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GSA TODAY

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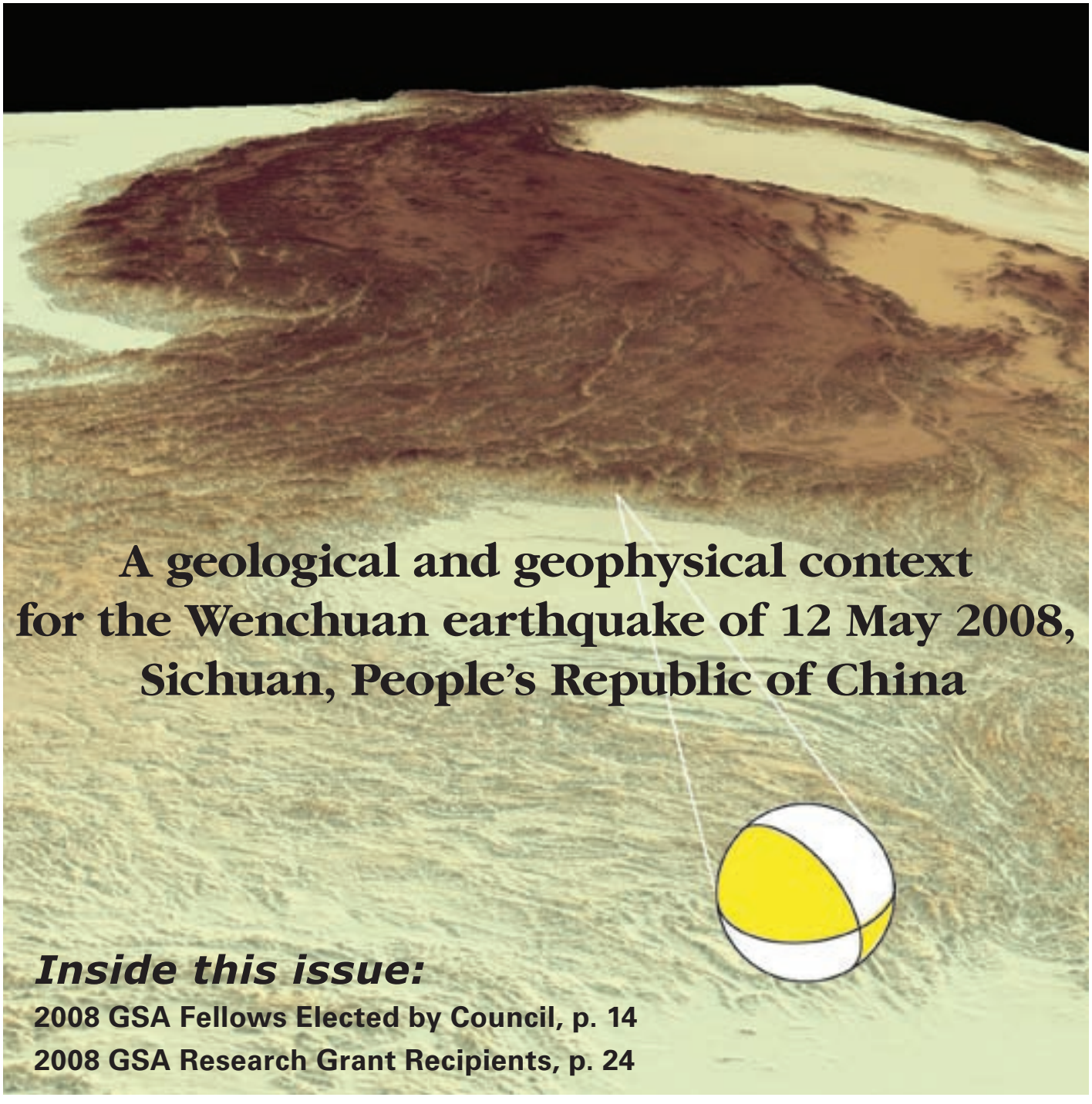

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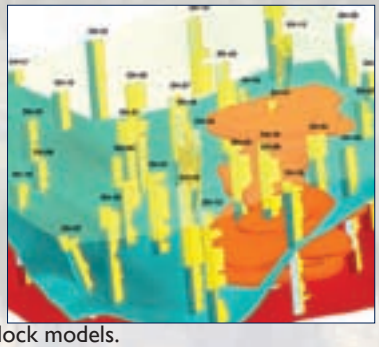

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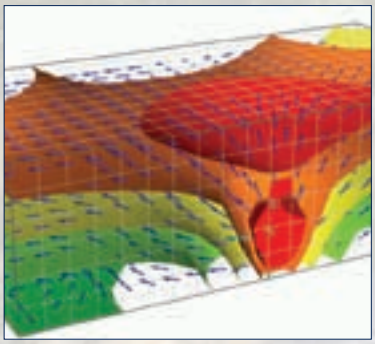

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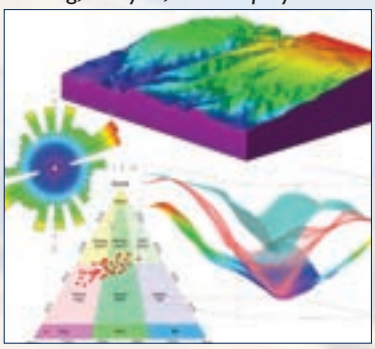

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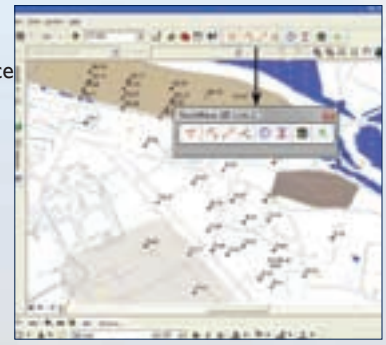

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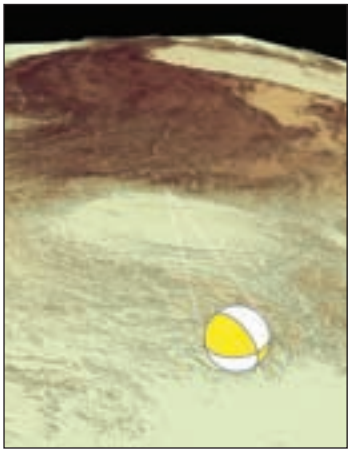

Cover: Three-dimensional view from the east of the Tibetan plateau, with epicenter and focal solution for the magnitude 7.9 earthquake that occurred in Sichuan, China, on 12 May 2008. Image constructed from ArcScene software with focal solution and epicenter location from the U.S. Geological Survey National Earthquake Information Center Web site, http://earthquake.usgs.gov/eqcenter/eqinthenews/2008/us2008ryan/. Digital topography data from 90-m resolution Shuttle Radar Topography Mission global dataset (Farr, T.G., et al., 2007, The Shuttle Radar Topography Mission: Reviews in Geophysics, v. 45, RG2004, doi: 10.1029/2005RG000183). Figure by Marin Clark. See p. 4–11.

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***GSA TODAY* STAFF:**
Executive Director and Publisher: John W. Hess
Science Editors: Stephen T. Johnston, University of Victoria, School of Earth & Ocean Sciences, Victoria, British Columbia V8W 3P6, Canada, stj@uvic.ca; and David E. Fastovsky, University of Rhode Island, Department of Geosciences, Woodward Hall, Rm. 317, Kingston, Rhode Island 02881, USA, defastov@uri.edu.
Managing Editor: Kristen E. Asmus, kasmus@geosociety.org
Graphics Production: Margo Y. Sajban

ADVERTISING:
Classifieds & Display: Ann Crawford, +1-800-472-1988, ext. 1053, +1-303-357-1053, Fax +1-303-357-1070; acrawford@geosociety.org

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A geological and geophysical context for the Wenchuan earthquake of 12 May 2008, Sichuan, People's Republic of China

B.C. Burchfiel, L.H. Royden, R.D. van der Hilst, B.H. Hager, *Dept. of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA;* ***Z. Chen,*** *Chengdu Institute of Geology and Mineral Resources, Chengdu, People's Republic of China;* ***R.W. King, C. Li, J. Lü, H. Yao,*** *Dept. of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA; and* ***E. Kirby,*** *Dept. of Geosciences, Pennsylvania State University, University Park, Pennsylvania 16802, USA;*

ABSTRACT

On 12 May 2008, a magnitude 7.9 earthquake ruptured the Longmen Shan margin of the eastern Tibetan plateau. This event occurred within the context of long-term uplift and eastward enlargement of the plateau. The area has numerous geological features not typical of active convergent mountain belts, including the presence of a steep mountain front (>4 km relief) but an absence of large-magnitude low-angle thrust faults; young high topography (post ca. 15 Ma) and thickened crust but low global positioning system (GPS) shortening rates (<3 mm/yr); and no coeval foreland subsidence. In our interpretation, crustal thickening beneath the eastern Tibetan plateau occurred without large-scale shortening of the upper crust but instead is caused by ductile thickening of the deep crust in a weak (low-viscosity) layer. Late Cenozoic shortening across the Longmen Shan could be as little as 10–20 km, with folding and faulting mainly accommodating differential surface uplift between the plateau and the Sichuan Basin. The earthquake of 12 May probably reflects long-term uplift, with slow convergence and right-slip, of the eastern plateau relative to the Sichuan Basin. GPS-determined rates in the vicinity of the 12 May event suggest an average recurrence interval of ~2,000–10,000 yr.

INTRODUCTION

On 12 May 2008, a magnitude 7.9 earthquake occurred beneath the steep eastern margin of the Tibetan plateau in Sichuan, China (Fig. 1). Rupture occurred over a length of ~270 km along a north-northeast–striking, west-dipping to steep fault beneath and parallel to the northeast-striking Longmen Shan thrust belt (as reported by the U.S. Geological Survey, National Earthquake Information Center, 2008). Coseismic slip, estimated at up to ~10 m, consists of thrust- and right-slip components, with initial rupture occurring at ~10–20 km depth (Ji, 2008). The rupture plane and the aftershock sequence extend northeast of the Longmen Shan range, and the faulting geometry along the rupture appears to be complex. Reverse and right-slip components are of comparable magnitude along the southwestern portion of the rupture, but right-slip dominates the northeastern portion of the rupture.

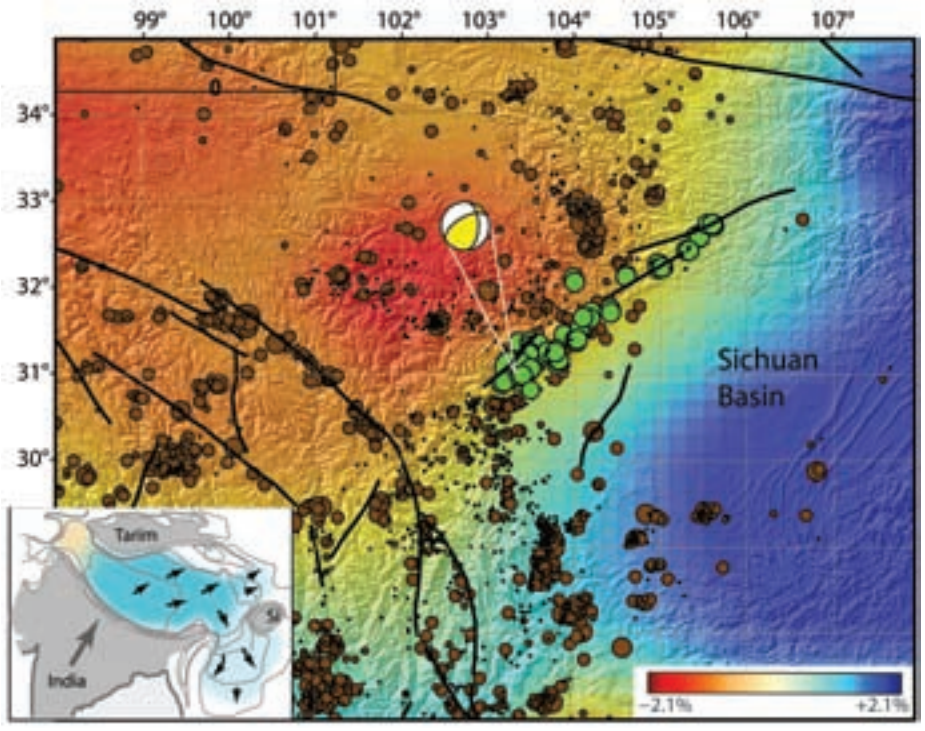

Figure 1. Epicenters of the 12 May 2008 Wenchuan earthquake and aftershocks (green circles), with focal mechanism for the main event as reported by the U.S. Geological Survey's National Earthquake Information Center (2008). Events are superimposed on map of lateral variation in P-wave speed at 100 km depth relative to a laterally homogeneous reference earth model (Li et al., 2006, 2008). Brown dots—regional seismicity (body wave magnitude m_b >3, symbol size scaled with magnitude, time interval 1964–2007 from Engdahl et al., 1998, EHB catalog). Inset shows regional-scale setting of Tibet with approximate directions of surface motion relative to eastern China. Si—Sichuan Basin.

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Several faults are likely candidates for rupture, including the northeast-trending Beichuan and Wenchuan faults. It is possible that coseismic displacement along the southwestern and northeastern segments of the fault break occurred on different, but contiguous, faults that broke during the same event. To date, surface ruptures have not been well documented, and details of the slip distribution and fault geometry remain unclear. Nevertheless, geological, geodetic, and geophysical data allow us to place this major seismic event within the context of ongoing deformation along the eastern margin of the Tibetan plateau.

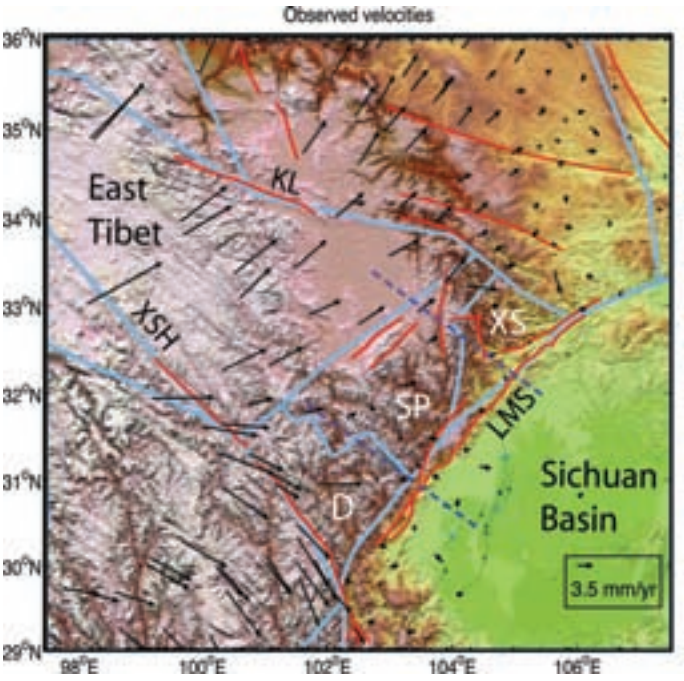

Figure 2. Selected active faults (red) and block boundaries used for GPS modeling (light blue). Blocks: D—Danba; SP—Songpan; XS—Xue Shan. Fault zones: XSH—Xianshuihe fault; KL—Kun Lun fault; LMS—Longmen Shan. Dashed purple lines—profile locations for Figure 3. Black arrows—observed GPS velocities relative to the South China block. Standard errors for north and east velocity components are 1–1.5 mm/yr.

OVERVIEW

In the vicinity of the 12 May 2008 earthquake, hereafter referred to as the Wenchuan earthquake, the eastern margin of the Tibetan plateau rises steeply westward from 500 m to >4000 m elevation (Figs. 2 and 3). Mountain peaks within the Longmen Shan reach elevations higher than 6000 m. The eastern plateau margin formed by the Longmen Shan coincides with steep gradients in crustal thickness (from 60–65 km in the west to ~40 km in the east; Xu et al., 2007; Yao et al., 2008) and seismic wave speed (from slow in the west to high in the east; Fig. 1).

Late Cenozoic deformation and crustal thickening in the Longmen Shan are related to eastward enlargement of the high Tibetan plateau. Global positioning system (GPS) data and earthquake focal solutions show eastward movement of upper crust away from the central Tibetan plateau and into the eastern plateau region at rates of ~15–20 mm/yr (Fig. 2). Eastward, crust located south of the left-slip Xianshuihe fault moves southeast relative to the Sichuan Basin, while crust north of the fault moves northeast.

Little of the northeastward crustal motion measured in the eastern plateau reaches the Longmen Shan (Zhou et al., 2007), but GPS sites west of and within the Longmen Shan are not sufficiently dense to determine where the deformation is localized. Mapping of important active fault zones provides some constraints, but the locations of some active deformation zones are still speculative. Elastic block modeling of GPS data indicates <~3 mm/yr convergence and ~1 mm/yr of right-slip along the Longmen Shan boundary. Northward, convergence is taken up across at least two zones. Our block model yields ~3 mm/yr of convergence across the Min Shan and ~1 mm/yr across the northern Longmen Shan; the latter also accommodates ~1 mm/yr of right-slip.

