geoscience Education.** Declan DePaor, Old Dominion Univ., ddepaor@odu.edu; Steve Whitmeyer, James Madison Univ., whitmesj@jmu.edu; Callan Bentley, Northern Virginia Community College, cbentley@nvcc.edu.
- T29. **Innovative and Multidisciplinary Approaches to Geoscience Education.** Jennifer Hanselman, Westfield State Univ., jhanselman@westfield.ma.edu; Jennifer Sliko, Penn State Univ.–Harrisburg, jls1093@psu.edu.
- T30. **Application of Digital Terrain Analysis in Geology, Hydrology, and Geoarchaeology.** Rick Chormann, New Hampshire State Geologist, frederick.chormann@des.nh.gov; John Lindsay, Guelph Univ., jlindsay@uoguelph.ca.
- T31. **Hydropedology at Hubbard Brook Experimental Forest: Landscape Patterns and Hydrologic Processes.** Scott Bailey, U.S. Forest Service, swbailey@plymouth.edu.
- T32. **Pegmatite Processes and Problems.** Paul Tomascak, Suny-Oswego, paul.tomascak@oswego.edu; Marin Lupulescu, New York State Museum, mlupules@mail.nysed.gov.

FIELD TRIPS

- Bedrock Geology and Tectonics of the Presidential Range on Nordic Skis.** J. Dykstra Eusden, Bates College, deusden@bates.edu.
- Mount Washington: Its Summit & Observatory.** Michelle Cruz, Mount Washington Observatory, mcruz@mountwashington.org.
- Landslides in the White Mountains.** P. Thompson Davis, Bentley Univ., pdavis@bentley.edu.
- Ground Penetrating Radar: Data Collection, Processing, and Analysis.** Steven Arcone, U.S. Army Cold Regions Research & Engineering Laboratory, steven.a.arcone@erdc.dren.mil.

Northeastern Section continued on p. 58

STUDENT OPPORTUNITIES

Mentor Programs

The Roy J. Shlemon Mentor Program in Applied Geoscience. Students will have the opportunity to discuss career prospects and challenges with professional geoscientists from multiple disciplines over a FREE lunch. Learn more at www.geosociety.org/mentors/shlemon.htm.

The John Mann Mentors in Applied Hydrogeology Program. Students interested in applied hydrogeology or hydrology as a career will have the opportunity to network with professionals in these fields over a FREE lunch. Learn more at www.geosociety.org/mentors/mann.htm.

On To the Future (OTF): Stop by the GSA Foundation booth at the Welcome Reception to ask an onsite representative about applying to OTF, which provides travel support to students underrepresented in the geosciences to attend their first GSA Annual Meeting (the next one is 1–4 Nov. 2015 in Baltimore, Maryland, USA). Learn more at community.geosociety.org/OTF/home/.

ACCOMMODATIONS

Hotel registration deadline: 27 Feb. 2015

Blocks of rooms and town homes have been reserved at the Omni-Mount Washington Resort for professionals and students. Individual rooms for professionals are specially priced at US\$156 + tax per room/night and can be reserved by calling +1-800-258-0330 and referring to the “NEGSA Meeting” or by going online at omnihotels.com and using the code “031815GEOLOGICA.” **Individual rooms for students and town homes for professionals and student groups** must be reserved by contacting Dr. Melissa Lombard, Student Housing Coordinator, melissalombard@alum.rpi.edu. These room blocks will book quickly, so reserve your space soon.

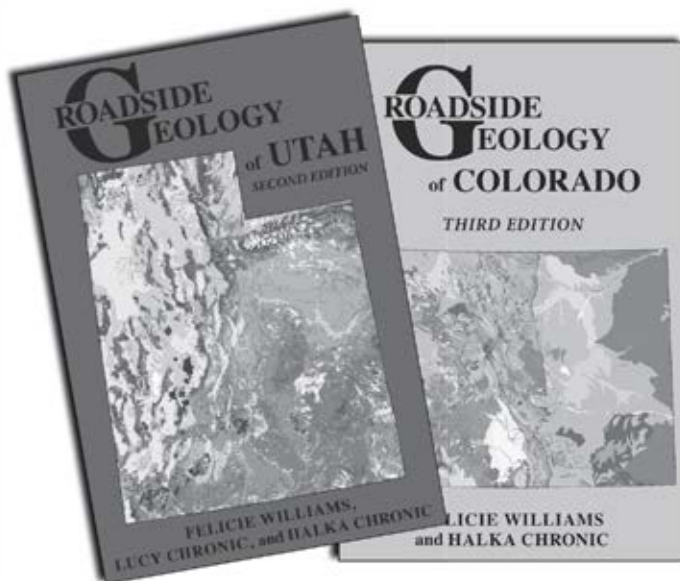
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Field Trip Co-Chairs: Woody Thompson, woodrow.b.thompson@maine.gov; Melissa Lombard, htimsyssim@gmail.com

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Edited by Timothy G. Fisher and Edward C. Hansen

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The 17,500 km of Great Lakes' shoreline is North America's "third coast." This coast has been the setting for a number of classic studies in coastal geomorphology and Quaternary geology, especially on the subjects of coastal dunes and the effects of deglaciation and isostatic rebound on lakes and coasts. In the past decade and a half, there has been a revival of interest in these processes along the Great Lakes. This volume includes an interdisciplinary mix of papers spanning a variety of temporal scales, offering a substantive overview of this recent research. The majority of the papers investigate the relationship between dune activity, lake levels, and climate. In addition to offering insights into coastal processes in general, the data presented in this paper could help inform decisions on how to manage and mitigate the human impact on this fragile natural environment.

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Open Access: The Story So Far

Jeanette Hammann, GSA Director of Publications

Note: This article is intended to provide some background on open access publication and recent developments that affect scholarly publishing programs. GSA Council is currently weighing options for how GSA can position its publication program in this new environment, and information on that plan will be disseminated as it becomes available.

The ability to gain access to scientific literature varies by who you are and where you work, so your reaction to the phrase “open access” is likely to vary as well. Faculty members at large research universities often have seamless access to thousands of papers via their libraries’ collections, while those at smaller schools may have a more limited choice of books and journals. Researchers outside of academia may have subscriptions through employers or professional societies, or they may use pay-per-view options as needed. Others may have access only by direct appeal to authors or publishers.

As a reader, if you can get what you need when you need it, without barriers or hardship, you are unlikely to think too much about open access. As a researcher, you may be concerned about open access only when your funding sources have a say in how you publish your results, or you may equate papers that are freely available as having a better chance at citation.

