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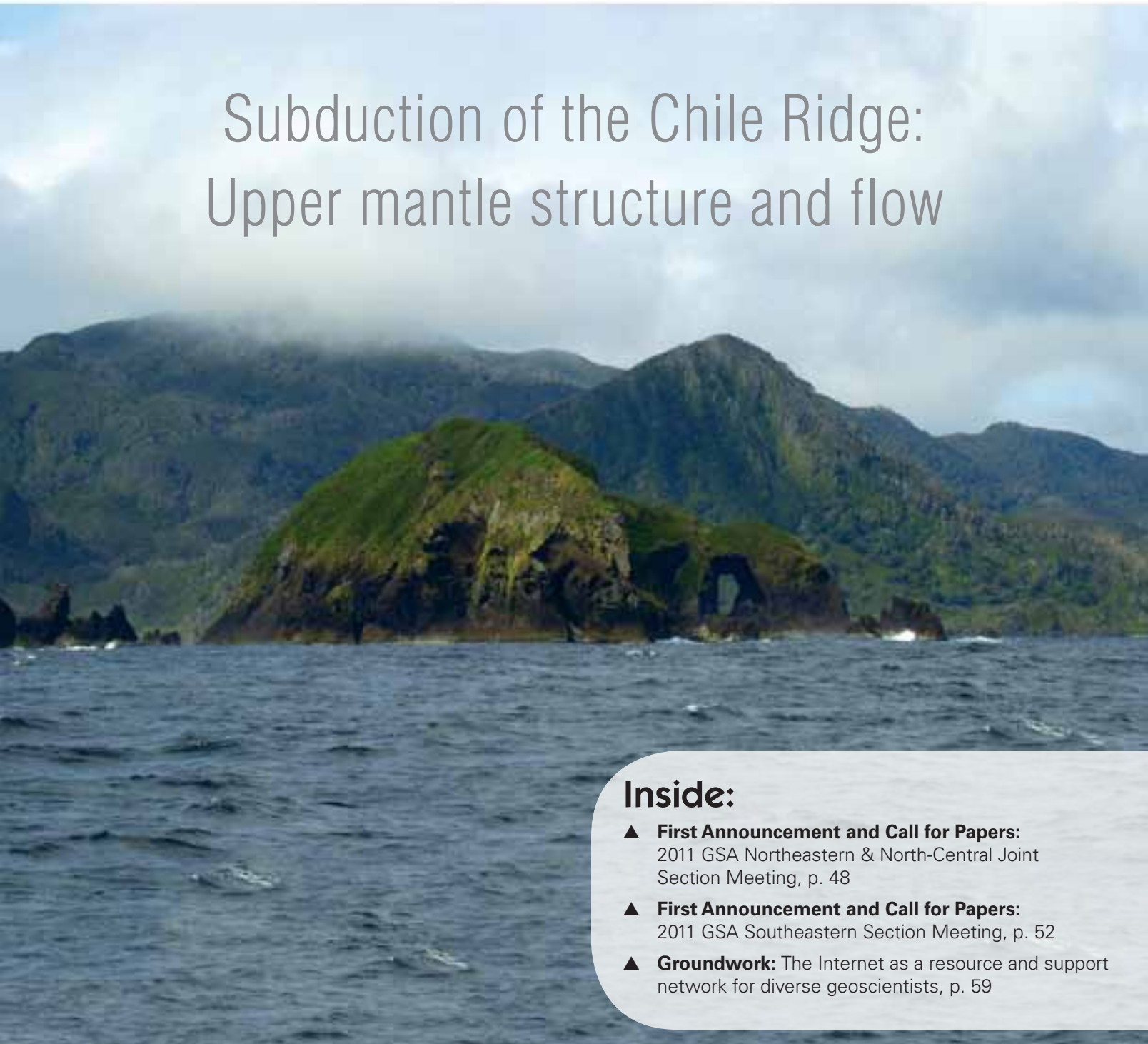
Subduction of the Chile Ridge: Upper mantle structure and flow



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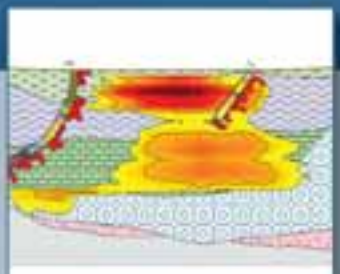

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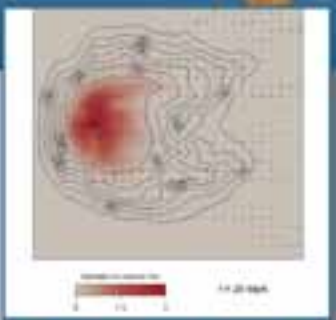

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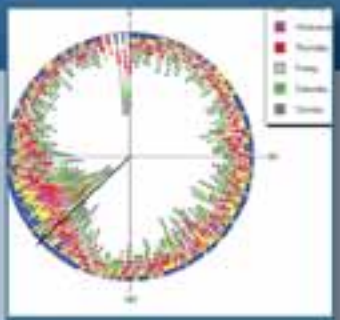

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SCIENCE ARTICLE

Cover: Elephant Rock, an evocatively shaped sea stack ~1 km off the west coast of the Taitao Peninsula, Chile (visible in background), is made up entirely of the Taitao Ophiolite, an obducted sliver of Nazca Plate oceanic crust. This portion of the Nazca Plate crust formed at the Tres Montes segment of the Chile Ridge spreading center prior to its subduction beneath South America. Photo by R.M. Russo. See "Subduction of the Chile Ridge: Upper mantle structure and flow", p. 4–10.

Subduction of the Chile Ridge: Upper mantle structure and flow

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ABSTRACT

We deployed 39 broadband seismometers in southern Chile from Dec. 2004 to Feb. 2007 to determine lithosphere and upper mantle structure in the vicinity of the subducting Chile Ridge. Body-wave travel-time tomography clearly shows the existence of a long-hypothesized slab window, a gap between the subducted Nazca and Antarctic lithospheres. P-wave velocities in the slab gap are distinctly slow relative to surrounding asthenospheric mantle. Thus, the gap between slabs visible in the imaging appears to be filled by unusually warm asthenosphere, consistent with subduction of the Chile Ridge. Shear wave splitting in the Chile Ridge subduction region is very strong (mean delay time ~3 s) and highly variable. North of the slab windows, splitting fast directions are mostly trench parallel, but, in the region of the slab gap, splitting fast trends appear to fan from NW-SE trends in the north, through ENE-WSW trends toward the middle of the slab window, to NE-SW trends south of the slab window. We interpret these results as indicating flow of asthenospheric upper mantle into the slab window.

INTRODUCTION

Spreading ridge subduction is an apparent contradiction—an impossibility if we assume ridges mark the upwelling limbs of mantle convection cells, or a geodynamic oddity if we believe that ridges spread passively, pulled apart by distant sinking slabs. And yet, there is good evidence that ridge subduction has occurred with some regularity, leaving a distinct record of rather pronounced effects on the geology and tectonics of the continental plates that overrode those ridges. Ridge subduction is invoked to explain odd tectonics and magmatism during the Neoarchean beneath the Dharwar craton of India (Manikyamba et al., 2007), during the Paleozoic in China (Jian et al., 2008), during the Mesozoic in Alaska, and during the Paleogene in the Java-Sumatra region (Whittaker et al., 2007). In fact, the very concept of ridge subduction was developed to explain Neogene tectonics and magmatism in western North America that were difficult to ascribe to Farallon plate subduction alone (Atwater, 1970; DeLong and Fox, 1977; Dickinson and Snyder, 1979; Thorkelson and Taylor, 1989), and since then a host of observations from Central America (Johnston and Thorkelson, 1997) to Baja (e.g., Rogers et al., 1985; Michaud et al., 2006; Pallares et al., 2007) to British Columbia (Groome et al., 2003; Audet et al., 2008) to Alaska (e.g., Sisson and Pavlis, 1993; Sisson et al., 2003; Breitsprecher et al., 2003; Cole et al., 2006; Qi et al., 2007) have been associated with spreading ridge subduction beneath western North America in some way.

Beyond the clear effects on the overriding plate, ridge subduction is the last stage of destruction of one of the two oceanic lithospheres involved in the process, and, depending on the exact geometry of the ridge with respect to the consuming trench, may mark the introduction of new oceanic plate into the subduction system. In most cases, ridge subduction seems likely to result in wide separation of the subducted lithospheres that were once contiguous at their intervening ridge-transform boundary, at least at depths greater than a few hundred kilometers. Such divergence between the trailing edge of the completely consumed plate and the leading edge of the conjugate plate opens slab windows and provides gaps through which asthenospheric mantle can flow and mix (Thorkelson, 1996). The implications for geochemical cycling in the mantle, at arcs (Gutiérrez et al., 2005), and even at unsubducted portions of the spreading ridge may be profound (Klein and Karsten, 1995; Karsten et al., 1996). Given the possible effects of ridge subduction on the geology of overriding continental plates, and on mantle mixing, some direct imaging of how ridge subduction actually works is desirable. Currently, the Chile Ridge, a long-lived wide ocean basin spreading ridge, is subducting beneath southern South America, affording a perfect opportunity to examine exactly what happens when a ridge meets a trench and is recycled into the mantle.

SUBDUCTION OF THE CHILE RIDGE

The actively spreading Chile Ridge (Fig. 1) has been subducting beneath South America since mid-Miocene time (Cande et al., 1987; Breitsprecher and Thorkelson, 2009; Eagles et al., 2009). The spreading segment between the Taitao and Darwin transform faults is currently at the trench and converging with South America at a geologically determined rate of a bit over 8 cm/yr directed N79°E (Spitzak and DeMets, 1996a, 1996b). Space geodetic observations yield somewhat slower convergence rates, 6.6 cm/yr for Nazca–South America and 1.85 cm/yr for Antarctica–South America convergence (Wang et al., 2007). Past subduction of Chile ridge segments has been associated with a wide range of effects on the overriding continent,

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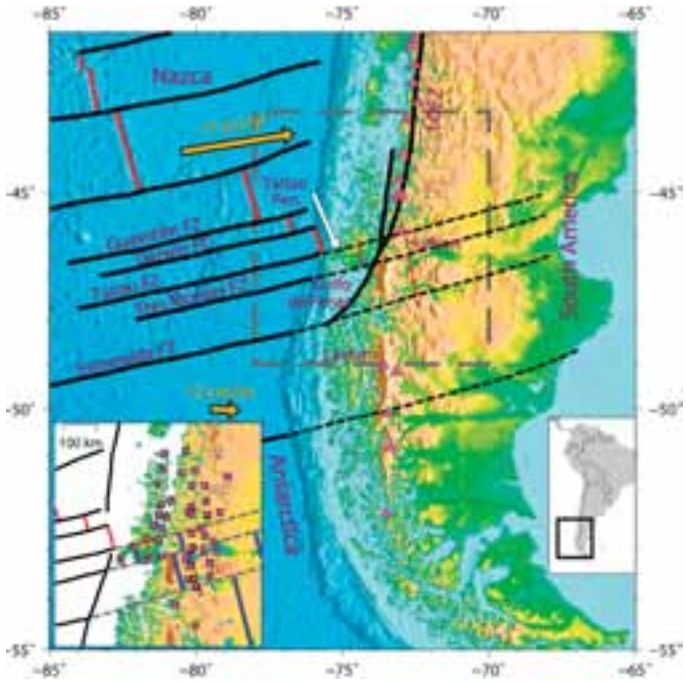

Figure 1. Actively spreading ridge segments (red) and transform faults/fracture zones (black); projections of subducted Chile Ridge structures (dashed black lines). Purple triangles are arc volcanoes; note gap in volcanic arc between Hudson and Lautaro. Relative convergence velocities from Spitzak and DeMets (1996a, 1996b) and Wang et al. (2007). Heavy dashed gray lines mark study area shown in inset, lower left: Chile Ridge Subduction Project station sites (squares). Slab window boundaries predicted from marine paleomagnetic data, subduction rates, and slab dip marked by heavy blue lines (Murdie and Russo, 1999). Inset, lower right: study region. FZ—fault zone; LOFZ—Liquiñe-Ofqui fault zone.

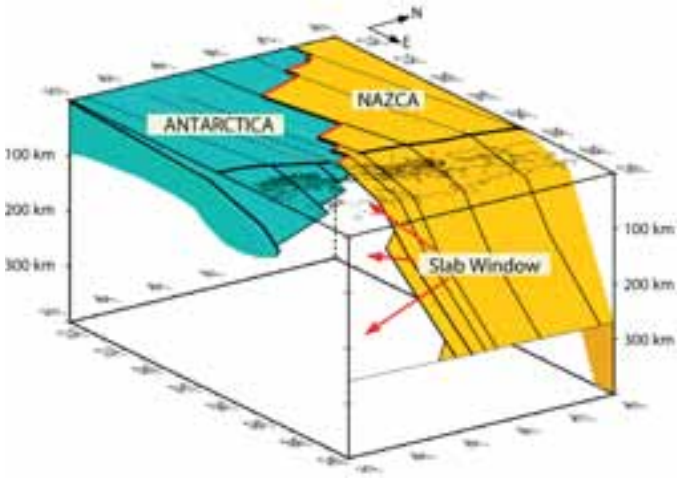

Figure 2. Development of slab windows, as projected from Chile Ridge surface structure and magnetic anomalies (e.g., Fig. 3) (Murdie and Russo, 1999). Separation of the trailing edge of the Nazca plate and the leading edge of the Antarctic plate opens a slab window once ambient temperatures are high enough to prevent lithosphere formation.

including highly variable structure of the continental forearc (Cande and Leslie, 1986; Cande et al., 1987; Bangs et al., 1992; Lagabrielle et al., 2004; Ranero et al., 2006), as well as important differences between structures, morphology, and evolution in foreland areas north and south, and backarc areas well east of the present triple junction (Ramos, 1989; Flint et al., 1994; Cembrano et al., 2002; Lagabrielle et al., 2004). Obduction of a Plio-Pleistocene ophiolite sequence (Forsythe and Nelson, 1985; Nelson et al., 1993; Bourgois et al., 1996; Lagabrielle et al., 2000; Veloso et al., 2005, 2007; Shibuya et al., 2007) and recent volcanism on the Tres Montes Peninsula anomalously close to the trench (Forsythe et al., 1986; Lagabrielle et al., 1994, 2000) are both attributed to the ridge subduction. A pronounced gap in the active Patagonian volcanic arc (Fig. 1) (Cande and Leslie, 1986; Ramos and Kay, 1992; Gutiérrez et al., 2005), eruption of back-arc–like plateau basalts in eastern Chile and western Argentina (Charrier et al., 1979; Ramos and Kay, 1992; Kay et al., 1993; Gorring et al., 1997; Espinoza et al., 2005, 2008; Guivel et al., 2006), anomalous isotopic signatures from rocks dredged from Chile Ridge ridge segments at or adjacent to the trench (Klein and Karsten, 1995; Karsten et al., 1996), and anomalous seismicity, gravity (Murdie et al., 1993, 2000), and upper mantle flow (Murdie and Russo, 1999) have also been deemed consequences of the subduction of the Chile spreading ridge.

Implicit in the slab window idea is the assumption that spreading between the trailing and leading edges of the subducted ridge continues after subduction, but that no new lithosphere is formed after subduction, leading to a progressively widening gap between the two edges of the former ridge (Fig. 2) (Delong and Fox, 1977; Dickinson and Snyder, 1979; Thorkelson and Taylor, 1989; Thorkelson, 1996; Gorring et al., 1997; Thorkelson and Breitsprecher, 2005). Although the exact form of slab window mantle flow is unknown, such mantle flow should be detectable via shear wave splitting analysis, and we have attempted to characterize the Chile Ridge subduction slab window flow field using splitting observations of extant regional data (Murdie and Russo, 1999) and larger-scale upper mantle flow indicators (Alvarez, 1982; Russo and Silver, 1994, 1996; Russo et al., 1996; Anderson et al., 2004).

As part of the ongoing Chile Ridge Subduction Project (CRSP), we deployed 39 broadband seismometers (Fig. 1) from late 2004 to early 2007 in the region where the Chile Ridge subducts. The basic goals of the seismic deployment were (1) to detect whether a Patagonian slab window between subducted Nazca and Antarctic lithosphere exists; (2) if so, to resolve its shape and extent; (3) to determine the form of asthenospheric mantle flow in the vicinity of any slab window; and (4) to confirm that a slab window allows direct contact between mantle flow associated with ridge spreading processes and the base of the overriding (i.e., South American) lithosphere. Such interaction would explain many aspects of the anomalous forearc and backarc volcanism that has been associated with the Patagonian slab window. The geodynamic implications of ridge subduction are important: Subduction of actively spreading ridges implies that mantle convection return flow is not strongly localized at oceanic spreading ridges (ridges spread passively, unforced by convective upwelling). Any indication that upwelling mantle flow is occurring in the geodynamically equivocal setting of ridge subduction would be important information for understanding global geodynamics.

TRAVEL-TIME INVERSIONS AND STRUCTURE OF THE SUBDUCTED SLABS

We used P-waves recorded at 39 stations of the CRSP seismic network to determine anomalous travel times that can be ascribed to local upper mantle structure. Suitable events for this study come from a well-distributed set of backazimuths (Supplemental Data Figs. DR1 and DR2[1]), a result of operating the network stations for a minimum of two years. A well-distributed group of source events ensures even sampling of the upper mantle structure, with raypaths crossing at as many angles as possible, allowing us to isolate structure at depth.

Results of the P-wave travel-time inversions are shown in Figure 3, with images at depths of 100 and 200 km. Travel-time anomalies mapped into velocity structure at these depths are color-coded: blue represents fast velocities, and red shows regions with velocities that are slow relative to a commonly used model of seismic velocities that varies only with depth. The subducted Nazca slab is clearly visible in Figure 3 as a high-velocity region in the northern part of the maps, and this anomaly shifts eastward at depth, as we would expect for a slab with an eastward dip. Because of the event-station distribution, we are unable to resolve the subducted Antarctic lithosphere very well (few stations were deployed in the SW of the study region over the shallow Antarctic slab; see Fig. 3). However, the very low velocities present at the depth projections of the expected slab window are clearly visible, and we take this as first-order evidence that the slab window exists. We note that the high-velocity anomalies we associate with the Nazca slab are clearly bounded by the down-dip projection of the Taitao transform fault that now forms the southern edge of the subducted Nazca plate, as predicted (Murdie and Russo, 1999; Breitsprecher and Thorkelson, 2009). Note also that the low seismic velocity anomalies present in the slab

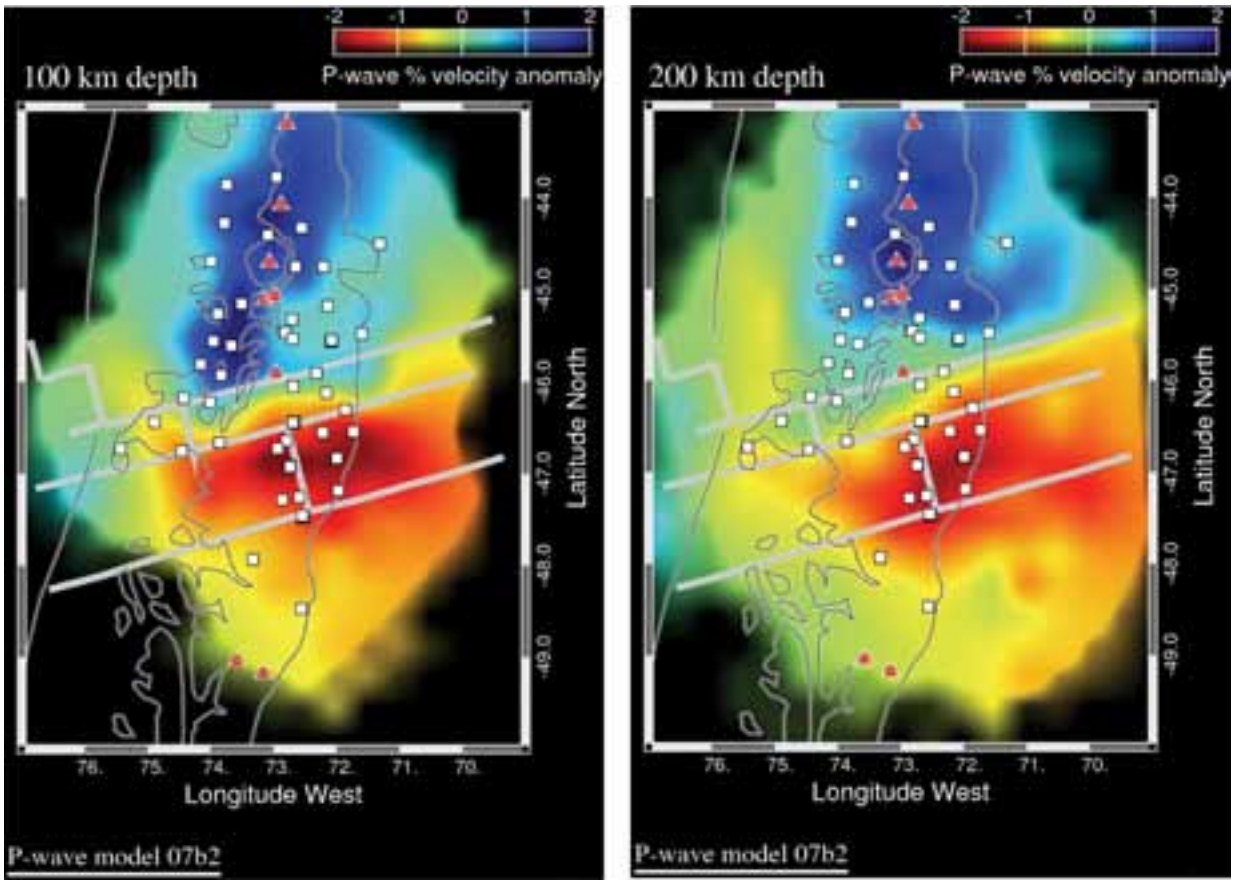

Figure 3. Map views of P-wave velocity anomalies at 100 km (left) and 200 km (right). Velocity anomaly relative to radial Earth model IASP91 (Kennett and Engdahl, 1991) shown as a perturbation percentage; see key at upper right of each map. High velocities are blue; low velocities red; where resolution is poor, colors fade to black. The subducted Nazca lithosphere is visible as the linear NNE-trending fast anomaly, and the slow velocities of the slab window are red. Structure of the Chile Ridge projected to depth shown by heavy gray lines. Stations of the CRSP seismic network are white squares, and red triangles show locations of active arc volcanoes; note the gap in the arc in the region of the slab window. Thin white lines are Chile coastline and political border with Argentina and also mark the subduction trench westward of the coastline. At 200 km depth, note broadening and eastward shift of the high-velocity anomalies associated with the Nazca slab. Slow velocities of the slab windows also shift eastward and broaden at depth, as expected given increasing separation of the trailing edge of the Nazca slab from the leading edge of Antarctica (see Fig. 2).

[1]GSA Data Repository Item 2010263, supplemental text and figures DR1–DR5, can be accessed online at www.geosociety.org/pubs/ft2010.htm; copies can also be obtained via e-mail to gsatoday@geosociety.org.

gap are actually slower than the typical seismic velocity of the asthenosphere, so these slow regions really do represent anomalously slow—and therefore most likely relatively warm—asthenospheric mantle.

SHEAR WAVE SPLITTING AND UPPER MANTLE FLOW

Although we have established that a slab window is present between subducted Nazca and Antarctic lithosphere, and that seismic velocities in this gap are consistent with the presence of warm asthenosphere, the question remains whether upper mantle flow beneath the subducted lithosphere (Russo and Silver, 1994) is perturbed by these structures. We use observations of shear wave splitting to evaluate this issue. The most common interpretation of teleseismic shear wave splitting is based on development of a linear preferred orientation of natural upper mantle minerals, predominantly olivine, with a tendency for aggregates of these minerals to align in the shear plane parallel to the direction of tectonic extension (Gueguen and Nicolas, 1980; Christensen, 1984; Nicolas and Christensen, 1987; Ribe, 1989a, 1989b; Ribe and Yu, 1991; Zhang et al., 2000).

Shear wave splitting observed at the CRSP seismic network is strong (mean δt is 2.98 s) and variable. Although the results we present here are preliminary (see Fig. DR3; footnote 1)—only phases from larger-magnitude, deeper earthquakes have been analyzed—they are likely already robust in the sense that more measurements will probably add only marginally to the total already in hand, given the relative difficulty of generating high-amplitude core phases at the requisite distances ($\Delta > 88°$; Silver and Chan, 1991). We used SKS, SKKS, S´S´, and PKS phases to determine the splitting fast directions and delay times shown in Figure 4.