GEOLOGY OF THE WENCHUAN EARTHQUAKE REGION

Longmen Shan

The Cenozoic deformation of the Longmen Shan, including the active faulting related to the Wenchuan earthquake, is superimposed on a preexisting Mesozoic orogen. This older

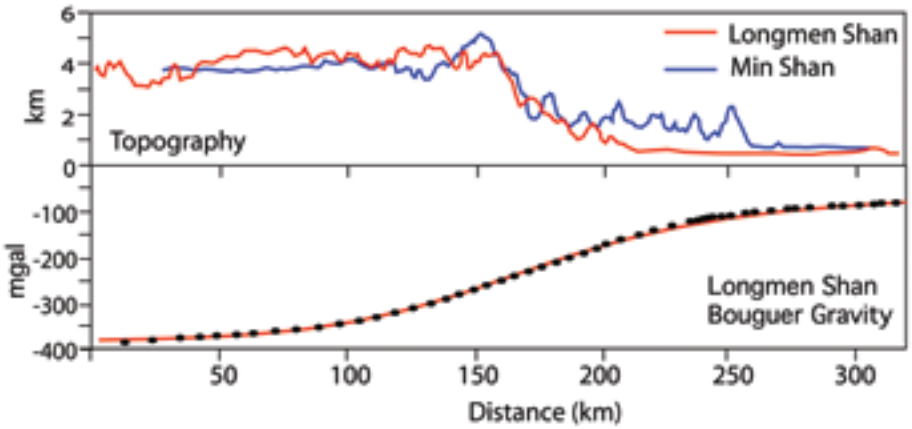

Figure 3. Topography profiles across the Min Shan and Longmen Shan and observed (dots) and computed (line) Bouguer gravity anomalies for Airy compensation of the Longmen Shan for a density contrast between crustal root and mantle of 400 kg/m^3. Gravity data from Jiang and Yu (2005).

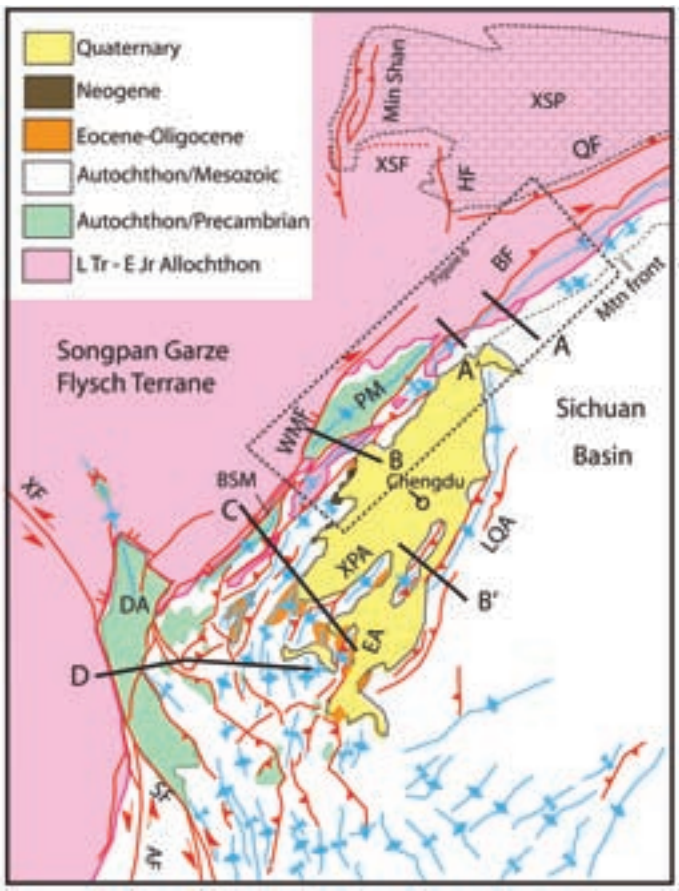

Figure 4. General tectonic map of the Longmen Shan region. AF—Anninghe fault; BF—Beichuan fault; HF—Huya fault; QF—Qingchuan fault; SF—Shimian fault; WMF—Wenchuan-Maowen fault; XF—Xianshuihe fault; XSF—Xue Shan Fault; BSM—Baoshan massif; PM—Pengguan massif; XSP—Xue Shan plateau (pattern/dashed outline); DA—Danba antiform; EA—Emei anticline; LQA—Longquan anticline; XPA—Xiong Po anticline. Red—major Cenozoic faults; purple—Upper Triassic–Lower Jurassic thrusts; blue—Cenozoic folds. On Cenozoic faults: barbs—thrust faults; ticked lines—normal faults; arrows—strike-slip. Figure 5 cross sections and location of map in Figure 6 also indicated.

deformation provides the starting geometry for later Cenozoic deformation (see Burchfiel et al., 1995).

Mesozoic deformation in the Longmen Shan took place in Late Triassic and Jurassic time, when two distinct structural sequences were deformed and juxtaposed by thrust faulting (Figs. 4 and 5). The autochthonous lower sequence consists mainly of late Precambrian basement rocks overlain by an incomplete section of latest Proterozoic to Middle Triassic shallow-water sedimentary rocks and Upper Triassic–Jurassic clastic rocks that appear to be foredeep basin deposits and grade eastward into finer-grained strata in the Sichuan Basin.

The eastern part of the upper structural sequence has a Precambrian crystalline basement overlain by a thick succession of latest Proterozoic to Lower Triassic shallow-water, highly metamorphosed sedimentary rocks. The western part of the upper sequence consists of up to 10 km of Middle to Upper Triassic flysch, which extends across a broad area of eastern Tibet as the Songpan Garze flysch. This upper structural

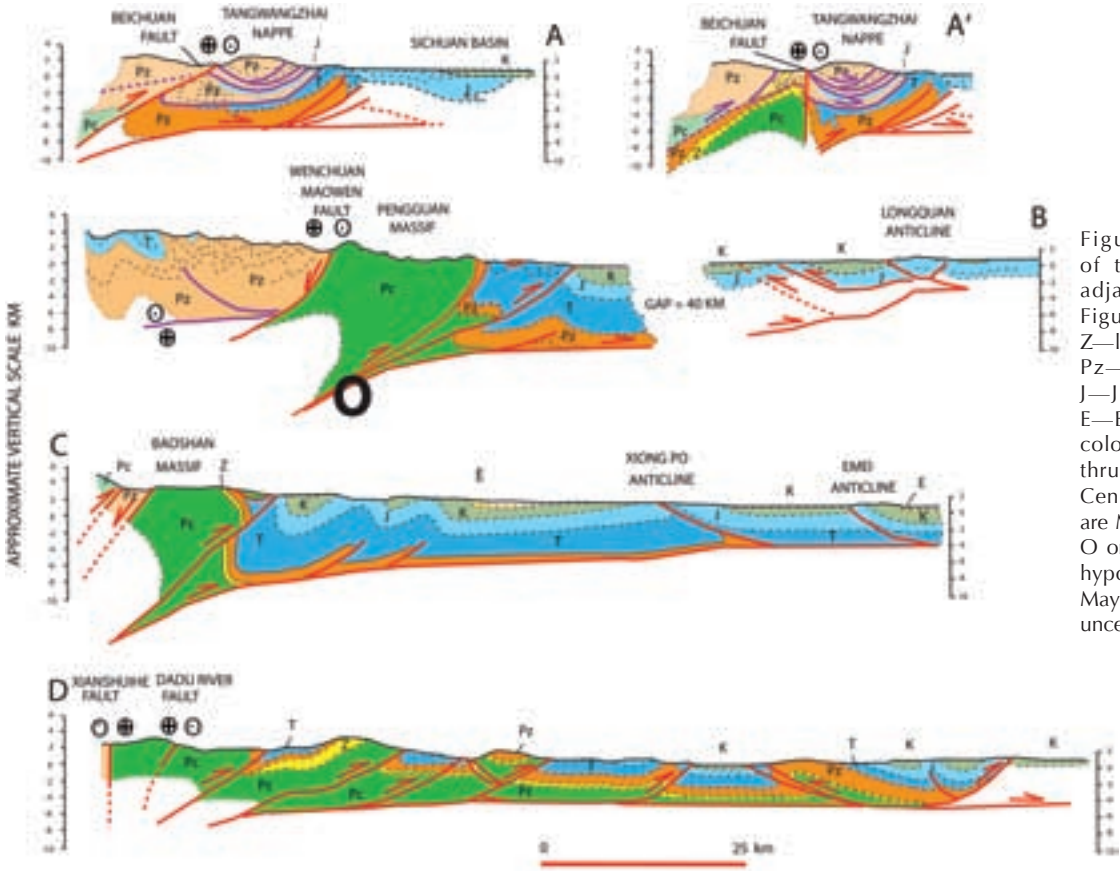

Figure 5. Cross sections of the Longmen Shan and adjacent area; locations in Figure 4. Pc—Precambrian; Z—latest Proterozoic (Sinian); Pz—Paleozoic; T—Triassic; J—Jurassic; K—Cretaceous; E—Eocene-(Oligocene?); pale colors indicate the Mesozoic thrust complex; red lines are Cenozoic faults; purple lines are Mesozoic faults. Large, bold O on section B is approximate hypocenter location of the 12 May 2008 earthquake, with an uncertainty in depth of ± 5 km.

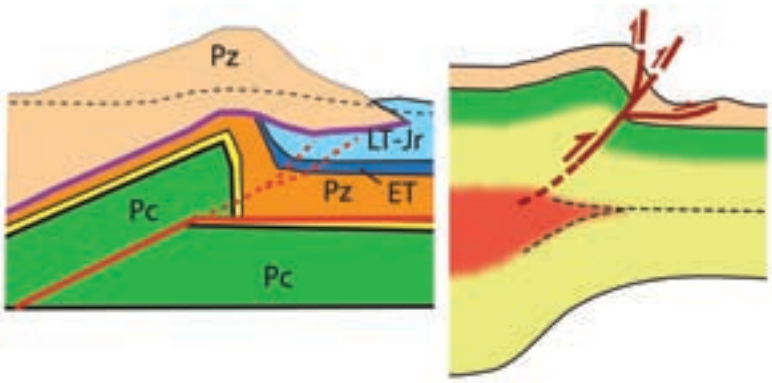

Figure 7. Left: Idealization of cross section A′ as a fault propagation fold, with minor slip on a subhorizontal fault extending eastward below the western Sichuan basin. Possible faults through the syncline that might propagate to the surface are indicated by red dashed lines. Pc—Precambrian crystalline basement; Pz—Paleozoic strata; ET—Early Triassic strata; LT-Jr—Late Triassic foredeep strata. Right: Sketch showing a highly simplified geometry that might relate upper crustal faulting and folding in the Longmen Shan to thickening of a weak, low-viscosity layer (red shading) in the deep crust beneath eastern Tibet. (Sketch is not to scale.) Thin dashed line in the mid-crust illustrates the possible disruption of the flexurally strong portion of the Sichuan Basin lithosphere.

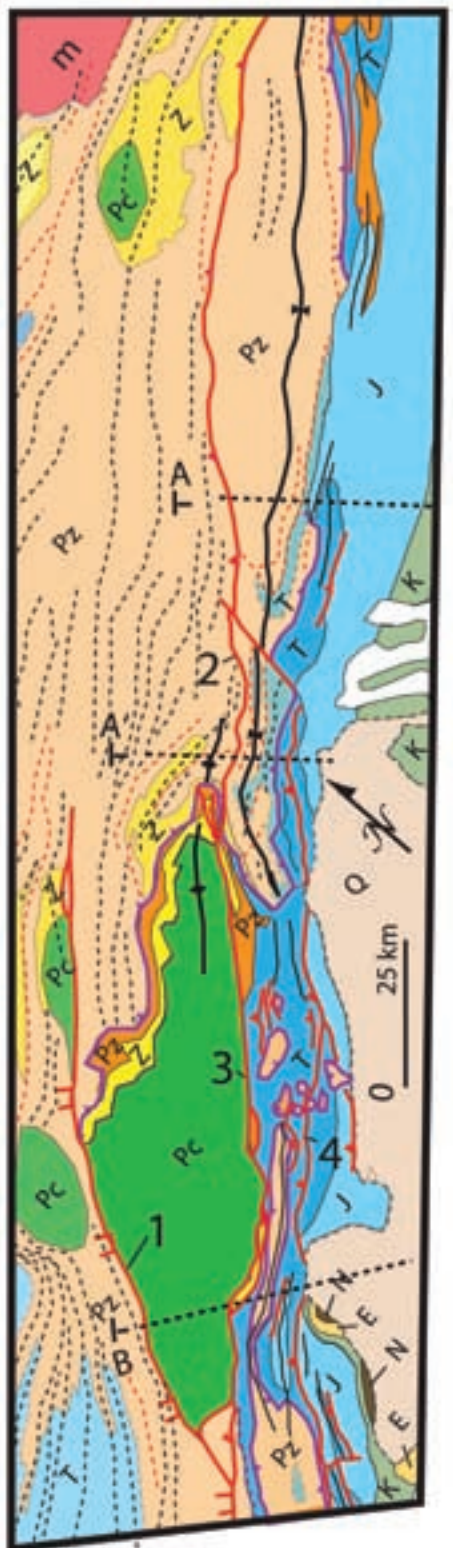

Figure 6. Detailed geologic map of the Longmen Shan. Pale colors indicate the Mesozoic thrust complex. Locations of some cross sections shown. Pc—Precambrian; Z—latest Proterozoic (Sinian); Pz—Paleozoic; T—Triassic; J—Jurassic; K—Cretaceous; E—Eocene-(Oligocene?); m—metamorphic rocks of unknown protolith; N—Neogene. Solid red lines are major Cenozoic faults; thin black lines are Cenozoic fold axes; purple lines are Mesozoic faults. Thin dashed black lines indicate fold axes in the Mesozoic thrust complex, and thin red lines are faults in the Mesozoic thrust complex, both presumed to be of Mesozoic age. Heavy black lines show a synform and an antiform that fold the Mesozoic thrust complex and are presumed to be Cenozoic. Major faults: 1—Wenchuan-Maowen fault; 2—Beichuan fault; 3—Yingxiu-Beichuan fault; 4—Guanxian-Anxian fault.

sequence was imbricated and emplaced eastward over the lower structural sequence in Late Triassic to Middle Jurassic time. Transitional units between the two structural sequences are generally not found.

Thrust sheets override the older foredeep deposits, and thrust contacts are sealed in places by Middle Jurassic strata, constraining the end of thrusting to the pre–Middle Jurassic. The foredeep deposits continue into the Late Cretaceous, but large post–Middle Jurassic, pre-Oligocene structures have not been identified.

The Mesozoic thrust complex and its underlying autochthon were refolded and thrust eastward in Cenozoic time. Cenozoic folding of the Precambrian basement is well expressed in the Baoshan and Pengguan massifs (Figs. 4 and 5). Along the southwestern margin of the Sichuan Basin, Eocene and probable Oligocene red beds are deformed by northeast-trending folds and thrust faults that merge northward into the Longmen Shan. These rocks constrain the Cenozoic deformation in this area to have been initiated in the late or post-Oligocene. Uncommon, presumed Neogene, conglomerates in the Longmen Shan (Fig. 6) are less folded than the underlying Early Cenozoic rocks.

Cenozoic thrust faults in the Longmen Shan do not have large displacements; folded strata can be matched across the faults. At the north end of the Pengguan massif, the plunging fold that involves basement also folds the overlying Mesozoic thrust complex, and at the north end of both basement massifs, sedimentary rocks on the west side of the massifs have a gentle west dip where the basement plunges beneath them. The large-scale Cenozoic structure of the Longmen Shan appears to be similar to that of a fault propagation fold that has been strongly modified by faults (Fig. 7).

External structures of the Longmen Shan merge with those of the western Sichuan Basin. Folds in the Sichuan Basin are underlain by a décollement that continues to the west beneath the folds of the eastern Longmen Shan. This décollement must ramp down into the basement east of the Pengguan and Baoshan massifs (Fig. 5, sections B and C). Some thrust faults along the eastern front of the Longmen Shan may also root into the basement, but correlation of sedimentary strata across these thrust faults suggests small displacements.

Northwest of Chengdu, most of the Cenozoic shortening appears to be concentrated in the folded structure of the

Pengguan massif. At this latitude, only one fold (the Longchuan anticline) is present in the Sichuan Basin, indicating only a few kilometers of displacement on the décollement beneath the basin. Here, Cenozoic folding along the eastern front of the Longmen Shan also does not require much shortening. North of the Longchuan anticline, the Mesozoic foredeep deposits are more uniformly inclined, dipping 15°–20°E and flattening eastward to merge with strata in the Sichuan Basin. This suggests that a triangle zone (a type of blind thrust fault) may be present at depth beneath the range front.

South of the Pengguan massif, folding in the basin becomes more widely distributed; thrust faults also appear to the west within the Sichuan Basin and along the eastern flank of the Longmen Shan (Fig. 4), indicating increased displacement on the décollement. South of the Sichuan Basin, the structures are more complex and involve crystalline basement (Fig. 5, Section D).