But all indicators point to changes ahead for every researcher, reader, institution, and publisher as open access initiatives and mandates continue to transform scholarly publishing.

The open access movement began on more than one front, and it gained momentum as the Internet made more and more resources available online. But even before the idea that “online = free” became a common expectation, many researchers wanted their research to be openly available without barriers, such as required subscriptions or paywalls.

In 2002, the Budapest Open Access Initiative first defined the term *open access*, and other initiatives followed (<http://www.budapestopenaccessinitiative.org/>). In 2003, a group of individuals from academia, publishing, professional societies, libraries, and government agencies released the Bethesda Statement on Open Access Publishing in order to define and support the concept of open access (<http://dash.harvard.edu/handle/1/4725199>).

Universities, facing ever-tightening library budgets and ever-growing subscription prices, objected to what they felt was “paying twice” for research—once to support the research and researchers and again to buy the resulting papers back through subscriptions for their libraries.

In the political realm, a growing number of people began to support the idea that research funded by taxes should be freely available to the tax-paying public.

The publishing community at large initially lobbied against government mandates for open access, resulting in some publishers being portrayed as greedy and ignoring the public good. Examples were made of larger commercial publishers who “bundle” journal subscriptions, forcing libraries to buy large packages at what was perceived to be outrageous prices.

Society publishers quickly realized that tricky times lay ahead. It seemed that all publishers, large and small, commercial and nonprofit, were being swept into the same pile. And by this time, many professional, nonprofit societies had come to rely on publication revenue to fund other projects and programs—research grants, educational programs, professional development, public policy efforts, and so on.

After years of debate and delays, open access mandates started to make headway, initially in the realm of health and medicine.

Canadian and European funding agencies were among the first to propose and then mandate open access publication or institutional repositories for publicly funded research. (The Canadian Institutes of Health Research adopted an open access self-archiving policy in 2007; the UK-based Wellcome Trust developed policies starting in 2003.)

In the United States, the Public Access Policy of the National Institutes of Health was put in place in 2008. It requires all investigators who are funded by the NIH to submit electronic versions of their final peer-reviewed manuscripts to the National Library of Medicine’s publicly available PubMed Central no later than 12 months after the official date of publication.

For GSA publications, a key turning point was the passage of the Research Councils UK (RCUK) mandate, which went into effect 1 April 2013 for any submitted papers which resulted from research wholly or partially funded by the RCUK. (The seven UK Research Councils: Arts & Humanities Research Council; Biotechnology & Biological Sciences Research Council; Economic & Social Research Council; Engineering & Physical Sciences Research Council; Medical Research Council; Natural Environment Research Council; and Science & Technology Facilities Council). With a percentage of authors submitting papers to GSA getting funding from, for example, the NERC, the “someday” open access mandate became real.

GSA has, in fact, offered an open access option since 2008. The article processing charge was (and is) US\$2,500 and started with *Geology*. In 2013, GSA adopted an open access policy that accommodates the RCUK mandate that went into effect April 2013. (See the policy at <http://www.geosociety.org/pubs/openAccess.htm>.)

The next big public mandate appears to be coming from the U.S. Office of Science and Technology Policy, which on 22 February 2013 released a directive requiring federal agencies with US\$100 million or more in research and development funding to submit draft open access policies by 22 August 2013 (http://www.whitehouse.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf). As of this writing, the result of that directive has not yet been released.

FURTHER READING

1. Maintained by the Copyright Clearance Center: www.openaccessresources.org.
2. Published by the Society for Scholarly Publishing: <http://scholarlykitchen.sspnet.org>.

Call for Applications

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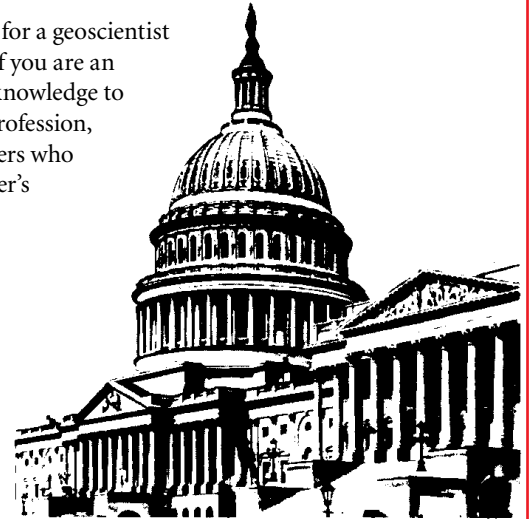
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GSA FOUNDATION UPDATE

P. Geoffrey Feiss, GSA Foundation President

E-an Zen, 1928–2014, Citizen-Geologist



GSA is grateful to Dr. E-an Zen, GSA president in 1992, for his vision and robust endorsement for placing education, communication, and outreach among GSA's priorities. In his GSA Presidential Address, Zen extolled GSA members "to accept our public obligation to be good citizen-geologists" and described the need to "cast our nets widely" to communicate basic geoscience knowledge (*GSA Today*, v. 3, no. 1, p. 2–3; online via link at www.geosociety.org/aboutus/pastPresidents.htm). Citizen-geologist Zen maintained that clearer communication about the ways geology and geological ideas affect our lives would elevate public appreciation for the contribution of geology to their welfare and lead to wiser policy decisions about resource use.

Over the decades, GSA has established effective education and outreach programs that have influenced thousands of members, students, educators, and policy makers. However, GSA has not yet developed a program that fulfills Zen's vision for the interdisciplinary exchange of geoscience information between scientists and non-scientists.

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E-AN ZEN FUND

To honor Zen's vision, service to society, and contributions as a scientist, the GSA Foundation is initiating an effort to establish the "E-an Zen Fund." The fund will inspire innovative GSA-led approaches to communicating geoscience knowledge to non-scientists for the benefit of society. Our goal is to raise at least US\$100,000—a target that will be realized with support from those who have been inspired by Zen's exceptional character or who recognize the importance of supporting this GSA priority. To quote Zen once again:

If we want the world to pay greater attention ... and allocate more resources for geology, then we need to demonstrate the importance of geology in public affairs. And we must accept our public obligation to be good citizen-geologists. (Zen, 1993)

Your support of this effort will leverage the expertise of GSA members and the skills of GSA planning teams to create new possibilities for effective and productive communication. Please contact Chris Tallackson, GSA Foundation Director of Development, at +1-303-357-1007 or ctallackson@geosociety.org with any questions about supporting the E-an Zen Fund or any other GSA program.

Thank you!