We assume that the heterogeneous structure visible in the travel-time inversions may have a strong effect on the orientations of upper mantle fabrics in the triple junction region. In order to separate these potential effects on observed shear wave splitting, we traced rays through a three-dimensional upper mantle velocity model derived from the travel-time inversions (Figs. DR4 and DR5; footnote 1) to determine which parts of the study area were actually sampled by waves arriving from different source events around the globe. We chose the 200 km piercing points (halfway from the 410 km depth of olivine transformation to the surface) along these rays and projected this point to the surface as the point at which to display splitting results (Fig. 4). The variable splitting at CRSP stations reflects variable anisotropy in the upper mantle below. The shear wave phases we used to make the measurement integrate splitting due to anisotropy all along their paths through the upper mantle, so, conceivably, the anisotropy could be in the overlying South American crust and upper mantle, in the upper mantle wedge for those stations sited eastward enough to overlie a significant thickness of the wedge, within the subducted Nazca and Antarctic slabs, and beneath the slabs. Given the large delay times, and by analogy with results elsewhere in South America and the world, the predominant anisotropic source to these splits is likely beneath the slab (Russo and Silver, 1994; Fouch and Fischer, 1996; Anderson et al., 2004; Pozgay et al., 2007; Abt and Fischer, 2008; Hoernle et al., 2008). The local/regional earthquake shear wave splitting due to crustal and upper mantle

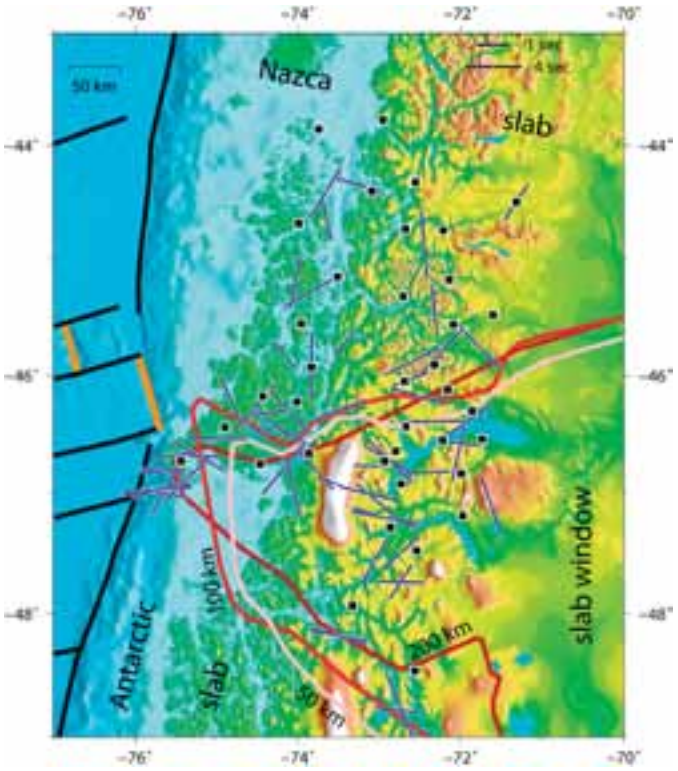

Figure 4. Map of shear wave splitting measurements. Blue bars trend in the fast polarization direction; lengths are proportional to delay times. Fast trends are variable, but splitting delays are uniformly high (mean = 2.98 s), which is near the global maximum for teleseismic splitting. Strong, variable splitting indicates a variable upper mantle flow field beneath South America and the subducted Nazca and Antarctic slabs. Patagonian slab window boundary defined by P-wave tomography (Fig. 3), shown at three depths: heavy pink, red, and dark red lines.

wedge anisotropy trend predominantly N-S in the study region (R.E. Murdie and R.M. Russo, 2010, personal commun.), significantly different from those of the teleseismic shear wave splitting, indicating that the teleseismic signal is primarily a deeper upper mantle anisotropy, as also expected from the much greater delay times (2–3 s) of the teleseismic data compared to the local splitting delays (0.05–0.3 s).

The presence of a Patagonian slab window complicates the South American upper mantle flow field, which is visible in the splitting fast trends sampling upper mantle near and within the slab gap: North of the subducted ridge, fast shear wave polarization trends—and hence, upper mantle flow beneath the Nazca slab—are predominantly parallel to the slab strike (trench parallel). South of the triple junction, they align more E-W and in many cases parallel the ENE-WSW trend of the subducted Taitao transform fault that now forms the southern boundary of the Nazca slab. Note the fanning of the splitting fast trends from waves sampling the western portions of the slab window: Splitting fast shear wave directions rotate from NW-SE trends, north of the western slab window opening, to ENE-WSW within the window, to NE-SW in the southern portion of the window (Fig. 4). We interpret these results to indicate that the gap between the Nazca and Antarctic slabs visible in the travel-time inversions allows asthenospheric upper mantle to flow into the separation between the subducted

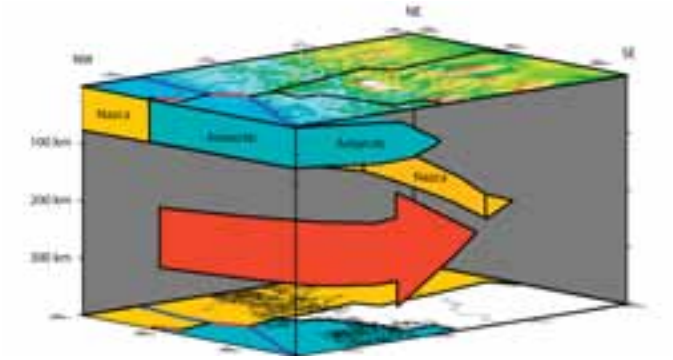

Figure 5. Schematic 3-D block diagram of upper mantle flow in the vicinity of the slab window delineated by the travel time inversions (Fig. 3); view from SW. Top map shows relief and locations of Chile Ridge structures before and after subduction. Bottom shows coastline and Chile Ridge structures over color-coded slab plates: Nazca plate—yellow; Antarctic plate—blue-green; same colors for portions of the slab visible in the block diagram itself. Red arrow generally parallels shear-wave splitting fast trends and upper mantle flow in the vicinity of the slab window opening. The northern, shallower portion of the slab window is not visible from this viewpoint.

lithospheres (Fig. 5). The majority of fast shear wave directions for stations north of the slab window trend closer to N-S than otherwise; e.g., predominantly trench-parallel, which appears to be the basic upper mantle flow direction for western South America north of the triple junction (Russo and Silver, 1994, 1996; Anderson et al., 2004).

CONCLUSIONS

Travel-time inversions demonstrate that the subduction of the Chile Ridge beneath South America has resulted in the opening of an asthenosphere-filled gap between the trailing edge of the Nazca plate and the leading edge of the Antarctic plate. These results provide the first imaging of a forming slab window, representing the first direct evidence for the existence of structures postulated to explain tectonics and magmatism on a variety of continents throughout Earth's history. Observations of shear wave splitting, resulting from systematic orientation of upper mantle mineral fabrics due to flow, indicate that the slab window perturbs the regional sub-slab upper mantle flow field. Asthenospheric flow into the gap between subducted lithospheric slabs beneath South America appears to be the likely cause of the observed shear wave splitting.

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REFERENCES CITED

Abt, D.L., and Fischer, K.M., 2008, Resolving three-dimensional anisotropic structure with shear wave splitting tomography: Geophysical Journal International, v. 173, p. 859–886, doi: 10.1111/j.1365-246X.2008.03757.x.

Alvarez, W., 1982, Geologic evidence for the geographical pattern of mantle return flow and the driving mechanism of plate tectonics: Journal of Geophysical Research, v. 87, p. 6697–6710.

Anderson, M.L., Zandt, G., Triep, E., Fouch, M., and Beck, S., 2004, Anisotropy and mantle flow in the Chile-Argentina subduction zone from shear wave splitting analysis: Geophysical Research Letters, v. 31, L23608, doi: 10.1029/2004GL020906.

Atwater, T., 1970, Implications of plate tectonics for the Cenozoic tectonic evolution of western North America: Geological Society of America Bulletin, v. 81, p. 3513–3535.

Audet, P., Bostock, M.G., Mercier, J.P., and Cassidy, J.F., 2008, Morphology of the Explorer–Juan de Fuca slab edge in northern Cascadia: Imaging plate capture at a ridge-trench-transform triple junction: Geology, v. 36, p. 895–898, doi: 10.1130/G25356A.1.

Bangs, N.L.B., Cande, S., Lewis, S., and Miller, J., 1992, Structural framework of the Chile margin at the Chile Ridge collision, *in* Behrmann, J.H., Lewis, S.D., Musgrave, R.J., et al., eds., Proceedings of the ODP, Initial Reports., v. 141, Ocean Drilling Program, College Station, Texas, USA, p. 11–21.

Bourgois, J., Martin, H., Lagabrielle, Y., Le Moine, J., and Fritos Jara, J., 1996, Subduction erosion related to spreading-ridge subduction: Taitao peninsula (Chile margin triple junction area): Geology, v. 24, p. 723–726, doi: 10.1130/0091-7613(1996)024<0723:SERTSR>2.3.CO;2.

Breitsprecher, K., and Thorkelson, D.J., 2009, Neogene kinematic history of Nazca-Antarctic-Phoenix slab windows beneath Patagonia and the Antarctic Peninsula: Tectonophysics, v. 464, p. 10–20, doi: 10.1016/j.tecto.2008.02.013.

Breitsprecher, K., Thorkelson, D.J., Groome, E.G., and Distal, J., 2003, Geochemical confirmation of the Kula-Farallon slab window beneath the Pacific Northwest in Eocene time: Geology, v. 31, p. 351–354, doi: 10.1130/0091-7613(2003)031<0351:GCOTKF>2.0.CO;2.

Cande, S.C., and Leslie, R.I.B., 1986, Late Cenozoic tectonics of the southern Chile trench: Journal of Geophysical Research, v. 91, p. 471–496, doi: 10.1029/JB091iB01p00471.

Cande, S.C., Leslie, S.D., Parra, J.C., and Hobart, M., 1987, Interaction between the Chile Ridge and the Chile Trench: Geophysical and geothermal evidence: Journal of Geophysical Research, v. 92, p. 495–520, doi: 10.1029/JB092iB01p00495.

Cembrano, J., Liven, A., Reynolds, P., Arancibia, G., Lopez, G., and Sanhueza, A., 2002, Late Cenozoic transpressional ductile deformation north of the Nazca–South America–Antarctica triple junction: Tectonophysics, v. 354, p. 289–314, doi: 10.1016/S0040-1951(02)00388-8.

Charrier, R., Linares, E., Niemeyer, H., and Skarmeta, J., 1979, K-Ar ages of basalt flows of the Meseta Buenos Aires in southern Chile and their relation to the southeast Pacific triple junction: Geology, v. 7, p. 436–439, doi: 10.1130/0091-7613(1979)7<436:KAOBFO>2.0.CO;2.

Christensen, N.I., 1984, The magnitude, symmetry and origin of upper mantle anisotropy based on fabric analyses of ultramafic tectonics: Geophysical Journal of the Royal Astronomical Society, v. 76, p. 89–112.

Cole, R.B., Nelson, S.W., Layer, P.W., and Oswald, P.J., 2006, Eocene volcanism above a depleted mantle slab window in Southern Alaska: Geological Society of America Bulletin, v. 118, p. 140–158, doi: 10.1130/B25658.1.

DeLong, S.E., and Fox, P.J., 1977, Geological consequences of ridge subduction, *in* Talwani, M., and Pitman, W.C., eds., Island Arcs, Deep Sea Trenches and Back-Arc Basins: Washington, D.C., American Geophysical Union Maurice Ewing Series No. 1, p. 221–228.

Dickinson, W.R., and Snyder, W.S., 1979, Geometry of subducted slabs related to San Andreas transform: The Journal of Geology, v. 87, p. 609–627, doi: 10.1086/628456.

Eagles, G., Gohl, K., and Larter, R.D., 2009, Animated tectonic reconstruction of the Southern Pacific and alkaline volcanism at its convergent margins since Eocene times: Tectonophysics, v. 464, p. 21–29, doi: 10.1016/j.tecto.2007.10.005.

Espinoza, F., Morata, D., Pelleter, E., Maury, R.C., Suárez, M., Lagabrielle, Y., Polvé, M., Bellon, H., Cotten, J., De la Cruz, R., and Guivel, C., 2005, Petrogenesis of the Eocene and Mio-Pliocene alkaline basaltic magmatism in Meseta Chile Chico, southern Patagonia, Chile: Evidence for the participation of two slab windows: Lithos, v. 82, p. 315–343.

Espinoza, F., Morata, D., Polvé, M., Lagabrielle, Y., Maury, R.C., Guivel, C., Cotten, J., Bellon, H., and Suárez, M., 2008, Bi-modal back-arc alkaline magmatism after ridge subduction: Pliocene felsic rocks from central Patagonia (47°S): Lithos, v. 101, p. 191–217, doi: 10.1016/j.lithos.2007.07.002.

Flint, S.S., Prior, D.J., Agar, S.M., and Turner, P., 1994, Stratigraphic and structural evolution of the Tertiary Cosmelli Basin and its relationship to the Chile triple junction: Journal of the Geological Society, v. 151, p. 251–268, doi: 10.1144/gsjgs.151.2.0251.

Forsythe, R.D., and Nelson, E.P., 1985, Geological manifestations of ridge collision: Evidence from the Golfo de Penas–Taitao Basin, Southern Chile: Tectonics, v. 4, p. 477–495, doi: 10.1029/TC004i005p00477.

Forsythe, R.D., Nelson, E.P., Carr, M.J., Kaeding, M.E., Herve, M., Mpodozis, C., Soffia, J.M., and Harambour, S., 1986, Pliocene near-trench magmatism in southern Chile: A possible manifestation of ridge collision: Geology, v. 14, p. 23–27, doi: 10.1130/0091-7613(1986)14<23:PNMISC>2.0.CO;2.

Fouch, M.J., and Fischer, K.M., 1996, Mantle anisotropy beneath northwest Pacific subduction zones: Journal of Geophysical Research, v. 101, p. 15,987–16,002, doi: 10.1029/96JB00881.

Gorring, M.L., Kay, S.M., Zeitler, P.K., Ramos, V.A., Rubiolo, D., Fernández, M.I., and Panza, J.L., 1997, Neogene Patagonian plateau lavas: Continental Magmas associated with ridge collision at the Chile Triple Junction: Tectonics, v. 16, p. 1–17, doi: 10.1029/96TC03368.

Groome, W.G., Thorkelson, D.J., Friedman, R.M., Mortensen, J.K., Massey, N.W.D., Marshall, D.D., and Layer, P.W., 2003, Magmatic and tectonic history of the Leech River Complex, Vancouver Island, British Columbia; evidence for ridge-trench intersection and accretion of the Crescent Terrane, *in* Sisson, V.B., Roeske, S.M., and Pavlis, T.L., eds., Geology of a Transpressional Orogen Developed during Ridge-Trench Interaction along the North Pacific Margin: Geological Society of America Special Paper 371, p. 327–353.

Gueguen, Y., and Nicolas, A., 1980, Deformation of mantle rocks: Annual Review of Earth and Planetary Sciences, v. 8, p. 119–144, doi: 10.1146/annurev.ea.08.050180.001003.

Guivel, C., Morata, D., Pelleter, E., Espinoza, F., Maury, R.C., Lagabrielle, Y., Polvé, M., Bellon, H., Cotten, J., Benoit, M., Suárez, M., and de la Cruz, R., 2006, Miocene and Late Quaternary Patagonian basalts (46–47°S): Geochronometric and geochemical evidence for slab tearing due to active spreading ridge subduction: Journal of Volcanology and Geothermal Research, v. 149, p. 346–370, doi: 10.1016/j.jvolgeores.2005.09.002.

Gutiérrez, F., Gioncada, A., González Ferran, O., Lahsen, A., and Mazzuoli, R., 2005, The Hudson Volcano and surrounding monogenetic centres (Chilean Patagonia): An example of volcanism associated with ridge-trench collision environment: Journal of Volcanology and Geothermal Research, v. 145, p. 207–233, doi: 10.1016/j.jvolgeores.2005.01.014.

Herron, E.M., Cande, S.C., and Hall, B.R., 1981, An active spreading center collides with a subduction zone: A geophysical survey of the Chile margin triple junction: Geological Society of America Memoir 154, p. 683–701.

Hoernle, K., Abt, D.L., Fischer, K.M., Nichols, H., Hauff, F., Abers, G.A., van den Bogaard, P., Heydolph, K., Alvarado, G., Protti, M., and Strauch, W., 2008, Arc-parallel flow in the mantle wedge beneath Costa Rica and Nicaragua: Nature, v. 451, doi: 10.1038/nature06550.

Huber, P.J., 1981, Robust Statistics: New York, John Wiley & Sons, 320 p.

Jian, P., Liu, D., Kroner, A., Windley, B.F., Shi, Y., Zhang, F., Shi, G., Miao, L., Zhang, W., Zhang, Q., Zhang, L., and Ren, J., 2008, Time scale of an early to mid-Paleozoic orogenic cycle of the long-lived Central Asian Orogenic Belt, Inner Mongolia of China: Implications for continental growth: Lithos, v. 101, p. 233–259, doi: 10.1016/j.lithos.2007.07.005.

Johnston, S.T., and Thorkelson, D.J., 1997, Cocos-Nazca slab window beneath Central America: Earth and Planetary Science Letters, v. 146, p. 465–474, doi: 10.1016/S0012-821X(96)00242-7.

Karsten, J.L., Klein, E.M., and Sherman, S.B., 1996, Subduction zone geochemical characteristics in ocean ridge basalts from the southern Chile Ridge: Implications of modern ridge subduction systems for the Archaean: Lithos, v. 37, p. 143–161, doi: 10.1016/0024-4937(95)00034-8.

Kay, S.M., Ramos, V.A., and Marquez, M., 1993, Evidence in Cerro Pampa volcanic rocks for slab melting prior to ridge-trench collision in southern South America: The Journal of Geology, v. 101, p. 703–714, doi: 10.1086/648269.

Kennett, B.L.N., and Engdahl, E.R., 1991, Travel times for global earthquake location and phase identification: Geophysical Journal International, v. 105, p. 429–465.

Klein, E.M., and Karsten, J.L., 1995, Ocean-ridge basalts with convergent-margin geochemical affinities from the Chile Ridge: Nature, v. 374, p. 52–57, doi: 10.1038/374052a0.

Lagabrielle, Y., Le Moigne, J., Maury, R.C., Cotten, J., and Bourgois, J., 1994, Volcanic record of the subduction of an active spreading ridge, Taitao Peninsula (southern Chile): Geology, v. 22, p. 515–518, doi: 10.1130/0091-7613(1994)022<0515:VROTSO>2.3.CO;2.

Lagabrielle, Y., Guivel, C., Maury, R.C., Bourgois, J., Fourcade, S., and Martin, H., 2000, Magmatic-tectonic effects of high thermal regime at the site of active ridge subduction: The Chile Triple Junction model: Tectonophysics, v. 326, p. 255–268, doi: 10.1016/S0040-1951(00)00124-4.

Lagabrielle, Y., Suarez, M., Rossello, E.A., Herail, G., Martinod, J., Regnier, M., and de la Cruz, R., 2004, Neogene to Quaternary tectonic evolution of the Patagonian Andes at the latitude of the Chile Triple Junction: Tectonophysics, v. 385, p. 211–241, doi: 10.1016/j.tecto.2004.04.023.

Manikyamba, C., Kerrich, R., Khanna, T.C., and Subba Rao, D.V., 2007, Geochemistry of adakites and rhyolites from the Neoarchaen Gadwal greenstone belt, eastern Dharwar Craton, India: Implications for sources and geodynamic setting: Canadian Journal of Earth Sciences, v. 44, p. 1517–1535, doi: 10.1139/E07-034.

Michaud, F., Royer, J.-Y., Bourgois, J., Dyment, J., Calmus, T., Bandy, W., Sosson, M., Mortera-Gutierrez, C., Sichler, B., Rebolledo-Viera, M., and Pontoise, B., 2006, Oceanic-ridge subduction vs. slab break off: Plate tectonic evolution along the Baja California Sur continental margin since 15 Ma: Geology, v. 34, p. 13–16, doi: 10.1130/g22050.1.

Murdie, R.E., and Russo, R.M., 1999, Seismic anisotropy in the region of the Chile Margin Triple Junction: Journal of South American Earth Sciences, v. 12, p. 261–270, doi: 10.1016/S0895-9811(99)00018-8.

Murdie, R.E., Prior, D.J., Styles, P., Flint, S.S., Pearce, R.G., and Agar, S.M., 1993, Seismic responses to ridge-transform subduction: Chile triple

junction: Geology, v. 21, p. 1095–1098, doi: 10.1130/0091-7613(1993)021<1095:SRTRTS>2.3.CO;2.

Murdie, R.E., Styles, P., Prior, D.J., and Daniel, A.J., 2000, A new gravity map of southern Chile and its preliminary interpretation: Revista Geologica De Chile, v. 27, p. 49–63.

Nelson, E., Forsythe, R., Diemer, J., Allen, M., and Urbina, O., 1993, Taitao Ophiolite: A ridge collision ophiolite in the forearc of southern Chile: Revista Geologica De Chile, v. 20, p. 137–165.

Nicolas, A., and Christensen, N.I., 1987, Formation of anisotropy in upper mantle peridotites—A review, *in* Fuchs, K., and Froidevaux, C., eds., Composition, Structure and Dynamics of the Lithosphere-Asthenosphere System: Washington, D.C., American Geophysical Union Geodynamics Series, v. 16, p. 111–123.

Pallares, C., Maury, R.C., Bellon, H., Royer, J.-Y., Calmus, T., Aguillo-Robles, A., Cotten, J., Benoit, M., Michaud, F., and Bourgois, J., 2007, Slab-tearing following ridge-trench collision: Evidence from Miocene volcanism in Baja California, Mexico: Journal of Volcanology and Geothermal Research, v. 161, p. 95–117, doi: 10.1016/j.jvolgeores.2006.11.002.

Pozgay, S.H., Wiens, D.A., Conder, J.A., Shiobara, H., and Sugioka, H., 2007, Complex mantle flow in the Mariana subduction system: Evidence from shear wave splitting: Geophysical Journal International, v. 170, p. 371–386, doi: 10.1111/j.1365-246X.2007.03433.x.

Qi, C., Zhao, D., and Chen, Y., 2007, Search for deep slab segments under Alaska: Physics of the Earth and Planetary Interiors, v. 165, p. 68–82, doi: 10.1016/j.pepi.2007.08.004.

Ramos, V.A., 1989, Foothills structure in Northern Magellanes Basin, Argentina: AAPG Bulletin, v. 73, p. 887–903.

Ramos, V.A., and Kay, S.M., 1992, Southern Patagonian plateau basalts and deformation: Backarc testimony of ridge collisions: Tectonophysics, v. 205, p. 261–282, doi: 10.1016/0040-1951(92)90430-E.

Ranero, C.R., von Heune, R., Weinrebe, W., and Reichert, C., 2006, Tectonic processes along the Chile convergent margin, *in* Oncken, O., Chong, G., Franz, G., Giese, P., Götze, H.-J., Ramos, V.A., Strecker, M.R., and Wigger, P., eds., The Andes: Active Subduction Orogeny: Berlin, Springer, p. 91–124.

Ribe, N.M., 1989a, A continuum theory for lattice preferred orientation: Geophysical Journal International, v. 97, p. 199–207, doi: 10.1111/j.1365-246X.1989.tb00496.x.

Ribe, N.M., 1989b, Seismic anisotropy and mantle flow: Journal of Geophysical Research, v. 94, p. 4213–4223, doi: 10.1029/JB094iB04p04213.

Ribe, N.M., and Yu, Y., 1991, A theory for plastic deformation and textural evolution of olivine polycrystals: Geophysical Journal International, v. 94, p. 4213–4223.

Rogers, G., Saunders, A.D., Terrell, D.J., Verma, S.P., and Marriner, V.F., 1985, Geochemistry of Holocene volcanic rocks associated with ridge subduction in Baja California, Mexico: Nature, v. 315, p. 389–392, doi: 10.1038/315389a0.

Russo, R.M., and Silver, P.G., 1994, Trench-parallel flow beneath the Nazca plate from seismic anisotropy: Science, v. 263, p. 1105–1111.

Russo, R.M., and Silver, P.G., 1996, Cordillera formation, mantle dynamics, and the Wilson Cycle: Geology, v. 24, p. 511–514, doi: 10.1130/0091-7613(1996)024<0511:CFMDAT>2.3.CO;2.

Russo, R.M., Silver, P.G., Franke, M., Ambeh, W.B., and James, D.E., 1996, Shear wave splitting in Northeast Venezuela, Trinidad, and the eastern Caribbean: Physics of the Earth and Planetary Interiors, v. 95, p. 251–275, doi: 10.1016/0031-9201(95)03128-6.

Shibuya, T., Komiya, R., Anma, R., Ota, T., Omori, S., Kon, Y., Yamamato, S., and Maruyama, S., 2007, Progressive metamorphism of the Taitao ophiolite: Evidence for axial and off-axial hydrothermal alterations: Lithos, v. 98, p. 233–260, doi: 10.1016/j.lithos.2007.04.003.

Silver, P.G., and Chan, W.W., 1991, Shear wave splitting and subcontinental mantle deformation: Journal of Geophysical Research, v. 96, p. 16,429–16, 454, doi: 10.1029/91JB00899.

Sisson, V.B., and Pavlis, T.L., 1993, Geologic consequences of plate reorganization: An example from the Eocene southern Alaska fore arc: Geology, v. 21, p. 913–916, doi: 10.1130/0091-7613(1993)021<0913:GCOPRA>2.3.CO;2.

