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**The California Arc:
Thick Granitic Batholiths,
Eclogitic Residues,
Lithospheric-Scale Thrusting,
and Magmatic Flare-Ups**

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jgeiss@unm.edu

FIELD TRIP CO-CHAIRS

Eric A. Erslev
(970) 491-5661
fax 970-491-6307
erslev@cnr.colostate.edu

Jerry Magloughlin
(970) 491-1812
fax 970-491-6307
jerrym@cnr.colostate.edu

HOT TOPICS CHAIR

Steve Getty
(710) 389-6512
fax 719-389-6910
sgetty@coloradocollege.edu

GSA TECHNICAL PROGRAM OFFICER

Nancy Carlson
(303) 357-1061
ncarlson@geosociety.org

GSA SHORT COURSE PROGRAM OFFICER

Edna Collis
(303) 357-1034
ecollis@geosociety.org

For More Information

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On the cover: View of the Sierra Nevada batholith in Yosemite National Park. The 100–85 Ma Sierran crest is seen along the horizon in this view looking from Mount Hoffmann. Photo by Steve Kidder.

The California Arc: Thick Granitic Batholiths, Eclogitic Residues, Lithospheric-Scale Thrusting, and Magmatic Flare-Ups

*Mihai Ducea, University of Arizona,
Department of Geosciences,
Tucson, AZ 85721, USA,
ducea@geo.arizona.edu*

ABSTRACT

Recent geological and geophysical data show that a significant fraction of the crust (~33 km) in the central Sierra Nevada batholith is granitic, requiring that the batholith be underlain by a significant residual mass prior to Cenozoic extension. Although batholith residua are commonly thought to be granulites, xenolith data indicate that eclogite facies residues were an important part of the California arc at depth. The arc was continuously active for >140 m.y., yet most surface and/or shallow crustal magmatism took place via two short-lived episodes: one in the Late Jurassic (160–150 Ma), and a second, more voluminous one in the Late Cretaceous (100–85 Ma). These magmatic flare-ups cannot be explained solely by increases in convergence rates and magmatic additions from the mantle. Isotopic data on xenoliths and midcrustal exposures suggest that North American lower crustal and lithospheric mantle was underthrust beneath accreted rocks in the arc area. The Late Cretaceous flare-up is proposed to be the result of this major west dipping–lithospheric scale thrusting, an event that preceded flare-up by ~15–25 m.y. I suggest that the central part of the arc shut off at ~80 Ma because the source became melt-drained and not because of refrigeration from a shallowly subducting slab.

INTRODUCTION

Cordilleran batholiths are extensive belts of intermediate calc-alkalic plutons

that formed above subduction zones. Understanding the petrology and tectonic framework of these granitic batholiths has stirred great geologic controversies and continues to pose several major problems in modern geology, such as quantifying the rates and processes of crustal growth versus recycling in arc environments (e.g., Hamilton, 1988). One of our major limitations in deciphering large-scale arc magmatic features is the limited knowledge of their vertical dimension. How deep do they extend, what is their composition at depth, and how thick is the crust beneath arcs? How much of the crustal thickening is tectonic versus magmatic? Are batholiths riding on major thrust faults or emplaced along major strike-slip faults? Is magmatism in major arcs steady state, and how do magmatic rates correlate with plate convergence rates?

Mesozoic arc rocks of the western North American Cordillera (Anderson, 1990) are exposed throughout California (Fig. 1) and once formed a continuous belt that has since been dismembered by Cenozoic tectonism. This paper presents an updated view on the composition, structure, and tectonic evolution of the magmatic arc of California.