A series of steeply dipping faults, some of which are active, parallel the Longmen Shan margin and cut or otherwise interact with the Cenozoic fold-and-thrust structure (Figs. 2, 4, and 6). The contact of Paleozoic and Mesozoic rocks with the Precambrian basement along the east side of the Pengguan massif is a steep-to-vertical fault or faults (profile A′, Fig. 5). The same contact is depositional on the east side of the Baoshan massif and the northeast side of the Pengguan massif. To the north, these faults offset the thrusts of the Mesozoic thrust complex by <1 km, indicating little displacement on this steep fault system. The fault system continues northeast for >100 km as the Beichuan fault, a likely candidate for rupture during the 12 May Wenchuan earthquake.

The west sides of the Baoshan and Pengguan massifs are truncated by steep, west-dipping normal faults that have a right-slip component and merge with the eastern boundary faults at the southern end of the Pengguan massif. The fault system is exposed almost directly above the epicenter of the Wenchuan earthquake as the Wenchuan-Maowen fault; however, this fault's location, sense of shear, and surface dip are not compatible with the focal mechanism for the initial rupture.

The magnitude of Cenozoic shortening across the Longmen Shan is variable but small, probably on the order of tens of kilometers. In eastern Tibet, few Cenozoic shortening structures are observed in the field, except in the Min Shan range to the north. The geometry of the Cenozoic shortening structures in the Longmen Shan is such that only some of the dip-slip displacement on deep faults may reach the surface, while the rest may be absorbed by folding within the overlying layers and in the Sichuan Basin.

Sichuan Basin

The Sichuan Basin is roughly circular, containing >10 km of primarily Mesozoic and Paleozoic sedimentary rocks and rimmed along its southern margin by Cenozoic structures that merge westward and northward into the Longmen Shan. To the north and east, the surrounding ranges are folded belts of Late Triassic–Cretaceous and Late Cretaceous age, respectively. Thus, the basement beneath the basin remained relatively undeformed during the Mesozoic and Cenozoic deformations that affected the surrounding regions. Seismic tomography suggests that the basin is underlain by a lithosphere with higher than average P and S wave speeds at depths shallower than 250 km, indicating a relatively strong cratonic root (Fig. 1).

Rocks exposed in the Sichuan Basin are mainly Cretaceous and, locally, Jurassic. Eocene rocks are folded and exposed in active anticlines that form ridges within the southwestern part of the basin and are unconformably overlain by Pleistocene conglomerate and sandstone (Fig. 4). Between folds, Eocene and Quaternary strata are generally subhorizontal. Quaternary strata are present only in the southwestern part of Sichuan Basin, southwest of the Longchuan anticline. These strata are typically <100 m thick and are ponded behind the rising anticlines.

South and East of the Longmen Shan

To the south and east of the Longmen Shan, the eastern plateau wraps around the southern margin of the Sichuan Basin (Fig. 2). This area contains complexly superposed structures, including north-south– and northwest-southeast–trending Cenozoic folds and thrust faults. The faults and folds involve Precambrian basement, Paleozoic sedimentary strata, and Jurassic-Cretaceous foredeep deposits that correlate with rocks in the Longmen Shan and Sichuan Basin. These structures appear to be thin-skinned features above a shallow décollement within the basement. The westernmost folds and thrust faults continue from this region into the Longmen Shan, where they form the frontal structures along the range (Fig. 4).

Min Shan and Huya Region

The Min Shan, rising higher than 4000 m, are bounded on the west by the Min Jiang fault zone and on the southeast by the Huya fault zone (Fig. 4). Both fault zones consist of steep, active, west-dipping reverse faults (Kirby et al., 2000). In 1879, a magnitude ~7–8 earthquake occurred along the Min Jiang fault zone (Editorial Board, State Seismological Bureau, 1989) and in 1976, a magnitude 7.2 earthquake ruptured the Huya fault zone with dip-slip and left-slip components of displacement (Jones et al., 1984).

The western slope of the Min Shan is an erosion surface cut on older rocks. The surface is blanketed by west-dipping Quaternary deposits (Kirby et al., 2000), including a 7-km-wide basin filled with strata that dip 10°–20° west, indicating Quaternary tilting or folding.

The Min Jiang and Huya fault systems interact with the active, east-west–trending Xue Shan and Qingchuan faults, which relay deformation southward and eastward from the southern end of the Min Shan (Figs. 2 and 4). Faults in this area generally follow the boundary between the Xue Shan plateau (consisting of basement and a Paleozoic platform section) and Triassic flysch, suggesting that the fault geometry is controlled by a contrast in crustal strength between the two domains. The active faults of the northern Longmen Shan lie outboard of the Min Shan.

TOPOGRAPHY

The Longmen Shan and the Min Shan are asymmetric ranges bounded by steep, high-relief margins on their eastern sides and only modest western slopes. To the west, elevations rise toward >5000 m on the Tibetan plateau. The steepest margin on the eastern Tibetan plateau occurs where the Longmen Shan border the Sichuan basin; elsewhere, the plateau margin is gently sloping. To the north, the crest of the Longmen Shan deviates westward from the range front and continues into the Min Shan (Figs. 2 and 3). Much of the active convergence along the east side of the plateau follows the high topography of these ranges.

The modern high topography of the Longmen Shan and the eastern plateau was probably not established until the Late Cenozoic. Low-temperature isotopic dating indicates that relief along the Longmen Shan developed between 5 and 12 Ma (Kirby et al., 2002), while initiation of rapid river incision into the eastern plateau appears to have begun between 8 and 15 Ma (Clark et al., 2005; Ouimet, 2007).

ESTIMATES OF DEFORMATION BASED ON GPS MEASUREMENTS

Elastic strain accumulation during interseismic intervals influences surface displacements measured by GPS; accurate interpretation of GPS data should account for this accumulation of elastic strain and, in complex regions like eastern Tibet, for three-dimensional (3-D) fault geometries and 3-D elastic structure. In this analysis of GPS data, we use the block modeling method of Meade and Hager (2005a), in which interseismic strain accumulation is assumed to be balanced eventually by elastic strain release on fault zones (Meade, 2007; Meade and Hager, 2005b; Meade et al., 2002; Molnar and Ghose, 2000). The results are independent of the GPS reference frame assumed; velocities shown here are relative to southern China.

The Meade (2007) block model for Tibet used the GPS velocity field of Zhang et al. (2004) and yielded ~3 mm/yr right-slip and ~2 mm/yr convergence along the Longmen Shan boundary. We use the more recent velocity field of Gan et al. (2007) combined with that of Shen et al. (2005) and an updated solution from the network of King et al. (1997) and Chen et al. (2000). We found it impossible to fit the updated GPS data adequately with the Meade (2007) block geometries; therefore, we modified the block geometry west of the Longmen Shan to be more consistent with geologic structures and regional GPS data. In particular, we divided the eastern part of Meade's East Tibetan Plateau Block into three small blocks (Fig. 2). The East Tibet–Songpan boundary coincides with a belt of $m_b \geq 4$ seismic events (Fig. 1), where Shen et al. (2005) previously pointed out a GPS velocity gradient. The Danba-Songpan boundary is also defined by seismicity and connects to the Longmen Shan boundary near the epicenter of the Wenchuan earthquake. The Songpan–Xue Shan boundary extends through the active Min Shan and Huya fault zones, connecting the Longmen Shan boundary to the Kun Lun fault.

With this block geometry, we fit the GPS data to within their uncertainties (2–3 mm/yr in two dimentions with 90% confidence) in the Sichuan Basin, Songpan, and Xue Shan blocks. Due to limited data and one anomalous site, we believe that results for the Danba block are not reliable. All blocks northwest of the Sichuan Basin show northwest translation plus clockwise rotation. The initial rupture site for the Wenchuan earthquake lies near the southwestern end of the Songpan–Sichuan Basin block boundary. On this boundary, we estimate a roughly uniform 1 ± 1 mm/yr right-slip. Assuming a 45° west-dipping fault, we estimate 1 ± 1 mm/yr dip-slip in the southwest, increasing to 3 ± 1 mm/yr in the northeast. The sense of slip given by the block model is consistent with available estimates of the focal mechanism for the Wenchuan earthquake, with dip-slip and right-slip components (Ji, 2008).

The Xue Shan–Sichuan Basin boundary has an estimated 1 ± 1 mm/yr right-slip and dip-slip displacement, increasing slightly from southeast to northwest. Ji's (2008) finite fault solution indicates that primarily right-lateral strike-slip motion occurred on this fault segment during the Wenchuan earthquake.

The Songpan–Xue Shan boundary along the Min Jiang fault system yields estimated dip-slip motion increasing from south (2 ± 1 mm/yr) to north (3 ± 1 mm/yr) on an assumed 45° west-dipping fault. Significant strike-slip occurs only along the jog in the boundary that corresponds to the right-slip Qingchuan fault. The Songpan–East Tibet boundary shows relatively uniform deformation along its length: 3 ± 1 mm/yr right-slip and 2 ± 1 mm/yr convergence.

CRUSTAL COMPENSATION

The development of the Longmen Shan appears closely linked to its proximity to the Sichuan Basin. The lack of significant Late Cenozoic subsidence in the Sichuan Basin indicates little flexural loading of Sichuan Basin lithosphere during Late Cenozoic thrust faulting and uplift of the Longmen Shan. Gravity data across the Longmen Shan also suggest that little flexural loading of the Sichuan Basin occurred in Late Cenozoic time, and the crust here is (nearly) Airy-compensated (Fig. 3; but see Jiang and Yu, 2005).

These observations suggest that (i) the Sichuan lithosphere may be broken, or its flexural strength nearly zero, beneath the eastern Longmen Shan; or (ii) loading of the Sichuan lithosphere occurred by emplacement of crust over, under, and/or into the flexurally strong portion of the Sichuan lithosphere such that the net vertical load on the Sichuan lithosphere is small (Fig. 7). In either case, mechanical coupling between loads represented by the high topographic edifice of the plateau and the foreland lithosphere is small and highly atypical of foreland fold-and-thrust belts. This observation is important and should be incorporated into analyses of Cenozoic deformation in the Longmen Shan.

VARIATIONS IN ELASTIC AND RHEOLOGICAL STRUCTURE

P-wave tomography reveals a seismically fast structure beneath the Sichuan Basin extending to ~250 km depth (Li et al., 2006, 2008; Fig. 1), indicating that the basin is underlain by a deeply rooted, probably cold, craton-like lithosphere. Together with the observation that the Sichuan Basin largely escaped Mesozoic and Cenozoic deformations that affected the surrounding zones, this suggests that the Sichuan Basin lithosphere is mechanically strong compared to surrounding regions.

Above ~250 km depth, the eastern plateau region is seismically slow, probably reflecting lower mechanical strength and elevated temperatures in the lithosphere (see Li et al., 2006, 2008). Alkali-rich magmatic rocks that were erupted in the eastern plateau from earliest Cenozoic to Pliocene time have melt temperatures in excess of ~1300 °C at depths of 80–100 km, indicating anomalously high temperatures at the base of, and probably throughout, the crust of the eastern plateau (Holbig and Grove, 2008). Magnetotelluric data from the eastern and south-central plateau also indicate a hot, fluid-rich middle crust (Nelson et al., 1996). Surface-wave tomography (Yao et al.,

2006, 2008) and receiver function analysis (Xu et al., 2007) from regional arrays in eastern Tibet show structures with low shear wave speed in the middle and lower crust.

Such large variations in rheologic structure have important effects on deformation at all time scales. Incorporating such variations in calculations of expected coseismic displacements for this earthquake produces results that differ by 20% in the near-field and by a factor of two in the far-field. Over geologic time, the crustal low-velocity zones may form an irregular, interconnected, network of channels in the middle and lower crust (Yao et al., 2006, 2008). Determining how these structures affect the postseismic deformation that will be observed in the next months to years will provide a unique opportunity to compare crustal rheologies on geodetic and geologic time scales.

CRUSTAL THICKENING PROCESS

The age of crustal thickening beneath the Longmen Shan and eastern plateau is probably similar to that of surface uplift, which is younger than 15 Ma. Based partially on the absence of significant Late Cenozoic shortening structures south of the Kun Lun fault, Clark and Royden (2000) proposed that crustal thickening in eastern Tibet occurred largely within a weak (low-viscosity) zone in the mid- to lower crust. A variety of data are consistent with this interpretation (e.g., high crustal temperatures, slow seismic wave speeds, flat to gently dipping topographic surfaces, etc.). If this interpretation is generally correct, the zone of weak crust probably does not extend beneath the eastern Longmen Shan, because crust with extensive zones of weakness at depth cannot support steep topographic gradients of significant lateral extent.

Clark and Royden (2000) also postulated that the edge of the high plateau may be narrowly localized along the Longmen Shan because the mechanically strong lithosphere of the Sichuan Basin obstructs eastward flow of weak crust at depth (also see Cook and Royden, 2008). In their conception, localization of Late Cenozoic deformation and active faulting along the Longmen Shan is largely controlled by the rheological contrast between the weaker crust of eastern Tibet and the craton-like crust/lithosphere of the Sichuan Basin. They attributed the northeastward motion of east Tibetan crust, relative to the Sichuan Basin, as related to the growth of the eastern plateau to the northeast, with northeastward-moving crustal fragments within eastern Tibet diverted around the mechanically strong Sichuan Basin block (Fig. 1 inset and Fig. 2).

ROLE OF LATE CENOZOIC FAULTING IN THE LONGMEN SHAN

We propose that the primary function of Late Cenozoic structures in the Longmen Shan is to accommodate differential uplift across the eastern plateau margin and the northeastward movement of Tibetan crust relative to the Sichuan Basin. We also propose that the modified fault-propagation fold structure of the Longmen Shan is linked to ductile thickening within the deeper crust in a manner that is not completely clear. Figure 7 shows a simplified illustration of one possible geometry, in which upper-crustal layers of the Longmen Shan are folded upward above a ductilely thickening deeper crust. Competent rocks in the lower crust or upper mantle, if present, may also be flexed downward at the base of the enlarging crustal root, perhaps imparting a small flexural signal to the Moho (see gravity analysis of Jiang and Yu, 2005).

This interpretation is consistent with the predominance of Late Cenozoic high-angle reverse faults over gently dipping thrust faults in the Longmen Shan and Min Shan and with the slow rates of GPS-determined convergence. It is also consistent with the lack of Late Cenozoic foreland subsidence in the Sichuan Basin, because the geometry indicated in Figure 7 may produce little to no net loading (and could produce uplift) of the foreland region.

SLIP RATE AND RECURRENCE INTERVAL

Long-term rates of vertical uplift of ~0.3–0.8 mm/yr can be obtained by dividing the topographic relief across the Longmen Shan (~4 km) by the estimated initiation age for surface uplift (ca. 5–12 Ma). Adding an estimated 5–8 km for denudation above the Pengguan and Baoshan massifs (Kirby et al., 2002) yields estimated rates of rock uplift of ~0.7–1.2 mm/yr. The GPS-estimated rate of dip-slip, 1 ± 1 mm/yr, near the epicenter of the Wenchuan earthquake, is assumed to occur on a 45° west-dipping fault, giving convergence and differential uplift of ~0.7 ± 0.7 mm/yr. We suggest that the magnitude of Late Cenozoic shortening across the Longmen Shan may not be much larger than the magnitude of vertical rock uplift, perhaps as little as 10–20 km.

Approximate bounds on the average recurrence interval for earthquakes similar to the 12 May 2008 event are obtained by dividing the average coseismic slip of ~5 m (Ji, 2008) by the GPS-determined dip-slip rate of 1 ± 1 mm/yr, or by the estimated long-term uplift rate of ~0.7–2.2 mm/yr. Both suggest an average recurrence interval in the general range of 2,000–10,000 yr.

GPS-determined slip rates across the Longmen Shan, and estimated recurrence intervals, are dependent in detail on the model assumptions used in analyzing the data. For the block model used here, deformation rates computed across the Longmen Shan are sensitive to the assumed number and location of blocks. The results are also sensitive to potential rheological inhomogeneities in the lithosphere. Undoubtedly, the results presented here will continue to be refined, especially because some of the block boundaries are marked by zones of diffuse seismicity without well-determined active faults. Ongoing study of coseismic and postseismic displacements related to the 12 May 2008 Wenchuan earthquake should provide much data to test the hypotheses presented in this paper.

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Derek Cornforth, Cornforth Consultants Inc., *for* Cornforth, Derek, 2005, Landslides in Practice: *Investigation, Analysis and Remedial/Preventative Options in Soils*: New York, John Wiley and Sons, 596 p.

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Jon J. Major, U.S. Geological Survey, Vancouver, Washington, *for* Major, Jon J., 2004, Posteruption suspended sediment transport at Mount St. Helens: Decadal-scale relationships with landscape adjustments and river discharges: *Journal of Geophysical Research*, v. 109, F01002, doi: 10.1029/2002JF000010.

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GSA's newly elected Fellows will be recognized at the 2008 Joint Annual Meeting GSA Presidential Address & Awards Ceremony on Saturday, 4 October, at the George R. Brown Convention Center in Houston. We invite you to read some of what their nominators had to say.