Sisson, V.B., Pavlis, T.L., Roeske, S.M., and Thorkelson, D.J., 2003, Introduction: An overview of ridge-trench interactions in modern and ancient settings, *in* Sisson, V.B., Roeske, S.M., and Pavlis, T.L., eds., Geology of a Transpressional Orogen Developed during Ridge-Trench Interaction along the North Pacific Margin: Geological Society of America Special Paper 371, p. 1–18.

Spitzak, S., and DeMets, D.C., 1996a, Constraints on present-day plate motions south of 30 degrees S from satellite altimetry: Tectonophysics, v. 253, p. 167–208, doi: 10.1016/0040-1951(95)00069-0.

Spitzak, S., and DeMets, D.C., 1996b, Erratum: Constraints on present-day plate motions south of 30 degrees S from satellite altimetry: Tectonophysics, v. 261, p. 347–348, doi: 10.1016/0040-1951(95)00185-9.

Thorkelson, D.J., 1996, Subduction of diverging plates and the principles of slab window formation: Tectonophysics, v. 255, p. 47–63.

Thorkelson, D.J., and Breitsprecher, K., 2005, Partial melting of slab window margins: Genesis of adakitic and non-adakitic magmas: Lithos, v. 79, p. 25–41, doi: 10.1016/j.lithos.2004.04.049.

Thorkelson, D.J., and Taylor, R.P., 1989, Cordilleran slab windows: Geology, v. 17, p. 833–836, doi: 10.1130/0091-7613(1989)017<0833:CSW>2.3.CO;2.

Veloso, E.A.E., Anma, R., and Yamazaki, T., 2005, Tectonic rotations during Chile Ridge collision and obduction of the Taitao ophiolite (southern Chile): The Island Arc, v. 14, p. 599–615, doi: 10.1111/j.1440-1738.2005.00487.x.

Veloso, E.A.E., Anma, R., Ota, T., Komiya, T., Kagashima, S., and Yamazaki, T., 2007, Paleocurrent patterns of the Taitao ophiolite constrained by anisotropy of magnetic susceptibility and paleomagnetic analyses: Sedimentary Geology, v. 201, p. 446–460, doi: 10.1016/j.sedgeo.2007.07.005.

Wang, K., Hu, Y., Bevis, M., Kendrick, E., Vargas, R.B., and Lauria, E., 2007, Crustal motion in the zone of the 1960 Chile earthquake: Detangling earthquake-cycle deformation and forearc-sliver translation: Geochemistry Geophysics Geosystems, v. 8, p. Q10010, doi: 10.1029/2007GC001721.

Whittaker, J.M., Müller, R.D., Sdrolias, M., and Heine, C., 2007, Sunda-Java trench kinematics, slab window formation and overriding plate deformation since the Cretaceous: Earth and Planetary Science Letters, v. 255, p. 445–457, doi: 10.1016/j.epsl.2006.12.031.

Zhang, S., Karato, S., Fitzgerald, J., Faul, U.H., and Zhou, Y., 2000, Simple shear deformation of olivine aggregates: Tectonophysics, v. 316, p. 133–152, doi: 10.1016/S0040-1951(99)00229-2.

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GSA PRESIDENTIAL ADDRESS & AWARDS CEREMONY

Saturday, 30 Oct., 7–9 p.m.
Colorado Convention Center, Four Seasons Ballroom 4

Please join us Saturday evening for GSA President Joaquin Ruiz' Presidential Address, "From the core of the Earth to the top of the mountains: A renaissance in earth sciences." Following this address, the citations and responses for the 2010 recipients of the Penrose Medal, the Arthur L. Day Medal, the Young Scientist Award (Donath Medal), the President's Medal of the Geological Society of America, the GSA Public Service Award Medal, the Bromery Award for the Minorities, the GSA Distinguished Service Award, the Subaru Outstanding Woman in Science Award, and the American Geological Institute (AGI) Medal in Memory of Ian Campbell will be presented. The John C. Frye Environmental Geology Awardee, the GSA Division awardees, and the newly elected GSA Fellows will also be announced. A reception will immediately follow the ceremony. *No reservations, tickets, or invitations required.*

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Eric J. Essene*


George E. Gehrels


Dana L. Royer

Keyhole Inc.
(developers of Earth Viewer, now Google Earth)


Marilyn J. Suiter


Jonathan G. Price


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ARTHUR L. DAY MEDAL
George E. Gehrels, University of Arizona

YOUNG SCIENTIST AWARD (DONATH MEDAL)
Dana L. Royer, Wesleyan University

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Founders: John Hanke, Chikai Ohazama, Mark Aubin, Phil Keslin, and Avi Bar-Zeev
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Kateryna Klochko, Carnegie Institution of Washington

AGI MEDAL IN MEMORY OF IAN CAMPBELL
Vicki Cowart, Planned Parenthood of the Rocky Mountains (formerly at Colorado Geological Survey)

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* Deceased. The medal will be accepted by Eric Essene's wife, Joyce Budai. John W. Valley of the University of Wisconsin will present the Gold Medal Lecture on Sunday.

2010 GSA GOLD MEDAL LECTURES

Colorado Convention Center, Room 605
Sunday, 31 Oct.,
10 a.m.–noon

Please join us for the second annual GSA Gold Medal Lectures, a special public event hosted by GSA to honor its awardees. *No reservations, tickets, or invitations required.*

- John W. Valley (University of Wisconsin) will speak in honor of Penrose Medalist **Eric J. Essene** (deceased; Univ. of Michigan), highlighting Essene's contributions to the theoretical and experimental underpinnings of geothermobarometry.
- Arthur L. Day Medalist **George E. Gehrels** (University of Arizona) will reflect on his work applying the fundamental tools of chemistry and physics to the study of U-Th-Pb geochronology and tectonics.
- Donath Medalist **Dana L. Royer** (Wesleyan University) will elaborate on his studies of how plants can be used to reconstruct ancient environments and the (paleo-) physiological fundamentals behind these plant-environment relationships.

Questions from the audience are encouraged. GSA President Joaquin Ruiz will chair the program.

Come have a look at our NEW *digital* Hall of Fame on the lower level of the Colorado Convention Center outside the Four Seasons Ballroom.

This year, the Hall of Fame honors:

- Current and past GSA geoscience award winners;
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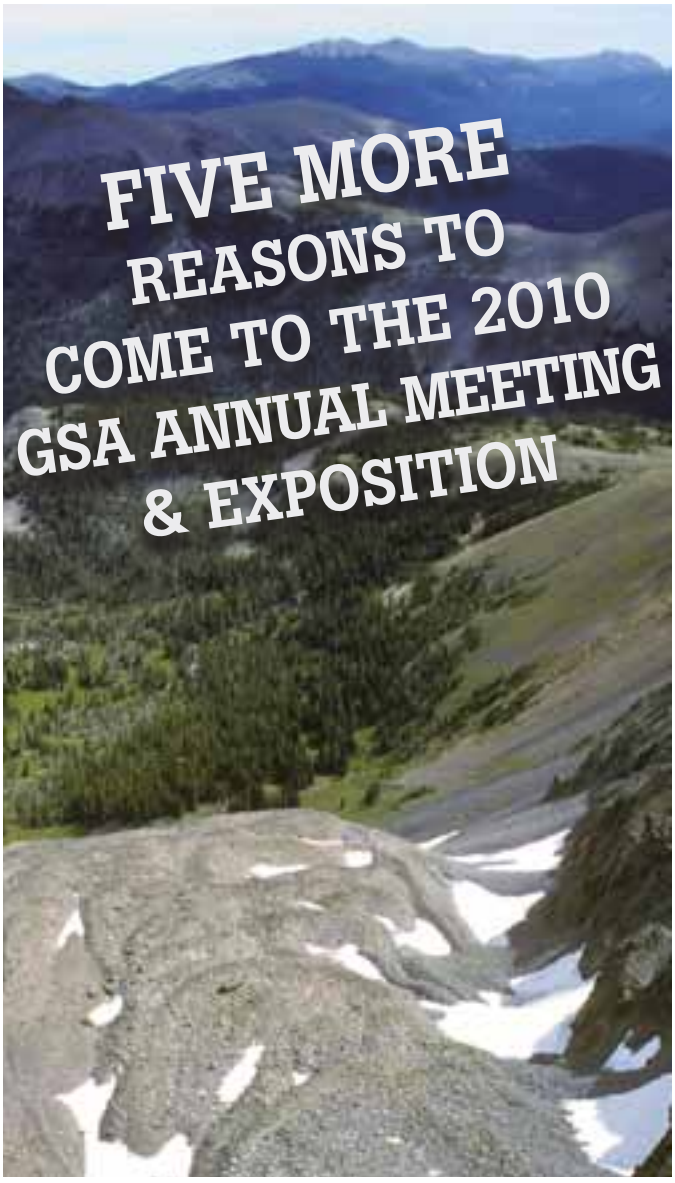

Rock glacier, northern Colorado. Photo by Marli Bryant Miller, University of Oregon, www.marlimillerphoto.com.

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Find it on Saturday at the Presidential Address & Awards Ceremony; Sunday at the Gold Medal Lectures; Monday during the Subaru Outdoor Life Lecture; and all meeting long at the Lunchtime Lectures, Pardee Symposia, and, the core of the meeting, the multifaceted technical program, which includes three new special sessions.

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Colorado is one of the nicest states in the lower 48 to visit, and our special tours and complimentary guest seminars will help show you why.

5. Professional Development.

Present your latest work, learn what your colleagues are doing, and discover fresh research ideas; pick up some continuing education credits through one of our 21 short courses, the field trips, or just through meeting attendance; and even meet with National Science Foundation representatives. One great strength of GSA's technical program is that it works to enhance current and future collaboration among students, those up & coming in the field, and established geoscientists in academia, government, industry, and private companies.

PURCHASE CARBON OFFSETS FOR YOUR TRIP

The Geological Society of America encourages attendees to offset travel emissions via the Colorado Carbon Fund. All contributions to the fund support new clean energy projects in Colorado that reduce greenhouse gas emissions. To participate, please check the box on your registration form, and we'll collect US$25 for the fund. If 10% of this year's 6,500 attendees donate, we could offset more than 800 tons of CO_2—that's equal to the emissions from burning nearly 90,000 gallons of gasoline.

Pardee Keynote Symposia

These unique interdisciplinary sessions cover issues on the leading edge of a scientific discipline or area of public policy and address broad, fundamental issues in the geosciences. Selection is on a competitive basis, all speakers are invited, and all sessions will take place at the Colorado Convention Center.

P1. **Symbiosis and Global Change in Ancient and Modern Earth Systems,** Tues., 2 Nov., 8 a.m.–noon.

P2. **Evolving Moon: Recent Advances in Understanding Our Planetary Neighbor from NASA's Lunar Reconnaissance Orbiter and Other Missions,** Mon., 1 Nov., 1:30–5:30 p.m.

P3. **Why Aren't Our Ideas Getting Attention? Finding a More Convincing Voice on Controversial Issues,** Sun., 31 Oct., 1:30–4:30 p.m.

P4. **Mineral Evolution: The Coevolution of the Geo- and Biospheres,** Mon., 1 Nov., 8 a.m.–noon.

P5. **Rapid Environmental/Climate Change in the Cretaceous Greenhouse World,** Wed., 3 Nov., 8 a.m.–noon.

P6. **Seeing the True Shape of Earth's Surface: Applications of Airborne and Terrestrial LiDAR in the Geosciences,** Sun., 31 Oct., 8 a.m.–noon.

P7. **Impacts of Ocean Acidification: The Other CO_2 Crisis,** Wed., 3 Nov., 1:30–5:30 p.m.

P8. **Exploring for Life in the Cosmos: Celebrating Five Decades of Astrobiology,** Tues., 2 Nov., 1:30–5:30 p.m.

Joseph T. Pardee

The Pardee Keynote Symposia are made possible by a grant from the Joseph T. Pardee Memorial Fund.

Diversity in the Geosciences Social Reception

Colorado Convention Center, Room 606
Tues., 2 Nov, 5:30–7:30 p.m.

The GSA Diversity in the Geosciences Committee and the NSF would like to invite you to this forum for socializing, sharing ideas, and meeting other geoscience community members interested in diversity issues.

Appetizers and cash bar provided.

New GSA Division Honors Peter W. Lipman

GSA's Mineralogy, Geochemistry, Petrology, and Volcanology (MGPV) Division will present its first Distinguished Geologic Career Award to **Peter W. Lipman,** USGS emeritus scientist, on Sun., 31 Oct., with a citation by Olivier Bachman. The presentation includes a 45-min. keynote lecture by Lipman, titled, "Southern Rocky Mountain cookbook for the making of large ignimbrite eruptions," followed by a special session with an international roster of speakers (see p. 17).

2010 GSA Annual Meeting & Exposition
Denver, Colorado, USA

Lunchtime Lectures Series

Thomas Ahlbrandt

GSA Lunchtime Lecture 3

Thomas Ahlbrandt, *Michel T. Halbouty Lecturer*
The Global Petroleum Revolution: A New Era

Tuesday, 2 Nov., 12:15–1:15 p.m.

Thomas Ahlbrandt is currently vice president of exploration at Falcon Oil and Gas in Denver, Colorado, USA, for which he manages unconventional oil and natural gas exploration in Hungary and Australia. He previously served as CEO and chairman of the board at PetroHunter Energy Corporation, and was the World Energy Project chief for the U.S. Geological Survey (USGS) in Denver.

While at the USGS, Ahlbrandt managed a group of 41 employees and led the 2000 USGS World Petroleum Assessment. The USGS assessment was the first of its kind to provide a rigorous geologic foundation for estimating undiscovered energy resources around the world. This analysis is summarized in American Association of Petroleum Geologists (AAPG) Memoir 86, *Global Resource Estimates from Total Petroleum Systems* (2005).

In addition to 22 years with the USGS, Ahlbrandt has 21 years of industry experience in exploration and research with ExxonMobil, BP-Amoco, Amerada Hess, and several independents, including MRO Associates; he was a founding partner of Petrostrat Exploration. He received his B.A. (1969) and Ph.D. (1973) degrees in geology from the University of Wyoming. During his career, Ahlbrandt has discovered conventional and unconventional oil and gas resources domestically (Rocky Mountain region) and overseas.

Ahlbrandt also serves as vice chairman of the United Nations Committee Ad Hoc Group of Experts on the Supply of Fossil Fuels. A report prepared by this group to harmonize the classification of reserve and resource terminology for oil, natural gas, coal, and uranium was adopted by the U.N. in 2004.

Ahlbrandt's contributions to geology have been recognized with numerous industry and association awards, including the Meritorious Service Award of the Department of Interior (2006), the AAPG's Distinguished Lecturer (2002–2003) and Distinguished Service awards (2002), Outstanding Scientist by the Rocky Mountain Association of Geologists (1999), and Distinguished Alumnus of the University of Wyoming (2000). He served on the AAPG Executive Committee as chair of the House of Delegates and as a U.S. representative for the World Petroleum Council from 1997 to 2003.

THE GEOLOGICAL SOCIETY OF AMERICA®

GSA's Lunchtime Lectures series offers four one-hour presentations (one for each day of the meeting) by high-profile speakers on broad topics relevant to today's world. Bring your lunch and prepare to be challenged and inspired! Information on each speaker will appear in subsequent issues of *GSA Today* as well as on the meeting Web site, www.geosociety.org/meetings/2010/.

Special Technical Sessions

NEW *This Year!* Three special sessions extend and enhance opportunities for diverse learning and presentation modes within the technical program. Each four-hour session will be structured by the individual organizers to best fit their purpose.

GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division Special Session

Colorado Convention Center, Room 203
Sunday, 31 Oct., 1:30–5:30 p.m.

In this session, GSA's new Mineralogy, Geochemistry, Petrology, and Volcanology (MGPV) Division will present its first Distinguished Geologic Career Award to GSA Fellow Peter W. Lipman, with a citation by Olivier Bachman. Lipman will present a 45-minute keynote talk, "Southern Rocky Mountain cookbook for the making of large ignimbrite eruptions." Next, an international roster of speakers will present 30-minute geologic overviews of some of Earth's major volcanic belts, including the Chilean Andes, the Trans-Mexican Volcanic Belt, the Basin and Range, the Sierra Madre Occidental, the Taupo Volcanic Zone, the Kamchatka Peninsula, and the Columbia River Basalt Group.

Structural Geology and Tectonics 30th Anniversary Symposium

Colorado Convention Center, Room 704/706
Tues., 2 Nov., 1:30–5:30 p.m.

2010 marks the 30th anniversary of GSA's Structural Geology and Tectonics Division (SG&T). This special symposium is designed to honor the Division, which is one of GSA's largest. Gary Axen of the New Mexico Institute of Mining and Technology and Kate Huntington of the University of Washington will deliver SG&T keynote lectures on their research. SG&T Outstanding Student Research Award recipients from the past five years will be encouraged to display posters of their current research, and the recipient of the inaugural Stephen E. Laubach Research in Structural Diagenesis Award will be announced. Merchandise bearing the one-off 30th anniversary SG&T logo will be available for sale; all proceeds will go directly to the newly established SG&T Division Student Fund, which will provide assistance to students to participate in meetings, short courses, and field trips. Following the symposium, SG&T will hold its annual business meeting, and recipients of the 2010 Outstanding Student Research Awards, Career Contribution Award, and Outstanding Publication Award will be honored.

Cutting-Edge Geoscience Exploration: The Best of AAPG

Colorado Convention Center, Room 103/105
Tues., 2 Nov., 1:30–5:30 p.m.

Three-dimensional seismic visuals, innovative structural geological applications, amazing application of the newest stratigraphic thinking—these concepts and more have captured presentation awards from a cadre of peers at the annual meetings of the American Association of Petroleum Geologists (AAPG). This session is designed to expose GSA attendees to the latest in *applied geoscience* for the advancement of resource development.

Neighboring volcanoes on Russia's Kamchatka Peninsula: Klyuchevskaya Volcano (north) and Bezymianny Volcano (south). False-color image captured by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) on NASA's Terra satellite on 13 Feb. 2010; http://earthobservatory.nasa.gov/IOTD/view.php?id=42758.

SUBARU

Outdoor Life Keynote Lecture

CELEBRATING EXPLORATION

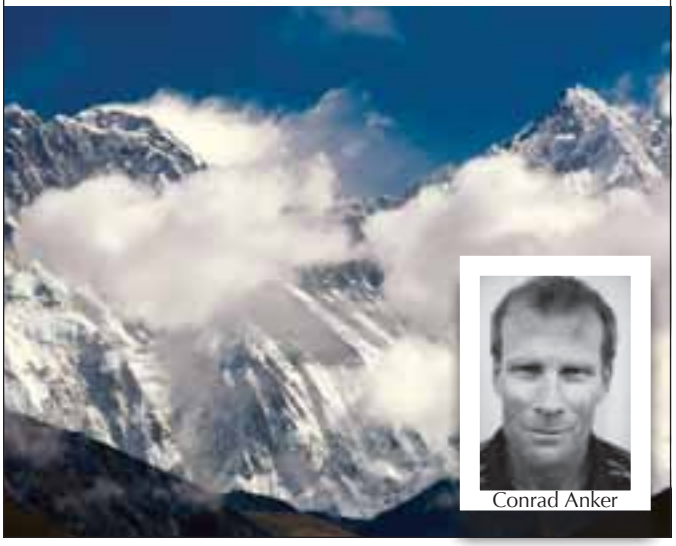
Colorado Convention Center
Monday, 1 Nov., 6–7 p.m.

Join American mountaineer Conrad Anker as he presents the behind-the-scenes story of his new documentary, *The Wildest Dream* (www.thewildestdreammovie.com; in theaters August 2010). Anker will share his experiences on Mount Everest through spectacular film footage, stunning photos, and thrilling stories as only he can tell them.

In May 1999, as a member of the Mallory & Irvine Research Expedition and en route to summiting Everest, Anker discovered the body of the eminent explorer George Mallory, whose disappearance, along with Sandy Irvine during their 1924 summit bid, had remained one of climbing's greatest mysteries. Anker's discovery and analysis of the find has shed new light on the pioneering climbs of early expeditions. Anker achieved his second summit of Everest on 14 June 2007 while filming *The Wildest Dream*, which is based on Mallory's quest.

Anker's specialty, simply put, is climbing the most technically challenging terrain in the world. This quest has taken him from the mountains of Alaska and Antarctica to the big walls of Patagonia and Baffin Island as well as the massive peaks of the Himalaya.

Anker will be available after his talk to sign his book, *The Lost Explorer*, co-written with David Roberts. Copies will also be available for sale (cash/check only).



Conrad Anker photo by Max Lowe Media.

SECOND ANNUAL PHOTO EXHIBITION

Geoscientists who are members of GSA and its Associated Societies will share their best geologic images at the 2010 Geological Society of America Photo Exhibition. The top 10 images juried into the show in each of four categories will be displayed in the Colorado Convention Center, and all submitted images will be shown on a large HD screen at the GSA booth. GSA meeting participants will vote for their favorites, and the top image in each category will be recognized with an award.

Categories:

Rocky Mountain regional geology; abstract images; geologic processes and features; and iconic landscapes.

Submission deadline:

10 September 2010; learn more in the June 2010 *GSA Today* (p. 16, www.geosociety.org/gsatoday/archive/20/).

Questions about the contest and exhibition may be directed to Ellen Bishop, +1-541-398-1810, paleobishop@gmail.com.

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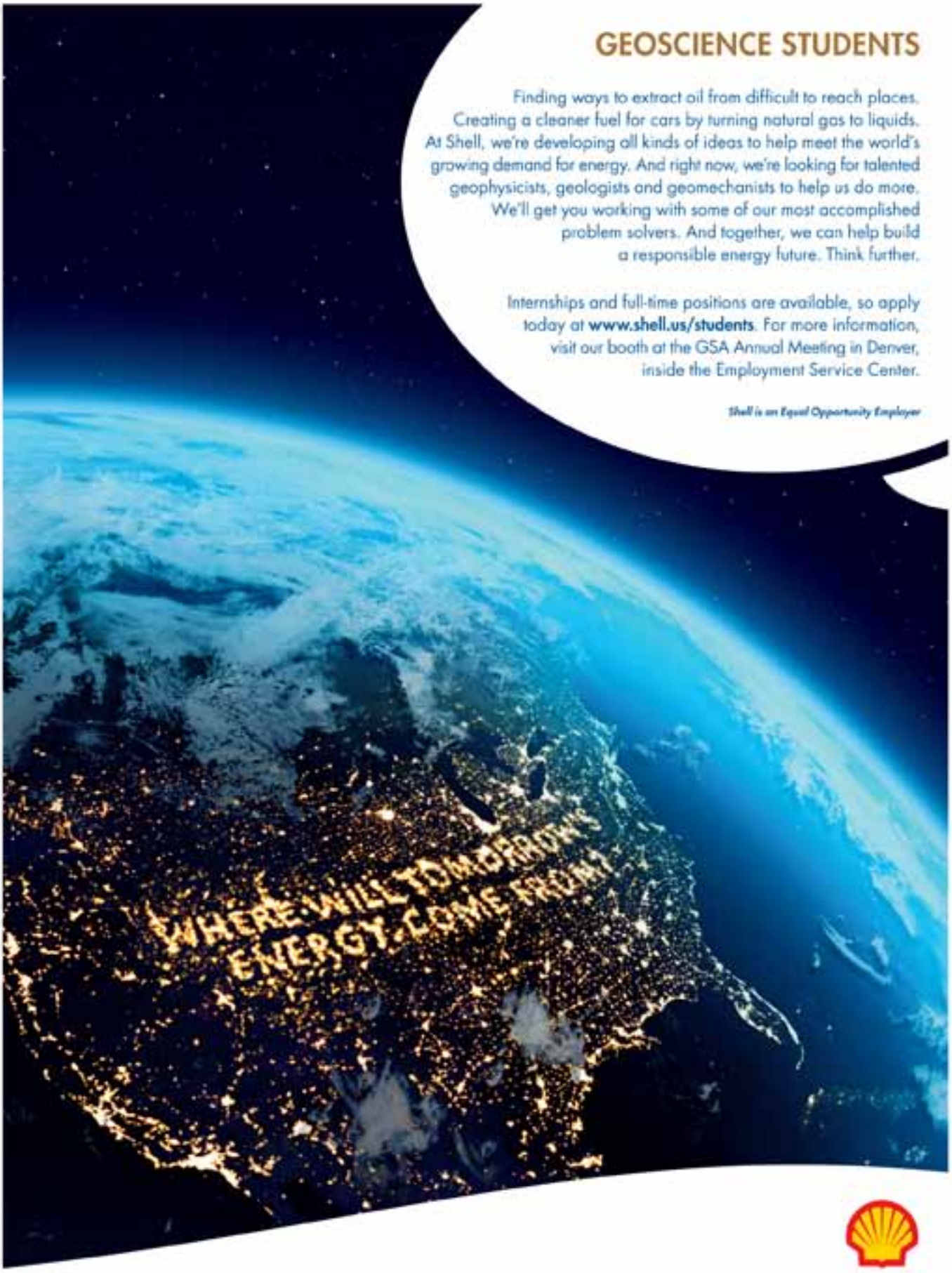


GEOSCIENCE STUDENTS

Finding ways to extract oil from difficult to reach places. Creating a cleaner fuel for cars by turning natural gas to liquids. At Shell, we're developing all kinds of ideas to help meet the world's growing demand for energy. And right now, we're looking for talented geophysicists, geologists and geomechanists to help us do more. We'll get you working with some of our most accomplished problem solvers. And together, we can help build a responsible energy future. Think further.