SETTING

The California arc formed as a product of the prolonged subduction of ocean floor beneath the southwestern edge of the North America plate (Dickinson, 1981). The arc was active between 220

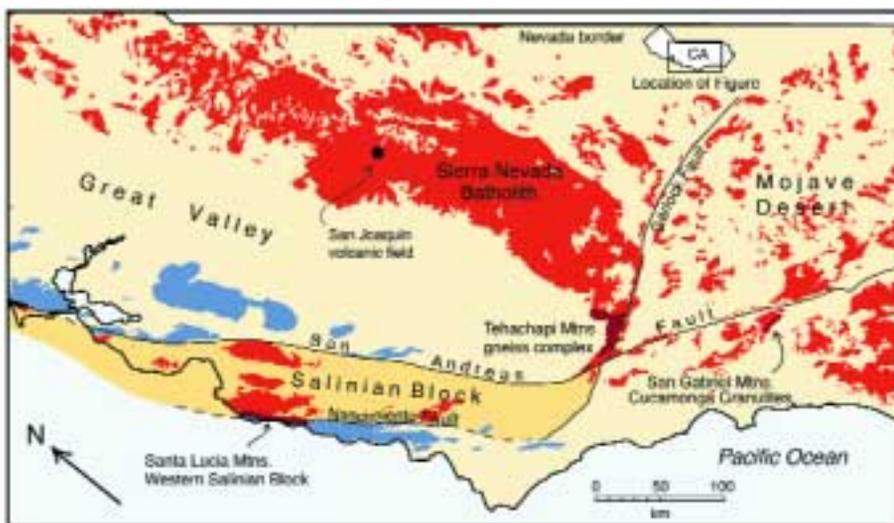


Figure 1. Map of central and southern California (after Jennings, 1977) showing geologic features discussed in text. Mesozoic granitic and related metamorphic rocks are in red. In blue are mainly Jurassic Franciscan formation rocks. Darker red areas show location of Mesozoic arc-related amphibolite-granulite terrains.

and 80 Ma. The igneous crystallization depths of the presently exposed rocks vary from 0 to ~30 km (Ague and Brimhall, 1988; Saleeby, 1990). Together, the segments of the California arc generated ~0.7 million km³ of granitic material. Figure 1 shows three key features that, together, provide information on the nature of the crust beneath the arc.

1. The granitoid plutons are mostly upper crustal exposures of tonalites and granodiorites, with only minor (<3% of exposed rocks) mafic intrusions. The central and southern Sierra Nevada batholith represents the main and most studied part of the arc and consists of >90% magmatic products.
2. Three deeper crustal exposures of the arc—the western Salinian block (Compton, 1960), the Tehachapi complex, southernmost Sierra Nevada (Ross, 1985), and the Cucamonga complex in the San Gabriel Mountains (Barth and May, 1992)—expose mid-crustal plutons and upper amphibolite to granulite facies framework rocks that equilibrated at as much as ~30 km beneath the arc.
3. Miocene volcanic rocks from the central Sierra Nevada in the San Joaquin volcanic field (Fig. 1; Dodge et al., 1986) host xenoliths representing samples of the deepest crust and upper mantle beneath the batholith.

A VERY THICK (30–35 km) GRANITIC BATHOLITH

In two classic papers, Bateman and Wahrhaftig (1966) argued for and Hamilton and Myers (1967) argued against thick granitoids underlying the currently exposed Sierra Nevada batholith. Various geophysical data such as gravity, heat flow, and various seismic results have not been able to resolve this controversy convincingly.

We now have two lines of evidence that argue strongly for a significant (35 km) thickness of granitoids (rocks that have >60% SiO₂) in the California arc. First, a recent seismic refraction study carried out across the Sierra Nevada shows that crustal rocks have V_p of 6–6.3 km/s throughout the ~33 km of seismologically defined crust, and are underlain by mantle peridotite (Fliedner and Ruppert, 1996). On this evidence, Fliedner et al. (2000) concluded that tonalites and granodiorites extend to the

deep crust in the southern Sierra Nevada. Second, the three exposed sections of the midcrustal arc rocks have intermediate compositions and are dominated by Mesozoic igneous and meta-igneous rocks. The southern Sierra Nevada is particularly important because it represents a tilted exposure through the batholith showing that arc-related granitoids dominate the shallow to ~30-km-deep section of the crust. The bulk chemistry of these deeper exposures corresponds to a low-silica tonalite (Saleeby, 1990).