GIVING TO THE GSA FOUNDATION

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ASSISTANT PROFESSOR OF GEOSCIENCES HYDROGEOLOGY

PACIFIC LUTHERAN UNIVERSITY

The Dept. of Geosciences at Pacific Lutheran University invites applications for a tenure-track position in hydrogeology at the level of Assistant Professor to teach beginning Sept. 1, 2015. Applications are welcomed from candidates with research and teaching interest over a wide spectrum of groundwater science applications that complement the areas of expertise of the current faculty. The areas of particular interest are low temperature aqueous geochemistry and/or geothermal exploration. Enthusiasm for interdisciplinary research and cultivation of new collaborations will be an asset in the position. We are seeking a person with a commitment to excellence in teaching at a predominately undergraduate institution, collegiality and flexibility to meet the needs of our students and the program, and a dedication to establishing a field-based research program that engages students. Teaching responsibilities will include hydrogeology, an upper division course in one's expertise, and topical lower division geoscience courses. Participation in extended field trip experiences, the general education program, and mentoring senior capstone research projects is also expected. Ph.D. in geology or closely related field is required. ABD will be considered, but Ph.D. must be in hand by Sept. 1, 2015.

PLU is a comprehensive university of 3,500 students offering a curriculum integrating the liberal arts and professional programs. Located in a uniquely scenic region of the Pacific Northwest, the university's campus is 40 miles south of Seattle and 40 miles west of Mount Rainier near Tacoma, Washington. PLU has an on-campus site for conducting aquifer tests and a nearby off-campus site with six observation wells and a stream, which provides the opportunity to study groundwater/surface water interaction. AA/EOE.

Submit application at <http://employment.plu.edu>. Required materials: cover letter, CV, statement of teaching philosophy, unofficial undergraduate and graduate transcripts, and potential research plans with undergraduates. Three confidential letters of recommendation will also be requested by PLU upon application. Review of applications will begin **October 1, 2014**, but the position will remain open until filled. For questions or more information, please contact Dr. Rose McKenney, Chair of Geosciences at +1-253-535-8726 or mckenra@plu.edu.

TENURE-TRACK FACULTY POSITION LOW TEMPERATURE GEOCHEMISTRY OR HYDROGEOLOGY

DEPARTMENT OF GEOLOGY

CALIFORNIA STATE UNIV. SACRAMENTO

The Geology Dept. in the College of Natural Sciences and Mathematics at California State University, Sacramento invites applications for a Low Temperature Geochemist or Hydrogeologist. Applicants must hold a Ph.D. in geology by August 2015. Proficiency in marine geology, geological oceanography, stable isotopes, water chemistry, water resources, flood characterization, groundwater modeling, contaminant transport, groundwater flow, and aquifer analysis is a plus. The successful candidate will embrace the opportunity to teach general education courses to a diverse student population, conduct a field-based research program that involves undergraduate and graduate geology students, and be a fully engaged participant in a small, collegial department. Enthusiasm and a commitment to teaching and mentoring are essential. This is a tenure-track position at the Assistant Professor rank, beginning August 2015. Salary will be dependent on qualifications and professional experience. Screening of applications will begin **15 October 2014**; position open until filled. For the full vacancy announcement, please visit www.csus.edu/hr/facultyvacancies/vacancies.html.

ASSISTANT RESEARCH SCIENTIST EXPEDITION PROJECT MANAGER STAFF SCIENTIST

INTERNATIONAL OCEAN DISCOVERY PROGRAM (IODP) TEXAS A&M UNIVERSITY

The International Ocean Discovery Program (IODP) at Texas A&M University invites applications for an Assistant Research Scientist (Expedition Project Manager/Staff Scientist) with expertise in any aspect of borehole geophysics. A Ph.D. in geosciences or related field, and demonstrated on-going research experience is required. Applicants must have a demonstrated fluency in written and spoken English. Experience as a seagoing scientist, especially in scientific ocean drilling, is preferred.

This position will serve as the Expedition Project Manager to coordinate all aspects of pre-cruise expedition planning, sea-going implementation, and post-cruise activities. These duties include sailing as the IODP scientific representative on a two-month IODP expedition approximately once every 1 to 2 years.

Individual scientific research, as well as collaboration with colleagues at Texas A&M University in fulfilling its educational mission, is required.

This position will also provide scientific advice on laboratory developments in their area of specialization. Applicants must be able to cooperate and work harmoniously with others, have the ability to be an effective team leader, and foster collaboration among diverse scientific participants. Passing a new employee medical exam and annual seagoing medical exams are a requirement of the position.

Salary will be commensurate with qualifications and experience of the applicant. This is a regular full time position, contingent upon continuing avail-

ability of funds for IODP. We will begin reviewing applications on 30 Sept. 2014, but will continue to accept applications until candidates are selected for interviews. Applicants may access the TAMU application at <https://jobpath.tamu.edu> and apply online with reference to Posting Number O00156FY14, attach a curriculum vita, list of published papers, statement of research interests, and names and addresses of three references. Quick Link: <http://jobpath.tamu.edu/postings/74115>.

ASSISTANT PROFESSOR OF GEOLOGY IN SEDIMENTOLOGY, ALLEGHENY COLLEGE

The Geology Dept. at Allegheny College invites applicants for a tenure-track position to begin Fall 2015. A Ph.D. is strongly preferred at the time of appointment; strong ABD candidates may be considered. We seek a collegial, field-based geologist with a strong commitment to liberal arts undergraduate education who will work as part of a small and active departmental team. The successful candidate will have demonstrated strength in clastic sedimentology with a process-oriented approach in areas such as basin analysis and depositional systems. Experience with carbonate and/or geomorphologic systems, teaching undergraduates, and/or previous work in geoscience industry will be assets. The teaching load consists of two laboratory courses per semester. Courses to be taught include physical geology, historical geology, sedimentology/stratigraphy, at least one other course to support the department curriculum (based on the strength of the candidate), and college-wide first-year/sophomore seminars. The appointee will be expected to advise and work closely with undergraduate students in course work, including senior research projects, and will provide evidence of excellence in teaching and ongoing scholarship. Allegheny College is a highly selective private liberal arts college with a dedicated faculty of teacher-scholars. The Dept. of Geology has a tradition of high-quality undergraduate education and active involvement of students in research. Facilities include a computer lab with GIS software, Geoprobe drill rig, Rigaku Miniflex XRD, Dionex Ion Chromatograph, Perkin Elmer Flame/Furnace AAS, JEOL SEM-EDS-CL, and well-equipped instructional labs. To apply, send electronic copies of a letter of application, statements of teaching and research interests, CV, transcripts, and the names and contacts of three references, all as PDF to Sedimentology Search, Dept. of Geology, Allegheny College, Meadville, PA 16335, geosedsearch2014@allegheny.edu. Review of applications will begin Sept. 22, 2014. More information on Allegheny College and the Dept. of Geology may be obtained at <http://sites.allegheny.edu/geol/>. Allegheny College is an Equal Opportunity Employer, with a strong institutional commitment to develop a diverse faculty and staff. Women and members of other under-represented groups are encouraged to apply.