Internships and full-time positions are available, so apply today at **www.shell.us/students**. For more information, visit our booth at the GSA Annual Meeting in Denver, inside the Employment Service Center.

Shell is an Equal Opportunity Employer

Registration

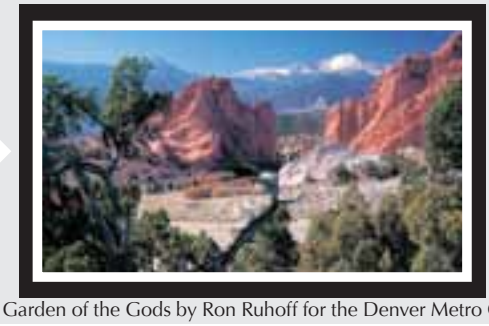
Has your abstract been accepted? Bringing a guest?
Going on a field trip or taking a short course?
Interested in getting new ideas for future research and collaboration?

Photo courtesy Denver Metro Convention & Visitors Bureau.

Save $$ by registering online before 27 September.

Online registration will be open throughout the meeting, but at an additional cost. Go to **www.geosociety.org/meetings/2010/reg.htm** for complete fee information, to register, or to download a hard-copy registration form.

We'll need your mailed* or faxed** hard-copy registration form by **29 October.** Beginning at 7 a.m. MDT on Saturday, 30 October, you'll be able to register onsite at the Colorado Convention Center, Lobby A.



Garden of the Gods by Ron Ruhoff for the Denver Metro Convention & Visitors Bureau.

Registration Desk Hours (30 Oct.–3 Nov.)

Saturday: 7 a.m.–6 p.m.

Sunday: 6:30 a.m.–8 p.m.

Monday & Tuesday: 7 a.m.–4:30 p.m.

Wednesday: 7 a.m.–11 a.m.

Royal Gorge Bridge; photo courtesy Denver Metro Convention & Visitors Bureau.

You'll need a badge for that…

When you get to the convention center, please check in at the advanced registration desk in Lobby A to pick up your badge. Badges are required for entrance to all annual meeting events.

Mountain goats; photo courtesy Denver Metro Convention & Visitors Bureau.

May we assist you?

GSA is committed to making the annual meeting accessible to everyone. If you need auxiliary aids or service because of a disability, please check the appropriate box on the registration form. If you have suggestions or need further information, contact William Cox, wcox@geosociety.org, +1-303-357-1013. It's best if you let us know your needs by 27 September.

***Mail to** The Geological Society of America, P.O. Box 9140, Boulder, CO 80301-9140, USA
****Fax to** +1-303-357-1071 **Phone:** U.S.: +1-303-357-1000 or +1-888-443-4472 • Outside the U.S.: +1-800-472-1988, option 3
www.geosociety.org/meetings/2010/

Presenter Information

Speaker Ready Room

Colorado Convention Center, Room 101

Fri., 29 Oct., 3–6 p.m.

Sat., 30 Oct., 8 a.m.–8 p.m.

Sun.–Tues., 31 Oct.–2 Nov., 6:30 a.m.–6:30 p.m.

Wed., 3 Nov., 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. Technicians will be on-hand to offer assistance.

To submit your presentation prior to the meeting (deadline: 11:59 p.m. EDT, 27 Oct.), please upload to the Conference Exchange Web site; see **http://gsa.confex.com/gsa/2010AM/cfp.epl.** 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 will not be able to submit your presentation prior to the meeting, please do so in the speaker ready room *the day before* your presentation. 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: If your presentation was created on a Mac and converted to run on a PC, please test it before you come 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. **We strongly recommend that you test your Mac-produced presentation** on a Windows-based system *before* coming to the meeting.

Technical Session Room Equipment

GSA will provide

- A laptop computer (with MS Office 2007). Presentations prepared on a Mac will work, but must be saved in a PC format;
- A speaker timer;
- An LCD projector and screen;
- A laser pointer; and
- A lectern/podium with light and microphone.

Poster Presentations

You will be provided one horizontal, freestanding 8-ft-wide × 4-ft-high display board along with Velcro for hanging your poster in the Exhibit Hall. Each poster booth will share a 6-ft by 30-in table, and electricity will be available in the poster area at no charge. Posters will be on display throughout the scheduled day (9 a.m.–6 p.m.); authors should be present either 9–11 a.m. *or* 2–4 p.m. and are encouraged to be at their posters during the 4:30–6 p.m. beer reception as well.

Poster Printing Service

GSA has again teamed up with DPi Printing to offer presenters the option of having posters printed in advance and available for pick up at the meeting. The approximate cost for an 8-ft × 4-ft poster is US$100. All orders must be prepaid and received on or before 28 October, and posters should be submitted as PDF files at final size.

1. Go to www.dpi-sf.com;
2. Click PLACE ORDER;
3. Create a login and password, then log in;
4. Select GSA2010;
5. Fill in the required information, attach the PDF file, and hit send.

Valid ID is required for pick up at the Poster Information Desk in Exhibit Hall B of the Colorado Convention Center. If you have questions, please contact DPi Printing either through their Web site or at +1-415-216-0031.

All presenters must pay the annual meeting registration fee.

Questions? Contact Nancy Wright, nwright@geosociety.org, +1-303-357-1061.

Travel & Transportation

Denver International Airport (DIA). Photo used with permission from the Denver Metro Convention & Visitors Bureau.

Air Travel

Denver International Airport (DIA; www.flydenver.com) is 24 miles northeast of downtown Denver and is serviced by all major airlines.

United Airlines Discount

Use code **585RS** to receive at least a 5% discount on roundtrip flights for the GSA Annual Meeting when you reserve by phone at +1-800-521-4041, online at www.united.com, or through your travel agent (with United MeetingsPlus). The discount applies to travel between 20 Oct.–13 Nov. 2010 only. Hertz offers up to 20% off car rental (discount code **CV02R30006**) when you reserve a car in conjunction with your United Airlines flight.

Train

Denver's Union Station, 1701 Wynkoop Street, is ~13 blocks from the Colorado Convention Center. The station is open 5 a.m.–9:30 p.m. daily. Union Station is served by **Amtrak's California Zephyr route.** Find route schedules and fare information at www.amtrak.com.

DIA Ground Transportation

The DIA ground transportation information desk (+1-303-342-4059) is on Level 5 of the main terminal and is open 6:30 a.m.–11:30 p.m. daily. All commercial transportation arrives and departs outside the Level 5 doors on both the east and west sides of the terminal. Passengers must wait outside at the designated terminal "island" for transportation pick up. Go to www.flydenver.com/parkinggt and select "Maps and Video" then "Ground Transportation" for a Level 5 map. All RTD buses are wheelchair/handicap accessible. Taxis and the SuperShuttle can provide assistance to limited numbers of people with prior notice and reservations.

Shuttle Service

The **SuperShuttle** counter (+1-303-370-1300) is also on Level 5. Shuttles operate daily every 15 min., 7 a.m.–5:15 p.m., and then as needed. SuperShuttle serves all downtown hotels from DIA for US$19 each way or US$38 roundtrip. Save US$6 on the roundtrip fare with discount code **GWMPA** when you reserve ahead by calling +1-800-258-3826 or going online at www.supershuttle.com. You can also use this code to save US$5 each way on private sedan/SUV trips to and from DIA.

Public Bus Service: RTD SkyRide

Route and fare information is available at the Regional Transportation District (RTD) desk on Level 5. Downtown Denver is served by **SkyRide route AF** (US$10 cash each way): Buses leave DIA for downtown every 30 min. from 6:45 a.m. to 12:45 a.m., and the trip takes ~55 min. Catch the bus from Island 5 outside Level 5 East Terminal exit door 511 or West Terminal exit door 506.

Taxis

Metro Taxi (+1-303-333-3333) and **Yellow Cab** (+1-303-777-7777) operate at the same flat rate of US$55 from DIA to downtown Denver and US$84 from DIA to Boulder; a US$3.50 gate fee applies to taxis leaving DIA. Taxi stands are located outside East Terminal exit doors 505/507 and West Terminal exit doors 510/512.

Car Rental

Multiple car rental companies operate on Level 5 of the main terminal. **Enterprise Rent-a-Car** offers a 5% discount when you make reservations online via the Enterprise Business Rental Program (www.enterprise.com; +1-800-593-0505) and use rental number **1299A11** and pin **GEO.** Receive up to a 20% discount with **Hertz** when you make reservations in conjunction with your United Airlines flight using discount number **CV02R30006.**

Downtown Denver and the Convention Center are connected by light rail. Photo by Steve Crecelius for the Denver Metro Convention & Visitors Bureau.

Publish with GSA

The Numbers Are In

The 2009 ISI impact factors are up from 2008 for *Geology*, *GSA Bulletin*, and *Geosphere*, according to the ISI Journal Citation Reports, and GSA was recently notified that *Lithosphere* has been accepted into the Science Citation Index and Web of Science.

GSA Bulletin has published definitive geoscience works since 1890—and it's as timely, relevant, and whip-smart as ever. Join a top-notch roster of international contributors: submit a paper to *GSA Bulletin.* 2009 impact factor: 3.101; 5-year: 4.324; cited half-life: >10 years. Submit online: http://www.editorialmanager.com/gsabulletin/

Geology articles are innovative, provocative, and timely. Of interest to a broad audience, papers in *Geology* often describe a significant advance in the field. 2009 impact factor: 4.368; 5-year: 4.843; cited half-life: >10 years. Submit online: http://www.editorialmanager.com/geology/

Geosphere targets an international audience with its high-quality research results from all geosciences fields. An online format encourages extensive use of color, animations, and interactivity. Impact factor: 1.681. Submit online: http://www.editorialmanager.com/geosphere/

Lithosphere, now accepted into the Science Citation Index and Web of Science, highlights research that addresses how the surface, crust, and mantle interact to shape the physical and chemical evolution of the lithosphere at all spatial and temporal scales. Submit online: http://www.editorialmanager.com/lithosphere/

Take a Free Peek at GSA's Online Journals

Click on the "Free Sample Issue" link at the following pages:

http://geology.geoscienceworld.org/
http://bulletin.geoscienceworld.org/
http://geosphere.geoscienceworld.org/
http://lithosphere.geoscienceworld.org/

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Have an idea for a book or a whole session's worth of papers? Consider making a permanent record of this work by publishing a GSA Special Paper organized and edited by you and your colleagues. GSA Special Papers are carefully prepared, are published quickly after acceptance, and have a worldwide distribution in print and online. Please communicate your interest by submitting a proposal to Don Siegel or Pat Bickford (GSA Books Editorial Office, Department of Earth Sciences, Syracuse University, 204 Heroy Geology Lab, Syracuse, NY 13244-1070, USA, +1-315-443-7300, gsabooks@syr.edu).

Events & Deadlines

27 September
- Early Registration Deadline
- Housing Deadline

4 October
- Registration Cancellation Deadline

27–30 October
- Premeeting Field Trips

29–31 October
- Short Courses & Workshops

30 October
- GSA Presidential Address & Awards Ceremony: 7–9 p.m.

31 October
- GSA Gold Medal Lectures
- Welcoming Party & Exhibits Opening: 6–8 p.m.

31 October–3 November
Technical Program
- Oral Sessions
- Posters: Hung all day with half-day sessions, authors present a.m. or p.m.

31 October–3 November
- Lunchtime Keynote Lectures: 12:15–1:15 p.m.

1 November
- Group Alumni Reception: 7–9:30 p.m.
- Private Alumni Receptions

1–2 November
- Exhibit Hall Open: 9 a.m.–6 p.m.

3 November
- Exhibit Hall Open: 9 a.m.–2 p.m.

4–6 November
- Postmeeting Field Trips

Housing

Deadline: 27 September

GSA has selected Visit Denver as our official housing bureau. Neither GSA nor Visit Denver will telephone or send faxes offering "special" Denver hotel rates. In the event you have problems with your reservation or accommodations, GSA can only assist in reconciling those issues if the reservation was booked through Visit Denver. If you have questions about an unauthorized solicitation, the online system, or about housing in general, please contact Becky Sundeen, bsundeen@geosociety.org.

Making Your Reservation

To take advantage of GSA meeting rates, please book your reservation by **27 September.** After this date, room blocks will be released and hotels may charge more for accommodations.

Please make your reservations using only ONE of the following options:

- Reserve online via link at www.geosociety.org/meetings/2010/;
- By FAX to +1-303-571-9435; or
- Print and mail the online housing form to GSA-Visit Denver Housing Bureau, 1555 California Street, Suite 300, Denver, CO 80202-4264, USA.

Questions only: Send an e-mail to housing@visitdenver.com (reference the GSA Annual Meeting and include your acknowledgment number) or call the Visit Denver Housing Bureau at +1-303-892-1112 ext. 601 (Mon.–Fri., 9 a.m.–4:45 p.m. MDT, excluding holidays).

Modifying/Canceling Your Reservation

On or before 21 October: Changes to name, stay dates, or address, as well as special requests can be made via www.geosociety.org/meetings/2010/ or by contacting the Visit Denver Housing Bureau.

After 21 October: All changes and cancellations must be made directly with the assigned hotel. Please DO NOT contact the hotel directly until after 21 Oct. 2010.

Cancellation requests received after 27 Sept. 2010 will be subject to a US$25 cancellation fee. Cancellations made within 72 hours of the scheduled arrival date are subject to a fee equal to one night's room rate plus tax. These fees will be charged to the credit card used to make the reservation.

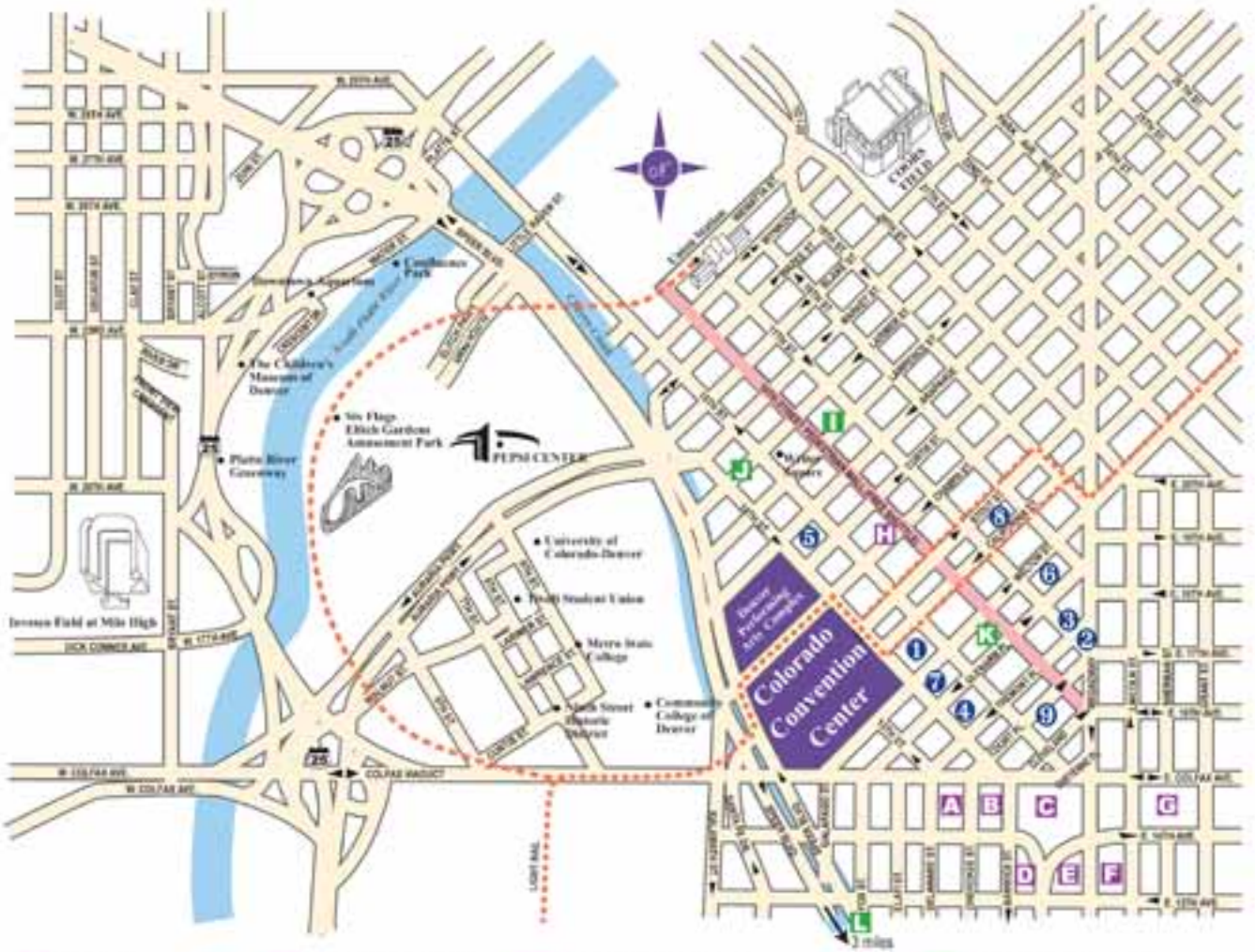
GSA Travel & Housing e-Bulletin Board

Need to share a room or arrange a carpool? Use the GSA Travel & Housing e-Bulletin Board at **www.geosociety.org/meetings/2010/lodging.htm.** This electronic bulletin board was a big success last year, thanks to you! Use this system to connect with other meeting attendees and talk about whatever you want, whenever you want. Meet new people, coordinate your schedules, and plan activities.

2010 GSA Annual Meeting & Exposition
Reaching New Peaks in Geoscience

Denver Street & Hotel Map

1. Hyatt Regency (Headquarters Hotel), 650 15th Street, Denver, CO 80202—US$185
2. Brown Palace, 321 17th Street, Denver, CO 80202—US$189
3. Comfort Inn, 401 17th Street, Denver, CO 80202—US$129
4. Crowne Plaza, 1450 Glenarm Place, Denver, CO 80202—US$139
5. Curtis (a Doubletree Hotel), 1405 Curtis Street, Denver, CO 80202—US$143
6. Grand Hyatt, 1750 Welton Street, Denver, CO 80202—US$172
7. Hilton Garden Inn, 1400 Welton Street, Denver, CO 80202—US$155
8. Marriott City Center, 1701 California Street, Denver, CO 80202—US$179
9. Sheraton Downtown, 1550 Court Place, Denver, CO 80202—US$155



- A U.S. Mint
- B Denver City & County Building
- C Civic Center Park
- D Denver Art Museum
- E Denver Public Library
- F Colorado History Museum
- G Colorado State Capitol Building
- H Denver Visitor Information Center
- I Tabor Center Shopping
- J Larimer Square Shopping
- K Pavilions Shopping
- L Cherry Creek Shopping

Thank You Sponsors:

Your support of the Geological Society of America's Annual Meeting & Exposition continues a tradition of more than a century of serving science and the profession. The Society appreciates your investment in the growth of current and future leaders in the geosciences community.

Double-Diamond (US$40,000+)

SUBARU

Subaru of America Inc.

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Chevron

Chevron

Columbia

Columbia Sportswear

EnCana
energy for people

EnCana Energy

Silver (US$2,500+)

RioTinto

Rio Tinto

Bronze (US$1,000+)
Alpha Natural Resources

Patron (US$500+)
Dennis Printing

Additional support from:
Earth Systems Imaging

GSA would like to acknowledge and give a special thank you to the GSA Foundation for their continued support.

Mentor Program Schedule

Hyatt Regency Denver, Centennial Ballroom A

Sun., 31 Oct., 5–6:30 p.m.

This mentor program, sponsored by Subaru of America Inc. and the Association for Women Geoscientists (AWG), addresses issues faced by women in geology. This informal gathering will begin with remarks from Kateryna Klochko (Subaru Outstanding Woman in Science Award recipient), Lori Eversull (Vulcan Materials), and Mary Anne Holmes (Univ. Nebraska), along with moderator Sara Welna (AWG President). A reception follows, with appetizers provided. We invite all GSA meeting attendees to take advantage of this forum for networking, sharing ideas, and getting to know other women geoscientists and geoscience educators.

Sponsored by

SUBARU

Association for Women Geoscientists

Geology in Government

Colorado Convention Center,
Four Season Ballroom 1

Mon., 1 Nov., 11:30 a.m.–1 p.m.

This popular program, sponsored by the GSA Foundation, features a FREE lunch for undergraduate and graduate students with a panel of mentors representing the Wisconsin Geological Survey, NASA, the National Science Foundation, the U.S. National Park Service, the U.S. Geological Survey, OSHA, and the GSA Congressional Science Fellowship. 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.

Geology in Industry

Colorado Convention Center,
Four Season Ballroom 1

Tues., 2 Nov., 7– 8:30 a.m.

Chevron

RioTinto

Alpha Natural Resources

ExxonMobil

Chevron, Rio Tinto, Alpha Natural Resources, ExxonMobil and the Society of Economic Geologists cosponsor this mentor program, which features a FREE breakfast for undergraduate and graduate students with a panel of mentors representing these companies, along with geoscientists from CH2M Hill, Western Mining, and Ames Construction. 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.

Invitation Only

John Mann Mentors in Applied Hydrogeology Program

This program underwrites the cost for up to 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 meeting by 27 September. The first 25 students who respond to an e-mail invitation on 28 September, based on these criteria, will receive FREE tickets for the luncheon.

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Full program descriptions are available at **www.geosociety.org/mentors/.**
Questions about Mentor Programs? Contact Jennifer Nocerino, jnocerino@geosociety.org.

FIELD TRIP FINANCIAL AID

Geology and Natural Hazards of Golden (Trip 410)

GSA's Engineering Geology Division will subsidize the first 33 student registrants for Trip 410. You must pay the full field-trip fee when registering, but will be reimbursed US$20 after the meeting.

Chalk Creek Valley: Colorado's Natural Debris Flow Laboratory (Trip 423)

The Engineering Geology Division will also help defray the cost of Trip 423 for both students (US$100) and regular Division members (US$30; new members included). Send applications for reimbursement to Bill Schulz, wschulz@usgs.gov.

Geologic History of the Gold Belt Byway & Western Pikes Peak Country (Trip 422)

The Paleontological Society will provide financial assistance to its student members to take part in Trip 422. Please send a statement about what you would hope to gain from this trip, the names and e-mail addresses of two references, and evidence of current student enrollment and Paleontological Society membership to Herb Meyer, herb_meyer@nps.gov.

Field Trips

Avoid the sting of missing out on a coveted field-trip opportunity!

It's not too late to sign up for a field trip, but they do fill up quickly, so we recommend you register soon. Read about all 25 proposed trips at **www.geosociety.org/meetings/2010/fieldTrips.htm.**

Fossil wasp (*Palaeovespa*) from Florissant Fossil Beds National Monument (trip 422); photo by Herb Meyer.

GSA EMPLOYMENT SERVICE CENTER

Looking for EMPLOYMENT in the geosciences?

Post your online profile and résumé now! This is a FREE service to all GSA members.

Looking for QUALIFIED CANDIDATES in the geosciences?

The **GSA Employment Service Center** offers a database of candidates seeking positions in more than 30 geoscience specialties.

- Search online by specialty, experience, location, and more;
- Post your open position(s);
- Access to the database is only US$300 through 30 April 2011.

Please take advantage of our interview services at the 2010 GSA Annual Meeting & Exposition on 1–2 November in Exhibit Hall B of the Colorado Convention Center. This service includes an interview booth, appointment scheduling, an area for job postings, and access to the applicant database.

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2010 Denver Employment Services Center, Sponsored by Shell

www.geosociety.org/Employment_Service/ • Toll Free +1-800-472-1988, ext. 1036

K–12 Education Events

Educators in the Denver area and visitors to our region will find a number of events to be of interest, including those noted below:

Geoscience Educators' Social Reception

Colorado Convention Center, Lobby B
Saturday, 30 Oct., 5–7 p.m.

Join other educators in a relaxing forum for socializing, sharing ideas, and meeting other geoscience community members interested in education. *Appetizers and cash bar provided.*

Field Trips

This year's field trips travel to locations as diverse as Morrison (dinosaur quarries; Red Rocks Amphitheatre) and Boulder (urban stream ecosystem), Colorado; Missoula (Lewis and Clark Line), Montana; and the Book Cliffs in eastern Utah. Check out at all 25 trips at **www.geosociety.org/meetings/2010/fieldTrips.htm.**

Short Course Recommendations for K–12 Teachers

Read course descriptions at **www.geosociety.org/meetings/2010/courses.htm.**

508. **Education Research I: Conducting Qualitative Geoscience Education Research.** Sat., 30 Oct., 8 a.m.–noon. Fee: US$118. Limit: 35. CEU: 0.4.

517. **A City State-of-Mind: Creating Effective Geoscience Assignments for Urban Students.** Sat., 30 Oct., 9 a.m.–5 p.m. Fee: US$70. Limit: 20. CEU: 0.8.