Mohamed G. Abdelsalam, Missouri University of Science and Technology
Member: GSA North-Central Section

Mohamed Abdelsalam has helped resolve geologic problems in northeastern Africa and Arabia. He has contributed to our understanding of the tectonic evolution of Sudan. He is a leader in the field of remote sensing, Afar neotectonics, and geomorphology of the Nile. He was president of the Geologic Society of Africa.
—Robert J. Stern

Eric J. Barron, Jackson School of Geosciences
Member: GSA South-Central Section

Eric J. Barron, Dean, Jackson School of Geosciences at The University of Texas at Austin, is a true renaissance person having many talents, diverse interests, and accomplishments. He is an educator, administrator, researcher, scientific writer, and ambassador for professional societies. In addition, he has long-term service to the federal government and international organizations.
—David A. Stephenson

Rex C. Buchanan, Kansas Geological Survey
Member: GSA South-Central Section, GSA Geology and Society Division, and GSA History of Geology Division

Rex C. Buchanan is recognized for his distinguished efforts in communicating geology to the general public and public officials; service to the AESE, AGI, and GSA; training of scientists to communicate effectively with their colleagues and the press; and administration of outreach and service programs for the Kansas Geological Survey.
—Jonathan H. Goodwin

Brenda J. Buck, University of Nevada–Las Vegas
Member: GSA Cordilleran Section and GSA Sedimentary Geology Division

Brenda Buck's nomination to GSA Fellowship recognizes distinguished contributions to soil science, particularly soil morphology and mineralogy, and its application to geology and the human environment. Her research spans from modern to ancient, from geomorphic applications of modern soils to implications of paleosols for ancient climates, tectonics, and paleogeography.
—Timothy F. Lawton

Timothy B. Byrne, University of Connecticut
Member: GSA Cordilleran Section and GSA Structural Geology and Tectonics Division

I nominate Tim Byrne based on his more than 50 published papers and three decades of onland and offshore research related to the structural evolution of convergent margins as well as his contributions to our understanding of the geology of southwest Alaska, the Nankai margin/Shimanto belt of Japan, and Taiwan.
—Donald M. Fisher

Susan H. Cannon, U.S. Geological Survey–Denver
Member: GSA Rocky Mountain Section and GSA Engineering Geology Division

Sue Cannon is noted for her cutting-edge research in debris-flow hazards, currently in post-fire areas of the western U.S., and the creation of physically based models that can be used to estimate erosion and sediment production over a variety of landscapes and burned areas. Her accomplishments are measured by being on more than 13 policy committees, convener of more than 15 conferences, more than 100 technical presentations, and 67 published reports.
—Robert H. Fakundiny

Paterno R. Castillo, Scripps Institution of Oceanography
Member: GSA Cordilleran Section and GSA Planetary Geology Division

Pat Castillo has over 20 years of professional experience in geosciences and has been a GSA member since 1988. He is an international leader in petrology and geochemistry. His research has inspired the international community on a number of fundamental geodynamic problems of global significance. He has excelled in science as a researcher and in education as a teacher and mentor. Therefore, I strongly believe that Paterno R. Castillo should be elected a Fellow of the Geological Society of America for his fundamental contributions in petrology, geochemistry, and mantle chemical geodynamics.
—Yaoling Niu

C. Blaine Cecil, U.S. Geological Survey–Reston
Member: GSA Southeastern Section; Sedimentary Geology Division

Blaine Cecil is a leading researcher in coal and has made significant contributions in the geochemistry of and paleoclimatic controls on coal distribution. He has been generous in sharing information and tireless in his dedication to the geosciences, including holding office in the Coal Geology Division of GSA.
—Judith T. Parrish

Yue-Gau Chen, National Taiwan University
Member: GSA Quaternary Geology and Geomorphology Division

Yue-Gau Chen is the leading researcher and promoter of active tectonics in Taiwan, post-1999 Chi-Chi earthquake. Also, he facilitated numerous research collaborations between Taiwan geologists and leading U.S. researchers, producing internationally important results and raising up a new generation of Taiwan scientists skilled in active tectonics and earthquake geology.
—John Suppe

Jeffrey R. Chiarenzelli, St. Lawrence University
Member: GSA Northeastern Section

Jeff Chiarenzelli has made fundamental contributions to the geology of the Hudsonian orogen and the Adirondack Mountains, principally through zircon geochronology, and they represent breakthroughs. He has also made important contributions to techniques dealing with toxic wastes and PCBs. Beyond these, he has been an outstanding teacher of undergraduates.
—James M. McLelland

Peter D. Clift, University of Aberdeen
Member: GSA Sedimentary Geology Division

An extraordinary sedimentologist, Peter D. Clift is a leader in his field, with the ability to distill tectonic and climatic signals in large, complex, sedimentary and volcanic systems by synthesizing geochemical, sedimentological, petrological, and geophysical data sets. His outstanding body of work and collaborative efforts merit his attainment of fellowship in the Geological Society of America.
—Kathleen M. Marsaglia

Laura J. Crossey, University of New Mexico
Member: GSA Rocky Mountain Section, GSA Geobiology & Geomicrobiology Division, GSA Geoscience Education Division, GSA Hydrogeology Division, and GSA Sedimentary Geology Division

Laura J. Crossey is an exceptionally gifted and productive earth science researcher, instructor, and mentor. Her sustained, broad, and deep research contributions include geochemical processes in streams, meteoroid impact structures, hydrothermal alteration of volcaniclastics, cave geomicrobiology, and hydrochemical studies in the Grand Canyon.
—Lynn M. Walter

Peter S. Dahl, Kent State University
Member: GSA Rocky Mountain Section

Peter S. Dahl has been an outstanding research geologist and teacher at Kent State University in Ohio since 1977. He has been recognized as an outstanding teacher and has had a distinguished research career, specializing in the chemical basis for U-Pb, Ar-Ar, and fission-track thermochronology; metamorphic geothermometry; and Precambrian geology.
—Marion E. Bickford

Warren C. Day, U.S. Geological Survey–Denver
Member: GSA Rocky Mountain Section and GSA Structural Geology and Tectonics Division

Warren Day's exemplary career in research and geological leadership at the U.S. Geological Survey includes co-leading a study of the Tintina metallogenic province of Alaska and supervising bedrock mapping and fracture studies at Yucca Mountain, Nevada. He is currently USGS Deputy Regional Geologist for Science, Central Region.
—Karl S. Kellogg

Laurance J. Donnelly, Halcrow Group Ltd.
Member: GSA Engineering Geology Division

Elected to fellowship as the 2007 E.B. Burwell, Jr., Award recipient.

Kenneth A. Eriksson, Virginia Polytechnic Institute and State University
Member: GSA Southeastern Section

Kenneth Eriksson is nominated for fellowship in the GSA for his outstanding career-long contributions to our understanding of Archean and Proterozoic sedimentary systems throughout the world. Ken has guided numerous Ph.D. and M.S. students and served as a mentor after completion. As co-chief editor for twelve years, he guided the international journal *Precambrian Research.*
—Edward L. Simpson

Thomas J. Evans, Wisconsin Geological and Natural History Survey
Member: GSA North-Central Section and GSA Geology and Society Division

Thomas J. Evans has served the geological profession for over 35 years, primarily at two state geological surveys. He is an expert on metallic mineral resource policy and works with policy makers at all levels of government. Dr. Evans is a founding member of GSA's Geology and Society Division.
—James M. Robertson

William C. Evans, U.S. Geological Survey–Menlo Park
Member: GSA Cordilleran Section

William C. Evans is nominated in recognition of outstanding contributions in the areas of gas chemistry and volcano-hazards mitigation.
—Steven E. Ingebritsen

Luca Ferrari, Universidad Nacional Autónoma de México–Juriquillas
Member: GSA Cordilleran Section

Luca Ferrari's outstanding career includes research and publications that greatly advance understanding of the geologic development and tectonic setting of the major volcanic belts of Mexico; directorship of the Centro de Geociencias (UNAM); extensive editorial responsibilities, especially of the *Revista Mexicana de Ciencias Geológicas*; and mentoring of students and colleagues.
—Christopher D. Henry

Anthony R. Fiorillo, Museum of Nature & Science, Dallas, Texas
Member: GSA South-Central Section

Anthony Fiorillo has made outstanding research contributions to geology and paleontology, and, through his outreach to the public, is enhancing the credibility of science, and inspiring the next generation of geoscientists.
—David B. Loope

Herbert V. Frey, NASA–Goddard Space Flight Center
Member: GSA Northeastern Section, GSA Planetary Geology Division, GSA Geophysics Division, GSA Geoscience Education Division, and GSA Structural Geology and Tectonics Division

Herb Frey is nominated for his numerous contributions to the study of Mars, for career-long support of students in the geology and geophysical sciences, and for his contributions to the GSA Planetary Geology Division.
—James R. Zimbelman

Kevin P. Furlong, The Pennsylvania State University
Member: GSA Cordilleran Section, GSA Geophysics Division, GSA Geoscience Education Division, and GSA Structural Geology and Tectonics Division

Kevin Furlong is nominated for his distinguished contributions to the multidisciplinary study of lithosphere processes, including plate boundary evolution, thermal structure of the continents, and their implications for natural hazards.
—Rudy L. Slingerland

Carmala N. Garzione, University of Rochester
Member: GSA Northeastern Section

Elected to Fellowship as the 2007 Young Scientist Award (Donath Medal) recipient.

Alan R. Gillespie, University of Washington
Member: GSA Cordilleran Section and GSA Quaternary Geology and Geomorphology Division

Alan Gillespie's first-rate publications, strong editorial work, education of exceptionally well-known students, and general good humor about all things geological should have been recognized for GSA Fellowship some time ago.
—John F. Shroder

James D. Gleason, University of Michigan
Member: GSA Cordilleran Section and GSA Structural Geology and Tectonics Division

Jamie Gleason is nominated for his innovative contributions to fundamental and applied radiogenic isotope geochemistry and to important advances in resolving questions about the origins of lithogenic materials on land, under the ocean, and delivered from outer space.
—Philip A. Meyers

V.J.S. Grauch, U.S. Geological Survey–Denver
Member: GSA Rocky Mountain Section, GSA Geophysics Division, and GSA Structural Geology and Tectonics Division

V.J.S. (Tien) Grauch's outstanding research record is focused on using aeromagnetic data to characterize sedimentary basins via integrated geological and geophysical studies and to study the crust and gold deposits of northern Nevada. Her strong commitment to the geological profession is manifested in outreach efforts and service to GSA.
—G. Randy Keller

Stephen F. Greb, Kentucky Geological Survey
Member: GSA Southeastern Section, GSA Coal Geology Division, GSA Geoscience Education Division, and GSA Sedimentary Geology Division

Stephen F. Greb is nominated for significant contributions to coal geology. His work on structure, sedimentology, and paleoclimate of Appalachian Basin coal-bearing strata is widely recognized as highly innovative and influential. He has distinguished himself as a teacher, lecturer, and artist.
—Leslie F. Ruppert

Robbie R. Gries, Priority Oil & Gas LLC
Member: GSA Rocky Mountain Section and GSA International Division

Robbie Rice Gries is an exemplary leader in geological and professional organizations, especially in her current role as treasurer for the Geological Society of America. Since 1986, she's held leadership positions in five national, regional, and state organizations, many concurrent with holding executive positions with oil and gas companies.
—Jerome V. DeGraff

Linda C. Gundersen, U.S. Geological Survey–Reston
Member: GSA Northeastern Section, GSA Geoinformatics Division, GSA Geology and Health Division, and GSA Structural Geology and Tectonics Division

It is a pleasure to nominate Linda Gundersen, chief scientist for geology, U.S. Geological Survey, as a Fellow. Her most significant contribution to geology is in both administration of geologic programs and raising public awareness of geology. She is also well known for her studies on geologic control of Radon.
—A.K. Sinha and Martin B. Goldhaber

William R. Hammer, Augustana College
Member: GSA North-Central Section and GSA Sedimentary Geology Division

A distinguished vertebrate paleontologist, William R. Hammer has contributed much to the understanding of polar Gondwana vertebrate faunas through his research in Antarctica. His work has expanded our knowledge of Early Triassic faunas, and he was the first to document Middle and Late Triassic faunas and Early Jurassic faunas, including dinosaurs.
—James W. Collinson

Robyn E. Hannigan, Arkansas State University
Member: GSA South-Central Section

Robyn Hannigan is honored for her outstanding contribution as a geochemist-hydrologist, organometallic biogeochemist, and environmental scientist who has also made major breakthroughs in analytical instrumentation for speciation of organometals. She has shown exemplary leadership in enhancing diversity by training underrepresented minority students from across the nation in environmental science research.
—Asish R. Basu

Christopher L. Hill, Boise State University
Member: GSA Rocky Mountain Section, GSA Archaeological Geology Division, GSA History of Geology Division, and GSA Quaternary Geology and Geomorphology Division

Christopher L. Hill has published more than fifty papers in a broad range of geological subdisciplines, including geomorphology, sedimentology, vertebrate paleontology, and archaeological geology covering North America, Egypt, Israel, and Turkey. He has been very active and productive in GSA's Archaeological Geology Division.
—George R. Rapp

Hugh C. Jenkyns, University of Oxford

Among the world's leading sedimentary geologists, Hugh Jenkyns' major research contributions include seminal papers on Mesozoic sedimentation in the circum-Mediterranean area and Oceanic Anoxic Events, efforts that integrated outcrop and deep-sea core archives. His outstanding record of service includes membership on numerous DSDP/ODP/JOIDES panels and co-editorship of *Geology*.

—Robert E. Garrison

Harry M. Jol, University of Wisconsin–Eau Claire

Member: GSA North-Central Section, GSA Quaternary Geology and Geomorphology Division, and GSA Sedimentary Geology Division

Harry M. Jol has been one of the top North American researchers on the use of ground-penetrating radar in sedimentology and geomorphology for the past fifteen years, publishing 40 refereed journal articles, making over 200 conference presentations, and engaging in extensive collaborative research throughout the world.

—Ronald J. Goble

Alan E. Kehew, Western Michigan University

Member: GSA North-Central Section and GSA Quaternary Geology and Geomorphology Division

Research by Alan Kehew has provided significant insight into glacial paleohydrology; his model of catastrophic flood bursts is the basis for our understanding of Quaternary fluvial history in the Northern Great Plains. Equally important are Alan's contributions to applied geology through groundwater studies and textbooks for geological and environmental engineers.

—James T. Teller

Joanne Kluessendorf, Weis Earth Science Museum

Member: GSA North-Central Section

Joanne gave outstanding help and support to the GSA North-Central Section during the years that I was the Section's executive secretary. I could depend on her help whenever I needed it. She continues that service to the section and to GSA. Joanne also is director of the Weis Earth Science Museum. She played a major role in starting this museum.

—Robert F. Diffendal Jr.

Matthew J. Kohn, Boise State University

Member: GSA Rocky Mountain Section

Matthew Kohn is nominated for advances in phase equilibria, kinetics, thermodynamics, and geochronology of metamorphic systems, and for development and application of geochemical techniques for investigation of climate and orogenesis.

—William D. Carlson

Jeffrey Lee, Central Washington University

Member: GSA Cordilleran Section and GSA Structural Geology and Tectonics Division

Jeffrey Lee has a distinguished record of research in the field of continental tectonics. He has contributed to our knowledge of core complexes and gneiss domes in the Basin and Range, Alaska, and Tibet and to what we know about fault slip in the Eastern California Shear Zone, and is noted for his published geologic maps and years of teaching students in the field.

—Elizabeth L. Miller

Gordon S. Lister, Australian National University

Member: GSA Cordilleran Section and GSA Structural Geology and Tectonics Division

Gordon Lister is nominated for his groundbreaking contributions to the understanding of structural fabric in rocks, the development of Cordilleran-style metamorphic core complexes, and the development of passive continental margins, as well as discovery of core complexes in the Alpine-Himalayan chain.

—Brian P. Wernicke

David T. Long, Michigan State University

Member: GSA North-Central Section, GSA Geology and Health Division, GSA Hydrogeology Division, and GSA Limnogeology Division

David T. Long has conducted state-of-the-art research in environmental and aqueous geochemistry for 30 years. This research has provided over 85 refereed publications. Long is considered an international authority on trace metal dynamics, medical geochemistry, and acid-saline systems.

—W. Berry Lyons

Nancy J. McMillan, New Mexico State University

Member: GSA Rocky Mountain Section, GSA Geoinformatics Division, and GSA Geoscience Education Division

Nancy J. McMillan is an innovator in applied geochemistry and a regional expert in the study of continental volcanism of western North America. Her commitment to the geological sciences is reflected in her legacy at New Mexico State University as an administrator and undergraduate and graduate educator, and as a valued Councilor to the Society.

—Ren A. Thompson

Martin D. Mifflin, Mifflin & Associates

Member: GSA Cordilleran Section, GSA Hydrogeology Division, and GSA Quaternary Geology and Geomorphology Division

Elected to Fellowship as the 2007 Kirk Bryan Award for Research Excellence recipient.

Kitty Milliken, The University of Texas at Austin

Member: GSA South-Central Section and GSA Sedimentary Geology Division

Kitty Milliken is a widely published and cited researcher in sedimentary petrology. Her research has made fundamental contributions to understanding chemical and mechanical diagenetic processes in sandstones and mudstones that impart massive chemical change through water/rock interaction. Journal editorship and development of methods for teaching sandstone petrography support her nomination.

—Shirley P. Dutton

Lisa A. Morgan, U.S. Geological Survey–Denver

Member: GSA Rocky Mountain Section

Lisa Morgan is a respected volcanologist, geologist, teacher, and councilwoman. Her Snake River Plain and Yellowstone National Park studies helped lead to recognition of the "hotspot" track. Her numerous publications and popular field trips and lectures continue to inform professionals, policy makers, and the public about geologic processes and events.