This evidence suggests that ~25–30 km of the present-day Sierra Nevada crust

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comprises rocks that are mainly granitoids. Adding the average erosion depth of ~6 km in the Sierra Nevada (Ague and Brimhall, 1988) to the estimates from seismic data, one can conclude that the batholith must have been ~30–35 km thick. The calculated batholith thickness has important implications for the composition of the deeper arc crust. Calc-alkaline intermediate rocks cannot be directly extracted by mantle melting (Wyllie, 1984), thus requiring a second stage of fractionation or partial melting of mantle-derived rocks and significant crustal residues. If melting of the downgoing oceanic crust (Drummond and Defant, 1990) was responsible for arc magmas in California, the residue could have been “disposed of” via subduction. However, the negative ϵ_{Nd} values of most California arc magmas (published values range between +5 and –12 with an average of ~–6) are incompatible with such a model because the oceanic lithosphere has a fairly constant ϵ_{Nd} of ~+10. Therefore, most of the second-stage melting and/or fractionation and generation of a residue must have taken place in the lower lithosphere beneath the arc in a

complex transition from lower crust to upper mantle located on thickened continental crust (Hildreth and Moorbath, 1988). The residual mass could be (1) a restite (i.e., the solid left after partial melting and extraction of melt from the deep crust), (2) a cumulate (i.e., resulting from crystal fractionation in deep-seated magma chambers), or (3) both. In this paper, the nongenetic term residue is used to include restite and cumulate.

Simple mass balance calculations using major elements indicate that the ratio of residue to melt in an arc column is ~1 to 2 if the bulk material is basaltic or andesitic (Ducea, 1998). Thus, accepting a granitoid thickness of 30–35 km and assuming a 40 km depth for the transition from granulitic to eclogitic residues (Wolf and Wyllie, 1993), there may have been 30–50 km of eclogite facies residues beneath the batholith, depending on the bulk chemistry of the system.

RESIDUE BENEATH THE BATHOLITH Exposed Deeper Crust

The three midcrustal arc exposures in California consist of deformed sequences of metamorphosed intrusions interspersed with a commonly migmatized metasedimentary framework, all of which are intruded by younger, weakly deformed, or undeformed plutons. Cretaceous U-Pb zircon ages (e.g., Mattinson and James, 1986; Sams and Saleeby, 1988) indicate that the metamorphism and magmatism in these exposures is Cordilleran arc-related. The metamorphosed framework consists of mostly upper amphibolite and subordinate granulite facies rocks that record peak pressures of 7–9 kbar (Pickett and Saleeby, 1993; Barth and May, 1992; Compton, 1960). The rocks are heavily foliated, lineated, and partly migmatized. The intimate spatial association of amphibolite and granulite facies rocks is thought to reflect dehydration melting reactions of amphibolite protoliths (e.g., Hansen and Stuk, 1993). Several intrusions of large (>100 km²), undeformed bodies of pyroxene tonalites and granodiorites crosscut the foliated framework. The mineral assemblages of the undeformed plutons indicate that they were emplaced at pressures similar to those recorded by the metamorphic assemblage. Significantly, although there is widespread evidence for migmatization, it appears