TENURE TRACK ASSISTANT PROFESSOR PALEOCLIMATE/PALEONTOLOGY CALIFORNIA STATE UNIV. NORTHRIDGE

The Dept. of Geological Sciences at California State University Northridge invites applications for a full-

time tenure-track faculty position at the level of Assistant Professor in Paleoclimatology/Paleontology. We offer B.S. and M.S. degrees in Geology and in Geophysics. The successful candidate must have a Ph.D. at the time of appointment. Experience in post-doctoral research and/or University-level lecture instruction is desirable. We seek an innovative paleoclimatologist/paleontologist with technical expertise in one or more of the following fields: paleontology, paleoecology, low-temperature geochemistry, paleo-oceanography, geochronology, dendrochronology, palynology, or other techniques. We particularly seek candidates who both complement our current research program and integrate across tectonics, sedimentology, and stratigraphy. The successful candidate is expected to develop a vigorous research program, which includes seeking extramural funding, publishing peer-reviewed papers, and involving undergraduate and M.S. students. Furthermore, the successful candidate is expected to demonstrate teaching excellence and provide effective instruction to students of diverse backgrounds. Potential classes to be taught by the new hire include: a new undergraduate core course in Earth Systems, a general education course in climate change, and elective offerings at the upper-division and/or graduate level in the candidate's research specialty.

Applicants should submit a cover letter, CV, three letters of recommendation, statement of teaching philosophy and experience, and statement of research interests. Electronic submissions are strongly encouraged and should be sent to paleontology.search@csun.edu. Materials can also be sent to Paleontology Search Committee, Dept. of Geological Sciences, California State University Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8266. Review of applications will begin 1 January 2015. Priority will be given to applications received by this date, but the position remains open until filled. For additional information, see www.csun.edu/geology. The University is an EO/AA employer.

**TENURE TRACK ASSISTANT PROFESSOR
GEOPHYSICS**

CALIFORNIA STATE UNIV. NORTHRIDGE

The Dept. of Geological Sciences at California State University Northridge invites applications for a full-time tenure-track faculty position at the level of Assistant Professor in Solid Earth Geophysics or Earthquake Processes. The successful candidate must have a Ph.D. at the time of appointment. Experience in post-doctoral research and/or University-level lecture instruction is desirable. We seek an innovative geophysicist with technical expertise in passive or active source seismology, geodynamics, numerical modeling, or earthquake geophysics. We particularly seek candidates who both complement our current research program and integrate across tectonics and geophysics. We offer B.Sc. and M.Sc. degrees in Geology and in Geophysics. The successful candidate is expected to develop a vigorous research program, which includes seeking extramural funding, publishing peer-reviewed papers, and involving undergraduate and M.S. students. Furthermore, the successful candidate is expected to demonstrate teaching excellence and provide effective instruction to students of diverse back-

grounds. A successful candidate will enthusiastically contribute to teaching courses that provide rigorous preparation for students in our geophysics program at a range of levels. Course offerings include: an introductory course "Living with Earthquakes in California," a new undergraduate core course in Earth Tectonics and Structure, undergraduate courses in geophysics, and elective offerings at the upper-division and/or graduate level in the candidate's research specialty.

Applicants should submit a cover letter, CV, three letters of recommendation, statement of teaching philosophy and experience, and statement of research interests. Electronic submissions are strongly encouraged and should be sent to geophysics.search@csun.edu. Materials can also be sent to Geophysics Search Committee, Dept. of Geological Sciences, California State University Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8266. Review of applications will begin on 1 January 2015. Priority will be given to applications received by this date, but the position remains open until filled. For additional information, see www.csun.edu/geology. The University is an EO/AA employer.

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The University of Kentucky is an equal opportunity employer and encourages applications from minorities and women.

**GEOCHEMIST/PETROLOGIST
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The Dept. of Geology at Occidental College invites applications for an Assistant or Associate Professor in Geochemistry or Petrology. Occidental is a nationally ranked liberal arts college recognized for its diverse student body and outstanding undergraduate research program. We seek a colleague who values undergraduate teaching and can sustain an active research program involving undergraduates. Training applicable to teaching mineralogy, petrology, and geochemistry is required; these courses should enhance students' understanding of chemical processes acting on the earth, and increase students'

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DEPARTMENT OF
GEOLOGY**

The Department of Geology at Stephen F. Austin State University invites applications for the department chair position. We seek an individual with strong management, communication, and interpersonal skills to provide innovative and energetic leadership. Duties include managing curricula, budgets, student enrollment, personnel, program assessment, and developing strong, mutually beneficial relationships with industry and alumni. The incumbent will teach a reduced load of courses and develop a research program in his/her area of expertise. Applicants must have credentials for appointment at the associate or professor rank in geology.

Submit a letter of application, CV, and contact information for three references to <https://careers.sfasu.edu> (posting 0603046).

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

Review of applications will begin on Jan. 9 and will continue until the position is filled. Equal Opportunity Employer; Security-sensitive position; this position will be subject to a criminal history check.



expertise in quantitative and instrumental methods. The successful candidate will also contribute to teaching introductory geology and engage undergraduates in research projects.

Applications should include a statement of teaching and research interests in the context of a liberal arts college with a diverse undergraduate student body. Candidates should specifically address their ability to teach a diverse undergraduate student body and engage students in an ongoing research program. Submit statement, a curriculum vitae, 1–3 significant publications, and contact information for three referees to Dr. Margi Rasmore, Search Committee Chair, at geosearch1@oxy.edu. Search committee members will meet interested candidates at the GSA and AGU meetings; e-mail the committee to make arrangements. Members of underrepresented groups are especially encouraged to apply. **Review of applications will begin 15 October 2014, and will continue until the search closes on 31 December 2014.**

**PHYSICAL HYDROGEOLOGIST
DEPARTMENT OF GEOLOGY & GEOGRAPHY
WEST VIRGINIA UNIVERSITY**

West Virginia University invites applications for a tenure-track position at the Assistant Professor level in the Dept. of Geology & Geography beginning August 2015. We seek applications from individuals with interests in basic and applied aspects of fluid flow in the critical zone and/or deeper regimes. The successful applicant will possess demonstrable expertise in study of subsurface fluid flow and/or transport processes that may be applied to competitively-funded research problems.