—Betty A. Skipp

Charles M. Onasch, Bowling Green State University
Member: GSA North-Central Section

Charles M. Onasch is internationally known for contributions to structural geology and tectonics, especially in the field of deformation and microstructures in quartz. He also makes significant contributions to applied geology in environmental geophysics and engineering geology. Finally, he has played a major role in teaching and administration at Bowling Green State University.
—James E. Evans

Michael R. Perfit, University of Florida
Member: GSA Southeastern Section

Michael Perfit is nominated for the award of GSA Fellow for his distinguished contributions in marine geology and igneous petrology. Mike is a leader in marine geology, particularly in the geochemical study of oceanic ridges and the origin of tectonic plates, and is a valuable member of numerous international cooperative research programs.
—David A. Foster

Michael C. Pope, Washington State University
Member: GSA Cordilleran Section and GSA Sedimentary Geology Division

Mike Pope has been a very enthusiastic teacher and researcher in the general field of carbonate sedimentology. His data are field-based throughout the USA. He publishes his results in a timely manner and is always employing innovative techniques, including sequence analysis, isotope work, and now zircon-based geochronology.
—Peter E. Isaacson

Carol S. Prentice, U.S. Geological Survey–Menlo Park
Member: GSA Cordilleran Section, GSA Quaternary Geology and Geomorphology Division, and GSA Structural Geology and Tectonics Division

Carol S. Prentice is nominated for distinguished contributions to paleoseismological research on the San Andreas fault and other active faults worldwide, for service in promoting earthquake science during the centennial of the 1906 San Francisco Earthquake, and leadership as a board member of the Seismological Society of America and its establishment as a GSA Associated Society.
—Tina M. Niemi

Sarah M. Roeske, University of California–Davis
Member: GSA Cordilleran Section, GSA International Division, and GSA Structural Geology and Tectonics Division

Sarah Roeske has advanced our understanding of tectonic evolution of Alaska and Argentina; she has focused on uplift of high-*P*/low-*T* metamorphic rocks and the role of strike-slip faults at convergent margins. Additionally, she has edited two GSA Special Papers and been chair of the Cordilleran Section.
—Virginia B. Sisson

Donald Rosenberry, U.S. Geological Survey–Denver
Member: GSA North-Central Section and GSA Hydrogeology Division

Don Rosenberry's work in groundwater/surface water interactions has been both innovative and influential. He has collected and interpreted some of the key data sets that have provided new understanding of the influence of groundwater on ecology and water-resource management. His leadership has advanced research in the field.
—Laura E. Toran

Stephen M. Rowland, University of Nevada–Las Vegas
Member: GSA Cordilleran Section and GSA History of Geology Division

Among his best-known achievements, Rowland has been among the primary researchers in determining the specific ecological requirements of Archaeociathid reef-builders in producing the oxygen in our atmosphere, without which, none of us would be here.
—David L. Weide

Charles M. Rubin, Central Washington University
Member: GSA Cordilleran Section

Charlie Rubin has had a distinguished career studying earthquakes and paleoseismology. His detailed, careful studies of the slip histories of active faults, particularly in southern California, have underpinned advances in understanding fault interactions, seismic hazards, and earthquake clustering.
—Douglas W. Burbank

Paul M. Santi, Colorado School of Mines
Member: GSA Rocky Mountain Section and GSA Engineering Geology Division

Paul Santi has applied his award winning research to the practical problems of mass movement hazards and groundwater contamination, published the results, and trained his students. He brought wick drain mitigation for landslides to a viable solution. He currently serves as the chair of the Engineering Geology Division.
—Robert A. Larson

Andrei M. Sarna-Wojcicki, U.S. Geological Survey–Menlo Park
Member: GSA Cordilleran Section and GSA Quaternary Geology and Geomorphology Division

Elected to membership as the 2007 Kirk Bryan Award for Research Excellence recipient.

Andrew C. Scott, University of London
Member: GSA Coal Geology Division

Elected to membership as the 2007 Gilbert H. Cady Award recipient.

William E. Scott, U.S. Geological Survey–Vancouver
Member: GSA Cordilleran Section and GSA Quaternary Geology and Geomorphology Division

William F. Scott is nominated for his accomplishments and leadership in geology and volcanology of Cascade volcanoes, assessment of hazards and mitigation of risk at arc volcanoes, Quaternary geology of the Bonneville basin and eastern Snake River Plain, and communication of volcanic hazards information to the public.
—Charles R. Bacon

Abdul Shakoor, Kent State University
Member: GSA North-Central Section and GSA Engineering Geology Division

Abdul Shakoor is a distinguished engineering geologist and has been solely responsible for recognition of the Geology Department at Kent State University as one the leading universities in education and training of engineering geologists. He has already produced 62 M.S. and 9 Ph.D.s, and has published about 90 articles; he also serves as the co-editor of *Environmental and Engineering Geoscience*.
—Syed E. Hasan

Thomas Sisson, U.S. Geological Survey–Menlo Park
Member: GSA Cordilleran Section

Tom Sisson is cited for influential studies in experimental petrology, geologic mapping, and volcano hazards. His work has elucidated processes of magma formation in subduction zones, bubble growth, and degassing in magmas relevant to understanding explosive volcanic eruptions and volcanic landslide and eruption hazards at Mount Rainier and Hawaii.
—Carol A. Finn

Diane R. Smith, Trinity University
Member: GSA South-Central Section

Diane R. Smith is nominated for Fellowship in the Geological Society of America for her contributions to the petrology and mineralogy of igneous rocks, her dedication to undergraduate geological education, and her service to the Geological Society of America at both sectional and national levels.
—John M. Sharp Jr.

Douglas K. Solomon, University of Utah
Member: GSA Cordilleran Section and GSA Hydrogeology Division

Kip Solomon has distinguished himself for innovative research in the use of isotopes, chlorofluorocarbons, and noble gases to delineate groundwater recharge and subsurface mass transport; selfless professional service to the GSA Hydrogeology Division, the International Atomic Energy Agency, and the U.S. National Research Council; and excellence in teaching and mentoring.
—Alan E. Fryar

Ralph E. Taggart, Michigan State University
Member: GSA North-Central Section

Ralph E. Taggart, chair of geological sciences at Michigan State University, has contributed to understanding the climate, ecology, and vegetation dynamics of Pacific Northwest Cenozoic ecosystems; is a superb teacher, teaching mentor, and textbook author; and has provided the highest level of service to his university and community.
—Aureal T. Cross

Robert C. Thomas, University of Montana–Western
Member: GSA Rocky Mountain Section and GSA Geoscience Education Division

Elected to Fellowship as the 2007 GSA Distinguished Service Award recipient.

Margaret D. Thompson, Wellesley College
Member: GSA Northeastern Section

Margaret Thompson is an excellent scientist who has had an exemplary career as a research scientist and educator. She is one of the most active and productive Appalachian geologists in New England, and has served as a role model for many young women during her tenure at Wellesley College.
—Sandra M. Barr

Christine E. Turner, U.S. Geological Survey–Denver
Member: GSA Rocky Mountain Section and GSA Geology and Society Division

Christine E. Turner is elected to Fellowship for her unique contributions in sedimentology, sedimentary geochemistry, uranium ore deposits, and the interpretation of ancient ecosystems. She also has a superb record of leadership in cooperative scientific studies, management, and service to the geological community.
—Fred Peterson

David P. West, Jr., Middlebury College
Member: GSA Northeastern Section and GSA Structural Geology and Tectonics Division

Dave West is nominated for his many research contributions, particularly his innovative studies of strike-slip faults in the northern Appalachians. He is an inspiring teacher who has influenced many young geologists. Dave has worked tirelessly for the betterment of GSA and other professional societies.
—Daniel R. Lux

John W. Whitney, U.S. Geological Survey–Denver
Member: GSA Cordilleran Section and GSA Quaternary Geology and Geomorphology Division

John Whitney has for 30 years been a world-renowned research geologist for the U.S. Geological Survey. His excellent career of applied geology projects for the people of this country and in the third world makes it appropriate to nominate him as a GSA Fellow.
—Charles D. Harrington

Michael L. Williams, University of Massachusetts–Amherst
Member: GSA Northeastern Section, GSA Geoinformatics Division, GSA Geoscience Education Division, and GSA Structural Geology and Tectonics Division

Mike Williams' pioneering work of improving and expanding monazite dating of microstructural fabrics to orogenic scales has profoundly advanced understanding in the Canadian Shield, Cordillera, and Appalachians. He is a gifted teacher at all levels and has served unstintingly as departmental chair and on important geologic committees, local to national.
—Donald U. Wise

2008 GSA Fellows

Yu-Shu Wu, Lawrence Berkeley National Laboratory
Member: GSA Cordilleran Section and GSA Hydrogeology Division

Yu-Shu Wu is nominated for his outstanding work on flow and transport in unsaturated fractured media and his scientific leadership of a multidisciplinary team in quantitative investigations of multiphase and heat flow radionuclide transport at the Yucca Mountain unsaturated zone in support of the Department of Energy's Yucca Mountain Project of nuclear waste isolation.
—Hongbin Zhan

Maria T. Zuber, Massachusetts Institute of Technology
Member: GSA Northeastern Section and GSA Planetary Geology Division
Elected to Fellowship as the 2007 G.K. Gilbert Award recipient.

GSA Fellows!

If you see the names of deserving GSA Members on pages 21 and 22 of this issue who have yet to be elevated to GSA Fellowship, please follow up on your duty to nominate them. Keep GSA Fellowship strong and vibrant by sending in your nominations today!

Guidelines and nomination forms: www.geosociety.org/members/fellow.htm. **Questions?** Please e-mail awards@geosociety.org or you can call +1-800-472-1988 ext. 1028 or +1-303-357-1028.

Thanks For Your Membership!

Salutations to GSA's 100-Plus Year-Old Members

The Geological Society of America celebrates the 100th birthdays of GSA Senior Fellow **Paul-Emile Auger** of Québec, Canada, and GSA Member **Philip S. Morey** of Red Rock, Texas, USA. GSA extends its best wishes and proudly honors each of their 50-plus years of membership. GSA would also like to pay tribute to the 101st birthday of Honorary Fellow **Zun-Yi Yang** of Beijing, China.

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GSA Celebrates New 50-Year Members for 2008

The Geological Society of America salutes the following Members and Fellows for their 50-year membership in GSA. We appreciate their dedication and loyalty for all these years! *The following lists only those Members and Fellows who are celebrating their 50-year membership anniversary in 2008.* You'll find a complete list of Members and Fellows who have surpassed the 50-year mark at www.geosociety.org/grants/. Asterisks indicate GSA Fellows.

William M. Adams*
Donald L. Baars*
Carl S. Benson
Gilbert T. Benson
Robert A. Berner*
Arthur L. Bloom*
Gary M. Boone*
William B. Bull*
Don W. Byerly
Donald Robert Coates*
Victor Colombini
Kent C. Condie*
James F. Conley*
G. Gordon Connally*
John K. Costain*
John E. Cotton
Howard R. Cramer*
Whitman Cross II
Graham R. Curtis*
Edward J. Cushing*
Arthur R. Dahl*
Rodger E. Denison*
William Richard Dickinson*
William H. Duhling
Don L. Eicher*

Jack B. Epstein*
James R. Evans*
Roy L. Farnsworth
Arthur B. Ford*
Robert Orville Fournier*
Robert E. Fox*
Lawrence A. Frakes*
Howard L. Garrett*
Gary R. Gates
Philip R. Grant Jr.*
Marc H. Grunenfelder
Edwin D. Gutentag*
Orwoll Milton Hackett*
Richard L. Handy*
James L. Harding*
C. Earl Harris Jr.*
Richard D. Harvey*
C. Vance Haynes*
David C. Hedlund
Eugene Thornton Herrin Jr.*
Paul L. Hilpman*
F.N. Houser*
John Hall Howard*
William W. Jenney
David C. Jonson

Martin Kirchmayer*
David M. Knowles
Frank C.W. Kresse
Robert K. Lattimore*
David J. Leveson*
Donald H. MacDonald*
Robert E. Maurer
Wallace Ronald McCord
Donald G. McCubbin*
John Parmelee McDowell*
Clark Ernest McHuron*
James R. McIntyre
Dean A. McManus*
Virginia Mee-Burns
Buster W. Miller*
Glen A. Miller*
Malcolm M. Mouat
Herman S. Muskatt*
Dale James Nyman
Gerhard Oertel*
Harry J. Olson
Meredith Eggers Ostrom*
Richard James Proctor*
John R. Reid Jr.*
Mark Rich*

James Edwin Rogers*
Charles Alexander Ross*
LouElla Rankin Saul*
A.E. Scheidegger*
Ronald L. Shreve*
Herbert Skolnick*
Andrew M. Spieker*
Edward A. Stanley*
Peter H. Stauffer*
Jack A. Sunderman
Thomas L. Thompson*
Rudolf Trumpy*
James W. Valentine*
George L. Vinson*
F. Michael Wahl*
Joseph G. Wargo*
Charles E. Weaver*
F. Harold Weber
John O. Wheeler*
E.H. Timothy Whitten*
Warren E. Yasso*

GSA Celebrates 25-Year Members for 2008

The Geological Society of America salutes the following Members and Fellows for their 25-year membership in GSA. We appreciate their dedication and loyalty! *The following lists only those Members and Fellows who are celebrating their 25-year membership in 2008.* Asterisks indicate GSA Fellows.

Richard J. Abitz
Halbert E. Adams
Ronald H. Affolter
Jerry L. Aiken
Thomas J. Algeo
Elizabeth Y. Anthony*
Shigeo Aramaki*
Allan H. Atkinson
Harry S. Audell
Melanie A.W. Barnes
C. Tucker Barrie

Andrew P. Barth
John W. Bartley
Raymond J. Beach
Thilo G. Bechstaedt
James E. Beget*
William M. Belvin
David A. Bennett
Victoria C. Bennett*
Margaret E. Berry
Randall P. Biang
Ross A. Black

Richard J. Bottjer
Keith B. Brady
Alan L. Bressler
David A. Bristol Jr.
Kenneth A. Broberg
William E. Brooks
David M. Brown
Mark R. Byrnes
Phyllis A. Camilleri
Bruce S. Campbell
Timothy R. Carr

William Cavazza*
Michael M. Cheatham
Terri L. Cheatham
Xu Chen
Joseph R. Chepega
Anne Furbish Choquette
J. Kelly Cluer
Bernard J. Coakley
James D. Collier
Janet M. Combes
Katherine A. Connors

Continued on next page.

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Gary L. Egan
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Lisa L. Ely
Gena M. Evola
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Nicholas Eyles
Richard E. Faflak
Kathleen M. Farrell
Michael F. Follo
Richard L. Ford
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George H. Gagliarde
Edward E. Geary*
Sharon Geil
John W. Gephart
Dru Germanoski
Billy E. Giles
Luis A. Gonzalez
Patrick J. Gooding
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Jonathan T. Hagstrum
Sid P. Halsor
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Ardith K. Hansel*
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David J. Harbor
W. Burleigh Harris*
David S. Harwood*
Edward J. Hasenohr
Noralynn J. Hassold
Wayne D. Haydon
Jonathan L. Heiles
Donald F. Heinrichs*
Mark R. Hempton
Russell J. Henning
Tucker F. Hentz
Brittain E. Hill
Robin T. Holcomb
Eric J. Hubbard
John D. Humphrey*
Michael J. Jackson
L. Allan James
Susanne U. Janecke*
Greg K. Johnson
Kirk R. Johnson*
Peter R. Johnson
Rex J. Johnson
William K. Johnson
Craig H. Jones*
Douglas S. Jones*
Alice R. Kelley
Clarence G. Kennedy
David L. Kidder*
Jeffrey R. Knott
Michael H. Kortenhof
Gary L. Lass
Paul W. Layer
Carol Kindle Lee-Roark
Elana L. Leithold
Barry R. Levine
Dennis J. Low
Baerbel K. Lucchitta*
Michael E. Lukk
Timothy W. Lyons*
Ian D. MacGregor*
Linda M. Maher
MaryAnn Love Malinconico
Royal H. Mapes*
Antonette K. Markowski
Richard A. Marston*
Barton S. Martin
Philippe L. Masson
Osamu Matsubayashi
Salvatore J. Mazzullo*
William R. McCann
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Kirk D. McIntosh
Richard C. McMillan
Gregory A. Mead
Martha K. Merriam
Peter S. Meyer
Kevin L. Mickus
Gerard V. Middleton
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James G. Mills
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Lynn J. Moses
T. Clinton Mullins
Robert M. Negrini
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James Nicholls*
Dennis B. O'Connell
Scott N. Opdyke
James B. Paces
Mary Ann Parke
Judith Totman Parrish*
Hannah F. Pavlik
Simon M. Peacock*
Virginia L. Peterson
Brian N. Popp
Andre Potochnik
Carol S. Prentice*
Cynthia L. Pridmore
Robert P. Raeside
Robert A. Ratliff
J. Frederick Read
Donald L. Reed
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Sarah M. Roeske*
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Lynn E. Rust
Paul E. Sacks
James C. Sample
Kathryn Connors Sasowsky
Lauret E. Savoy*
Charles E. Savrda
Christopher A. Scholz
R. Randall Schumann
Sherryl A. Schussler
David B. Scott
Sheila J. Seaman
Errol D. Sehnke
Eugen Seibold*
Abdul Shakoor*
George H. Shaw
Hugh M. Shipman
Catherine W. Skinner*
David Lee Smith
Gary A. Smith*
Michael S. Smith
Randall B. Smith
Theodore H. Sobieski
Sean C. Solomon*
A.F. Spilhaus Jr.*
LeeAnn Srogi
Scott W. Starratt
Ralph F. Stearley
D. Mark Steinhauff
Gene M. Stevenson
Paul K. Strother
Kathleen Sullivan
Stephen A. Swift
Joseph J. Tanski
Lisa Tauxe*
Emily M. Taylor
Keith G. Thompson
Peter J. Thompson
Bernard P. Tissot*
Jan Tullis*
Michael A. Tuohy
Richard A. Volkert*
Paul A. Washington
Michael R. Waters*
C. Pius Weibel
Elizabeth M. Weiss
Lynda B. Williams*
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Steven F. Wojtal*
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Cheong-Yip Ron Yuen
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Poughkeepsie, New York, USA

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Washington, D.C., USA

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Fresno, California, USA

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Murray W. Hitzman
Colorado School of Mines
Golden, Colorado, USA

Claudia I. Mora
Los Alamos National Laboratory
Los Alamos, New Mexico, USA

2008 GSA RESEARCH GRANT RECIPIENTS

The GSA Committee on Research Grants met at GSA Headquarters in Boulder, Colorado, on Saturday, 29 March 2008, and awarded US$567,350 to 302 graduate students. The committee also selected eleven alternate candidates in the event that any grantees return all or part of their funds due to a change in their research project or receipt of funds from another source. The eighteen committee members for 2008 were Amy Draut (chair), Allen Dennis, Andrew Gombos, Hope Jahren, Lisa Pratt, Mark Steltenpohl, Sally Sutton, Joseph Meert, Kaye Shedlock, Lisa Stillings, Dibyendu Sarkar, Timothy White, Missy Eppes, Michelle Markley, Paul Tomascak, Darren Grocke, Patricia Holroyd, and Tim Lowenstein.