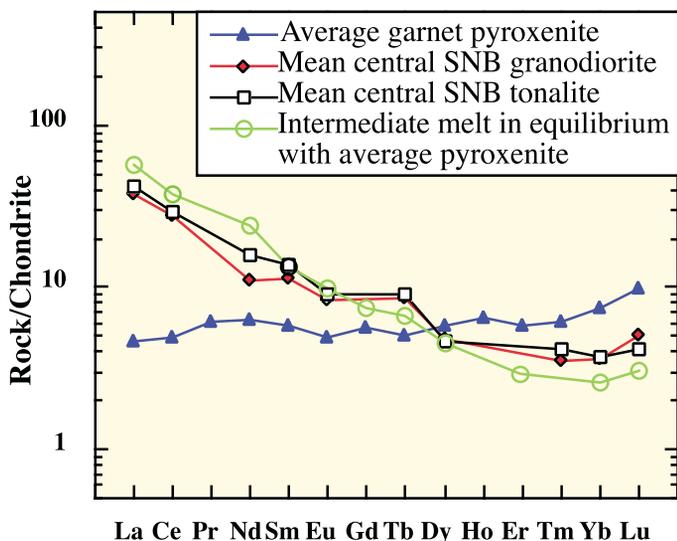


Figure 2. Chondrite-normalized rare earth element (REE) concentrations of intermediate melts in equilibrium with residue averaging garnet pyroxenite compositions. Average Sierran pyroxenite assumed to contain 50% clinopyroxene, 40% garnet, and 10% amphibole. Average REE compositions of surface granodiorites and tonalites in area (Dodge et al., 1982) shown for comparison. SNB—Sierra Nevada Batholith.

that these large plutons were generated at a deeper level, in the presence of a feldspar-poor residue, and that migmatite leucosome extraction was minimal.

U-Pb zircon geochronology indicates that dehydration melting in the section and the local formation of granulite facies rocks is coeval with the larger intrusions (90–100 Ma), and younger than the age of peak metamorphism (~115 Ma) (Mattinson and James, 1986; Pickett and Saleeby, 1994). Kinematic data indicate that deformation associated with the ~115 Ma amphibolite facies metamorphism is a result of ductile thrusting in the mid-crust (Compton, 1966).

Deepest Crust and the Upper Mantle: Xenoliths

San Joaquin volcanic field xenoliths comprise the following petrographic groups: (1) granulites, high-Al pyroxene- and feldspar-bearing rocks that equilibrated at depths between 30 and 35–45 km and are identical to the rocks exposed in the midcrustal exposures; (2) pyroxenites, garnet-bearing and feldspar-free rocks, which equilibrated at >35 km depth; (3) metasedimentary rocks (mostly quartzites and metapelites) with barometric record demonstrating residence in the deep crust (>40 km); and (4) peridotites, samples from the mantle lithosphere. The first three groups are lower crustal rocks and have mineral Sm-Nd ages of 80–120 Ma and initial Sr and Nd ratios consistent with an arc origin (Dodge et al., 1986; Ducea and Saleeby, 1998).

Garnet pyroxenites represent an eclogite facies suite that equilibrated at 10–30 kbar (Ducea and Saleeby, 1996). These rocks are never seen in Cordilleran crustal exposures and are oddities in any arc root terranes (they are found in the Jijal sequence of the Kohistan arc; Ringuette et al., 1999), but they are predicted by experiments to represent deep crustal (>10–15 kbar) residues of dehydration melting resulting in tonalitic melts

(Rapp and Watson, 1995; Wolf and Wyllie, 1993). These rocks are interpreted here to be an important part of the lower crustal residue beneath the arc. This is based on the large range of equilibration pressures for the Sierran garnet pyroxenites, the great thickness of batholithic crust, and mass balance constraints calling for a thick residue and hence a significantly thickened crust during arc formation. Trace element patterns are consistent with the garnet pyroxenite xenoliths being batholith residues. The observed rare earth element compositions of Sierran garnet pyroxenites would have been in equilibrium with the average trace element concentrations observed in arc granitoids (tonalites and granodiorites) from the San Joaquin area (Fig. 2). This result suggests that arc granitoids formed via partial melting or fractional crystallization at deep-crustal and/or upper-mantle depths and differentiated primarily from a garnet-rich, plagioclase-poor “eclogitic” residue. These observations do not preclude some melt extraction from having taken place within the realm of a shallower, granulite facies residue.

THICKER ARC CRUST AND LITHOSPHERE IN THE MESOZOIC

The present crust beneath the Sierra Nevada is thin (33 km thick; Wernicke et al., 1996) and is probably an effect of Late Cenozoic extension and delamination in the area. Two xenolith observations suggest that the Mesozoic crust was at least ~70 km thick and the mantle lithosphere was at least 120 km thick.