518. **Education Research II: Conducting Quantitative Geoscience Education Research.** Sat., 30 Oct., 1–5 p.m. Fee: US$118. Limit: 35. CEU: 0.4.

520. **Analogue to Digital/Mapping to GIS.** Sat., 30 Oct., 9 a.m. –5 p.m. Fee: US$39; includes lunch. Limit: 18. CEU: 0.8.

521. **Engaging Tomorrow's Decision-Makers in Today's Geoscience.** Sat., 30 Oct., 1–5 p.m. Fee: US$32. Limit: 50. CEU: 0.4. *Attendees will need to bring laptop computers.*

President's Student Breakfast Reception

Sunday, 31 Oct., 7–8:30 a.m.

Colorado Convention Center,
Four Seasons Ballroom 1

GSA President Joaquin Ruiz invites all students registered for the meeting to attend a free breakfast buffet sponsored by ExxonMobil Corporation. Ruiz and members of GSA leadership, along with ExxonMobil staff members, will be on hand to answer questions and address student issues.

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—it's a great opportunity to network with fellow students, and meet representatives of GSA.

Joaquin Ruiz. Photo © FOTOSMITH.

Sponsored by

ExxonMobil

Hosted by GSA

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Coffee and Beer BREAKS

Colorado Convention Center

Coffee (while it lasts)
Sun., 9 a.m., Exhibit Hall B (Poster Sessions)
Mon.–Wed., 9 a.m., Exhibit Halls A & B

Beer
Mon.–Wed., 4:30–5:30 p.m.,
Exhibit Halls A & B
All registered attendees will receive tickets for a complimentary beer at each afternoon beer break.

Personal Scheduler

GSA's *personal scheduler* is a simple, effective planning tool available to you at no charge.

We invite you to access the scheduler at **http://gsa.confex.com/gsa/2010AM/scheduler/index.epl.** Use it to search or browse meeting events, find exhibits you want to visit, and note presentations you don't want to miss. You can even write yourself a memo and create your own schedule of events, check it for conflicts, and download it to your computer, PDA, or smart phone.

The Personal Scheduler—a simple, effective planning tool available to you at no charge.

Guest Program

President's Guest Breakfast

Monday, 1 Nov., 8:30–9:15 a.m.

Consider this your invitation…

GSA's president and executive director are looking forward to meeting you during this complimentary breakfast just for registered guests.

Guest Hospitality Suite

Hyatt Regency Denver at Colorado Convention Center, Room Agate A/B.
Sun.–Wed., 31 Oct.–3 Nov., 8 a.m.–5:30 p.m.

GSA's Guest Hospitality Suite includes complimentary seminars, light food and beverages throughout the day, a welcome gift, and the President's guest breakfast. Suite staff will be on-hand to assist you with questions regarding restaurants, activities, and attractions, as well as offer general information about Denver.

As a registered guest, you are welcome to attend your companion's technical session(s), and you will also have admittance to the exhibit hall. In addition, you have the opportunity to sign up for professional field trips (additional fees apply) or attend open lectures.

COMPLIMENTARY GUEST SEMINARS

Guest Hospitality Suite, 10–11 a.m. *daily*
Sunday, 31 Oct.: **Jewelry by Beth Finesilver**
Monday, 1 Nov.: **Flute & Storytelling**
Tuesday, 2 Nov.: **Birds of Prey**
Wednesday, 3 Nov.: **Halfway to Heaven**

SPECIAL TOURS

All annual meeting attendees and guests are welcome to register for the following tours. Prices for these tours cover professional tour guide fees, transportation, admission, and gratuities. **Tours may be canceled if minimum attendance is not met, so please register early!**

Tour participants should check in at the Guest Hospitality Suite to be directed to the departure location at the Hyatt Regency Denver. Plan to arrive at the departure location 15–30 minutes before the scheduled departure time to ensure that you don't miss the bus; GSA is unable to refund tour costs. **We recommend** that you periodically check **www.geosociety.org/meetings/2010/** for updates and news about tours and seminars.

SUNDAY (31 Oct.)

Tour 101. **Haunted Denver**
1–4 p.m. Cost: US$44; minimum attendance: 20.

Get into the "spirit" of Halloween with a tour through Denver's most beautiful older neighborhoods. Enjoy some of Denver's architectural wonders while exploring the characters and events that inspired some of the city's best-known ghost stories. Highlights of the tour include John and Mary Elitch and their haunted amusement park; the imposing Lumber Baron Inn Bed and Breakfast; Horace and Baby Doe Tabor; the ghosts of Capitol Hill and its mansions; and a tour of old Mount Prospect Cemetery, known as Cheesman Park today.

MONDAY (1 Nov.)

Tour 102. **Georgetown Loop Railroad**
8:30 a.m.–2:30 p.m. Cost: US$84; minimum attendance: 20.

Enjoy an excursion into the high Rockies to Georgetown, an authentic 1860–1870s silver mine "boomtown." You will experience the Colorado Historical Society's Georgetown Loop Railroad, which travels between the towns of Georgetown and Silver Plume, taking you over the reconstructed Devil's Gate High Bridge and through spectacular Colorado mountain scenery. The tour concludes with free time in Georgetown to enjoy lunch and do some shopping.

TUESDAY (2 Nov.)

Tour 103. **Rocky Mountain Rendezvous and Historic Estes Park**
9 a.m.–6 p.m. Cost: US$94; minimum attendance: 20.

Your tour will begin with a drive up the spectacular U.S. 36 canyon to Estes Park, the eastern gateway to Rocky Mountain National Park. Early November is the tail-end of elk mating season, when the elk spend most of their time at lower elevations, making for great photo opportunities. You will tour Rocky Mountain National Park by motor coach, visiting the most scenic spots and landmarks. The tour will return to the charming town of Estes Park, where you will have free time to enjoy lunch and do some shopping. To keep you in the Halloween spirit, the excursion continues with a 90-minute behind-the-scenes ghost tour of the historic Stanley Hotel, which has long been considered one of America's most haunted hotels. The Stanley is also known for its architecture, famous visitors, and as the inspiration for Stephen King's novel, *The Shining*.

Tour 104. **A Colorado Castle**
1–5 p.m. Cost: US$95; minimum attendance: 20.

Cherokee Ranch & Castle is perched on a hilltop in Sedalia, Colorado, and showcases stunning views of the Rockies. Constructed between 1924 and 1926, the castle features architectural details drawn from English and Scottish castles. Today, Cherokee Castle is a museum housing historic collections of fine art, furnishings, and memorabilia from around the world. Art lovers often visit to see original drawings by Sir Christopher Wren, the architect of St. Paul's Cathedral in London. This tour covers details of the castle's history and architecture, as well as its unique furnishings and art collections. The visit includes a traditional afternoon English-style tea, with four kinds of tea and a delicious assortment of scones, pastries, and tea sandwiches.

WEDNESDAY (3 Nov.)

Tour 105. **Hammond's Candy Factory**

10 a.m.–noon. Cost: US$30; minimum attendance: 20.

Hammond's Candy Factory has been creating sweet treats in Denver since 1920. Over the years, the factory has outgrown itself and changed locations around the Denver area, but the candy is still made the way Carl Hammond made it, with the same tempting recipes and the same careful craftsmanship. Hundreds of different candies are manufactured in the factory, and guests will experience the sweet indulgence of an insider's tour. Guests will be guided through parts of the factory while hearing stories about the history of the famous candies and watching candy makers busy at work. The tour concludes with candy samples and a visit to the candy store.

2010 GSA Annual Meeting & Exposition
Reaching New Peaks in Geoscience

Short Courses

Short Courses fill up quickly; we recommend you register as soon as you decide which course is right for you. Signing up early can also save you money: After 27 Sept., short course fees increase by US$30 (except for K–12 teacher members).

For course descriptions, go to **www.geosociety.org/meetings/2010/courses.htm.** If you have questions about the courses or the continuing education units (CEUs) offered, please contact Jennifer Nocerino, jnocerino@geosociety.org.

501. **Training Session for Gale, A Free, Parallel Tectonics Code.** Sat., 30 Oct., 8 a.m.–5 p.m. FREE; includes continental breakfast and lunch. Limit: 50. CEU: 0.9. *Attendees will need to bring laptop computers.*

502. **Field Hydrogeology.** Sat., 30 Oct., 8 a.m.–5 p.m., US$210. Limit: 50. CEU: 0.9.

503. **Introduction to Near-Surface Geophysics for Non-Geophysicists.** Sat., 30 Oct., 8 a.m.–5 p.m., US$150. Limit: 45. CEU: 0.9.

Faculty/Graduate Student Courses

504. **Field Safety Leadership.** Fri.–Sat., 29–30 Oct., 8 a.m.–5 p.m., US$25; includes continental breakfast and lunch. Limit: 24. CEU: 1.8.

505. **Fundamentals of Seismic Structural Interpretation and Trap Analysis: Petroleum Industry Applications.** Fri.–Sat., 29–30 Oct., 8 a.m.–5 p.m., US$25; includes continental breakfast and lunch. Limit: 30. CEU: 1.8.

506. **Sequence Stratigraphy for Graduate Students.** Fri.–Sat., 29–30 Oct., 8 a.m.–5 p.m., US$25. Limit: 60. CEU: 1.8.

507. **Structural and Stratigraphic Concepts Applied to Basin Exploration.** Fri.–Sat., 29–30 Oct., 9 a.m.–5 p.m., US$25; includes continental breakfast and lunch. Limit: 30. CEU: 1.6.

508. **Education Research I: Conducting Qualitative Geoscience Education Research.** Sat., 30 Oct., 8 a.m.–noon, US$118. Limit: 35. CEU: 0.4.

509. **Using Online Volcano Monitoring Data in College and University Courses: The Volcano Exploration Project, Pu'u 'Ō'ō.** Sat., 30 Oct., 8 a.m.–noon, US$84; includes continental breakfast. Limit: 30. CEU: 0.4. *Attendees will need to bring laptop computers.*

510. **An Introduction to Using Active Learning to Reduce Student Misconceptions about Plate Tectonics.** Sat., 30 Oct., 8 a.m.–noon, US$25. Limit: 40. CEU: 0.4.

511. **Establishing and Sustaining an Undergraduate Research Program: A Professional Development Workshop for New and Future Faculty.** Sat., 30 Oct., 8 a.m.–5 p.m., US$50; includes continental breakfast and lunch. Limit: 30. CEU: 0.9.

512. **Terrestrial Laser Scanning (Ground-Based LiDAR) Methods and Applications in Geologic Research and Education.** Sat., 30 Oct., 8 a.m.–5 p.m., US$80; includes lunch. Limit: 20. CEU: 0.9.

513. **Knowledge Surveys: An Organization and Assessment Tool with Countless Benefits.** Sat., 30 Oct., 8 a.m.–5 p.m., US$61; includes continental breakfast. Limit: 30. CEU: 0.9.

514. **On the Cutting Edge Workshop: Teaching about Energy in Geoscience Courses.** Sat., 30 Oct., 8 a.m.–5 p.m., US$70. Limit: 40. CEU: 0.9. *Attendees will need to bring laptop computers.*

515. **Using Geoinformatics Resources to Explore the Generation of Convergent Margin Magma.** Sat., 30 Oct., 9 a.m.–5 p.m., US$25; includes continental breakfast and lunch. Limit: 20. CEU: 0.8. *Attendees will need to bring laptop computers.*

516. **U-Pb Geochronology and Hf Isotope Geochemistry Applied to Detrital Minerals.** Sat., 30 Oct., 9 a.m.–5 p.m., US$25; includes continental breakfast and lunch. Limit: 25. CEU: 0.8.

517. **A City State-of-Mind: Creating Effective Geoscience Assignments for Urban Students.** Sat., 30 Oct., 9 a.m.–5 p.m., US$70. Limit: 20. CEU: 0.8.

518. **Education Research II: Conducting Quantitative Geoscience Education Research.** Sat., 30 Oct., 1–5 p.m., US$118. Limit: 35. CEU: 0.4.

519. **Introduction to Geographic Information Systems (GIS) Using ArcGIS for Geological and Environmental Science Applications.** Sat.–Sun., 30–31 Oct., 9 a.m.–5 p.m., US$31. Limit: 20. CEU: 1.6.

K–12 Teacher Courses

520. **Analogue to Digital/Mapping to GIS.** Sat., 30 Oct., 9 a.m.–5 p.m., US$39; includes lunch. Limit: 18. CEU: 0.8.

KEY: —Faculty; —Graduate Student; —K–12 Teacher; —Professional

Short Courses continued

521. **Engaging Tomorrow's Decision-Makers in Today's Geoscience.** Sat., 30 Oct., 1–5 p.m., US$32. Limit: 50. CEU: 0.4. *Attendees will need to bring laptop computers.*

GSA Associated Society Courses

522. **Environmental Geochemistry for Modern Mining** (Society of Economic Geologists [SEG]). Fri.–Sat., 29–30 Oct., 8 a.m.–5:30 p.m. Early Registration (on or before 30 Sept.): Members, US$395; nonmembers, US$495; member students, $US195; nonmember students, US$245. Late Registration (after 30 Sept.): Members, US$495; nonmembers, US$595; member students, US$245; nonmember students, US$295. Limit: 100. ***Course registration through SEG only*** via e-mail at seg@segweb.org or by phone +1-720-981-7882.

523. **Quantitative Methods in Paleobiology** (The Paleontological Society). Sat., 30 Oct., 8:30 a.m.–5 p.m. FREE. Limit: 400.

Graduate School Information Forum

Colorado Convention Center, Exhibit Hall B • Sun.–Wed., 31 Oct.–3 Nov., 8 a.m.–6 p.m.

Searching for the right graduate school? Meet with university representatives from across the United States at the Graduate School Information Forum. This page lists institutions indicating their participation as of press time; for updates, go to **http://rock.geosociety.org/gsif/.** Check also for universities in the Exhibit Hall (p. 41).

UNIVERSITIES	SUN	MON	TUE	WED
Ball State Univ. Dept. of Geology	X			
Binghamton Univ.		X		
Central Washington Univ.	X	X		
Clemson Univ. Environmental Engineering & Earth Sciences		X		
Colorado School of Mines	X	X	X	
Colorado State Univ.		X		
Dartmouth College Earth Sciences Dept.	X	X		
Duke Univ. Div. of Earth & Ocean Sciences	X	X	X	
East Carolina Univ. Dept. of Geological Sciences	X	X		
Indiana State Univ. Earth & Environmental Systems		X		
Iowa State Univ. Dept. of Geological & Atmospheric Sciences		X		
Kansas State Univ. Dept. of Geology	X			
Miami Univ. Dept. of Geology	X	X		
Michigan State Univ.	X	X	X	
Missouri State Univ.	X	X		
Missouri Univ. of Science & Technology		X	X	
Northwestern Univ. Dept. of Earth & Planetary Sciences		X		
Ohio State Univ. School of Earth Sciences	X	X	X	
Oklahoma State Univ. School of Geology	X	X		
Penn State Univ. Geosciences Dept.	X	X		
Purdue Univ. Dept. of Earth & Atmospheric Sciences	X	X		
Rice Univ.		X	X	
San Diego State Univ.		X		
South Dakota School of Mines & Technology Dept. of Geology & Geological Engineering	X	X	X	
SUNY College at Oneonta	X	X	X	
Syracuse Univ.	X	X	X	
Texas A&M Univ. Dept. of Geology & Geophysics		X	X	
Texas Tech Univ.	X	X		
The Univ. of Alabama	X	X		
The Univ. of Montana	X			
The Univ. of Texas at San Antonio	X	X		
The Univ. of Texas at El Paso Dept. of Geological Science	X	X	X	
The Univ. of Tulsa	X	X		
Tulane Univ.	X	X	X	
Univ. of Arkansas–Fayetteville	X	X	X	
Univ. of California–Riverside	X	X		

UNIVERSITIES	SUN	MON	TUE	WED
Univ. of Cincinnati		X	X	
Univ. of Connecticut	X			
Univ. of Florida	X	X		
Univ. of Idaho	X	X		
Univ. of Kansas	X	X	X	
Univ. of Massachusetts–Amherst	X	X		
Univ. of Michigan	X	X	X	X
Univ. of Minnesota–Duluth	X	X		
Univ. of Nebraska–Lincoln Dept. of Geosciences	X			
Univ. of Nebraska–Lincoln School of Natural Resources	X	X	X	
Univ. of North Carolina–Charlotte Dept. of Geography & Earth Sciences	X	X		
Univ. of North Dakota		X		
Univ. of Notre Dame Dept. of Civil Engineering & Geological Sciences	X	X	X	
Univ. of Oklahoma School of Geology & Geophysics	X	X	X	
Univ. of Southern California Dept. of Earth Sciences	X	X	X	X
Univ. of Utah		X		
Univ. of Wisconsin	X	X		
Utah State Univ.	X	X	X	X
Vanderbilt Univ.	X	X		
Virginia Tech	X	X	X	
Western Michigan Univ.	X	X		

Exhibitors by Category

Colorado Convention Center, Exhibit Hall

(As registered by press time.)

Computer Software
Environmental Systems Research Institute Inc. (ESRI)
Golden Software Inc.
International Centre for Diffraction Data

Gems/Minerals Dealers, Jewelry/Gifts
Cal Graeber
Crystals Unlimited
Delight's Earthly Delights
Evogeneao
Finesilver Designs
Gems & Crystals Unlimited
GEOGRAPHICS
IKON Mining & Exploration
Janice Evert Opals
Komodo Dragon
Nature's Own
Xeno Designs

General Educational Products
Armfield Inc.
Cengage Learning - Brooks/Cole
Gemological Institute of America
Little River Research & Design
PALEOMAP Project
Renaissance Geology Group, Univ. of California–Berkeley
Ward's Natural Science Est. LLC
Waveland Press

Geographic Supplies and Related Equipment
Estwing Manufacturing Co.
Forestry Suppliers Inc.
Rite in the Rain

Geological Society of America
GSA Bookstore
GSA Foundation
GSA Geoinformatics Division
GSA Geology and Public Policy Committee
GSA Geology and Society Division
GSA Geoscience Education Division
GSA Headquarters Services
GSA History of Geology Division & History of Earth Sciences Society
GSA Hydrogeology Division
GSA Limnogeology Division
GSA Membership
GSA Planetary Geology Division
Minnesota Local Committee

Geological and Geophysical Instrumentation
Advanced Geosciences Inc.
ASC Scientific
Beckman Coulter Inc.
Bruker AXS Inc.
Cameca Instruments Inc.
Campbell Scientific Inc.
elementar Americas Inc.
EmCal Scientific Inc.
Gatan Inc.
Geophysical Survey Systems Inc.
Hach Hydromet
Horiba Instruments Inc.
In-Situ Inc.
Innov-X Systems
IsotopX Inc.
IXRF Systems Inc.
Leica Microsystems
Los Gatos Research
MALA GeoScience USA Inc.
Meiji Techno America
Optech Incorporated
Picarro Inc.
Rigaku Americas Corp.
Sensors & Software Inc.
Spectral Evolution
Thermo Scientific

Government Agencies (Federal, State, Local, International)
NASA
National Park Service
National Science Foundation
NOAA/NESDIS/National Geophysical Data Center
Office of Surface Mining
Rocky Mountain Oilfield Testing Center
U.S. Bureau of Land Management
U.S. Forest Service (USDA)
U.S. Geological Survey

Other
Consortium for Ocean Leadership
Consortium of Universities for the Advancement of Hydrologic Science Inc. (CUAHSI)
Council for International Exchange of Scholars
EarthScope
GEON
Geoprobe Systems
IRIS Consortium
Kendall Hunt Publishing Co.
Meet Minneapolis: Official Convention & Visitors Assoc.
Pyrolyzer LLC
Research Partnership to Secure Energy for America (RPSEA)
Retsch Inc.
Subaru of America Inc.
UNAVCO

Professional Societies and Associations
AAPG Bookstore/Student Programs
AASP - The Palynological Society
American Geological Institute
American Geophysical Union
American Institute of Professional Geologists
American Meteorological Society
American Quaternary Assoc.
Assoc. for Women Geoscientists
Assoc. of American State Geologists
Assoc. of Earth Science Editors
Assoc. of Environmental & Engineering Geologists
Clay Minerals Society
Colorado Scientific Society
Council on Undergraduate Research (CUR) Geoscience Division
Cushman Foundation
EARTHTIME
Environmental & Engineering Geophysical Society
European Geosciences Union (EGU)
Geochemical Society
Geological Assoc. of Canada (GAC)
Geological Society of London
Geoscience Information Society (GSIS)
GeoScienceWorld (GSW)
GSA Engineering Geology Division
International Assoc. of GeoChemistry
International Union of Geological Sciences
Karst Waters Institute
Mineralogical Assoc. of Canada
Mineralogical Society of America
National Assoc. of Black Geologists and Geophysicists
National Assoc. of Geoscience Teachers (NAGT)
National Cave and Karst Research Institute
National Earth Science Teachers Assoc. (NESTA)
Paleontological Society
Sigma Gamma Epsilon
Society for Sedimentary Geology (SEPM)
Sociedad Geología Mexicana
Society for the Preservation of Natural History Collections (SPNHC)
Society of Economic Geologists (SEG)
The Microbeam Analysis Society

Publications, Maps, Films
Allen Press Inc.
Cambridge University Press
Columbia University Press
Elsevier
McGraw-Hill Publishers
Micropaleontology Project
Mountain Press Publishing Co.
Nature Publishing Group
NRC Research Press
Paleontological Research Institution
Pearson
Sociedad Geológica Mexicana
Springer
Taylor & Francis
Treatise on Invertebrate Paleontology, Univ. of Kansas
University of California Press
University of Chicago Press
W.H. Freeman
W.W. Norton & Company
Wiley-Blackwell

Services (Exploration, Laboratories, Consulting, and Others)
Activation Laboratories Ltd.
Beta Analytic Inc.
Encana Corporation

Environmental Isotope Lab
GNS Science–Rafter Radiocarbon
Isotope Tracer Technologies
Ruen Drilling Inc.
Wells Research Laboratory Inc. (WRL)

State Surveys
Colorado Geological Survey

Universities/Schools
Baylor Univ. Dept. of Geology
China Univ. of Geosciences (Wuhan)
Colorado School of Mines Dept. of Geology & Geological Engineering
Geocognition Research Laboratory
Geoinformatics for the Geosciences
Instituto de Geología, Universidad Nacional Autónoma de México
Kansas State Univ. Geology Dept.
Louisiana State Univ. Dept. of Geology & Geophysics
Mississippi State Univ.
Space Science Institute
The Univ. of Texas at Austin Jackson School of Geosciences
The Univ. of Texas at Dallas
University Corporation for Atmospheric Research (UCAR)
Univ. of Nevada–Las Vegas
Univ. of Nevada–Reno
Univ. of Wyoming Geology & Geophysics Dept.

Exhibit Hall Hours

Sunday, 31 Oct., 6–8 p.m.
Monday, 1 Nov., 9 a.m.–6 p.m.
Tuesday, 2 Nov., 9 a.m.–6 p.m.
Wednesday, 3 Nov., 9 a.m.–2 p.m.

GSA Lunchtime Lectures

Colorado Convention Center
Sun.–Wed., 12:15–1:15 p.m.

The second year of GSA's new Lunchtime Lecture series promises to be as good as the first! Please pencil these lunchtime events into your schedule and check coming issues of *GSA Today* for topic highlights.

- ☑ Sunday, 31 Oct.: **Marcia Kemper McNutt,** Director of the United States Geological Survey
- ☑ Monday, 1 Nov.: **Timothy Killeen,** Assistant Director for the Geosciences, National Science Foundation
- ☑ Tuesday, 2 Nov.: *2010 Halbouty Lecturer* **Thomas Ahlbrandt,** Vice President of Exploration, Falcon Oil and Gas Ltd.
- ☑ Wednesday, 3 Nov.: **Haiti's Catastrophic Earthquake of 12 January 2010: Lessons Learned,** with moderator **Timothy H. Dixon,** University of Miami, and panelists **Roger Bilham,** University of Colorado; **Eric Calais,** Purdue University; and **Carol S. Prentice,** U.S. Geological Survey.

Childcare at the GSA Annual Meeting & Exposition

Location: Colorado Convention Center, Room 610–612

Days and Times
Sat., 30 Oct., 7 a.m.–6 p.m.
Sun., 31 Oct., 7 a.m.–7:30 p.m.
Mon.–Wed., 1–3 Nov., 7 a.m.–6 p.m.
Fee: US$7 per hour, per child; 2-hr min.
Register at www.kiddiecorp.com/gsakids.htm

Deadline: 27 September

(*This service may be cancelled if minimum enrollment is not met, so please register as soon as you know your childcare needs.*)

Age range: Six months to 12 years.

Children enrolled in the program will enjoy games, story time, arts and crafts, and other fun-filled activities for each age group.

KiddieCorp has provided high-quality programs to children at conventions, trade shows, and corporate events in the United States and Canada since 1986 and has worked with GSA meetings since 2005. For more information, contact meetings@geosociety.org.

Childcare services are a contractual agreement between each individual and the childcare company. GSA assumes no responsibility for the services rendered.

ANNUAL

Geoscience Educators' Social Reception

Colorado Convention Center, Lobby B
Sat., 30 Oct., 5–7 p.m.