Requirements include a Ph.D. or equivalent degree in geology or a related field, potential to establish a vigorous externally-funded research program, and potential for excellent teaching at the undergraduate and graduate levels. Qualified applicants should submit a single PDF file including: (1) statement of research interests; (2) statement of teaching philosophy; (3) curriculum vitae; and (4) list of three potential references to hydrogeo@mail.wvu.edu. Review of applications will commence on November 15 and continue until a successful candidate is identified. For additional information, please see <http://pages.geo.wvu.edu/hydrogeo> or contact the search chair Dorothy J. Vesper at djvesper@mail.wvu.edu. WVU is an EEO/Affirmative Action Employer and welcomes applications from all qualified individuals, including minorities, females, individuals with disabilities, and veterans.

**HYDROLOGY AND SURFACE PROCESSES
UNIVERSITY OF PITTSBURGH**

As part of sustainability initiative at the University of Pittsburgh, the Dept. of Geology and Planetary Science invites applications for a tenure-track assistant professor in hydrology or surface processes, pending budgetary approval. We seek applicants to expand our current research in sustainability and who link field-based geoscience research to quantitative sustainability themes. Areas of expertise may include, but are not limited to surface water, groundwater or catchment hydrology, land-atmosphere interactions,

fluvial and hill slope geomorphology, and landscape evolution. Candidates whose research explores the relationships between hydrology, geomorphology, and biogeochemistry in coupled natural-human systems and/or has implications for the sustainability of water or soil resources are encouraged.

The successful candidate will complement existing research clusters and establish an externally-funded, internationally recognized research program. Teaching duties include undergraduate and graduate courses in the candidate's area of expertise.

Review of applicants will begin on November 1, 2014, and continue until the position is filled. A Ph.D. is required at the time of appointment, and the position begins Fall 2015, subject to budgetary approval. To apply, e-mail the following materials as a single PDF file to geolsrch@pitt.edu: (1) a CV; (2) statements of research and teaching interests; (3) copies of three relevant publications; and (4) names and contact information of four references. Direct questions to the Search Committee Chair, Dr. Emily Elliott, eelliott@pitt.edu, +1-412-624-8882. The University of Pittsburgh is an Affirmative Action/Equal Opportunity Employer and values equality of opportunity, human dignity and diversity.

The University of Pittsburgh is the fifth largest recipient of federally sponsored research funding among U.S. universities and has \$900 million in annual research and development expenditures. Located in an urban setting, the University campus offers easy access to potential research, teaching and outreach venues including the Carnegie Museum of Natural History, the Carnegie Science Center, several urban watersheds, and proximity to long-term experimental catchments (Fernow, West Virginia). Pittsburgh is experiencing a "green renaissance" and is consistently ranked among the top places to live, work, and visit in the U.S.

**ASSOCIATE ENVIRONMENTAL
GEOSCIENTIST
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN**

The Illinois State Geological Survey (ISGS) is part of the Prairie Research Institute (PRI) at the University of Illinois at Urbana-Champaign which is centrally located between Chicago, St. Louis, and Indianapolis. PRI houses five large scientific surveys covering a wide range of expertise including biology, water resources, climate, geology, sustainable technology and archaeology. The ISGS is a premier state geological survey, with over 200 scientists and technical support staff, serving the needs of the public, government, and industry with earth science information and research relevant to natural resources, environmental quality, economic vitality, and public safety. The University is a land-grant institution that provides access to world-class laboratory and academic facilities, Big Ten athletic events, and internationally acclaimed cultural opportunities.

We are seeking an individual to conduct research related to the monitoring, verification, and accounting (MVA) programs at several large-scale carbon sequestration demonstration projects; develop,

deploy, facilitate, and document MVA efforts being conducted by the Midwest Geological Sequestration Consortium Partnership.

Master's degree in geology, chemistry, environmental engineering, or related discipline required. Ph.D. preferred. Minimum of five (5) years related industry and/or research experience (post bachelor's degree) required. Industry and/or research experience in areas of geochemistry, hydrogeology, or other related field highly preferred.

Applications must be received by 17 October 2014. To apply, please visit <https://jobs.illinois.edu/academic-job-board> to complete an online profile and to upload a (1) cover letter, (2) résumé/CV, (3) the names and contact information (including e-mail addresses) of three professional references. All requested information must be submitted for your application to be considered. Incomplete information will not be reviewed.

For further information please contact Lori Walston-Vonderharr, Human Resources, Illinois State Geological Survey, at lwalston@illinois.edu or +1-217-244-2401.

The University of Illinois is an EEO Employer/Vet/Disabled: <http://inclusiveillinois.illinois.edu/>.

**DIRECTOR
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN**

The Illinois State Geological Survey (ISGS) is part of the Prairie Research Institute (PRI) at the University of Illinois at Urbana-Champaign which is centrally located between Chicago, St. Louis, and Indianapolis. PRI houses 5 large scientific surveys covering a wide range of expertise including biology, water resources, climate, geology, sustainable technology and archaeology. The ISGS is a premier state geological survey, with over 200 scientists and technical support staff, serving the needs of the public, government, and industry with earth science information and research relevant to natural resources, environmental quality, economic vitality, and public safety. The University is a land-grant institution that provides access to world-class laboratory and academic facilities, Big Ten athletic events, and internationally acclaimed cultural opportunities.

We are seeking an individual to serve as the chief executive officer and lead scientist for the ISGS, who will provide outstanding leadership, direction, and overall administration for the development, coordination, and implementation of scientific research and service programs, public engagement activities, state-mandated functions, and professional services undertaken by the ISGS.

Advanced degree required, Ph.D. preferred, in an earth science discipline. Alternate degree fields may be considered depending on nature and depth of work experience as related to ISGS vision and priorities. Demonstrated successful research career and experience in research management, including science-related program development, science-team administration, and/or public service. An established leader demonstrated by success in an area of research core to the ISGS in a multidisciplinary research organization with a strong commitment to affirmative

action and diversity.

Ideal candidates will hold a doctoral degree and an academic track record appropriate for a tenured full professor at the University, or commensurately significant other qualifications in the field of earth science or related field.

Applications must be received by 31 October 2014. Applicants may be interviewed before the closing date; however, no hiring decision will be made until after that date. To apply, please visit <https://jobs.illinois.edu/academic-job-board> to complete an online profile and to upload a (1) cover letter, (2) résumé/CV, (3) the names and contact information (including e-mail addresses) of five professional references. All requested information must be submitted for your application to be considered. Incomplete information will not be reviewed.