1. Metasedimentary xenoliths found in the San Joaquin volcanic field are relatively fresh eclogite facies quartzites (i.e., the minor mafic phases present are mostly garnet and clinopyroxenes) that equilibrated at pressures in excess of 15 kbar. The deepest measured eclogite facies quartzite ($P \approx 25$ kbar; Ducea and Saleeby, 1998) indicates that the Mesozoic subarc crust was at least 70 km thick. This rock has North American isotopic signatures and has a mineral Sm-Nd age of 85 Ma. However, it is possible that the deepest crust represents a complex transition from lower crustal (mostly mafic with minor metasedimentary lithologies) to mantle assemblages.
2. Garnet peridotite xenoliths with North American lithospheric isotopic signatures equilibrated as deep as ~120 km (Mukhopadhyay and Manton, 1994; Ducea and Saleeby, 1998). This indicates that the mantle lithosphere beneath the arc was significantly thicker in the Mesozoic than at present and that even after a decrease of the angle of subduction during the Laramide orogeny, the top of the oceanic slab was never shallower than ~120 km in the central Sierra Nevada.

These observations strengthen the argument that the Cretaceous arc must have had a thick crustal root consisting mostly of residues and/or cumulates of the granitoids that make up the California batholith. Figure 3 is a schematic column through the arc lithosphere summarizing the data presented above.

MULTIPLE DEEP SOURCES OF ARC MAGMAS

The San Joaquin xenoliths, together with the well-known granitoids exposed at the surface in the area (Dodge et al., 1982), are ideal to check for isotopic heterogeneities in a vertical dimension through the arc. The xenolith “column” is located on

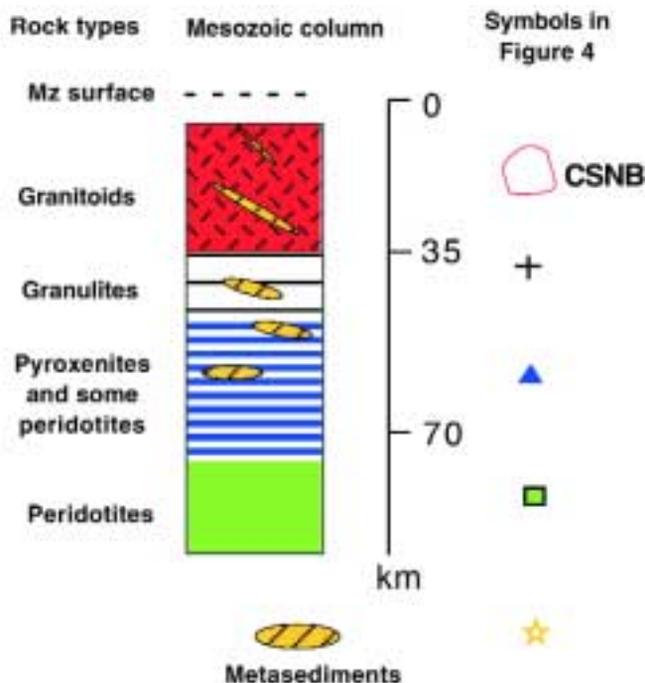


Figure 3. Simplified compositional column through California arc lithosphere, as constrained by surface exposures and xenolith data. Lower parts of lithospheric column may have changed significantly since the Miocene due to foundering of eclogite facies keel into mantle (Ducea and Saleeby, 1996). Symbols used in Figure 4 for samples with various compositions in lithospheric column also shown. CSNB—Cretaceous Sierra Nevada Batholith.

the axis of the composite Sierra Nevada batholith.