2008 Student Research Grant Statistics

Total proposals received	570
Total proposals funded	302
Total dollars awarded	US$567,350
Average award	US$1,879

2008 Partial List of Funding Sources
(all funds are in U.S. dollars)

Joseph T. Pardee Memorial Fund	$280,000
Peter Lipman Fund	$25,000
Total GSA Funding	**$305,000**

Geophysics Division (to augment Cox Award)	$1,050
Sedimentary Geology Division Award	$1,000
Structural Geology and Tectonics Division Award	$3,600
Geophysics Division Grant	$250
Total Division Funding	**$5,900**

Total National Science Foundation Funding*	**$180,900**

2008 List of GSA Foundation Funding Sources

Harold T. Stearns Award Fund	$3,100
Lipman Research Fund	$7,800
Blechschmidt Award	$1,400
Cox Award (Geophysics Division)	$1,500
Dillon Alaska Award	$3,500
Reed Research Award	$2,400
Sisson Research Award	$3,000
Minority Fund	$2,200
Hydrogeology Division Award	$3,500
Montagne Fund	$800
Research Fund	$6,000
GeoStar	$13,700
Curtis Fund	$5,000
Ross Fund	$11,100
Wanek Fund	$3,600
Snavely Fund	$3,000
Terman Fund (to be awarded in October)	$5,000
El Baz Student Research Grant (to be awarded in October)	$5,000
Total GSA Foundation Funding	**$77,100**

*NSF grant matched at least two to one by GSA and GSA Foundation.

2008 Outstanding Mention

The committee recognized 20 of the proposals to be of exceptionally high merit in conception and presentation.

Christina G. Carr, Montana State University, for "Fault segmentation control on alluvial fan development along the Centennial fault, southwest Montana."

Michelle M. Casey, Yale University, for "Extending stable isotope estimation of trophic levels into the fossil record using modern and fossil mollusks."

Peter Douglas, Yale University, for "Biomarker records of hydrological change at the time of the Maya collapse."

Chira Endress, The Pennsylvania State University, for "Geochemistry of Oligo-Miocene basalts from northeast Egypt: Implications for mantle source regions beneath the East African Rift System."

Jacquelyn L. Gill, University of Wisconsin–Madison, for "Is there evidence for a Younger Dryas impact event in lake sediment records from the Great Lakes region?"

Thomas K. Johnson, University of Minnesota–Duluth, for "Structural and kinematic study of Archean terranes."

Jennifer Kyle, University of Toronto, for "Viral mineralization."

Andrew B. Leslie, University of Chicago, for "Using the fossil record of conifers to investigate factors driving reproductive evolution in seed plants."

Sara Lincoln, MIT, for "The impact of Marine Group II Euryarchaeota on TEX-86 Paleothermometry."

Jeffrey H. Marsh, University of Maine, for "Investigation of coupled strain localization processes in continental crust."

Katherine M. Middlecamp, University of Pittsburgh, for "Isotopic investigation of anthropogenic sources of carbon and nitrogen to vegetation along an urban to rural gradient."

Scott N. Montross, Montana State University, for "Composition of gases in sediment-rich basal ice, implications for microbial activity at −15 °C."

Cristina M. Puscas, Univeristy of Alabama, for "Five centuries of ENSO record archived in a South-Pacific flank-margin cave stalagmite."

Alexa Sedlacek, The Ohio State University, for "Strontium and carbon isotope stratigraphy of the Permian-Triassic boundary interval in the Great Basin, USA: How much of a record is preserved?"

John S. Singleton, The University of Texas at Austin, for "Development of extension-parallel corrugations in the footwall of the Buckskin-Rawhide metamorphic core complex, west-central Arizona."

Misty Stroud, University of Florida, for "Isotopic analyses of the Grouse Creek block: A link to the Wyoming Province?"

Amanda Thomas, University of California at Berkeley, for "The birth of a fault: Surface velocity and deformation at Pillsbury Lake, CA."

Andrew J. Wall, The Pennsylvania State University, for "Analysis of crystallographic controls on Cu isotopic fractionation using time-resolved synchrotron X-ray diffraction."

Jennifer Wehby, University of Georgia, for "Compositional analysis of mortar from the House of the Vestals in Pompeii, Italy."

Anne Wiley, Michigan State University, for "Insights into Hawaiian petrel feeding ecology: A historical analysis using stable carbon and nitrogen isotopes."

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2008 Specialized Awards

The committee selected recipients of the specialized awards named in honor of the donors or as memorials to former Society Members.

Gretchen L. Blechschmidt Award

The Gretchen Louise Blechschmidt Award Fund was established for women in the geological sciences who have an interest in achieving a Ph.D. in the fields of biostratigraphy and/or paleoceanography; sequence stratigraphy analysis, particularly in conjunction with research in deep-sea sedimentology; and a career in academic research. The 2008 recipient is **Nathalie Dubois,** Dalhousie University.

John T. Dillon Alaska Research Award

The John T. Dillon Alaska Research Award honors the memory of Dillon, who was particularly noted for his radiometric age-dating work in the Brooks Range, Alaska. Two areas that serve as guidelines for selection of the award are field-based studies dealing with the structural and tectonic development of Alaska and studies that include some aspect of geochronology (either paleontologic or radiometric) to provide new age control for significant rock units in Alaska. The 2008 recipient is **Garrett Speeter,** University of Alaska–Fairbanks.

Robert K. Fahnestock Award

The Robert K. Fahnestock Award honors the memory of Fahnestock, a former member of the Research Grants Committee, who died indirectly as a result of service on the committee. The grant is awarded for the best proposal in sediment transport or related aspects of fluvial geomorphology, Fahnestock's field. The 2008 recipient is **Suzanne Walther,** University of Oregon.

Lipman Research Award

The Lipman Research Fund was established in 1993 and is supported by gifts from the Howard and Jean Lipman Foundation. The purpose of the fund is to promote and support student research grants in volcanology and petrology. The president of the Lipman Foundation, Peter W. Lipman, was the recipient of a GSA research grant in 1965. The 2008 recipient is **Alicja Wypych,** Miami University.

Bruce L. "Biff" Reed Scholarship Award

The Bruce L. "Biff" Reed Scholarship Fund was established to provide research grants to graduate students pursuing studies in the tectonic and magmatic evolution of Alaska, primarily, and also can fund other geologic research. The 2008 recipient is **Rory McFadden,** University of Minnesota.

Alexander Sisson Research Award

Family members of Alexander Sisson established a fund in his memory to promote and support research for students pursuing studies in Alaska and the Caribbean. The 2008 recipient is **Eric Helfrich,** Northern Arizona University.

2008 Specialized Awards continued on p. 26.

2008 Specialized Awards continued from p. 25.

Harold T. Stearns Fellowship Award

Stearns established the Harold T. Stearns Fellowship Award in 1973 for student research on aspects of the geology of the Pacific Islands and the circum-Pacific region. This year, the committee presented the award to two candidates: **David Pearson,** University of Arizona, and **Jacque Kelly,** University of Hawaii–Manoa.

John Montagne Fund

The John Montagne Fund was established in 2000 to support one recipient's research in the field of quaternary geomorphology. The 2008 recipient is **Jason Gulley,** University of Florida.

Alexander & Geraldine Wanek Fund

The Wanek Fund was established in 2002 to support research dealing with coal and petroleum resources, mapping, and engineering geology, marine resources, petroleum economics, appraisal, and evaluation, and the geology of phosphate resources. The 2008 recipient is **Sarah Colbert,** Colorado State University.

Charles A. & June R.P. Ross Research Fund

The Ross Research Fund was established in 2002 to support research in the fields of biostratigraphy (including, but not limited to, fossil age dating and the study of evolutionary faunal successions), stratigraphy and stratigraphic correlation, paleogeography and paleobiogeography, interpreting past environments of deposition and their biological significance, and the integration of these research areas into better global understanding of (1) past plate motions (plate tectonics and sea-floor spreading); (2) past sea-level events, including their identification and ages; and/or (3) climate changes and effects of those climate changes on Earth's inhabitants through geologic time. There should be, over time, a balance of money among the awards across these various subject subfield categories depending on the merit of the annual project proposals. The 2008 recipient is **Heidi Roop,** Northern Arizona University.

Parke D. Snavely, Jr., Cascadia Research Award Fund

The Parke D. Snavely, Jr., Cascadia Research Award Fund provides $1,500 to support field-oriented graduate student research that contributes to the understanding of the geologic processes and history of the Pacific Northwest convergent margin or to the evaluation of its hazard or resource potential. The 2008 recipient is **Daniel Ruscitto,** University of Oregon.

The Maurice "Ric" Terman Fund

The Maurice "Ric" Terman Fund provides one-year grants to fund Ph.D. theses and post-doctoral research of East Asian scientists. Countries currently include Cambodia, China, Indonesia, Japan, Korea, Malaysia, Papua New Guinea, Thailand, and Vietnam. The recipient will be chosen in the fall of 2008.

Farouk El-Baz Student Research Grant

This grant is to encourage and support desert studies by students worldwide, either in their senior year of undergraduate studies, or at the master's or Ph.D. level. The two recipients will be chosen in the fall of 2008.

Outstanding Mention and **Specialized Award** recipients will be formally recognized by GSA at the 2008 Joint Annual Meeting in Houston, where certificates and ribbons will be presented. Recipients and their advisors will be notified about this event later this summer.

2008 Gladys W. Cole and W. Storrs Cole Memorial Research Awards

The 2008 Cole Awards for postdoctoral research are funded by the GSA Foundation.

Benjamin J.C. Laabs of SUNY-Geneseo was awarded US$9,250 from the Gladys W. Cole Fund for research in the geomorphology of semiarid and arid terrains for his research project "Chronology and climate of the Angel Lake Glaciation, Northern Great Basin, U.S.A." The award will be presented at the Quaternary Geology & Geomorphology Awards Ceremony at the 2008 GSA Annual Meeting in Houston in October.

Lance L. Lambert of the University of Texas–San Antonio was awarded US$8,150 from the W. Storrs Cole Fund for research in invertebrate micropaleontology for his research project "A test of dispersal barriers versus paleoecological exclusion to explain different Eurasian and North American conodont successions in the Pennsylvanian." The award will be presented at the Cushman Foundation for Foraminiferal Research Awards Ceremony at the 2008 GSA Annual Meeting in Houston in October.

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2008 GSA Division Student Awards

Five GSA Divisions have recognized the following research grant recipients for submitting proposals of exceptionally high merit in conception and presentation. These students will be honored at their respective Division's award reception at the 2008 Joint Annual Meeting in Houston.

GEOPHYSICS DIVISION

Allan V. Cox Student Research Grant

Michael Marsh, Southern Illinois University, for "Magma dynamics in sill and dike systems. Constraints from magnetic fabrics and paleomagnetism in the Karoo Large Igneous Province."

Geophysics Student Research Grant Award

Matt Cosatt, Missouri State University, for "Analysis of gravity and magnetic data for regional structures related to the origin of mineralization within the tri-state mining district, MO, KS, OK."

HYDROGEOLOGY DIVISION

Hydrogeology Division Student Research Grant Awards

Kyle Brown, University of Arizona, for "Sr isotopes as tracer of groundwater mixing between agricultural irrigation waters and regional groundwaters in Saddle Mountains Basalt Aquifer."

Nathan R. Page, Colorado State University, for "A groundwater study in glacial till using ground penetrating radar: Glacier lakes ecosystems experimental site, Wyoming."

Moutusi Roy, University of Florida, for "Flow paths of submarine groundwater discharge (SGD) and its relation to redox conditions in a subterranean estuary, Indian River Lagoon, Florida."

Audrey H. Sawyer, The University of Texas at Austin, for "The role of wood debris in the hydrology and energy budgets of stream-groundwater systems."

Alejandro Villalobos-Aragon, The University of Texas at El Paso, for "Using chromium stable isotopes to monitor reactive transport of Cr in Leon Valley, Mexico."

QUATERNARY GEOLOGY AND GEOMORPHOLOGY DIVISION

J. Hoover Mackin Student Research Award

Rebecca Franklin, University of Arizona, for "Herbchronology of the alpine eastern Sierra Nevada."

J. Hoover Mackin Student Research Award Honorary Mention

Keith Laskowski, Yale University, for "N-alkane record of alpine glaciation."

Arthur D. Howard Student Research Award

Jonathan Harvey, Utah State University, for "Reconciling Holocene alluvial records on the Colorado Plateau."

Arthur D. Howard Student Research Award Honorary Mention

Summer Brown, Virginia Tech, for "Integrating apatite (U-TH)/He and fission-track dating to redefine the temporal and spatial history of the Teton Range, WY."

SEDIMENTARY GEOLOGY DIVISION

Sedimentary Geology Division Student Research Grant Award

Geoffrey Gilleaudeau, University of Tennessee, Knoxville, for "Investigation of unusual breccias in the Mesoproterozoic Atar Group, Mauritania: Tsunami deposits related to extraterrestrial impact?"

STRUCTURAL GEOLOGY AND TECTONICS DIVISION

Structural Geology and Tectonics Division Student Research Grant Awards

Nicholas J. Van Buer, Stanford University, for "Erosional exhumation of the Sierra Nevada batholith in the Basin and Range."

Timothy O. Nesheim, University of Iowa, for "Are 1.1 Ga deformational fabrics present in metasedimentary rocks of the Belt Supergroup in Northern Idaho?"

Jeffrey Hayden Marsh, University of Maine, for "Investigation of coupled strain localization processes in continental crust."