For further information please contact Lori Walston-Vonderharr, Human Resources, Illinois State Geological Survey, at lwalston@illinois.edu or +1-217-244-2401.

The University of Illinois is an EEO Employer/Vet/Disabled; <http://inclusiveillinois.illinois.edu/>.

**ASSOCIATE ENGINEERING GEOLOGIST
OR ENGINEERING GEOLOGIST
(DEPENDING ON QUALIFICATIONS)
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN**

The Illinois State Geological Survey (ISGS) is part of the Prairie Research Institute (PRI) at the University of Illinois at Urbana-Champaign which is centrally located between Chicago, St. Louis, and Indianapolis. PRI houses five large scientific surveys covering a wide range of expertise including biology, water resources, climate, geology, sustainable technology and archaeology. The ISGS is a premier state geological survey, with over 200 scientists and technical support staff, serving the needs of the public, government, and industry with earth science information and research relevant to natural resources, environmental quality, economic vitality, and public safety. The University is a land-grant institution that provides access to world-class laboratory and academic facilities, Big Ten athletic events, and internationally acclaimed cultural opportunities.

We are seeking an individual to plan, coordinate, and conduct basic and applied research related to engineering geology and earth hazards. Provide expertise on slope stability, earthquake hazards, underground construction stability, blasting and traffic vibrations, microseismicity related to human activities, urban hazards related to modification of the landscape, mine subsidence, and other topics related to the behavior of rocks and soils. Serve as principal investigator, lead research and geologic projects, and perform tasks in that capacity including management of grant funding and production of project, grant, or contract reports and deliverables. A minimum of a master's degree in geology, geological engineering, or related discipline with at least 4 years of relevant industry or research experience post master's degree. Demonstrated ability to conduct research related to the engineering properties of earth materials and ability to apply knowledge of the

engineering properties of earth materials to solving societal issues.

Applications must be received by 10 October 2014. To apply, please visit <https://jobs.illinois.edu/academic-job-board> to complete an online profile and to upload a (1) cover letter, (2) résumé/CV, (3) the names and contact information (including e-mail addresses) of three professional references. All requested information must be submitted for your application to be considered. Incomplete information will not be reviewed.

For further information please contact Lori Walston-Vonderharr, Human Resources, Illinois State Geological Survey, at lwalston@illinois.edu or +1-217-244-2401.

The University of Illinois is an EEO Employer/Vet/Disabled; <http://inclusiveillinois.illinois.edu/>.

**ASSOCIATE DEAN FOR RESEARCH
JACKSON SCHOOL OF GEOSCIENCES
THE UNIVERSITY OF TEXAS AT AUSTIN**

The Jackson School of Geosciences at The University of Texas at Austin seeks an Associate Dean for Research to enhance and promote the school's overall research excellence, including multi- and interdisciplinary research and collaboration across the school. The position is at least a half time. The rest of the appointment will be as faculty, research faculty, or research scientist, depending on the applicant's interests and qualifications.

The Jackson School of Geosciences is among the most established and well-regarded geoscience programs in the world. The school includes the University's Dept. of Geological Sciences, one of the country's oldest geoscience departments, and two world-renowned research units, the Institute for Geophysics and the Bureau of Economic Geology. The school is home to the world's largest academic geoscience community with 58 faculty, 150 research staff, and one of the largest combined graduate and undergraduate enrollments of any major geoscience program.

The Associate Dean for Research assists faculty and research scientists in planning and securing resources for large collaborative research initiatives and in evaluating and implementing research activities to advance excellence. The Associate Dean must be familiar with a wide range of research activities across the school and be able to serve as a school representative internally and externally. Duties include giving presentations on Jackson School research, organizing meetings with external stakeholders, and actively participating in institutional planning.

Candidates must have a Ph.D. in geoscience and at least 10 years of relevant academic research experience. Other qualifications include:

- Exceptional research reputation and publication record with demonstrated ability of obtaining significant levels of research funding;
- Experience in influencing change within a diverse academic organization;
- Demonstrated capacity to promote and contribute to the school's strategic research direction;
- Familiarity with a wide range of current geoscience research and ability learn new fields.
- Comprehensive knowledge of funding opportunities in the geosciences, including federal,

foundation and industry support;

- Ability to build relationships and contacts internally and externally; and
- Demonstrated ethical behavior, professionalism, leadership, interpersonal skills and management abilities.

Applications should include a letter describing their qualifications and interest in the position. Applicants should also include a description of relevant experience and accomplishments, curriculum vitae, and the names and addresses of four references (references will not be contacted without the candidate's permission).

E-mail applications to jsgdean@jsg.utexas.edu, or mail to Search Committee Chair, Office of the Dean, Jackson School of Geosciences, 2305 Speedway, Stop C1160, University of Texas at Austin, Austin, TX 78712-1692.

Review of applications will begin 15 Sept. 2014, but applications will be accepted until the position is filled.

The University of Texas at Austin is an Equal Opportunity Employer with a commitment to diversity at all levels. All qualified applicants will receive consideration for employment without regard to race, color, religion, gender, national origin, age, disability or veteran status. (Compliant with the new VEVRAA and Section 503 Rules.)

**JOHN K. COSTAIN FACULTY CHAIR
DEPT. OF MATHEMATICS
VIRGINIA TECH**

The Virginia Tech Dept. of Mathematics (www.math.vt.edu), in cooperation with the College of Science's Academy of Integrated Science (www.science.vt.edu/ais), invites applications from outstanding candidates for the John K. Costain Faculty Chair. The holder of the chair will be expected to pursue a nationally and internationally preeminent research program that provides leadership in energy-related directions, inclusive of petroleum exploration, in collaboration with the Computational Modeling and Data Analytics (CMDA) program. Appointment at the level of Professor is anticipated, but junior candidates with exceptional promise will be considered for appointment at the level of Associate Professor. The position is at the Blacksburg, VA, campus and has an anticipated start date of 10 August 2015.

Job requirements include a Ph.D. in a relevant scientific field at the time of appointment. In addition to pursuing an outstanding research program, the successful candidate will be expected to provide effective instruction and advising to a diverse population of graduate and undergraduate students. Other responsibilities include: continuing development of professional capabilities and scholarly activities, including travel to professional conferences; curriculum development; participation in department, college, and university governance; and professional service.