Two diagrams summarizing whole-rock Sr, Nd, and O isotopic measurements on these rocks indicate that vertical isotopic heterogeneities of the Sierra Nevada lithosphere are larger than the ones observed across the surface exposures of the entire batholith (Fig. 4). These data do not uniquely constrain the proportions of mantle versus crustal components in the arc (Miller et al., 1988), but help identify qualitatively three important end members that contribute to the isotopic heterogeneity of the batholith. These end members (S is sedimentary, C is old lower crustal, and M is young mantle [Fig. 4]) are treated as broad fields rather than points, given the likelihood of internal isotopic variability. End member S is characterized by high $\delta^{18}\text{O}$, $^{87}\text{Sr}/^{86}\text{Sr}_{100}$ (100 denotes that the radiogenic isotopes are age-corrected for 100 Ma) and relatively elevated $\epsilon_{\text{Nd}-100}$. The $\delta^{18}\text{O}$ data indicate that end member S is represented by rocks that must have resided at or near the surface of Earth prior to their transport to lower crustal depths, and thus is most likely sedimentary or volcanic in origin. The xenoliths richer in this component are either high-Al basalts or silica-rich metasediments. End member C comprises mafic and ultramafic rocks, has $^{87}\text{Sr}/^{86}\text{Sr}_{100}$, $\epsilon_{\text{Nd}-100}$, and $\delta^{18}\text{O}$ compatible with a Precambrian lower crustal and/or lithospheric mantle material (Taylor, 1988). The bulk chemistry of the garnet pyroxenites suggests that they are residual assemblages of the arc (Ducea and Saleeby, 1998). End member M is relatively elevated in $\epsilon_{\text{Nd}-100}$ and has a low

$\delta^{18}\text{O}$ (~6), typical for mantle-derived materials. The relatively elevated $\epsilon_{\text{Nd}-100}$ suggests that this component may be derived from young mantle beneath the arc.

The isotopic signatures of the xenoliths refine Kistler's (1990) proposal that two distinct types of lithosphere exist beneath the Sierra Nevada: accreted oceanic lithosphere (Panthalassan) beneath the western batholith, and an eastern continental lithosphere (North American). Specifically, the end members S (and possibly M) and C dominate the signatures of the accreted and autochthonous North American lithospheres, respectively. The data indicate that the central Sierra Nevada granitoids are chemically complementary and isotopically similar to the garnet pyroxenites and are dominated by the end member C component (Ducea and Saleeby, 1998).

LITHOSPHERIC-SCALE THRUSTING OF NORTH AMERICA BENEATH THE ARC

The data shown in Figure 4 indicate that granulites are dominated by the end member S component, and the garnet pyroxenites are dominated by the end member C component, suggesting that Precambrian basement units of western North