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2008 GSA RESEARCH GRANT RECIPIENTS

John Abeid
Pride Abongwa
Ingrid Abrahamson
Derek Adams
James Adamski
Steven Ahr
Brian Aillaud
Charles Allen
Jaron Andrews
Patrick Applegate
David Auerbach
Toby Ault
Jason Austin

Jacob Ball
Joanne Ballard
Anthony Beauchaine
James Bedison
Matthew Beedle
Melissa Berke
Ruchi Bhattacharya
Brian Blackstone
Kean Bliss
Christina Blue
Joshua Bonde
Olaf Borkiewicz
Jeff Bowman
Mara Brady
James Braid
Daniel Brothers
Christopher Brown
Kyle Brown
Summer Brown
Denise Burchsted

Denny Capps
Christina Carr
Lorraine Casazza
Michelle Casey
Megan Castles
Sungwook Choung
Abbey Chrystal
Morgan Churchill
Sara Cina
Heather Clark
Sarah Colbert
Joseph Collette
Elizabeth Colville
Zachary Coppa
Matthew Corbett
Matt Cosatt
Marcus Cottingham
Christopher Coughenour
Nicole Cutler

Ashley Dack
Lesley Dampier
Tathagata Dasgupta
Sarah Davidson
Nigel Davies
Brian Davis
Jesse Davis
Jeremy Deans
Darron deBoer
Kristyn DeMarco
Meagan DeRaps
Patricio Desjardins
Troy Dexter
Haylee Dickinson
Aaron Diefendorf
Peter Douglas
Marci Downs
Nathalie Dubois
Nicole Dudei
Michael Durcanin
Matthew Durkee

Aurora Elmore
Chira Endress
Simon Engelhart

Amanda Falk
Chelsea Feeney
Dolors Ferrés
Aaron Fitts
Megan Flory
Kathryn Flynn
Emily Foley
Steven Forrester
Rebecca Franklin

William Gallin
Eleanor Gardner
Marcus Gary
Matthew Gatewood
Amiya Ghosh
Jacquelyn Gill
Geoffrey Gilleaudeau
Jennifer Gillen
Hector González-Huizar
Enrique González-Torres
Candace Grand Pre
Rachel Grandpre
Craig Grimes
Jason Gulley
Mercedes Gutierrez

Melissa Hage
Melissa Halick
Bethiah Hall
Jared Hamilton
Ashley Harris
Joyce Harris
Jonathan Harvey
Cara Harwood
Andrew Haveles
Thomas Hearon IV
Kathryn Hedrick
Thomas Hegna
Eric Helfrich
Samuel Henderson
Dale Hess
Paulo Hidalgo
Jack Hietpas
William Hoffman
Paul Hong
Katharine Horst
Muhammad Hossain
Joel Hutson

Brian Jackson
Benjamin Johnson
Beth Johnson
Thomas Johnson

Eric Kelly
Jacque Kelly
Christopher Kemp
Thomas Key
Yuri Kimura
Tristan Kloss
Jesse Koch
George Koteas
Jennifer Kyle

Deidre LaClair
Nolen Lambert
Clayton Larkins
Ioan Lascu
Keith Laskowski
Corey Lawrence
Nathan Layfield
Lizette Leon Rodriguez
Andrew Leslie
Brian LeVay
Daniel Lewis
Athena Erin Lieuallen
Sara Lincoln
Gwen Linde
Xiaoming Liu
David LoBue
Henry Loope
Jessica Lopez Pearce
Anna Losiak
Peng Lu
Matthew Lusk

Kelsey MacCormack
Glen Mackey
Steven Maglio
Melissa Marietta
Jennifer Markham
Jeffrey Marsh
Michael Marsh
Rowan Martindale
Michelle Mary
Scott Mata
Nancy Kaitlin McCann
Scott McCoy
Rory McFadden
Dorien McGee
Ian McGlynn
Neil McKenzie
Emily Mercurio
Mike Meyer
Gary Michelfelder
Katherine Middlecamp
Thomas Mikesell
Brett Miles
Mary Milleson
Tamara Misner
Ross Mitchell
Svetlana Mizintseva
Scott Montross
Philip Mooney
Emily Moss
Erich Mueller
Dorina Murgulet
Bryan Murray
Timothy Myers

Patricia Nadeau
Sarah Needy
Timothy Nesheim
Bernd Neumann

Elizabeth Obbink
Tim O'Brien
Zeynep Oner

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2008 GSA RESEARCH GRANT RECIPIENTS

Nathan Page
François Paquay
Melissa Pardi
Karen Parker
Joshua Payne
David Pearson
Ionel Florin Pendea
Andrea Persons
Thomas Peryam
Jessica Pilarczyk
Peter Polito
Douglas Portis
Adelina Prentice
Jessica Pritchard
Mitchell Prnate
Aleksandar Prvanovic
Cristina Puscas

Mario Alfredo Ramos Arias
Pradeep Ranasinghage
Rachel Rapprecht
Kurt Refsnider
Christine Regalla
Barry Reno
David Riese
Karin Riley
Paul Riley
Leah Roberts
Jenifer Roell
Heidi Roop
John Roseberry
Moutusi Roy
Daniel Ruscitto
Daniel Rybczynski

Anthony Salem
Erin Saupe
Audrey Sawyer
Rebecca Schmeisser
Joshua Schmerge
Jenni Scott
Alexa Sedlacek
Emily Sekula
Bryan Sell
John Singleton
Paul Skudder
Krista Smilek
Dean Snidow
Margaret Snyder
Claire Spafford
Garrett Speeter
Kellen Springer
Blair Stanley
Eric Stewart
Heather Stewart
Marianne Stoesser
Christina Stout
Misty Stroud
Justin Stroup
Michelle Summa
Mark Sutcliffe
Catherine Sutera
Lars Svenson
Benjamin Swanson
Robert Swisher
Eva Szilvagyi

Jean Taggart
Zachary Taylor
Amanda Thomas
Carrie Thomason
Jesse Thompson
Jessica Thompson
Beau Tinnin
Carla Susanne Tomsich
Aislyn Trendell
Alka Tripathy
Zhijie Jack Tseng
Kyle Tumpane

Nicholas Van Buer
Jill VanTongeren
Lael Vetter
Alejandro Villalobos-Aragon

Erin Walker
Laura Walkup
Andrew Wall
Patrick Wall
Bradley Walls
Lindsay Walters
Suzanne Walther
Zhenzhu Wan
Jie Wang
Ryan Warden
Jennifer Wehby
Stephanie Welch
Zachary Wessel
Patrick Whelley
Anne Wiley
Eric Williams
Byron Winston
Jacalyn Wittmer
Heather Wolczanski
David Wolf
John Wood
Holly Woodward
Alicja Wypych

Stephanie Yurchyk

Jay Zarnetske
Yige Zhang

Selected Alternates for 2008

Alberto Barud-Zubillaga
Fabian Batista
Megan Elizabeth Beach
Whitney M. Behr
Kirstin S. Brink
Andres L. Cardenas
Ryan Dayton
William Charles Hassett
Andrea Schilling
Scott Szechenyi
Jay M. Thompson

The Kerry Kelts Research Awards of the Limnogeology Division

Application deadline: 10 August 2008

The Kerry Kelts Research Awards of the Limnogeology Division for undergraduate or graduate student research are named in honor of Kerry Kelts, a visionary limnogeologist and inspiring teacher. Up to three awards of US$350 each for use in research related to limnogeology, limnology, and paleolimnology are available. Application for this award consists of a summary of the proposed research, its significance, and how the award will be used (five-page maximum). Please send your summary as a PDF along with your name and a short (two-page max.) CV to the Limnogeology Division chair, Michael Rosen, **mrosen@usgs.gov, by 10 August 2008.** Awards will be announced at the Limnogeology Division Business Meeting and Reception at the 2008 Joint Annual Meeting in Houston in October.

We hope to increase the amount of the awards in succeeding years. If you are interested in supporting this program, please send your donations, designated for the Kerry Kelts Research Awards of the Limnogeology Division, to GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA.

ABOUT PEOPLE

GSA Member and 2007 GSA Distinguished Service Award recipient **Yildirim Dilek** has been awarded Miami University's prestigious Benjamin Harrison Medallion. The Harrison Medallion is presented to members of Miami University's faculty or staff for their outstanding national contributions to education.

GSA Senior Fellow **Farouk El-Baz,** director of the Boston University Center of Remote Sensing, has been honored by the Egyptian Ministry of Culture's Supreme Council of Antiquities with the "Golden Award" for his "unstinting efforts in preserving archaeological sites in Egypt."

In recognition of her outstanding contributions to the advancement of the geophysical sciences, GSA Member **Patricia Dove** of Virginia Tech has been named a 2008 Fellow of the American Geophysical Union.

GSA Teacher Member **Michelle Brand Buchanan** of Pineville Junior High in Pineville, Louisiana, is the first recipient of the Edward C. Roy Jr. Award for Excellence in K–8 Earth Science Teaching. Buchanan is also the 2007 National Association of Geoscience Teachers Outstanding Earth Science Teacher for Louisiana.

GSA Members **Richard B. Alley** of Penn State University and **Paul E. Olsen** of Columbia University have been elected to the U.S. National Academy of Sciences in recognition of their distinguished and continuing achievements in original research.

In Memoriam

Terry R. Bruns
Redwood City, California, USA
1 September 2006

Paul Louis Vincent Campo
Vista, California, USA
20 September 2007

Chizheng Chen
Houston, Texas, USA
notified 19 March 2008

Lawrence A. Chitwood
Bend, Oregon, USA
4 January 2008

James B. Coffman
Houston, Texas, USA
19 January 2008

J. Glenn Cole
Sapulpa, Oklahoma, USA
1 March 2008

William H. Dennen
Rockport, Massachusetts, USA
20 January 2008

Rodney T. Donnelly
La Mesa, California, USA
29 September 2007

John J. Dragonetti
Chesapeake, Virginia, USA
24 December 2007

John D. Edwards
Boulder, Colorado, USA
24 December 2007

Ludwig J. Frank II
Auburn, Washington, USA
notified 4 April 2008

Pembroke J. Hart
Washington, D.C., USA
6 February 2008

Richard L. Hay
Tucson, Arizona, USA
10 February 2006

Melvin J. Hill
Boulder, Colorado, USA
17 December 2007

Wayne Travis Jolly
St. Catharines, Ontario, Canada
9 February 2008

David L. Jones
Placerville, California, USA
31 December 2007

George L. King Jr.
Waco, Texas, USA
22 October 2007

J. Laurence Kulp
Puyallup, Washington, USA
29 June 2006

James F. Luhr
Washington, D.C., USA
notified 8 February 2008

Malcolm C. McKenna
Boulder, Colorado, USA
3 March 2008

Louis A. Newitt
Houston, Texas, USA
24 October 2007

William R. Normark
Menlo Park, California, USA
12 January 2008

Ralph B. Peck
Albuquerque, New Mexico, USA
notified 26 March 2008

James A. Peterson
Sedona, Arizona, USA
19 February 2008

Christopher J. Schuberth
Marlton, New Jersey, USA
13 May 2008

Glenn L. Shepherd
Wailuku, Hawaii, USA
11 March 2008

Douglas M. Sheridan
Lakewood, Colorado, USA
notified 22 February 2008

Robert Blake Smith
Wimberley, Texas, USA
notified 31 March 2008

Frederick M. Swain
Minneapolis, Minnesota, USA
2 March 2008

Edward J. Walter
Twinsburg, Ohio, USA
notified 25 March 2008

Please contact the GSA Foundation at +1-303-357-1054, drussell@geosociety.org, www.gsafweb.org, to contribute to the Memorial Fund. To honor a friend or colleague with a GSA Memorial, please go to www.geosociety.org/pubs/memorials/mmlGuid.htm. **See p. 31 of this issue for more information.**

GSA MEMORIALS: Keep The Memories Alive!

New on the Web!
A list of memorials published since 1972 is now online at **www.geosociety.org/pubs/memorials/index.asp,** and some are available for download as PDF files.

Every year, GSA publishes a memorial volume devoted to deceased GSA members. These memorials are written by associates, friends, or relatives of those who have passed away and are priceless, indispensable records of the fascinating individuals who have been part of GSA.

If you would like to honor a friend or colleague with a memorial, please send it as a Microsoft Word–compatible file via e-mail to awards@geosociety.org. The text should be limited to ~2,000 words and include a selected bibliography of the decedent's works in the earth sciences. Memorials also include a photo, so please send a picture of the person you are memorializing, either as a high-resolution .jpg attached (as a separate file) to your e-mail or a glossy photograph via post. Find complete guidelines for compiling a memorial at www.geosociety.org/pubs/memorials/mmlGuid.htm. Memorialists and family members of the deceased receive complimentary copies of the typeset memorial before it is included in the bound, published volume.

The following are GSA Members who passed away between January 2006 and April 2008 for whom no memorial has been published. Bold names signify those who passed away in 2007–2008; asterisks indicate a memorial is in progress.

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THE GEOLOGICAL SOCIETY OF AMERICA®

Your Science, Your Colleagues, Your Society:

Make an Impact—Serve on a GSA Committee!

2009–2010 COMMITTEE VACANCIES
DEADLINE: 15 JULY 2008

Now is your chance to influence your Society, your science, and your colleagues, and play an active role in an organization that has been serving geoscientists since 1888. GSA invites you to volunteer or nominate one of your fellow GSA Members to serve on a Society committee or as a GSA representative to other organizations.

Younger members are especially encouraged to become involved in Society activities both as committee volunteers and as nominators: graduate students are eligible to serve on GSA committees as full members.

If you volunteer or make recommendations, please give serious consideration to the specified qualifications for serving on a particular committee (see www.geosociety.org/aboutus/committees/0803commVacancies.pdf) and be sure that your candidates are GSA Members or Fellows.

To volunteer or nominate someone else, go to **www.geosociety.org/aboutus/committees** and follow the link to our online form, or download the form and complete it on paper. If you use the paper form, please return it to Pamela Fistell, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA; fax +1-303-357-1070. Questions? Please contact Pamela Fistell at +1-303-357-1000, ext. 0, +1-800-472-1988, ext. 0, or pfistell@geosociety.org. *Please use one form per candidate.*

Nominations received at GSA headquarters by **15 July 2008** on the official one-page or online form will be forwarded to the Committee on Nominations. The committee will present at least two nominations for each open position to the GSA Council at its fall meeting. Appointees will then be contacted and asked to serve, thus completing the process of bringing new expertise into Society affairs.

For details, including term and time commitments and the number of vacancies for each committee, please see the March or April/May issues of *GSA Today* or go to **www.geosociety.org/aboutus/committees**. Past issues of *GSA Today* are accessible online at **www.gsajournals.org.**

Nominate Your Next Officers and Councilors!

Nominations accepted until 15 July 2008

The GSA Committee on Nominations requests nominations for officers (vice president and treasurer) and Councilors to serve on GSA Council beginning in 2009. Each nomination should be accompanied by basic data and a description of the qualifications of the individual for the position recommended.

Find the online nomination form at **www.geosociety.org/aboutus/officers.htm** or send materials for officer and councilor nominations to Pamela Fistell, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA, pfistell@geosociety.org.

TERMS BEGIN 1 JULY 2009 (UNLESS OTHERWISE INDICATED [SEE WEB SITE]).

GSA Committees with Vacancies

Academic and Applied Geoscience Relations
Annual Program
Arthur L. Day Medal Award
Education
Geology and Public Policy
Honorary Fellows
Joint Technical Program
Membership
Minorities and Women in the Geosciences
Nominations
Penrose Conferences and Field Forums
Penrose Medal Award
Professional Development
Publications
Research Grants
Treatise on Invertebrate Paleontology Advisory
Young Scientist Award (Donath Medal)

You also have the opportunity to serve as a GSA Representative at the following organizations:

The American Association for the Advancement of Science (AAAS)
AGI Environmental Geoscience Advisory Committee
North American Commission on Stratigraphic Nomenclature
The U.S. National Committee on Soil Science

DEADLINE: 15 JULY 2008

GSA TODAY
Our Masthead Has Changed!

GSA Today is now being printed on paper certified by the Forest Stewardship Council (FSC). Accordingly, the masthead (see p. 3) includes the FSC logo, which is "the mark of responsible forestry," in that it identifies products that contain wood from well-managed forests. *GSA Today* continues to be printed in the United States using pure soy inks.

THE GEOLOGICAL SOCIETY OF AMERICA®

Student Travel Grants

HOUSTON 2008 JOINT ANNUAL MEETING

Application deadline: 2 September 2008

Students: Make your trip to the annual meeting easier on your wallet—check out the following grants!

❶ GSA Student Travel Grant for Minorities, Women, and Persons with Disabilities

The GSA Minorities and Women in the Geosciences Committee and the GSA Foundation announce the availability of student travel grant funds for one or more eligible students to attend the Joint Annual Meeting. The primary goal of this grant is to encourage the participation of women, minorities, and persons with disabilities in the geosciences at national meetings. Each student will receive GSA membership for 2009 and an average cash award of US$500 to be used for roundtrip airfare, hotel accommodations, meeting registration, and/or meals.

Apply online at **www.geosociety.org/meetings/2008/travelgrants.htm.** Contact Chris McLelland at +1-303-357-1082 or +1-800-472-1988, ext. 1082, if you have any questions.

Eligibility Requirements:

- Full-time student enrolled in an accredited university or college for the fall semester 2008 and majoring in geology, earth science, or a related field.
- U.S. citizenship, or permanent residency, with a valid social security number.
- Preference will be given to students presenting papers/posters either as primary or secondary authors.
- Undergraduate and graduate students may apply.
- Must be a GSA Student Member at the time of application.
- Awardees are expected to attend the entire meeting and to participate in GeoScience Day (a geological field trip for middle and/or high school students).

❷ GSA Section Travel Grant

The GSA Foundation has made US$4,500 in grants available to each of the six GSA Sections. The money, when combined with equal funds from the Sections, is used to help GSA Student Members travel to GSA meetings. **For eligibility requirements,** please visit the following Section Web sites or contact the Section secretary directly.

North-Central: www.geosociety.org/grants/ncgrant.htm
South-Central: www.geosociety.org/sectdiv/southc/index.htm#travel
Northeastern: www.geosociety.org/grants/negrant.htm
Southeastern: core.ecu.edu/geology/neal/segsa/travel.html

The Rocky Mountain and Cordilleran Sections offer student travel grants for their regional Section Meetings but not for the Joint Annual Meeting.

❸ Joint Meeting Student Travel Fund

This grant is for any student member of any of the organizations participating in the 2008 Joint Annual Meeting. Information and eligibility requirements are available in the STUDENTS section on the main meeting Web site at **www.acsmeetings.org/students/travel-grants/.**

Note: Applying for a travel grant DOES NOT register you for the meeting. You must register for the meeting (at www.acsmeetings.org/registrations/) ***before*** you can apply for a travel grant. You may apply for multiple grants but can only receive one. Notification of grant status will be made by e-mail, and you must pick up your check in person (with photo ID) in Houston.