The GSA Education Committee, the National Association of Geoscience Teachers (NAGT), the GSA Geoscience Education Division, Cutting Edge, the IRIS Consortium, the American Geological Institute (AGI), the Digital Library for Earth System Education (DLESE), the National Earth Science Teachers Association (NESTA), and UNAVCO invite all educators to a relaxing forum for socializing, sharing ideas, and meeting other geoscience community members interested in education.

Appetizers and cash bar provided.

Welcome Reception for Two-Year Geoscience Faculty

Colorado Convention Center, Lobby B
Sat., 30 Oct, 4–5 p.m.

Teach in a two-year college? Please join us at this welcome reception just before the main educators' social. Use this time to get to know your fellow two-year geoscience faculty and discuss the specific needs of community and junior college programs.

FIELD FORUM REPORT

Significance of Along-Strike Variations for the 3-D Architecture of Orogens: The Hellenides and Anatolides in the Eastern Mediterranean

16–22 May 2010
Samos, Greece, and Selçuk, West Turkey

CONVENERS

Uwe Ring, *Dept. of Geological Sciences, Canterbury University, Christchurch 8004, New Zealand*

Klaus Gessner, *Centre for Exploration Targeting M006, The University of Western Australia, 35 Stirling Highway, Crawley WA 6009, Australia*

Talip Güngör, *Dept. of Geology, Dokuz Eylül University, Turkey*

Nikos Skarpelis, *Dept. of Geology and Geoenvironment, University of Athens, Greece*

Dov Avigad, *Institute of Earth Sciences, The Hebrew University of Jerusalem, Jerusalem 91904, Israel*

Olivier Vanderhaeghe, *G2R, Nancy-Université, BP 239 54006 Vandoeuvre-les-Nancy, France*

Twenty geologists from around the world participated in this GSA Field Forum, the aim of which was to explore along-strike variations in the Hellenide-Anatolide orogen, from the eastern Aegean island of Samos to Anatolia. The forum began by exploring a unique section in western Samos where the contact of the Cycladic Blueschist Unit with an underlying Basal Unit is exposed. In the field, Uwe Ring provided an overview of the geologic and tectonic history of the Cycladic blueschists and set forth the goals of the Field Forum. Participants discussed various scenarios for the exhumation of the blueschists and concluded that the contact was likely to be a former large-scale thrust, reactivated as a top-east extensional shear zone in the Miocene. East-west extension in the Hellenide-Anatolide belt is uncommon, because the whole region appears to have undergone mainly N-S extension since the early Miocene. The Basal Unit on Samos is considered part of the External Hellenides and, on Samos, shows evidence for high-pressure metamorphism.

On the second day, participants presented talks and posters on thematic and regional tectonic aspects of along-strike

variations. The topics included large-scale correlations across the central and eastern Mediterranean orogens, differences in lithospheric structure across the Hellenide-Anatolide belt, and various manifestations of along-strike variations from orogens worldwide. This mini-symposium took place in an informal atmosphere, sparking lively discussion.

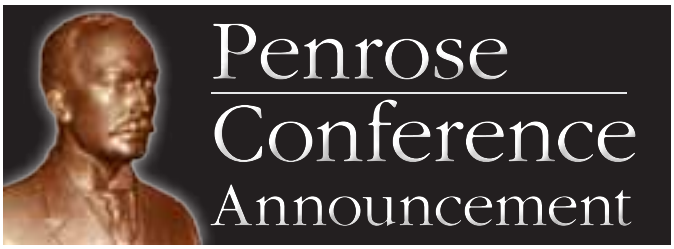
Participants sailed to western Turkey on the morning of day three and inspected the continuation of the Cycladic Blueschist Unit there in the afternoon. The remaining three days in western Turkey were devoted to exploring in detail the Menderes Nappes (also known as Menderes Massif) of the Anatolide Belt, which form the tectonic footwall below the Cycladic Blueschist Unit in western Turkey. The Menderes Nappes are the main manifestation of the pronounced lateral variations along the Hellenide-Anatolide orogen and are still a focus of major controversy in eastern Mediterranean tectonics. Discussions in the field centered on the following themes: (1) evidence for nappe piling in the Menderes Nappes; (2) timing of nappe stacking and metamorphic events in the Menderes Nappes; (3) how Miocene to Recent extension in west Turkey differ from that on Samos Island and the Aegean Sea region; (4) consequences of along-strike variations on the lithosphere architecture and subduction geodynamics; and (5) the implications of these differences when applied to lithospheric architecture and tectonic evolution in the region.

Participants drew the following main conclusions after examining the Anatolide Belt: (1) the Menderes Nappes represent a Tertiary nappe stack that was assembled under greenschist-facies metamorphism; (2) parts of the Menderes Nappes contain evidence for a late Proterozoic to Cambrian (ca. 550 Ma) orogeny, including eclogite- and upper amphibolite-facies metamorphism; (3) the Menderes Nappes are overlain—with a very pronounced metamorphic break—by the high-pressure metamorphosed Cycladic Blueschist Unit along the large-magnitude Cyclades-Menderes Thrust; (4) Miocene extensional deformation was N-S oriented, and the structural style of extension is very different from that on Samos Island—a pronounced difference was the development of a mid-Miocene erosion surface over much of the Anatolide belt, reflecting the growth of a regional plateau following the first phase of extension there; and (5) overall, the tectonic history of the Anatolide belt shows significant differences compared to that in the adjacent Aegean Sea region.

Forum participants summarized that the observed lateral variations must reflect major differences in lithospheric structure. In the Aegean Sea region, the continued underthrusting of the Adriatic plate in the Tertiary caused pronounced slab rollback and sustained high-pressure metamorphism that affected various tectonic units, including the Cycladic Blueschist Unit and the Basal Unit. In west Turkey, a different lithosphere—that of the Anatolide microcontinent— entered the subduction system. The lithosphere of the Anatolian microcontinent was probably more buoyant and thus resisted subduction to great depth, resulting in a greenschist-facies thrust belt and subsequent development of an orogenic plateau. Rollback in the Aegean Sea region caused much more N-S extension there compared to western Turkey. It was proposed that this differential extension may have been taken up in the easternmost Aegean and westernmost Turkey by a combination of transcurrent deformation and a large-scale mode-II fracture system responsible for E-W extension on Samos Island. In the late afternoon of the last day, the forum participants had the opportunity to visit the famous ruins in Ephesus near Selçuk.

Participants: Dov Avigad, Whitney Behr, Jamie Buschner, Rubén Díez Fernández, David W. Farris, Klaus Gessner, Bernhard Grasemann, Talip Güngör, Hanan Kisch, José R. Martínez Catalán, Robert B. Miller, Uwe Ring, Matias Sanchez Schneider, Stefan Schmid, Konstantinos Soukis, Nicolas Thébaud, Olivier Vanderhaeghe, Douwe J.J. van Hinsbergen, Francis Wedin, and Olga Zlatkin.

Rock glacier, northern Colorado. Photo by Marli Bryant Miller, University of Oregon, www.marlimillerphoto.com.



Neotectonics of Arc-Continent Collision

17–21 January 2011
Manizales, Colombia

CONVENERS

Paul Mann, Institute for Geophysics, Jackson School of Geosciences, The University of Texas at Austin, 10100 Burnet Rd.-ROC 196, Austin, Texas 78758, USA; paulm@utig.ig.utexas.edu

Carlos Vargas Jimenez, Departamento de Geociencias, Universidad Nacional de Colombia, Bogotá, Colombia; cavargasj@unal.edu.co

Caroline Whitehill, Institute for Geophysics, Jackson School of Geosciences, The University of Texas at Austin, Austin, Texas, USA; carrie@utig.ig.utexas.edu

DESCRIPTION AND OBJECTIVES

This Penrose Conference will bring together an international group of scientists to discuss the neotectonics and the seismic hazards of shallow slab subduction in areas of arc-continent collisions. In particular, we invite participants interested in discussing various aspects of arc-continent collisions around the globe.

1. How do the plate-tectonic settings and crustal structures of ongoing arc-continent collisions in different parts of the world (e.g., Taiwan, Papua New Guinea, Japan, Kamchatka, Italy, and Alaska) control the pattern of surface deformation and the geometry of shallowly subducted slabs? Are plate-driving forces the main control on the regional deformation patterns, or do mantle forces acting on subducted or broken-off slabs also play a role?
2. How do arc collision and shallow subduction generate anomalously broad crustal zones of deformation, as seen in such areas as Taiwan, Papua New Guinea, and the Andes of northwestern South America? Are these broad zones of crustal deformation "thin-skinned" and deforming on shallow detachments with large amounts of shortening or "thick-skinned" and rooted on older fault surfaces and reactivated rifts?
3. The process of vertically detaching slabs or "slab breakoff" and torn slabs shown by areas of strong slab-dip change is common to many areas of arc-continent collision and shallow subduction, yet the tectonic mechanisms and timing of this process are not well understood. How have recent advances in seismology, tomography, and geodynamic modeling improved our understanding of slab subduction and breakoff, and how do these breakoffs affect the pattern of observed earthquakes and slab-related volcanism?
4. Is coupling of the subducted slab and arc in arc-collision zones any greater than that observed along non-collisional subduction boundaries and, therefore, linked to higher levels of larger and more destructive earthquakes? How can improved academic understanding of arc collision and shallow subduction at all levels in the crust and upper mantle help improve maps of seismic hazard and be communicated to people living in broad plate-boundary zones?

Central Colombia was chosen as the meeting venue because it is an excellent natural laboratory in which to study all aspects of arc-continent collision as well as the neotectonics of shallow slab subduction. From the Late Cretaceous to the Miocene, accretion of arcs and oceanic plateaus shaped the active margin. Since the middle Miocene (ca. 12 Ma), the Panama arc has been colliding with the continental margin of the northwestern South American plate and superimposed on earlier tectonic events. This cumulative tectonic history has produced many features illustrative of the four conference themes: (1) formation of the widest area of the Andean mountain chain (500 km) over its >8000-km length from Colombia to Tierra del Fuego; (2) shallow subduction of the Caribbean slab beneath the northern Andes, with active slab tears defining distinct slabs seen with tomographic studies and "breakoff" occurring along the downdip edge of the slab; (3) large, historic earthquakes produced by strong coupling at the shallow subduction interface; and (4) thick Miocene to present sedimentary basins that provide a record of structural events.

PROPOSED ITINERARY

Monday, 17 Jan.: Overview of arc-continent collision and active tectonics.

Tuesday, 18 Jan.: Field day in the Nevado del Ruiz volcanic complex.

Wednesday, 19 Jan.: Talks and posters with a focus on shallow slab subduction and geohazards. Afternoon and evening breakout groups on neotectonic framework, basinal response, slab and far-field effects, and geohazards.

Thursday, 20 Jan.: Field day in the epicentral area of the Armenia Earthquake (M_W 6.2, 25 January 1999) and the Romeral Fault System.

Friday, 21 Jan.: Roundtable discussions and wrap-up presentations.

REGISTRATION, APPLICATIONS, AND LOGISTICS

Applications to participate, accompanied by an abstract, are due by **21 September 2010** (see convener contact information). All applicants will be notified of their application status no later than 1 October. Registration deadline: **15 October 2010.**

The registration fee will cover hotel lodging for five nights (16–21 January 2011) and all meals during the conference dates; airfare is not included. Check **www.geosociety.org/penrose/** for fee information and other details.

Participants are responsible for their own travel arrangements to Manizales, Colombia, and must arrive in Manizales no later than Sunday, 16 January. We recommend booking your flight from abroad to Bogotá to include a short 30-minute commuter flight from Bogotá to Manizales, 300 km west (~8-hr drive) of the capital. We will provide ground transportation between the Manizales airport and the conference venue.

The Romeral fault system (R) is an important active strike-slip zone that forms a suture between continental crust of northern South America and accreted arc and oceanic plateau crust of Pacific origin. The conference will include two day-trips to visit key localities along the fault near Manizales. Photo courtesy Carlos Borerro of Universidad de Caldas.

THE GEOLOGICAL SOCIETY OF AMERICA®

JOINT MEETING

46th Annual Meeting of the Northeastern Section, GSA
45th Annual Meeting of the North-Central Section, GSA
Pittsburgh, Pennsylvania, USA

20–22 March 2011

Pittsburgh, Pennsylvania, USA. Photo courtesy Greater Pittsburgh Chamber of Commerce.

Linking Northeastern & North-Central Sections: Pittsburgh, Pennsylvania, USA

LOCATION

Pittsburgh is a thriving city with a vibrant community, great restaurants, and many museums; the meeting venue, the Omni William Penn, is centrally located near dozens of bistros, eateries, and shops. The area features a variety of geologically interesting sites, including excellent examples of the Allegheny Front separating the Valley and Ridge and Appalachian Plateaus Provinces, terminal Laurentide moraines, oil, gas, coal, aggregates, and a wealth of additional natural resources, overprinted with myriad geotechnical hazards.

CALL FOR PAPERS

Abstract deadline: 14 December 2010

Please submit your abstract online at **www.geosociety.org/sections/ne/2011mtg/.** An abstract submission fee of US$10 for students and US$15 for all others will be charged. If you cannot submit the abstract online, please contact Nancy Wright, +1-303-357-1061, nwright@geosociety.org.

Symposia

1. **Marcellus—Exploration and Production.** William Zagorski, Range Resources, wzagorski@rangeresources.com.
2. **CO_2 Sequestration.** William Harbert, Univ. of Pittsburgh, harbert@pitt.edu.
3. **Applied Geology: Environmental, Engineering, and Hydrogeologic Applications.** Terry West, Purdue Univ., trwest@purdue.edu.
4. **Devonian Climate and Paleoecology—Insight from Stratigraphic Studies.** Dave Brezinski, Carnegie Museum of Natural History, dbrezinski@dnr.state.md.us.

Theme Sessions

We are still accepting input for additional sessions—please send your proposals to meeting technical chairs Rod Feldmann (North-Central Section), rfeldman@kent.edu, and Tom Anderson (Northeastern Section), taco@pitt.edu.

1. **Conodont Stratigraphy.** *Cosponsored by the Pander Society.* Jeff Over, SUNY Geneseo, over@geneseo.org.
2. **Mesozoic/Cenozoic Vertebrate Paleontology.** Michael Ryan, Cleveland Museum of Natural History, mryan@cmnh.org; Matt Lamanna, Carnegie Museum of Natural History, lamannam@carnegiemnh.org.
3. **Advances in Arthropod Paleobiology.** *Cosponsored by Paleontological Society.* Carrie Schweitzer, cschweit@kent.edu; Rod Feldmann, Kent State Univ., rfeldman@kent.edu.
4. **Paleozoic Vertebrate Paleontology.** Chuck Ciampaglio, Wright State Univ.–Lake Campus, chuck.ciampaglio@wright.edu.
5. **Devonian Sands of Northern Pennsylvania.** Gordon Baird, SUNY Fredonia, gordon.baird@fredonia.edu; Jeff Over, SUNY Geneseo, over@geneseo.org.
6. **Engineering Geology/Slope Stability.** Abdul Shakoor, Kent State Univ., ashakoor@kent.edu; Brian Greene, U.S. Army Corps of Engineers, retired.
7. **Theory and Application in Quaternary Paleoclimate Studies.** Joe Ortiz, Kent State Univ., jortiz@kent.edu.
8. **Surface Water–Groundwater Interaction: Biota and Chemical Influences.** Alison Smith, Kent State Univ., alisonjs@kent.edu; Don Palmer, Kent State Univ., dpalmer@kent.edu.
9. **Geology of the War of 1812 and Other Eighteenth- and Nineteenth-Century Wars in North America: Battles, Terrain, Monuments, and More.** Joe Hannibal, Cleveland Museum of Natural History, hannibal@cmnh.org; Kevin R. Evans, Missouri State Univ., kevinevans@missouristate.edu.
10. **Extending Geological Education beyond the Academy.** Robert Ross, Paleontological Research Institute, ross@museumoftheearth.org.

11. **Using Undergraduate Research to Help Students Engage with the World: Examples from the Field.** Tamra A. Schiappa, Slippery Rock Univ., tamra.schiappa@sru.edu.
12. **Innovative Data Management and Visualization in Applied Geology and Other Applied Topics.** *Cosponsored by Northern Ohio Geological Society (NOGS).* Matt Hammer, Sanborn, Head & Associates, mhammer@sanbornhead.com; Rob Porges, SAIC, porgesr@saic.com.
13. **Great Lakes History.** Tim Fisher, Univ. of Toledo, timothy.fisher@utoledo.edu.
14. **The Effect of Late Paleozoic Tectonics on Devonian Shale Gas.** Mark Evans, Central Connecticut State Univ., evansmaa@ccsu.edu.
15. **Karst and Hydrogeology.** Ira Sasowski, Univ. of Akron, ids@uakron.edu.
16. **Remote Sensing and Rift Tectonics.** Mohamed Abdel Salam, Missouri Univ. of Science & Technology, abdelsam@mst.edu.
17. **In the Field with Geoscience Education.** *Cosponsored by the National Association of Geoscience Teachers (NAGT).* Albert Kollar, Carnegie Museum of Natural History, kollara@carnegiemnh.org.
18. **Marcellus—Production and Disposal of Produced Water.** Roman Kyshakevych, Allegheny GeoQuest, romangkk@gmail.com.
19. **Geophysical Exploration in the Allegheny Plateau—Insights into the Structure of the Appalachian Foreland.** Brian Lipinski, EXCO Resources [PA] Inc., brian.lipinski@gmail.com.
20. **Coal Ash Placement—Potential Impacts upon Surface- and Groundwater Quality.** Henry Prellwitz, slagman1@verizon.net.
21. **Provenance of Organic Content in the Marcellus Shale.** Christopher Laughrey, Weatherford Labs, christopherlaughrey@weatherfordlabs.com.
22. **Urban Geochemistry.** Daniel Bain, Univ. of Pittsburgh, dbain@pitt.edu; Emily Elliot, Univ. of Pittsburgh, eelliot@pitt.edu.
23. **Lakes and Environmental Change.** Mark Abbott, Univ. of Pittsburgh, mabbott1@pitt.edu.
24. **Capturing Dynamic Processes with Satellite Imaging.** Michael Ramsey, Univ. of Pittsburgh, ramsey@ivis.eps.pitt.edu.
25. **Hazards in Pennsylvania's Appalachian Mountains: Modern Solutions to Age-Old Problems.** James Kilburg, Shaw Environmental, james.kilburg@shawgrp.com.
26. **The Origin of the Dunkard Group, the Youngest Paleozoic Strata in the Central Appalachian Basin.** Viktoras Skema, Pennsylvania Geological Survey, retired, skema@verizon.net; Blaine Cecil, cecilblaine@gmail.com; William DiMichele, dimichel@si.edu.
27. **Cultural Geology: Building Stones, Archaeological Materials, Terrain, and More.** Joe Hannibal, Cleveland Museum of Natural History, hannibal@cmnh.org; Tammie Gerke, Glenn A. Black Laboratory of Archaeology, Indiana Univ., tlgerke@indiana.edu.
28. **Effective Approaches to Earth System Science Instruction and Engagement in the K–12 Classroom.** Laura Guertin, Penn State Brandywine, guertin@psu.edu; Tanya Furman, Pennsylvania State Univ., furman@psu.edu.
29. **Formation, Growth, and Evolution of Laurentia: Architecture, Process, and Natural Resources.** Daniel Holm, Kent State Univ., dholm@kent.edu.
30. **Syncrystallization Evolution of Granitic Magma in Orogenic Belts.** Tathagata Dasgupta, Kent State Univ., tdasgupt@syr.edu; Scott Samson, Syracuse Univ., sdsamson@syr.edu.
31. **GeoPharmaceutical Connections: Links among Geology, Pharmaceuticals, and Medical Applications.** Steve York, MG, projectgeol@aol.com; Lou Brunetti, Ernest Mario School of Pharmacy, Rutgers, The State Univ. of New Jersey, brunetti@rci.rutgers.edu.
32. **Structural Geology and Natural Resources in the Central and Northeast United States.** W. Ashley Griffith, Univ. of Akron, wag8@uakron.edu; John C. Lewis, Indiana Univ. of Pennsylvania, jclewis@iup.edu.
33. **Undergraduate Research (Posters).** *Cosponsored by the Council on Undergraduate Research–Geosciences Division.* Robert Shuster, Univ. of Nebraska–Omaha, rshuster@mail.unomaha.edu; Michele Hluchy, Alfred Univ., fhluchy@alfred.edu; Matthew Powell, Juniata College, powell@juniata.edu.
34. **Faculty and Student Perspectives on Undergraduate Research: Models, Challenges, and Best Practices.** *Cosponsored by the Council on Undergraduate Research–Geosciences Division.* Meagen Pollock, College of Wooster, mpollock@wooster.edu; Prajukti (Juk) Bhattacharyya, Univ. of Wisconsin–Whitewater, bhattacj@uww.edu.

Pittsburgh, Pennsylvania, USA. Photo courtesy Greater Pittsburgh Chamber of Commerce.

35. **Climate Change Issues in Geoscience Education.** *Cosponsored by the National Association of Geoscience Teachers (NAGT).* P. Allen Macfarlane, Kansas Geological Survey, amacfarlane@topekacollegiate.org.
36. **Virtual Field-Trips for K–16 Geoscience Education.** *Cosponsored by the National Association of Geoscience Teachers (NAGT).* P. Allen Macfarlane, Kansas Geological Survey, amacfarlane@topekacollegiate.org; Don Duggan-Haas, Paleontological Research Institute, dugganhaas@gmail.com.
37. **Education, Environment, and Water.** Solomon Isiorho, IPFW, isiorho@ipfw.edu.
38. **Issues in Geoscience Education.** Carrie Wright, Univ. of Southern Illinois, clwright@usi.edu.
39. **Sedimentary Environments of Post-Paleozoic, Pre-Glacial Strata of the Midwest-Appalachian Region.** *Cosponsored by Great Lakes Section, SEPM.* C. Pius Weibel, Illinois State Geological Survey, weibel@isgs.illinois.edu.
40. **Advances in Defining Links between Deformation and Metamorphism.** Gregory Dumond, MIT, gdumond@mit.edu.
41. **Devonian Orogenesis in the Appalachian-Caledonian Mountain Belt—Where, When, and What Caused It?** Sandra M. Barr, Acadia Univ., sandra.barr@acadiau.ca; Paul Karabinos, Williams College, paul.m.karabinos@williams.edu; Cees R. van Staal, Geological Survey of Canada, cees.vanstaal@nrcan-rncan.gc.ca; Robert P. Wintsch, Indiana Univ., wintsch@indiana.edu; David P. West, Jr., Middlebury College, dwest@middlebury.edu.

FIELD TRIPS

1. **Depositional and Biotic Response to Long-Term Climate Change in the Late Carboniferous of the Central Appalachian Basin.** David K. Brezinski, Maryland Geological Survey and Carnegie Museum of Natural History; Albert D. Kollar, Carnegie Museum of Natural History.
2. **History and Geology of the Allegheny Portage Railroad.** John A. Harper, Pennsylvania Geological Survey.
3. **Geoarchaeology at Meadowcroft Rockshelter (36Wh297), Washington County, Pennsylvania.** J.M. Adovasio, Mercyhurst Archaeological Institute, Mercyhurst College.
4. **The Marcellus Shale Gas Play as Seen from Outcrops, Cores, and Logs within the Valley and Ridge of Pennsylvania.** Terry Engelder, Mike Arthur, and Rudy Slingerland, The Pennsylvania State Univ.; Gary Lash, SUNY Fredonia.
5. **Glacial Geology of Northwestern Pennsylvania.** Gary Fleeger, Pennsylvania Geological Survey; John Szabo, Univ. of Akron; Eric Straffin, Edinboro Univ. of Pennsylvania; Todd Grote, Eastern Michigan Univ.
6. **The Early Industrial Geology of Eastern Ohio and Western Pennsylvania: Grist Mills, Iron Furnaces, and Early Use of Coal Beyond the Allegheny Mountains.** Joe Hannibal, Cleveland Museum of Natural History; Tammie L. Gerke, Glenn A. Black Laboratory of Archaeology, Indiana Univ.; Mary K. McGuire, Univ. of Pittsburgh.
7. **The Old, the Crude, and the Muddy: Oil History in Western Pennsylvania.** Kathy J. Flaherty, ABARTA Oil & Gas Company; Kristin Carter, Pennsylvania Geological Survey.
8. **Late Devonian Paleontology and Paleoenvironments at Red Hill and Other Fossil Sites in the Catskill Formation of North-Central Pennsylvania.** Ted Daeschler, Academy of Natural Sciences of Philadelphia; Walt Cressler, West Chester Univ. of Pennsylvania.
9. **Western Pennsylvania Landslides and Rockfalls.** William R. Adams, Jr., Pennsylvania Dept of Transportation; James Hamel, Hamel Geotechnical Consultants; Richard Gray, DiGioa, Gray & Associates LLC.
10. **From Fort Pitt to Richardson's Courthouse: Geological Aspects of Select Eighteenth- and Nineteenth-Century Landmarks on Pittsburgh's Golden Triangle.** Joe Hannibal, Cleveland Museum of Natural History.
11. **Walking Tour of the Building Stones of Pittsburgh.** Led by members of the Pittsburgh Geological Society.