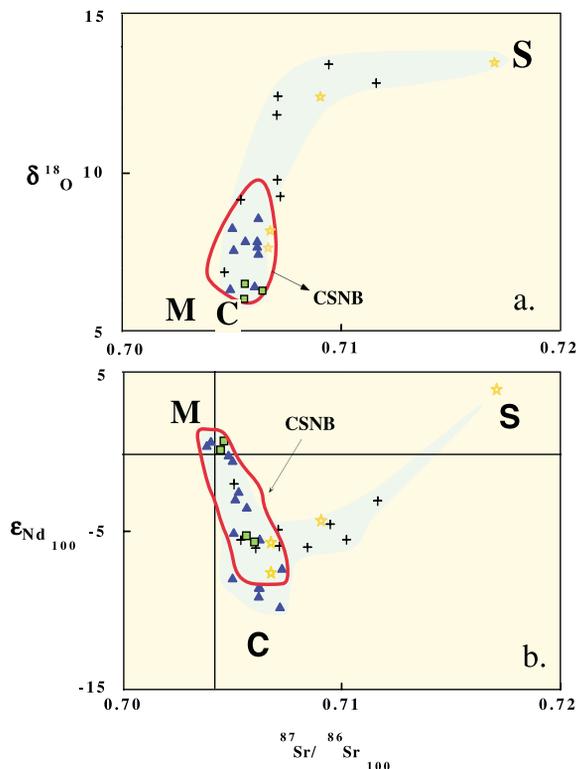


Figure 4. A: $^{87}\text{Sr}/^{86}\text{Sr}_{100}$ vs. $\delta^{18}\text{O}$ measured in lower crustal and upper mantle xenoliths from San Joaquin volcanic field. Trend defined by xenolith data shown as light blue field. Green squares—garnet peridotites; blue triangles—pyroxenites; crosses—granulites; brown stars—metasediments. End member C—old lower crustal; end member M—young mantle; end member S—sedimentary. **B:** $^{87}\text{Sr}/^{86}\text{Sr}_{100}$ vs. $\epsilon_{\text{Nd}-100}$ in San Joaquin xenoliths. Symbols as in Figure 4A. Data taken from Masi et al. (1981); DePaolo (1981); Domenick et al. (1983); Dodge et al. (1986); Mukhopadhyay (1989); Mukhopadhyay and Manton (1994); Ducea (1998); Ducea and Saleeby (1998); and Clemens-Knott (1996). CSNB—Cretaceous Sierra Nevada Batholith.

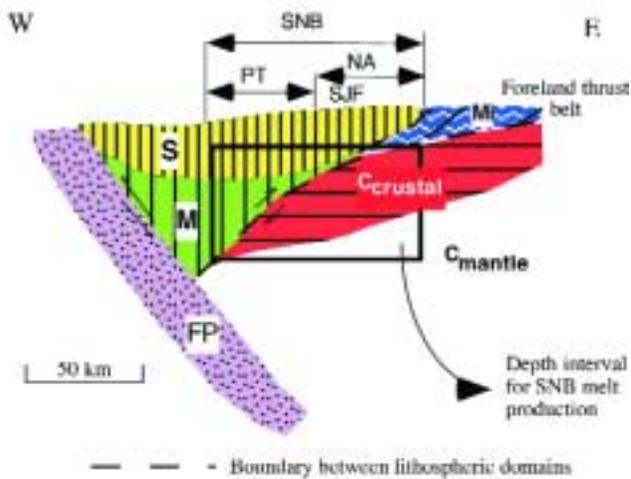


Figure 5. Schematic west-east interpretative cross section (vertical ~ horizontal scale) through Sierra Nevada lithosphere prior to generation of Cretaceous batholith. Approximate location of source region of Cretaceous Sierra Nevada batholith (SNB) is indicated, as well as Panthalassan (PT) and North American (NA) segments of batholith (Kistler, 1990). SJF marks the approximate location of San Joaquin xenolith probe in Sierra Nevada. Dark box delineates area that experienced partial melting during magmatic flare-up. Lithospheric domains: $C_{crustal}$ —Precambrian lower crust; C_{mantle} —Precambrian enriched-mantle lithosphere; S—accreted crustal rocks; M—accreted mantle; Mi—miogeoclinal rocks; FP—the subducting Farallon plate.

America were underthrust beneath Mesozoic arc rocks with oceanic or continental margin affinity. The ~30-km-deep amphibolite and granulite facies basement from the Santa Lucia, Tehachapi, and San Gabriel areas is isotopically rich in end member S (e.g., Mattinson, 1978; Pickett and Saleeby, 1994; Barth et al., 1992), consistent with that interpretation. This process led to the significant crustal and lithospheric thickening of the Mesozoic arc. Figure 5 is a schematic cross section of the proposed prebatholithic domains involved in Mesozoic magmatism in the California arc region. The scenario envisioned is that arc magmas tap different proportions of the two lithospheres depending on their location. The western Sierra Nevada plutons represent mixtures between young accreted mantle (end member M) and corresponding supracrustal rocks (end member S), whereas the central and eastern Sierra Nevada isotopic signature is dominated by the Precambrian lower crust-lithospheric mantle (end member C), and overthrust supracrustal rocks. The presence of the mantle slice of end member M shown in Figure 5 is constrained by the presence of a few spinel-bearing peridotites with the isotopic characteristics of this reservoir in the San Joaquin xenolith suites.