Prospective candidates are encouraged to contact Eric de Sturler (sturler@vt.edu) or Peter Haskell (phaskell@vt.edu) for further information. An online application is required. To complete the online application, go to www.hr.vt.edu/employment/, choose Current Job Openings, then Search Jobs, and

choose the Mathematics Dept. or choose posting number TR0140058. As part of the online application, please include a cover letter, a CV, a description of research achievements, and a statement of future plans for energy-related research and teaching within the Mathematics Dept. and the CMDA program. Four letters of recommendation should be mailed to Costain Chair Search, Dept. of Mathematics, Virginia Tech, Blacksburg, VA 24061, or e-mailed to costainsearch@math.vt.edu. Additional information about position requirements and responsibilities can be found at www.hr.vt.edu/employment/ or <https://www.math.vt.edu>. The faculty handbook (available at www.provost.vt.edu) gives a complete description of faculty responsibilities. It is university policy that, as part of the hiring process, the successful applicant must pass a criminal background check. Questions about the search may be addressed to costainsearch@math.vt.edu.

Applications received by Sept. 15, 2014, will receive full consideration, but the search will continue until an appointment is made. Virginia Tech is an EO/AA university, and offers a wide range of networking and development opportunities to women and minorities in science and engineering; applications from members of underrepresented groups are especially encouraged. Individuals with disabilities desiring accommodations in the application process should notify Ms. Debbie Williams (dbritts@math.vt.edu, +1-540-231-6536) or call TTY 1-800-828-1120.

GEOLOGY TENURE-TRACK POSITION HUMBOLDT STATE UNIVERSITY

Starting August 2015 / Job #7608

Seeking candidates with specialization in one or more areas of Geomorphology, Surficial Processes, Neotectonics, and/or Quaternary Geoscience. Instructional assignments may include: introductory and general education geology courses, required courses in field geology and geomorphology, at least one upper division/graduate level course in the candidate's specialty and summer field camp every two or three years.

To view complete vacancy announcement & to apply, please visit <http://apptrkr.com/477391>.

HSU is an EO/Title IX/ADA Employer.

ASSISTANT PROFESSOR SEDIMENTOLOGY/BASIN ANALYSIS DENISON UNIVERSITY

Denison University invites applications for a tenure track position in the Dept. of Geosciences, to begin in August 2015. We seek a broadly trained scientist engaged in the study of Sedimentology and/or Basin Analysis. Successful candidates are expected to be outstanding teacher/scholars, and contribute to the continued growth of the Dept. and College. Candidates must have a Ph.D. at the time of appointment.

We require a colleague who is committed to teaching excellence in the liberal arts tradition, is field-based, has broad interests beyond their individual specialty, and will provide a balance of classroom, field, and laboratory experiences for our students. Candidates must have the desire and ability to teach courses at all levels of the curriculum. In addition,

successful candidates are expected to maintain a vibrant, ongoing research program that actively incorporates undergraduate students.

Denison University is a highly selective, private residential liberal arts college enrolling approximately 2,100 undergraduate students from across the country and around the world. The college is located in the village of Granville, Ohio, 25 miles east of Columbus. For more information about Denison, visit our website at www.denison.edu.

All application materials will be handled electronically at <https://employment.denison.edu>. Applications must include: (1) a letter of application addressing the position requirements listed above; (2) a curriculum vita; (3) academic transcripts of undergraduate and graduate course work (unofficial acceptable); (4) a statement of teaching philosophy and experience; and, (5) a statement of your research program in a liberal arts context. In addition, please include the contact information for three persons who know you well, who will then be requested to upload reference letters. Completed application materials submitted by 27 October 2014, will receive full consideration, and evaluation will continue until the position is filled. We plan to meet with selected candidates at the 2014 GSA Annual Meeting in Vancouver, BC, Canada. Denison University is an Affirmative Action, Equal Opportunity Employer. To achieve our mission as a liberal arts college, we continually strive to foster a diverse campus community, which recognizes the value of all persons regardless of religion, race, ethnicity, gender, sexual orientation, disability, or socioeconomic background.

ASSISTANT PROFESSOR STRUCTURAL GEOLOGY AND TECTONICS UNIVERSITY OF MISSOURI

The Dept. of Geological Sciences at the University of Missouri invites applications for a tenure-track, Assistant Professor position beginning in August 2015 in the broadly defined area of Structural Geology and Tectonics. The successful candidate's research will ideally complement and expand upon one or more of the areas of departmental expertise in solid-earth processes including geodynamics, igneous and metamorphic petrology, neotectonics, and seismology. Completion of the Ph.D. at the time of appointment is required. Applicants should be prepared to prove eligibility to work in the United States. The successful applicant will be expected to teach across the curriculum, i.e., introductory classes, advanced undergraduate courses, and graduate courses in his/her area of expertise. The applicant will also be expected to develop an active, externally funded research program and to direct graduate student research at the M.S. and Ph.D. levels.

Please apply online at <http://hrs.missouri.edu/find-a-job/academic>.

In addition to a curriculum vitae (CV), applicants should include a letter describing their geologic interests and qualifications for the position, a teaching portfolio, and a list of three references (including contact information). Items other than the CV should be uploaded in the Attachments section of the application system. Initial screening of applicants will begin 1 October 2014, and will continue until

a suitable candidate is hired. Information about our department is available at <http://geology.missouri.edu>. The University of Missouri is an EO/AA/ADA employer.

RICHARD T. BUFFLER POST-DOCTORAL FELLOWSHIP THE INSTITUTE FOR GEOPHYSICS (UTIG) JACKSON SCHOOL OF GEOSCIENCES (JSG) THE UNIVERSITY OF TEXAS AT AUSTIN

A post-doctoral fellowship is being established within The Institute for Geophysics (UTIG), Jackson School of Geosciences (JSG), The University of Texas at Austin for the purpose of honoring Dr. Richard (Dick) T. Buffler, whose scientific research into the geology of the Gulf of Mexico (GOM) underpins our current rich understanding of this prolific hydrocarbon basin and the unique confluence of structural and stratigraphic processes related to its formation and fill.

Dick worked at UTIG from 1975 until his retirement in 2002, collecting and interpreting new seismic data from the Gulf basin. He participated in 12 GOM cruises (including co-chief scientist of DSDP Leg 77), and he authored or coauthored over 83 publications related to the Gulf. He also mentored 73 students many of whom produced Masters or Ph.D. theses related to the Gulf (33), and he helped lead a major UTIG research effort in the GOM, the Gulf Basin Depositional Synthesis (GBDS) project, which has enjoyed 19 years of continuous industry support under Dr. William E. Galloway and now its current director, Dr. John W. Snedden.