NEW!

GSA's Planetary Geology Division is offering two travel grants of US$500 each for students presenting first-authored papers at the 2008 GSA Annual Meeting.

See www.unb.ca/passc/GSA/ for more information.

GSA's Geoscience Education Division Establishes Geoscience Education Fund

Kristen St. John, *Chair, Geoscience Education Division*

With over 1,000 members, the Geoscience Education Division is one of the largest GSA Divisions. The GSA Geoscience Education Division broke new ground this spring by establishing its first endowed fund in the GSA Foundation, the **Geoscience Education Fund.**

The Geoscience Education Fund will broadly benefit Geoscience Education Division membership and will support the Division's mission of fostering the active participation of GSA Members in earth science education. By reallocating US$25,000 from a non-interest–bearing account to the new GSA Foundation fund, the Division expects to draw on the income earned to financially support geoscience education awards, grants, scholarships, and other activities as determined by the Geoscience Education Division management board. These funding opportunities include the recently established Geoscience Education Division Service Award, student travel awards, and student scholarships to participate in Division-sponsored field trips and workshops. The fund will also help offset the facilitator costs of geoscience education workshops held in conjunction with GSA meetings. As the Geoscience Education Fund grows, the Geoscience Education Division management board plans to add other focus areas, such as a student recognition award for best paper or presentation, geoscience education student receptions, and travel support for invited speakers and/or international presenters.

To start the new fund on a successful path, the Geoscience Education Division is making a fundraising call to all members and friends of the Division. We request members to "**Make a Donation—Double Your Dues**" this year in support of the Geoscience Education Fund. With 1000+ members (and dues at $5/person), our goal is to raise an additional $5,000 for the fund over the next year.

To make a donation, please complete the coupon below and send it to the GSA Foundation, or donate online at **gsafweb.org.** If you have questions about the Geoscience Education Division or the Geoscience Education Fund, please contact Kristen St. John, stjohnke@jmu.edu or call +1-540-568-6675.

Have An Item for The Auction?

The 2008 Joint Annual Meeting is right around the corner, but you still have plenty of time to donate an item to the Foundation's 9th Silent Auction. Suggested donations include jewelry, fossils, mineral samples, rare books, vacation packages, field gear, and camping equipment. All donations are tax-deductible. Contact Donna Russell at the Foundation for further information: +1-303-357-1054 or drussell@geosociety.org. Donations must be received by 1 September 2008.

Most memorable early geologic experience:

While prospecting for magnetic iron ore in northern Minnesota, I discovered that spider webs are always built mouth high.

—Bruce R. Doe

Is The Foundation in Your Will?

If you have named the Foundation in your will, please check the space on the coupon below. Your name will be added to the Pardee Coterie, which is the Foundation's planned-giving roster. All members of the Coterie will be invited to attend a special breakfast during the 2008 Joint Annual Meeting in Houston.

Support GSA Programs

Donate now!

1. **Enclosed is my contribution in the amount of $_____**

2. Please credit my contribution to the:
   - ❑ Geoscience Education Fund
   - ❑ Greatest Needs Fund
   - ❑ Other:_____Fund
   - ❑ I've named GSA Foundation in my Will *(please contact me)*

3. Name _____
   Address _____
   City / State / Zip _____
   Phone _____

4. Mail to: GSA Foundation • P.O. Box 9140 • Boulder, CO 80301
   or donate online at **www.gsafweb.org** cut out or copy

Positions Open

VISITING ASSISTANT PROFESSOR
STRUCTURAL GEOLOGY, UNIVERSITY OF AKRON

The University of Akron, Department of Geology and Environmental Science (GES), invites applications for a one-year, non–tenure-track Visiting Assistant Professor position in structural geology. This is a 9-month position that covers the period 25 August 2008 through May 2009. A Ph.D. in structural geology is preferred, though a highly qualified ABD would be considered. Applicant will maintain a full teaching load of three courses per semester including structural geology in fall 2009 and other introductory courses as needed.

UA serves about 25,000 students, and is a public institution of the University System of Ohio. Our department houses 10+ faculty members with diverse research specialties that include a focus on terrestrial records of environmental change and geoscience education. We offer bachelor and masters level degrees under a variety of options. See www.uakron.edu/geology for department details. Please submit a letter of application, full C.V., statements of research and teaching interest, and 2 letters of reference to Dr. David Steer; Chair, Structural Search Committee; Department of GES; University of Akron; Akron, OH 44325-4101, USA. Review of applications will begin immediately and continue until the position is filled. The University of Akron is committed to a policy of equal employment opportunity and to the principles of affirmative action in accordance with state and federal laws.

JOB OPPORTUNITIES AT THE DEPARTMENT OF GEOLOGICAL SCIENCES
RESEARCH SCIENTIST ASSOCIATE IV
THE UNIVERSITY OF TEXAS AT AUSTIN
JACKSON SCHOOL OF GEOSCIENCES

The Department of Geological Sciences in the Jackson School of Geosciences at the University of Texas at Austin seeks a scientist to oversee and run its Electron Microbeam Facilities. This lab serves a diverse community of researchers in the areas of igneous and metamorphic petrology, sedimentary petrology, structural petrology, geomicrobiology, paleontology, hydrology, and reservoir characterization. This scientist will maintain the facilities at full functionality, develop and improve analytical routines, train new and continuing users of the facilities, and participate in a graduate–level course in electron microbeam analytical techniques. The laboratory consists of a JEOL 8200 electron microprobe (both JEOL software and Probe for Windows® are installed), a Philips/FEI XL 30 ESEM (including CL and EBSD), a JEOL JSM6490LV SEM, and a Brüker D8 Advance X-Ray diffractometer. The minimum requirement is a Master of Science degree in geological sciences, material sciences, or a related field, and experience in operating electron microbeam instrumentation and in quantitative electron microprobe analysis. The preferred candidate will hold a Ph.D. in one of the above fields and have experience in ESEM operation, EBSD analysis, in training users in the operation of such facilities, and have working knowledge of both JEOL and Probe for Windows software. This position is permanent and fully funded, with salary level competitive and commensurate with qualifications. The option to pursue independent funding and to engage in independent research is open and negotiable.

Interested applicants should send, in electronic form, (1) a letter detailing their qualifications, (2) a resume or CV, and (3) names and contact information for three persons who could provide evaluations of suitability for the position, to Tinley Hald, HR Coordinator/Department of Geological Sciences, at thald@jsg.utexas.edu. Review of applications will begin on 1 July 2008 and continue until the position is filled. Applicants are also required to create an employment application through the University's Recruiting and Staffing Web site, www.utexas.edu/hr/empl/index.html.

Security sensitive; conviction verification conducted on applicant selected.

The University of Texas at Austin is an Affirmative Action/Equal Opportunity Employer.

STRATIGRAPHER/SEDIMENTOLOGIST, RESEARCH EMPHASIS: NEOGENE TERRESTRIAL SYSTEMS
KANSAS GEOLOGICAL SURVEY
UNIVERSITY OF KANSAS, LAWRENCE

Conduct and publish the results of fundamental and applied research in stratigraphy and sedimentology that is of national stature and relevant to Kansas. Develop both individual and cooperative research programs geared toward improved understanding of Neogene deposits in Kansas and developing a program that

Continued on p. 46.

Continued from p. 45.

bridges sedimentology/stratigraphy with hydrologic issues. Serve as the coordinator of KGS County Bulletin series summarizing updated earth sciences information of general use to the State of Kansas. Active participation as a project lead mapper in the STATEMAP component of the National Cooperative Geologic Mapping Program. Support KGS efforts in the areas of technical service and communication, education, and public information. Ph.D. degree (or expected by the time of appointment) in the earth sciences with an emphasis on stratigraphy and sedimentology. First consideration (priority) will be given to applications postmarked on or before 1 August 2008. Send letter of application addressing the required and preferred qualifications, vitae with publication record, and the names, addresses, telephone numbers and email addresses of three professional references to Annette Delaney, Human Resources, Kansas Geological Survey, The University of Kansas, 1930 Constant Avenue, Lawrence, KS 66047, USA; +1-785-864-2152 or hr@kgs.ku.edu. For further technical information contact Dr. Evan K. Franseen at the above address or evanf@kgs.ku.edu. Full announcement at www.kgs.ku.edu/General/jobs.html.

FACULTY OF SCIENCE
KUWAIT UNIVERSITY, KUWAIT

The Department of Earth and Environmental Sciences (EES) in the Faculty of Science at Kuwait University invites applications for appointment at ranks of Associate or Full Professor in the next academic year 2008/2009, in the following areas: Mineralogy/Petrology, Stratigraphy/Palynology, Petroleum Geosciences/Petroleum Reservoir, Environmental Geology/Land Degradation, Environmental Geology/GIS, Environmental Geochemistry/Clay Mineralogy, Geophysics: I. Seismic Exploration & Seismology, II. Well logging & Potential Field Methods.

Preference will be given to applicants for appointment at the ranks of Associate and Full Professor.

Required Qualifications: Ph.D. degree in the area of specialization from a reputable University. The applicants GPA in first university degree should be 3 points out of 4 (or equivalent). Research experience and significant publications in refereed international journals. Full command of teaching in English. Minimum of 5 years university teaching experience in the specified field. The successful candidates are expected to teach courses in their area of specializations at the undergraduate and graduate levels and to supervise master theses for graduate students.

Benefits include attractive tax-free salary according to rank and teaching experience (Professor's monthly salary varies from 2950 to 3192 KD., Associate Prof.'s salary varies from KD. 2265 to 2507 [KD.1 = $3.40]), annual air tickets for the faculty member and his/her family (spouse and up to three children under the age of 20), a one time settling-in allowance, housing allowance, free national health medical care, paid mid-term holidays and summer vacations, and end-of-contract gratuity. The University also offers an excellent academic environment and financial support for research projects.

To apply, send by express mail/courier service or email, within **two weeks** of the date of announcement, a completed application form, updated curriculum vitae (including mailing address, phone and fax numbers, e-mail address, academic qualifications, teaching and research experience, and a list of publications in professional journals up to 10 reprints), three copies of Ph.D., Masters, and Bachelor certificates and transcripts (An English translation of all documents in other languages should be enclosed), a copy of the passport, three recommendation letters, and names and addresses of three persons well-acquainted with the academic and professional work of the applicant. Please use PDF format for all electronic application materials. Applications and inquiries should be addressed to: Dean, Faculty of Science, Kuwait University, P.O. Box 5969, Safat, 13060, Kuwait, Tel: +965-4985602, Fax: +965-4836127, e-mail: jawadhi@kuc01.kuniv.edu.kw.

GEOCHEMICAL HYDROGEOLOGY
ASSISTANT PROFESSOR
PORTLAND STATE UNIVERSITY

The Department of Geology, Portland State University invites applications for a tenure-track Assistant Professor position in Geochemical Hydrogeology beginning 16 September 2008. This hire is part of a University initiative to enhance the science-perspective in the nationally renowned Freshman Inquiry program of University Studies. The successful candidate will be an active member of the University Studies Program and will teach the Freshman Inquiry class. Teaching and research in hydrogeology with an emphasis in geochemistry is an important contribution to the department, the university's effort in the water sciences, and to collaborations with our local US Geological Survey office. Qualifications for the position included a doctoral degree at the time of hire, a record of scholarly activities including publications in peer-review literature and a record of obtaining outside funding. We will consider applications to the broader subject of geochemical hydrology but our intent is to hire someone with interests and experience in hydrogeology. For application details, please see www.geology.pdx.edu Portland State University is an Affirmative Action, Equal Opportunity institution and, in keeping with the President's diversity initiative, welcomes applications from diverse candidates. The successful candidate will make significant and balanced contributions to teaching, research, and service, including development of a nationally respected externally funded research program.

TEACHING ASSISTANT PROFESSOR OF GEOLOGY
DEPARTMENT OF GEOLOGY & GEOGRAPHY
WEST VIRGINIA UNIVERSITY

The Department of Geology and Geography, West Virginia University, has an opening for a full-time (9-month), non-tenure track Teaching Assistant Professor of Geology. This position requires a person with a Ph.D. in Geology whose interests are in teaching undergraduate students. The position carries an 80% teaching and 20% service assignment. Each semester, the successful candidate will teach two large-enrollment sections of physical and/or historical geology and two additional undergraduate courses. The area of specialty in Geology is open. We especially encourage applications from individuals who have an interest in teaching introductory and capstone courses, plus a course in their specialty.

Teaching Assistant Professors at WVU are eligible for promotion; however, promotion to senior ranks is not a requirement for institutional commitment and career stability in a Teaching Faculty appointment. The successful candidate will join a faculty that takes great pride in having members who have been recognized at the university, state, and national levels for excellence in teaching. The Department occupies the newly renovated Brooks Hall with state-of-the-art teaching technologies and facilities. We embrace field work as a component of all upper division undergraduate courses and welcome candidates who are interested in involvement in our Geology Field Camp.

Candidates should send: (1) letter of application detailing teaching area interests; (2) curriculum vitae; (3) teaching evaluations as available; and (4) names, phone numbers, e-mail and mail addresses of three referees to the following address: Teaching Assistant Professor Search Committee, Department of Geology and Geography, West Virginia University, Morgantown, WV 26506-6300. Questions may be directed to geolteaching@mail.wvu.edu or +1-304-293-5603. Review of applications will begin 15 August 2008 and continue until the position is filled. The starting date is 1 January 2009. Please see www.geo.wvu.edu, www.wvu.edu, and www.morgantown.com. West Virginia University is an Equal Opportunity/Affirmative Action employer. Women and minority candidates are especially encouraged to apply.

DEPARTMENT OF GEOLOGICAL SCIENCES
UNIVERSITY OF CANTERBURY

The Department of Geological Sciences at the University of Canterbury invites applications for a **Lecturer/Senior Lecturer/Associate Professor** in Hazard and Disaster Management. (Reference Number A169–08J).

Applicants must hold a Ph.D. or equivalent qualification in an appropriate area of geoscience and its application to hazard and disaster management. They should have an established high-quality research and publication track record, and a demonstrated ability to lead a research program and gain external funding. Evidence of a commitment to excellent teaching at undergraduate and postgraduate levels, as well as supervision of postgraduate research students in the Hazard and Disaster Management programme are key requirements.

More information on our teaching and research programs is available on our website www.geol.canterbury.ac.nz, and further information can be obtained from Head of Department Professor Jarg Pettinga, e-mail: jarg.pettinga@canterbury.ac.nz. The closing date for applications is 31 July 2008. It is anticipated that the successful applicant will begin duties at the start of Semester 1, 2009 (February) or close to that date. For more detailed information on this position and to apply online visit http://vacancies.canterbury.ac.nz.

The Sedimentary Record of Meteorite Impacts

edited by Kevin R. Evans, J. Wright Horton Jr., David T. King Jr., and Jared R. Morrow

Large meteorite impacts are agents of sedimentation; sedimentary particles are generated through brecciation, which then are transported, emplaced, and deposited. Up until the 1960s, the geologic community largely regarded meteorite impacts as geologic sideshows and curiosities, which were inherently controversial. Today, it is widely recognized that large impacts have played a pivotal role in the evolution of Earth's biota and sculpted the surface of the planet. Although the future holds risks of impact, ancient impact structures may also be viewed as resources, where breccia bodies and peripheral strata host accumulations of hydrocarbons and ore deposits. This Special Paper examines the sedimentary record of impacts, including the generation of impact melts in sedimentary target rocks; structures such as Chesapeake Bay, Gardnos, Lockne, Mjølnir, and Weaubleau; and distal deposits from the Alamo, Avak, and Chicxulub impacts.

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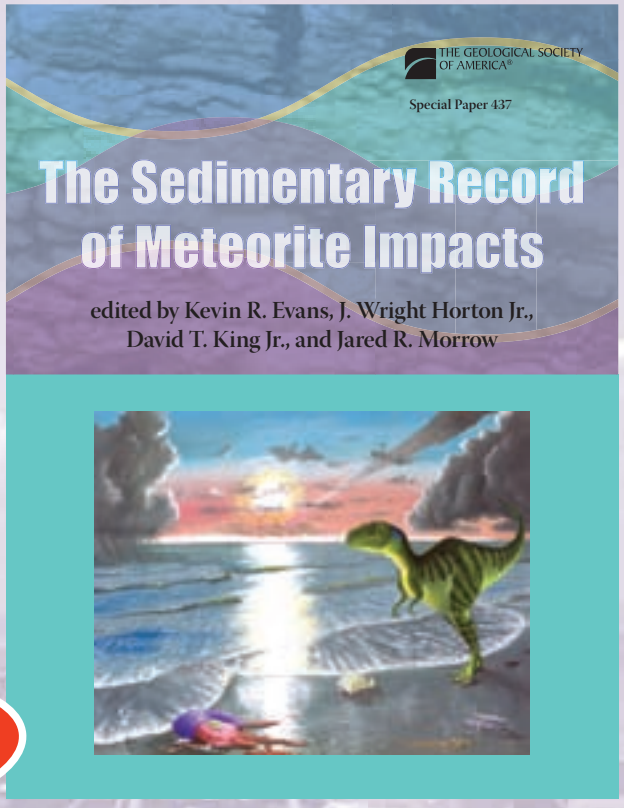

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