WORKSHOPS

We are still accepting proposals for workshops; please send yours to workshop chair David B. Hacker, dhacker@kent.edu.

1. **Geology of National Parks: Spreadsheets, Quantitative Literacy, and Natural Resources.** Len Vacher, Univ. of South Florida, vacher@usf.edu; Judy McIlrath, Univ. of South Florida, jmcilrath@usf.edu; Tom Juster, Univ. of South Florida, juster@usf.edu.
2. **New Methods for Designing Effective Interactive Geologic Maps and Field Excursions in Google Earth.** Steve Whitmeyer, James Madison Univ., whitmesj@jmu.edu; Declan De Paor, Old Dominion Univ., ddepaor@odu.edu.
3. **Classroom Strategies That Improve Learning and Engage Students.** David Steer, Univ. of Akron, steer@uakron.edu.
4. **Ultrashallow Environmental Geophysics.** Gregory Baker, Univ. of Tennessee, gbaker@tennessee.edu.
5. **Climate Change Issues in Geoscience Education.** P. Allen Macfarlane, Kansas Geological Survey, amacfarlane@topekacollegiate.org.

REGISTRATION

Early registration deadline: 14 February 2011
Cancellation deadline: 21 February 2011

Registration opens in December 2010. For further information, or if you have special requirements, please contact the local committee chairs: Daniel Holm (North-Central Section), dholm@kent.edu, and Patrick Burkhart (Northeastern Section), patrick.burkhart@sru.edu. You'll also find up-to-the-minute details on field trips, workshops, student travel grants, the guest program, and symposia and theme sessions at **www.geosociety.org/sections/ne/2011mtg/.**

ACCOMMODATIONS

GSA has reserved a block of rooms at the historic Omni William Penn Hotel, 530 William Penn Place, Pittsburgh, Pennsylvania 15219, USA, at US$149/night double occupancy, with a US$10 fee for each additional person.

OPPORTUNITIES FOR STUDENTS

Mentor Programs

The Roy J. Shlemon Mentor Program in Applied Geosciences is designed to extend the mentoring reach of individual professionals from applied geology to undergraduates and graduate students.

The Mann Mentors in Applied Hydrogeology Program presents mentoring opportunities for undergraduate, graduate, and recent graduate students with a declared interest in applied hydrogeology as a career.

Read more about both programs at **www.geosociety.org/mentors/.**

Volunteering

The committee and officers of GSA's North-Central and Northeastern Sections rely on student volunteers to help meetings run smoothly, and we are pleased to offer student volunteers free registration for the meeting in return for ~7 hours of volunteer work. Contact student volunteer coordinator Tamra Schiappa, tamra.schiappa@sru.edu, for more information.

CALL FOR PAPERS

GROUNDWORK
Furthering the Influence of Earth Science

The goal of the *GSA Today* "Groundwork" series is to *lay the groundwork* for furthering the influence of earth science on education, policy, planning, and funding. The series supports GSA's mission in "promoting the geosciences in the service to humankind" and GSA's vision of "supporting the application of geoscience knowledge and insight to human needs, aspirations, and Earth stewardship." Articles can include in-depth geoscience commentary, short observations and analysis of hot topics, and discussion of policy news and issues.

Characteristics of a "Groundwork" Article:

1. This should be a complete, stand-alone article (ongoing or serial commentary or meetings summaries are not appropriate for this series).
2. If authors have supplemental information, they may choose to include as an online GSA Supplemental Data item.
3. Articles must be no longer than 1,400 words with two small figures or 1,600 words with one figure (which equals two typeset pages in *GSA Today*). The philosophy behind this is twofold: (1) keeping an article short can increase the clarity and quality of the writing; and (2) a short article encourages readers to engage and seek more information.
4. Color figures may be included at no cost to authors.
5. *GSA Today* science editors will be responsible for review and acceptance of the articles (all articles are peer-reviewed), as well as guiding authors regarding revising to *GSA Today* standards.
6. Articles will be published on a space-available basis after acceptance.

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2011

NORTHEASTERN/ NORTH-CENTRAL
Joint Section Meeting
Pittsburgh, Pennsylvania, USA
20–22 March 2011
Abstract deadline:
14 December 2010

SOUTHEASTERN
Section Meeting
Wilmington, North Carolina, USA
23–25 March 2011
Abstract deadline:
14 December 2010

SOUTH-CENTRAL
Section Meeting
New Orleans, Louisiana, USA
27–29 March 2011
Abstract deadline:
18 January 2011

ROCKY MOUNTAIN/ CORDILLERAN
Joint Section Meeting
Logan, Utah, USA
18–20 May 2011
Abstract deadline:
15 February 2011

GSA Section Meeting Schedule

THE GEOLOGICAL SOCIETY OF AMERICA®

SOUTHEASTERN

60th Annual Meeting of the Southeastern Section, GSA
Wilmington, North Carolina, USA

23–25 March 2011

Exploration to exploitation: Geosciences' role in natural resource stewardship

LOCATION

The Dept. of Geography and Geology at the University of North Carolina–Wilmington is pleased to host the 60th Annual Meeting of the GSA's Southeastern Section at the new Wilmington Convention Center, located on the banks of the scenic Cape Fear River.

Keynote Speaker: William G. Ross Jr., Duke University professor, environmental lawyer, and former Secretary of the North Carolina Dept. of Environment and Natural Resources.

CALL FOR PAPERS

Abstract deadline: 14 December 2010

Submit abstracts online at **www.geosociety.org/sections/se/2011mtg/.** An abstract submission fee of US$10 for students and US$15 for all others will be charged. If you cannot submit the abstract online, please contact Nancy Wright, +1-303-357-1057, nwright@geosociety.org.

Symposia

1. **From Triassic Basins to Hydrogeological and Environmental Characterization of Coastal Plain Environments: A Tribute to the Illustrious Geosciences Career of Paul A. Thayer.** Mary Harris, Savannah River National Laboratory, mary.harris@srnl.doe.gov; Harry Roberts, Louisiana State Univ., hrober3@lsu.edu.
2. **Coastal Response to Sea-Level and Climate Changes: A Tribute to the Career of Stan Riggs.** David Mallinson, East Carolina Univ., mallinsond@ecu.edu; Dorothea Vonderporten Ames, East Carolina Univ., amesd@ecu.edu.
3. **Coastal Response to Tidal Inlets: A Tribute to the Career of Bill Cleary.** Spencer Rogers, North Carolina Sea Grant, rogerssp@uncw.edu; Duncan Fitzgerald, Boston Univ., dunc@bu.edu.
4. **Significant Fossil Sites in the Southeast: Why They Are Important and How They Contribute to Our Knowledge of the Fossil Record.** *Cosponsored by the Southeastern Section of The Paleontological Society.* Sandy Ebersole, Alabama Geological Survey, sebersole@gsa.alabama.gov; Melanie Devore, Georgia College and State Univ., melanie.devore@gcsu.edu.

Theme Sessions

1. **Surficial and Subsurface Geology and Hydrogeology of the Cape Fear River Basin.** Jean Self-Trail, USGS, jstrail@usgs.gov; Kathleen Farrell, North Carolina Geological Survey (NCGS), kathleen.farrell@ncdenr.gov.
2. **Practical Applications of Engineering and Environmental Geology.** Brad Worley, North Carolina Dept. of Transportation, bdworley@ncdot.gov; Paul Weaver, Kleinfelder Engineering, chair@aegcarolinas.org.
3. **Piedmont Geology: New Mapping and New Perspectives.** David Blake, Univ. of North Carolina–Wilmington, blaked@uncw.edu; Edward F. Stoddard, NCGS, skip_stoddard@ncsu.edu; Phil Bradley, NCGS, pbradley@ncdenr.gov.
4. **Watershed Processes: Hydrology, Geomorphology, Soils, and Ecology.** Timothy J. Callahan, College of Charleston, callahant@cofc.edu; Eric Henry, Univ. of North Carolina–Wilmington, henrye@uncw.edu.
5. **Micropaleontology of the Southeast.** *Cosponsored by the Southeastern Section of The Paleontological Society.* Ronald Lewis, Auburn Univ., lewisrd@auburn.edu; Steve Culver, East Carolina Univ., culvers@ecu.edu.
6. **Geologic Maps, Geophysical Maps, Digital Geologic Maps, and Derivatives from Geologic and Geophysical Maps (Poster Session).** Michael W. Higgins, The Geologic Mapping Institute, mhiggins@mindspring.com; Ralph F. Crawford, The Geologic Mapping Institute, crawford@sprintmail.com.
7. **Macropaleontology of the U.S. Coastal Plain.** *Cosponsored by the Southeastern Section of The*

Paleontological Society. Patricia Kelley, Univ. of North Carolina–Wilmington, kelleyp@uncw.edu; Gregory Dietl, Paleontological Research Institution, gpd3@cornell.edu.

8. **Graduate and Undergraduate Research (Poster Session).** Lee Phillips, Jr., Univ. of North Carolina–Pembroke, lee.phillips@uncp.edu.
9. **From the Mason-Dixon to the Caribbean: The Historic Development of Geology in the American South.** Michael Smith, Univ. of North Carolina–Wilmington, smithms@uncw.edu; Anne Whitt, NCGS, anne.whitt@ncmail.net.
10. **Karst Geology and Hydrology.** Lee Florea, Western Kentucky Univ., lee.florea@wku.edu; Douglas Gamble, Univ. of North Carolina–Wilmington, gambled@uncw.edu.

WORKSHOPS

1. **Standardized Core Logging Techniques for Students.** Kathleen Farrell, NCGS, kathleen.farrell@ncdenr.gov; Jean Self-Trail, USGS, jstrail@usgs.gov.

FIELD TRIPS

1. **Plio-Pleistocene Stratigraphy and Paleontology of Southeastern North Carolina.** *Cosponsored by The Paleontological Society and the National Association of Geoscience Teachers (NAGT).* Co-Leaders: Greg Dietl, Lauck Ward, Tricia Kelley.
2. **Natural Gas Potential of the Sanford Sub-Basin, Deep River Basin, North Carolina.** Co-Leaders: Kenneth Taylor and Jeff Reid, NCGS.

ACCOMMODATIONS

A block of rooms has been reserved for meeting attendees at the Hilton Wilmington Riverside, 301 North Water Street, Wilmington, NC, 28401-3934, USA, +1-910-763-5900.

LOCAL COMMITTEE

General chair: Richard Laws, laws@uncw.edu
Technical program chair: William Harris, harrisw@unce.edu
Field trip chair: Kenneth Taylor, kenneth.b.taylor@ncdenr.gov
Exhibits chair: John Huntsman, huntsmanj@uncw.edu
Student volunteers: Tricia Kelley, kelleyp@uncw.edu
Guest activities: W. Frank Ainsley (deceased)

Meeting Sponsor

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Donna L. Russell, *Director of Operations*

Meet Anna Christensen
GSA Foundation's New Chief Development Officer

Anna Christensen joined the GSA Foundation staff in mid-July as its chief development officer. With broad experience in development planning, planned giving, major gifts, and annual fundraising, her many talents will be a tremendous asset to both the Foundation and its Development Committee.

Christensen comes from Indiana State University, where she worked for seven years as the director of development for the College of Arts & Sciences. Prior to that, she held fundraising positions at Scripps College and with the Mono Lake Committee in Lee Vining, California, USA. She holds a B.A. in biology from Scripps College and an M.A. in philanthropic studies from Indiana University.

While she has called many places home, Christensen was born in Colorado and is happy to be returning to the West. The Foundation Board of Trustees and the GSA Foundation staff whole-heartedly welcome Christensen as she joins the group at GSA Headquarters in Boulder, Colorado, USA.

Most memorable early geologic experience:

Sixty years later, I still feel the surge of the turquoise ocean within the black basaltic columns framing Fingal's Cave on Scotland's Isle of Staffa.

—Ian W. Dalziel

Is the Foundation in Your Will?

While updating your will, please don't forget to add a bequest to the Foundation. Your thoughtful gift can make a great difference. You may choose to give a specific dollar amount in your will or a percentage of your estate/trust.

The correct language to be used in your will is as follows:

I hereby give, devise, and bequeath to the Geological Society of America Foundation, Inc., the sum of (specify amount). It is my desire that this bequest to the Geological Society of America Foundation, Inc., be use for the following purposes: (*indicate either a specific Foundation Fund or specify that your gift is to be used at the Foundation's discretion*).

Please call the Foundation office at +1-303-357-1054 to receive a free copy of "Update Your Will" or e-mail Donna Russell, drussell@geosociety.org.

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Classified Rates—2010

Ads (or cancellations) must reach the GSA advertising office no later than the first of the month, one month prior to the issue in which they are to be published. Contact advertising@geosociety.org, +1.800.472.1988 ext. 1053, or +1.303.357.1053. All correspondence must include complete contact information, including e-mail and mailing addresses. To estimate cost, count 54 characters per line, including punctuation and spaces. Actual cost may differ if you use capitals, boldface type, or special characters. Rates are in U.S. dollars.

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Positions Open	$8.85	$8.60
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First 25 lines	$0.00	$4.50
Additional lines	$4.50	$4.50
Fellowship Opportunities	$8.85	$8.60

Positions Open

SENIOR HYDROGEOLOGIST, SENIOR GEOCHEMIST
TETRA TECH

Tetra Tech is a leading provider of consulting, engineering, and technical services worldwide. Tetra Tech's mission is to be the premier worldwide consulting, engineering, and construction firm. Tetra Tech puts its clients first. We understand our clients' needs and deliver smart, cost-effective solutions that meet those needs. Our people are our number one asset. Our workforce is diverse and includes leading experts in our fields. Our entrepreneurial nature and commitment to success provide challenges and opportunities for all of our associates. Tetra Tech takes on our clients' problems as if they were our own. We develop and implement real-world solutions that are cost-effective, efficient and practical.

OPEN POSITIONS:

Senior Hydrogeologist: The candidate will be responsible for developing and implementing business plans, managing projects, writing proposals, and providing senior review of technical reports, maintaining and expanding client relationships, and providing senior level mentorship and technical guidance for junior and mid-level staff on environmental remediation, surface and groundwater, and other aspects of a variety of projects. Ph.D. preferred, or M.S. in hydrogeology, geology, environmental science, geological engineering, or equivalent, with an emphasis on quantitative analysis and a focus in hydrogeology. Registered as either a P.E., or a P.G., or qualified to register immediately; Extensive experience in business development and client, project and staff management

Senior Geochemist: The candidate will be responsible for developing and implementing business plans, working within teams to develop solutions for the geochemistry portion of various projects. Must have project management experience and the ability to maintain and expand client relationships. Experience with thermodynamic modeling programs (PHREEQE, MINTEQ, GWB), ability to design programs to characterize potential for metal leaching and acid rock drainage, including application of geochemical testing methods for ML/ARD and prediction of water chemistry. Ph. D. desired, or M.S. degree in geology, geochemistry, environmental science, chemistry, or equivalent, with an emphasis on quantitative analysis and a focus in environmental geochemistry. Registered as a P.G., or qualified to register immediately.

To apply, please go online, www.tetratech.com, and click on the careers tab.

WILLIAM E. WHITE POSTDOCTORAL SCHOLARSHIP IN GEOLOGICAL SCIENCES AND GEOLOGICAL ENGINEERING
QUEEN'S UNIVERSITY AT KINGSTON
ONTARIO, CANADA

The Dept. of Geological Sciences and Geological Engineering of Queen's University, one of Canada's premier earth-science departments, invites applications for its William E. White Postdoctoral Scholarship, created from a fund endowed by the estate of William E. White. The award will be made for one year and may be renewed for a second year. The annual stipend will be no less than $50,000.

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

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

Applicants should send a curriculum vitae, a statement of research interests, and samples of research writing to the following address. Applicants should contact their referees and arrange for at least three confidential letters of reference to be sent to the address below. Review of complete applications will begin on 15 Sept. 2010.

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

TECHNICAL DIRECTOR IN GEOLOGY
DEPARTMENT OF GEOLOGY, CARLETON COLLEGE

The Geology Dept. at Carleton College invites applications for a full-time (12-month), permanent position as the Technical Director in Geology. We seek a broadly trained individual with excellent organizational and communication skills to help support the educational and research mission of the department. This person will be responsible for managing field trip logistics for classes and extended trips (including group camping), maintaining and training students on university-level analytical equipment, purchasing and receiving equipment and supplies, and overseeing student workers. A keen interest in understanding the natural world, and a commitment to a supporting role in a laboratory and field-based science department, is essential to success in this position; M.S. degree in geology preferred. Please visit our Web site for a complete job description: http://apps.carleton.edu/curricular/geol/geotechjob.

Carleton's geology department averages between 15 and 25 majors in each graduating class; it is a vibrant place that emphasizes cooperation, discussion, field work, inquiry-based learning, creativity and intellectual depth in a supportive atmosphere. Carleton's geology department has a strong, successful tradition of teaching geology as one of the liberal arts and we are looking for someone to help carry on that tradition.

The position begins 15 March 2011. Interested individuals should submit by email in PDF format a letter of application, including a resume, short statement of relevant job and research experience, and the names and addresses of three references to geosearch@carleton.edu. To ensure full consideration, applications should be received by 15 Oct. 2010. Carleton College is an equal opportunity/affirmative action employer, and we are committed to developing our faculty and staff to better reflect the diversity of our student body and American society. Women and members of minority groups are strongly encouraged to apply.

TEACHING POSTDOCTORAL POSITION
ECOHYDROLOGY, BOSTON COLLEGE

The interdisciplinary Environmental Studies Program (www.bc.edu/envstudies) at Boston College seeks to hire a Visiting Assistant Professor for a two to three-year term position starting between 15 January and 15 July 2011. The successful candidate will be housed in the Dept. of Geology and Geophysics (www.bc.edu/geosciences) and participate in teaching, research and student advising activities. The position includes teaching 8–10 credits (~3 courses) per year of undergraduate environmental science courses and seminars on ecosystems, water resources, anthropogenic impacts, and sustainability. Applicants' research interests should be at the intersection of hydrologic and ecologic processes in terrestrial and/or coastal systems. The candidate will aid in academic and research advising of undergraduate Environmental Studies minors. This teaching postdoctoral position will include strong teaching and research mentoring by department faculty, and the candidate will work closely with the Director of the Environmental Studies Program. Applicants should send a curriculum vita, statements of teaching and research interests, and the names and contact information of three references as a single PDF-file e-mail attachment to ecohydroposition@bc.edu. Review of applications will begin on 27 Sept. 2010 and continues until the position is filled. Boston College is an academic community whose doors are open to all students and employees without regard to race, religion, age, sex, marital or parental status, national origin, veteran status, or handicap.

TENURE-TRACK POSITION
ASSISTANT PROFESSOR GEOLOGY
WHITMAN COLLEGE

The Dept. of Geology at Whitman College invites applications for a tenure-track position at the Assistant Professor level beginning in August of 2011. Ph.D. is required by the time of appointment. Applicants should have demonstrated expertise in teaching and research in the fields of hydrology, soils, and GIS. Teaching responsibilities consist of three courses plus labs (or equivalent) per year and participation in departmental field trips and senior seminar. In addition to teaching courses in their areas of expertise, the successful candidate is expected to teach an introductory course and develop an active research program that involves undergraduate students. The Dept. of Geology is a member of the Keck Geology Consortium and highly values student-faculty collaborative research. Whitman College wishes to reinforce its commitment to enhance diversity, broadly defined, recognizing that to provide a diverse learning environment is to prepare students for personal and professional success in an increasingly multicultural and global society. In their application, candidates should address their interest in working as teachers and scholars with undergraduates in a liberal arts environment that emphasizes close student-faculty interaction; how their cultural, experiential, and/or academic background contributes to diversity; and their interest in participating in the College's general education offerings. Materials should include a letter of application; curriculum vitae; statements addressing the candidate's teaching interests and scholarly agenda; three letters of reference; graduate transcripts; teaching evaluations or other evidence of demonstrated or potential excellence in undergraduate instruction.

Deadline: 30 September 2010.

Send materials to: Kevin Pogue, Dept. of Geology, Whitman College, 345 Boyer Ave, Walla Walla, WA 99362.

We anticipate providing interview opportunities at the GSA annual meeting in Denver.

No applicant shall be discriminated against on the basis of race, national or ethnic origin, age, gender, sexual orientation, marital status, religion, creed, or disability. Whitman College, located at the foot of the Blue Mountains, between the Cascades and the Rockies, is a small, selective, liberal arts college dedicated to providing excellent educational opportunities for students. The College provides generous professional development support for both research and teaching. For additional information about Whitman College and the Walla Walla area, see www.whitman.edu and www.wallawalla.org.

FACULTY FELLOW IN GEOLOGY
MINERALOGY/GEOCHEMISTRY, COLBY COLLEGE

The Dept. of Geology invites applications for a one-year, non-tenure track, Faculty Fellow in mineralogy/geochemistry beginning 1 Sept. 2011. The successful applicant will be expected to teach a core-curriculum Mineralogy course with laboratory and an upper division course of his/her choice for geology majors during the academic year. The upper division course should complement those already offered in the department. The remainder of the teaching assignment will focus on an introductory course offering for potential majors and non-majors (100-level). Additionally, the candidate may have the opportunity to direct one or more independent research projects. Colby is a highly selective liberal arts college recognized for excellence in undergraduate education and for close student-faculty interaction. Ph.D. with teaching experience at time of employment preferred; ABDs encouraged to apply. Applicants should submit a letter of application, curriculum vitae, statements of teaching and research Interests, and three letters of reference to Dr. Robert A. Gastaldo, Chair, Dept. of Geology, 5807 Mayflower Hill Drive, Waterville, ME 04901. Review of applications will begin on 22 Nov. 2010 and will continue until the position is filled. Colby is an Equal Opportunity/Affirmative Action employer, committed to excellence through diversity, and strongly

encourages applications and nominations of persons of color, women, and members of other under-represented groups. For more information about the College, please visit the Colby Web site: www.colby.edu.

ASSISTANT/ASSOCIATE PROFESSOR
GEOLOGY, SOUTHERN UTAH UNIVERSITY

The Dept. of Physical Science at Southern Utah University (located in Cedar City, Utah) is searching for a full-time, tenure track Assistant Professor of Geology to start 16 August 2011. Salary: commensurate with qualifications & experience.

Duties & Responsibilities: Teach diverse geology courses at the undergraduate level, including: freshman general, paleontology, sedimentation and stratigraphy; advise students; work effectively as a member of the Physical Science Dept.; establish an externally funded undergraduate research program that complements existing efforts in the department; serve on department, college, university committees; other assignments as determined by department chair and dean.

Minimum Qualifications: Ph.D. in sedimentology, stratigraphy, paleontology, or biostratigraphy with demonstrated success in, and strong commitment to, undergraduate teaching and research; demonstrated ability to teach stratigraphy, sedimentology, and paleontology at undergraduate level; strong oral and written communication skills, leadership skills and ability to work effectively with colleagues in an undergraduate academic setting essential. Desirable: demonstrated ability to teach additional geology courses; ability to develop strong, externally funded, undergraduate research program; college teaching (beyond graduate teaching assistant) experience preferred.

To ensure full consideration, please create your application through http://jobs.suu.edu and attach the following documents: cover letter, resume/CV, contact information for at least three professional references, statement of teaching philosophy, statement of research philosophy, copies of unofficial transcripts. Open until filled. Questions can be directed to Human Resources at jobs@suu.edu or +1-435-586-7754.

Southern Utah University is an Affirmative Action/Equal Opportunity Employer.

TENURE TRACK ASSISTANT PROFESSOR, PETROLOGY
CALIFORNIA STATE UNIVERSITY–NORTHRIDGE

The Dept. of Geological Sciences invites applications for a tenure-track position at the Assistant Professor level in the area of Igneous/Metamorphic Petrology and/or Geochemistry. 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. Particular subareas of interest that complement existing strengths in the department include, but are not limited to, volcanology, tectonomagmatism, mantle petrology, economic geology, and geochronology. 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 wherever feasible. Furthermore, the successful candidate is expected to demonstrate teaching excellence and provide effective instruction to students of diverse backgrounds in a multicultural setting. Instruction will include (1) undergraduate core courses in mineralogy and igneous & metamorphic petrology; (2) elective offerings at the upper-division and/or graduate level in the candidate's research specialty; and (3) courses in support of the department's program in general education and/or preparation of K–5 teachers in natural sciences.

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: geology.petrologist.search@csun.edu. Materials can also be sent to: Petrologist Search Committee, Dept. of Geological Sciences, California State University Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8266. Review of applications will begin 15 Sept. 2010. 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.

EARTH SURFACE PROCESSES
ASSISTANT PROFESSOR, DENISON UNIVERSITY

The Dept. of Geosciences at Denison University invites applications for a tenure track position to begin in Fall 2011. We seek a broadly trained scientist engaged in the study of Earth surface processes and/or environmental change, who shows potential as an outstanding teacher/scholar and who will enhance the diversity of our program. Specific areas of interest include: (1) active tectonics, geomorphology, geophysics or (2) climate or ocean sciences, low-temperature geochemistry, sedimentology/stratigraphy.