The successful applicant for this new position should have the following skills:

1. Demonstrated research interest in basin-scale depositional systems, ranging from alluvial to deep-water, siliciclastics and carbonates, Pleistocene to base Mesozoic;
2. Competence in seismic interpretation, including experience with 2D or 3D seismic workstation software;
3. Competence in geological interpretation of well logs;
4. Knowledge of biostratigraphy and use of fossil datums for correlation;
5. Excellent oral presentation and writing skills; and
6. Experience with ArcGIS and other computer software (Word, Excel, Powerpoint, etc.).

Essential Job Functions

1. Identify and lead new research avenues in Gulf of Mexico depositional systems that support existing and future exploration efforts of the GBDS Industrial Associates;
2. Generate scientific publications that enhance the technical reputation of UTIG, JSG, and The University of Texas at Austin;
3. Conduct and present research to industrial associates with clarity and a deep understanding of their oil and gas industry challenges;
4. Collaborate with UTIG and JSG researchers and faculty, where appropriate;
5. Mentor undergraduate and graduate students as appropriate; and
6. Domestic travel as needed.

The position will have two years of initial support and will be based in Austin, Texas. Interested

persons should submit a detailed Curriculum Vitae (CV) that includes academic and professional experience, statement of research interests, and names and contact information of three references to Post-DocUTIG@ig.utexas.edu. For full consideration, applications must be received by 15 October 2014.

Situations Wanted

EXPERIENCED XRF ANALYSTS

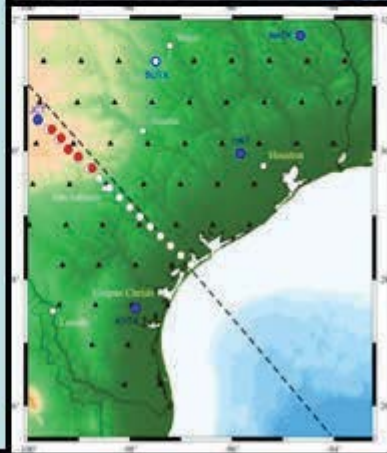
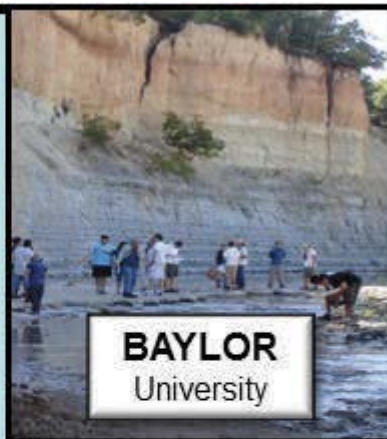
With large, established clientele seeking new/existing lab at educ/res institution. Post start-up, lab is self-supporting. We train & employ students for part-time work experience. For info., including CVs: conrey@mail.wsu.edu.

Opportunities for Students

Ph.D. position, Geomicrobiology, Rutgers University. A Ph.D. position is available at the Dept. of Earth and Environmental Sciences, Rutgers University–Newark in geomicrobiology with the start as early as January 2015. We are looking for a motivated student with interest in microbial ecology, biogeochemistry, or biomineralization. An interest in planetary sciences and astrobiology is desirable. To learn more about the lab, please visit www.geomicrobiologylab-rutgers.com.

Prospective students should contact Dr. M. Glamoclija (m.glamoclija@rutgers.edu) by e-mail and send their CV and a statement of research interests.

Baylor Geology in Waco, TX offers M.S and Ph.D. research in a variety of subjects and in superb teaching and research facilities. We are interviewing for an entry-level faculty position in mineralogy-petrology and recently hired a numerical modeler. **Please visit our booth #311 in the exhibits area at the 2014 GSA meeting in Vancouver, BC, or visit our website at:**
<http://www.baylor.edu/Geology/>



TENURE-TRACK MINERALOGIST/PETROLOGIST, DEPARTMENT OF GEOLOGY, 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 continually 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.

The Department of Geology at Baylor University invites applications for a tenure-track Assistant Professor in Mineralogy or Petrology, beginning August of 2015. Applicants must hold a Ph.D. in geology, geochemistry, mineralogy or petrology at the time of appointment. The Department currently consists of 16 geoscientists (<http://www.baylor.edu/Geology/>).

Research: We seek an individual with research interests in mineralogy, igneous or metamorphic petrology or high-temperature geochemistry who is capable of building a strong, externally funded research program. Research space is available in the 500,000 ft² "state-of-the-art" Baylor Sciences Building. Research equipment current available includes a Siemens D5000 X-ray diffractometer, a Rigaku Primus wavelength-dispersive X-ray fluorescence spectrometer, a Thermo-Finnigan Delta V IRMS, and sample preparation facilities including a strong-acid-rated fume hood and high-temperature furnace. A shared ICP-MS instrument is also available, as well as a SEM, TEM, and confocal microscopy in a shared lab facility. **Teaching:** We seek an individual with a strong commitment to excellence in teaching, and require that he/she contribute significantly to the undergraduate program, by teaching undergraduate mineralogy and petrology courses, as well as contributing to the graduate (M.S. and Ph.D.) programs in Geology by teaching graduate courses or seminars in his/her areas of specialization. **Application Process:** Send letter of application, including statement of teaching and research interests, curriculum vitae, official transcripts, and the names and contact information for three references to: Dr. Steve Dworkin, Chair, Search Committee, Department of Geology, Baylor University, One Bear Place #97354, Waco, TX 76798-7354 (Tel: 254-710-2361; e-mail: Steve_Dworkin@baylor.edu). The review of applications will begin November 3, 2014. To ensure full consideration, application must be completed by November 17, 2014.

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.

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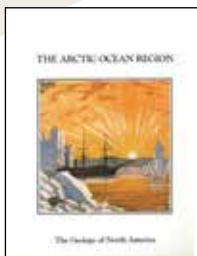
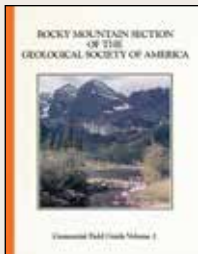


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GSA has finished digitizing the complete Decade of North American Geology series, including the Centennial Field Guides, Continent-Scale Map Series, Continent-Ocean Transects, and all 26 volumes of the Geology of North America.

This monumental project, describing and illustrating the geology and geophysics of North America, was created to help celebrate GSA's 100th anniversary. The collection that once filled a floor-to-ceiling bookshelf can now be downloaded and read on your tablet or computer. The discipline- and region-specific books are just US\$9.99 each and include files of the oversized plates.

Start exploring at <http://rock.geosociety.org/store/>.



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