We seek a colleague who is committed to teaching excellence in the liberal arts tradition, is field-oriented, has broad interests beyond their specialty, and will provide a balance of classroom, field and laboratory experiences for our students. Denison is a selective liberal arts college strongly committed to, and supportive of, excellence in teaching and active faculty research that involves undergraduate students. A Ph.D. at the time of appointment is required.

All application materials will be handled electronically at https://employment.denison.edu. Please include a letter of application; statements of your approaches to teaching and research in a liberal arts setting as well as ways in which your expertise would expand, enrich and complement our program; a vita; academic transcripts; and contact information for three references. Please contact Dr. David Greene, Dept. of Geosciences, Denison University, Granville, OH 43023; +1-740-587-6476; greened@denison.edu for more information about the position. Application materials should arrive by 25 Oct. 2010 for full consideration, although the search will remain open until the position is filled. We plan to meet with selected candidates attending GSA in early November. 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 socio-economic background.

TWO ENDOWED FULL PROFESSOR POSITIONS
BOONE PICKENS SCHOOL OF GEOLOGY
OKLAHOMA STATE UNIVERSITY

The Boone Pickens School of Geology at Oklahoma State University (OSU) seeks applications for two endowed chairs: The Chesapeake Energy Corporation Chair of Petroleum Geoscience and the Devon Energy Corporation Chair of Basin Research. We are particularly interested in candidates with interests in one or more of the following: unconventional energy resources, petrophysics, reservoir characterization/modeling, tectonics of sedimentary basins, depositional and diagenetic systems, and basinal fluids. These chairs will be filled at the level of Professor, will carry tenure in the School of Geology, and will be effective August 2011. Applicants must have a Ph.D. degree in geology or related field and have an outstanding record of research. The applicant must be committed to excellence in teaching both undergraduate and graduate students, will be expected to supervise M.S. and Ph.D.-level graduate students and develop courses in her or his specialty.

The successful candidates will join a faculty of eleven geoscientists and will take leadership roles in a department that has close ties to the petroleum industry. The school's teaching and research facilities include state of the art geophysical field and laboratory equipment and software, the Devon Visualization Laboratory, and a wide range of petrographic and geochemical instrumentation. The School also has a recently renovated field camp facility near Canon City, Colorado.

Candidates should submit a letter of application, including a discussion of research interests and approach to teaching, along with a curriculum vitae and contact information for three references to: Endowed Chair Search, Boone Pickens School of Geology, 105 Noble Research Center, Oklahoma State University, Stillwater, Oklahoma 74078-3031. Screening of candidates will begin on 8 Nov. 2010 and continue until the position is filled. More information about the Boone Pickens School of Geology can be found on the Web at http://geology.okstate.edu along with additional information about these opportunities. Inquiries may be directed to Dr. Todd Halihan (todd.halihan@okstate.edu) or Dr. Jay Gregg (jay.gregg@okstate.edu). Committed to health and safety Oklahoma State University maintains a tobacco free work environment. Oklahoma State University is an Affirmative Action/Equal Opportunity/E-Verify employer committed to diversity.

DEPT. OF EARTH AND ATMOSPHERIC SCIENCES
UNIVERSITY OF HOUSTON

The Dept. of Earth and Atmospheric Sciences at the University of Houston invites applicants for four subdisciplines of geology and geophysics to fill two tenure line positions at the Associate Professor or Professor levels. Candidates are sought to participate in our expansion plans in geology and geophysics that will help to meet demands created by a dynamic and growing undergraduate and graduate student enrollment and expanding interdisciplinary collaborative research opportunities. Candidates are expected to have the ability to conduct transformational research in their disciplines and to have a demonstrated record of exceptional research productivity, peer-reviewed publication, external research funding, and outstanding teaching and mentoring skills. Candidates should have an international reputation in their field of interest. Successful tenure-line faculty appointees will be expected to teach at both the undergraduate and graduate levels. Of the four disciplines advertised below, the two top candidates are expected to be appointed by 15 Jan. 2011.

Structural Geologist: The Dept. of Earth and Atmospheric Sciences invites applicants for a tenure-track faculty position at the Associate Professor or Professor level in Structural Geology, with an emphasis on fault zone deformation processes. We especially seek candidates with a thorough understanding of the mechanics of fluid saturated rocks, permeability barriers, fault sealing, interaction between fluid flow, deformation and mineralization, and the characterization, evolution and mechanics of fractures and fault populations. Preference will be given to candidates who have quantitative approaches to analysis of fault zone geometry, kinematics and dynamics at all scales. Experience in interpreting faults and fault zones in seismic sections and/or within core or boreholes may be beneficial.

Sedimentologist/Stratigrapher: The Dept. of Earth and Atmospheric Sciences invites applicants for a tenure-track faculty position at the Associate Professor or Professor level in the field of sedimentology/stratigraphy. The successful candidate must have a demonstrated record of research excellence in related areas such as diagenesis, sedimentary petrology, petrophysical properties, facies and stratigraphies architecture, experimental or numerical modeling, and/or reservoir characterization. Preference will be given to candidates with the ability to integrate an array of outcrop, well, seismic, laboratory, and other data to solve fundamental geologic problems.

Rock Physicist: The Dept. of Earth and Atmospheric Sciences invites applicants for a tenure-track faculty position at the Associate Professor or Professor level in the field of rock physics with expertise in the measurement, theory, and interpretation of physical rock properties. Candidates with expertise in high-pressure and high-temperature experimental rock physics measurement are sought. The successful candidates would be a collaborator in the UH Rock Physics Consortium and will have access to a full range of teaching and research facilities within the department and university, including a fully equipped and state-of-the-art Rock and Fluid Physics Laboratory and a Seismic Acoustics Laboratory. Equipment in the rock physics lab includes: (1) apparatus for rock P- and S-wave velocity measurement rated to 15,000 psi and 150°C; (2) fluid modulus measurement capability rated to 20,000 psi and 200°C; (3) a time-lapse simulation setup; (4) anisotropy measurement; (5) special setups for unconsolidated sediments and shales with simultaneous resistivity measurement; and (6) standard rock properties measurements.

Marine Geophysicist–Multicomponent Seismology: The Dept. of Earth and Atmospheric Science invites applicants for a tenure-track faculty position at the Associate Professor or Professor level in the field of marine geophysics. We especially encourage applicants with experience in marine seismic operations and acquisition systems (particularly ocean-bottom seismometers). Preference will be given to candidates with expertise in the processing, analysis, and interpretation of multi-component seismic reflection and/or refraction data as well as familiarity with seismic streamer and multi-component seismic reflection and/or refraction acquisition systems. The successful candidate will have access to a new group of ocean-bottom seismometers, ocean-going opportunities, extensive high-performance computing hardware and a wide variety of industry-standard seismic processing and interpretation software.

INFORMATION FOR APPLICANTS: The department currently has 25 tenure-line faculty and 18 research faculty appointments and offers a comprehensive set of geosciences undergraduate and graduate degree programs in geology, geophysics, and atmospheric sciences. For more information about the department, please visit our Web site at www.geosc.uh.edu

Applicants for all positions should submit: (1) a letter of application including statements of teaching and research interests; (2) curriculum vitae; (3) three letters of references (letters must be received before the applications will be considered); and (4) an official Ph.D. graduate school transcript showing date of degree and degree conferred to Dr. John F. Casey, Chair, University of Houston, Dept. of Earth

and Atmospheric Sciences, 312 Science and Research Bldg. 1, Houston, TX 77204-5007.

Signed reference letters may be submitted by referees as attached files via email to Tram Nguyen at tnguye36@mail.uh.edu. Further information could be obtained from the departmental Web page at www.geosc.uh.edu or by calling +1-713-743-3402. Evaluations will begin 15 Sept. 2010 and will continue until the positions are filled.

The University of Houston is an Equal Opportunity/Affirmative Action Employer. Minorities, women, veterans, and persons with disabilities are encouraged to apply.

FACULTY POSITION, GEOLOGY DEPARTMENT PETROLOGY/MINERALOGY, BRYN MAWR COLLEGE

The Dept. of Geology at Bryn Mawr College invites applications for a full-time, tenure-track Assistant Professor position to begin 1 July 2011 in the general areas of mineralogy/geochemistry/petrology. Applicants should demonstrate strong potential for excellent teaching and creative research, as well as interest in offering courses in mineralogy, geochemistry and petrology. The hire will be expected to participate in Bryn Mawr's interdisciplinary environmental studies program. The candidate's research specialty is open, but ideally will complement those of other faculty members at the College. Demonstrated teaching ability and a Ph.D. at the time of appointment are required, and a commitment to supporting women and underrepresented groups in the geosciences is desired.

Located in suburban Philadelphia, Bryn Mawr College is a highly selective liberal arts college for women who share an intense commitment to intellectual inquiry, an independent and purposeful vision of their lives, and a desire to make meaningful contributions to the world. Bryn Mawr comprises an undergraduate college with 1,300 students, as well as coeducational graduate programs in social work and in some humanities and sciences. The College promotes faculty excellence in both research and teaching, and has strong consortial relationships with Haverford College, Swarthmore College, and the University of Pennsylvania. Bryn Mawr College is an equal-opportunity employer; minority candidates and women are especially encouraged to apply.

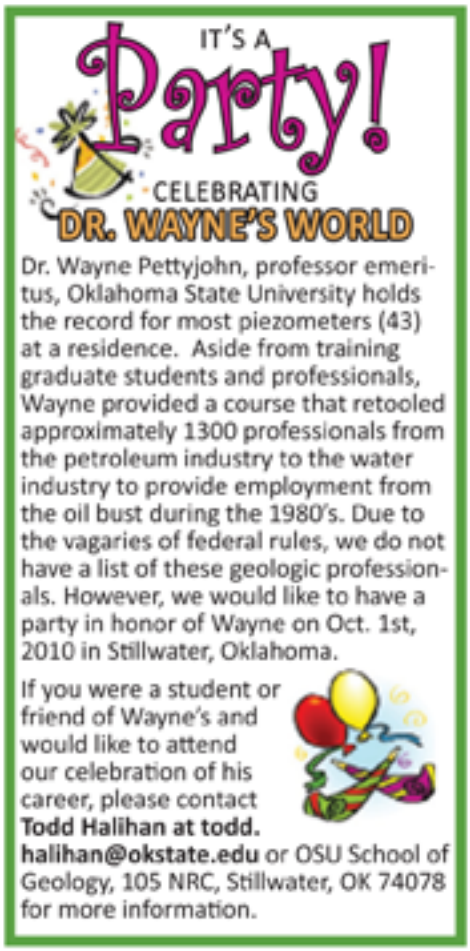
Applicants should submit a CV, a statement of teaching and research goals, a list of possible courses that could be offered, and the names and contact information of three references to: Geology Search, Dept. of Geology, Bryn Mawr College, 101 N. Merion Ave., Bryn Mawr, PA 19010 (e-mail contact: jjacoby@brynmawr.edu). Members of the department will be available for preliminary interviews at the Geological Society of America annual meeting in October, and formal review of applications will begin on 15 Nov. 2010. Details about the department are available at www.brynmawr.edu/geology/.

ASSISTANT PROFESSOR DEPARTMENT OF PHYSICS, ASTRONOMY AND GEOSCIENCES, FISHER COLLEGE OF SCIENCE AND MATHEMATICS, TOWSON UNIVERSITY

Applications are invited for a tenure-track assistant professor appointment at Towson University in the Dept. of Physics, Astronomy and Geosciences starting fall 2011. A Ph.D. in a relevant area is required. Postdoctoral experience is preferred. Applicants are expected to possess a strong commitment to excellence in teaching, show potential for a productive research/scholarly program, and pursue external funding to support research programs involving undergraduate and/or graduate students. This position supports the Geology program with the potential to interact with students in the interdisciplinary graduate and undergraduate programs in Environmental Science and Studies. Preference is given to candidates with research interests in the areas of surficial processes, hydrology, hydrogeology, hydrogeochemistry, biogeochemistry, environmental geophysics or forensic geology. Information on the Dept. Physics, Astronomy and Geosciences can be found at wwwnew .towson.edu/pags.

Submit a curriculum vitae, copies of transcripts from all institutions attended, one-page statement on teaching philosophy, statement on research interests, and arrange for three letters of reference to be sent c/o Dr. Steven Lev, Chair PAGS Search Committee, 8000 York Road, Towson University, Towson, MD 21252, slev@towson.edu.

Electronic submission of application materials is encouraged. Review of applications will begin on 27 Sept. 2010 and will continue until the position is filled.



GSA ANNUAL MEETINGS

LOOK TOWARD THE FUTURE

2011
Minneapolis, Minnesota, USA
(9–12 October)

2012
Charlotte, North Carolina, USA
(4–7 November)

2013
Denver, Colorado, USA
(27–30 October)

2014
Vancouver, British Columbia, Canada
(19–22 October)

2015
Baltimore, Maryland, USA
(1–4 November)

KU KANSAS GEOLOGICAL SURVEY
The University of Kansas

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Full-time position serving as the Director of the Kansas Geological Survey (KGS) and State Geologist. Must develop and articulate a vision of KGS programs, understand the concept of serving Kansas through high-quality research in the applied geosciences, and embrace a collegial leadership style. Requires doctorate in the geosciences with 10 years professional experience, 3 years administrative experience, national recognition in geoscience research, excellent communication skills, knowledge of natural resources and the environmental aspects of their use, and demonstrated ability to deal with natural-resource policy issues.

The KGS is a research and service division of the University of Kansas (KU), Lawrence. Created in 1889, the Survey studies the geology of Kansas, develops new techniques for exploring and analyzing geologic data, and produces and disseminates maps, reports, and scientific papers. Among the premier earth-science research and service institutions in the U.S., the KGS has an annual state budget of $6 million and employs more than 90 researchers, support staff, and students in four research sections and a number of service sections. Staff collaborate extensively with faculty and students in academic departments at KU.

Complete announcement/application information at www.kgs.ku.edu/General/jobs.html. Review will begin Nov. 19, 2010, position open until filled. For further information contact Jim Butler (jbutler@kgs.ku.edu). KU is an EO/AA employer.

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AGU

GROUNDWORK
Furthering the Influence of Earth Science

The Internet as a resource and support network for diverse geoscientists

Anne J. Jefferson, *Dept. of Geography and Earth Sciences, University of North Carolina, 9201 University City Blvd., Charlotte, North Carolina 28223, USA, ajefferson@uncc.edu;* ***Kimberly A. Hannula,*** *Dept. of Geosciences, Fort Lewis College, 1000 Rim Drive, Durango, Colorado 81301, USA;* ***Patricia B. Campbell,*** *Campbell-Kibler Associates, Inc., 80 Lakeside Drive, Groton, Massachusetts 01450, USA; and* ***Suzanne E. Franks,*** *2435 Edgecomb Ave., Glenside, Pennsylvania 19038, USA*

Many geologists think mentoring is provided by colleagues sharing a hallway, networking happens over beer at GSA, and learning about new research occurs when reading a journal or attending a conference. For a small but growing group of geoscientists, mentoring, networking, and learning about exciting new research are activities that can take place at any time of day and involve interacting with people all around the world. Imagine a mini-GSA meeting happening at all times. These geoscientists are taking advantage of the interactions and knowledge-sharing afforded by the Internet, through blogs, Twitter, and similar user-generated social media outlets. There are at least 250 geo-blogs and almost 300 people tweeting about geoscience topics (see lists at http://geoblogs.stratigraphy.net/?action=list and http://twitter.com/theAGU/geo-space-ocean-scientist).

Women and minority geoscientists are taking an active part in building this online community without geographic constraints. At least 35 women geoscientists regularly or occasionally blog about geoscience topics, and more than 150 women bloggers write about their lives as scientists and their scientific interests (e.g., Scientiae Carnival, http://scientiae-carnival.blogspot.com/). The number of women geoscientists who read blogs, but do not write them, may be much higher. At least 112 women geoscientists are using Twitter to discuss a wide variety of geosciences topics (http://hydrogeo.wordpress.com/2010/06/27/women-geo-types-on-twitter/).

The online opportunities for mentoring, networking, and knowledge sharing may be particularly valuable for women and minority geoscientists. Virtual networks offer opportunities to provide support and reduce the professional isolation that can be felt in physical work environments where there are few colleagues of a similar gender, race, or ethnicity. Although women now receive almost half (40%–45%) of the undergraduate degrees in geosciences, the proportion of women in tenure-track academic positions is only 14% (Martinez, 2008). The situation for underrepresented minorities is much worse, with just 5%–6% of degrees at any level going to minority students. Indeed, the geosciences are the least ethnically diverse of the science and engineering disciplines (Huntoon and Lane, 2007).

As the numbers of bloggers and Twitter users indicate, women geoscientists are using social networking, but we wanted to know what benefits these users saw from their online activities. In an anonymous online survey conducted during August and September 2009, we assessed the experiences of women geoscientists who read and write blogs. The survey asked about (1) reading and blogging habits; (2) blogs the respondents read; (3) why participants read blogs; (4) what benefits the participants gained from reading blogs; and (5) the experience of blogging. The survey received 102 responses; 89% (91) of respondents were women, and 92% (94) were white. Because of the small number of men respondents and concerns about the representativeness of the men responding, we chose to look at the results for women only. The small number of non-white respondents made it impossible to break out the results by race or ethnicity. Therefore, while the results we report are from all women respondents, they primarily reflect the experiences of white women.

Students (31% [28]) and faculty (26% [24]) dominated the responses, though there were also a number of people working in industry (16% [15]), government (12% [11]), and other categories. Respondents included bloggers (41% [37]) and non-bloggers (59% [52]). The women geoscientists write about a variety of topics; 27% (10) blog under their real-life name, 59% (22) write under pen names (pseudonyms), and 14% (5) write anonymously. More than 90% of blog readers reported reading blogs about geology and other sciences, as well as blogs about the lives of women in science and various non-science topics.

Women reported professional and social benefits from reading blogs. We used a five-point scale (1: strongly agree; 3: neutral; 5: strongly disagree) to assess perceived benefits. Of the professional benefits, respondents were most positive about learning things outside their specialty (avg. 1.9), followed by learning within their specialty (avg. 2.3), learning about pedagogy (avg. 2.4), and learning about technology (avg. 2.5). Based on these responses, we conclude that these women blog readers perceive positive professional benefits from their online reading. This suggests that social and other online media could be strategically used to supplement the resources available to all geoscientists, regardless of their gender, ethnicity, geographic location, or employment status.

GSA Today, v. 20, no. 9, doi: 10.1130/GSATG91GW.1

Of the social benefits of reading blogs, women were equally positive about the benefits for finding a greater variety of role models than in their off-line life, making their own experiences seem more normal, feeling connected to women scientists, and providing information and perspective on the lives of women scientists (avg. 2.2). These four statements were highly correlated (r = 0.56 to 0.64); women who responded positively (or negatively) to one statement tended to respond positively (or negatively) to the other statements in that group. Respondents were somewhat positive about the utility of blogs for telling them about what work as a geoscientist is like (avg. 2.4), feeling connected within their field (avg. 2.4), and participating in gender discussions (2.6). These results suggest that social media, such as blogs, provide a benefit to women geoscientists by giving them an outlet to counter the isolation they might be experiencing in their educational or work environments and contributing to a normalization of their experiences.

When the survey responses are divided into students, faculty, industry-based geoscientists, and government geoscientists, differences in the apparent social benefits of blog reading are striking (Fig. 1). Geoscience students perceived the strongest benefits from blog reading, while faculty most strongly agreed that blogs helped them find role models and normalize their experience by finding that many other faculty share their experiences and perspectives. Women in industry perceived less social benefit from blog reading than those in academia, but women in government were the most negative about their blog-reading experiences. In particular, their responses indicated that blog reading had not been helpful to them in finding role models.

There are at least two possible explanations for the differences in perceived benefits of blog reading between academic and non-academic geoscientists. One reason for the disparity could be that academia may be a less supportive environment for women than industry and government, leading academic women to find greater benefits from online interactions and mentoring. The National Academies' report, "Beyond Bias and Barriers" (Committee on Maximizing the Potential of Women in Academic Science and Engineering, 2006), cited a number of ways that academic science and engineering puts women at a disadvantage and ways that the climate for women scientists could be improved. A second, not mutually exclusive, possible explanation for the differences in experiences between academic and non-academic women in our data set is that academic women are represented in greater numbers in terms of both survey response and blog authorship. There were twice as many academic women respondents as there were from industry and government. Of the women geoscientists who wrote blogs at the time of our survey, there were 11 faculty, six students, six women in industry, and five women in government. In addition, there are many academic women-in-science blogs written by women in other fields. Women in industry or government may not see their experiences represented amongst all the academics writing blogs. There may be too few non-academic women writing blogs for industry and government women to find social support networks online. Such

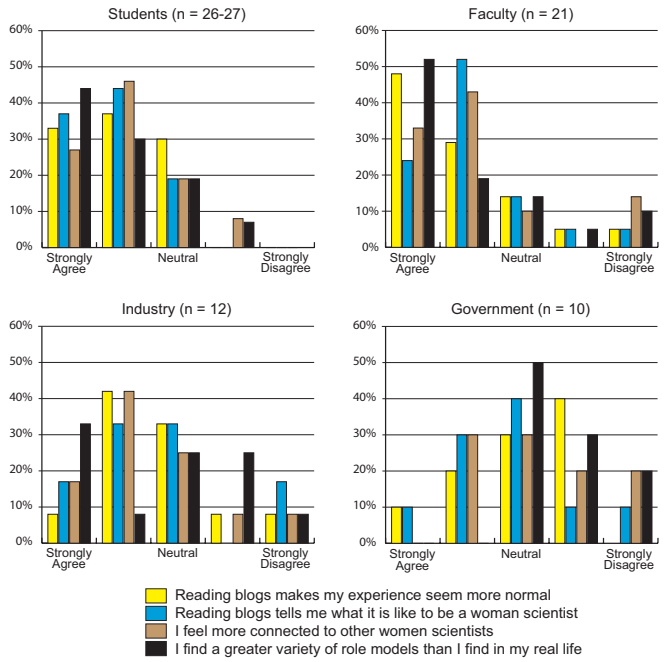

Figure 1. Perceived benefits of reading blogs by women geoscientists in different employment sectors.

low numbers may be due to official policies or unofficial workplace climates that prohibit or discourage blogging.

The lack of support through social media is likely to be experienced more acutely by minority geoscientists, particularly minority women. If women in government don't see their experiences reflected, what about African-American, Latina, American Indian, or Asian-American women geoscientists who are reading blogs or following Twitter? The role of social media in supporting international geoscientists is also unknown. The new and rapidly developing social media networks may not be able to counter isolation or provide support for minority geoscientists unless there is a critical mass of diverse voices writing blogs and providing Twitter updates that reflect and normalize the experience of the non-white, female, and non-academic geoscience communities. Such a critical mass is much more likely to occur if, more than just being accepted or even welcomed, diverse voices are actively sought out and supported by leaders in the geosciences.

Blogs and other social media may provide a source of community and role models for women geoscientists and help in the recruitment and retention of women from undergraduate education to faculty or industry careers. Our survey results show that blogs are already providing valuable benefits to white, academic women geoscientists, but that existing social media networks could be doing a better job of supporting minority geoscientists and those outside academia. We believe that professional societies, employers, funding agencies, and individual geoscientists should recognize the potential value of social media for supporting a diverse geoscience community. To be effective, such recognition should be accompanied by policies that encourage geoscientists to actively participate in geoscience-related social media opportunities.

Time spent online could be considered an integral part of continuing professional development and networking, a vital complement to the face-to-face opportunities offered at professional meetings like GSA's Annual and Section Meetings.

REFERENCES CITED

Committee on Maximizing the Potential of Women in Academic Science and Engineering, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2006, Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering: Washington, D.C., National Academies Press, 348 p.

Huntoon, J.E., and Lane, M., 2007, Diversity in the Geosciences and Successful Strategies for Increasing Diversity: Journal of Geoscience Education, v. 66, no. 6, p. 447–458.

Martinez, C., 2008, Female participation in the academic geoscience community: American Geological Institute Geoscience Currents, no. 9.

Manuscript received 22 Feb. 2010; accepted 28 May 2010.

NOTICE
of Council Meeting

2010 GSA Annual Meeting
Denver, Colorado, USA

Saturday, 30 Oct., 8–11 a.m.
and Wednesday, 3 Nov., 8 a.m.–noon

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Meetings of the GSA Council are open to Fellows, members, and associates of the Society, who may attend as observers, except during executive sessions. Only councilors and officers may speak to agenda items, except by invitation of the chair.

Coming to *GSA Today* in October 2010

- **Science Article:** Caldera collapse: Perspectives from comparing Galápagos volcanoes, nuclear-test sinks, sandbox models, and volcanoes on Mars
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Publications Highlights

Impact Factors on the Rise

Thomson Reuters released its 2009 numbers, and all of GSA's impact factors increased:

Geology is the #1 ranked geology journal (of 50) according to impact factor and five-year impact factor. Its impact factor, which is currently 4.368, has increased six years in a row.

Geological Society of America Bulletin's impact factor rose to 3.101, with a five-year impact factor of 4.324. It is the #17 ranked multidisciplinary geosciences journal (of 153).

Geosphere, which is in the multidisciplinary geosciences category, had an impact factor of 1.681this year, climbing from 1.627 in 2008.

Lithosphere has been accepted into the Science Citation Index and the Web of Science, but it has not yet received an impact factor.

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