No sharp transition from one lithospheric type to the other is preserved in the isotopic record of the surface granitoids, questioning the commonly inferred near-vertical boundary between Panthalassa and North America along the $^{87}\text{Sr}/^{86}\text{Sr} = 0.706$ isopleth. The lithospheric-scale thrusting hypothesis can explain the smooth isotopic gradients measured in the surface granitoids across the arc. Thrusting was likely synchronous with the ductile deformation in the amphibolite to granulite facies frame-

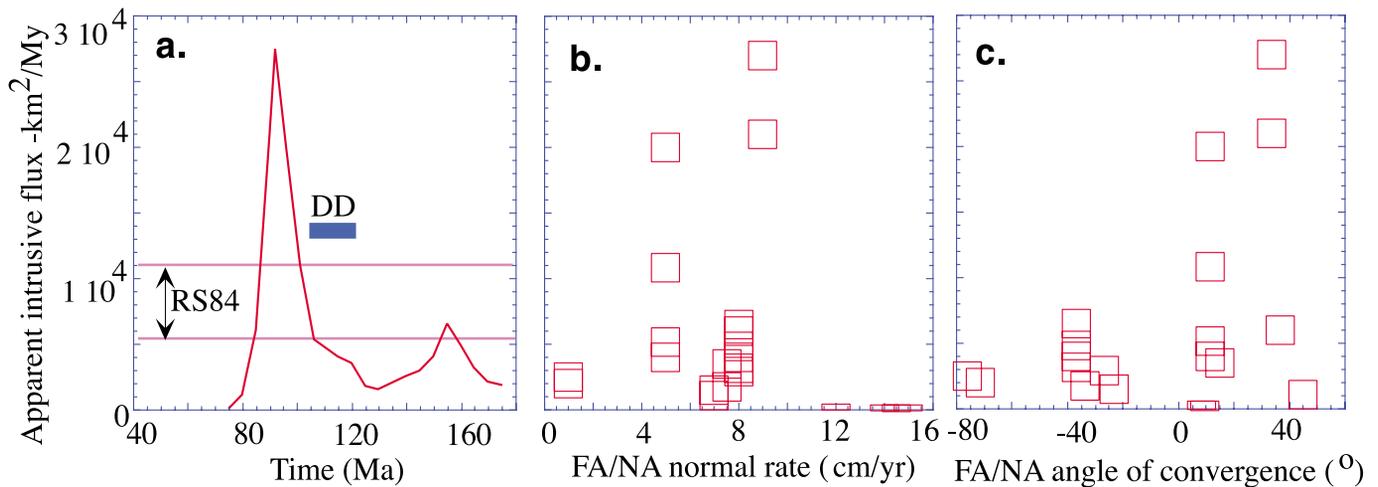


Figure 6. A: Plot of total California arc apparent intrusive flux (area of presently exposed plutonic rocks produced per units of time; in $\text{km}^2/\text{m.y.}$) vs. time of magmatism, using an updated version of CONTACT88 (Barton et al., 1988). About 600 plutons representing almost 65% of arc-exposed area have been included in database. Line labeled DD indicates period of ductile deformation in exposed mid-crust of arc and in granulite xenoliths. RS84 corresponds to magmatic addition rates in range of 20–40 $\text{km}^3/\text{km} \cdot \text{m.y.}$, typical of island arcs (Reymer and Schubert, 1984). Magmatic addition rate is defined as total volume of magma produced in an arc per unit of time scaled over length of arc, assuming an average granitoid thickness of 30 km for California arc. **B:** Plot of apparent intrusive flux vs. normal convergence rate between Farallon and North American plates in California (Page and Engebretson, 1985) for 5 m.y. intervals between 170 and 60 Ma. **C:** Plot of apparent intrusive flux vs. angle of convergence in degrees. Zero corresponds to normal convergence, positive angles reflect right-lateral motion, and negative angles represent left-lateral motion.

work in the middle crust. Ages of intrusive rocks that are concordant with the penetrative foliation as well as metamorphic peak ages known from the three exposed terranes all indicate that this ductile deformation lasted from ~125–103 Ma (Fig. 6A).

TWO SHORT (10–15 M.Y.) EPISODES OF VOLUMINOUS ARC MAGMATISM IN THE 140 M.Y. LIFE OF THE ARC

A database compiling ages, petrography, surface area, and exposure depths of dated plutons representing >60% of the surface area of the arc reveals that the arc was continuously but variably active between ~220 and 80 Ma. There are no correlations between depth of emplacement and ages or between latitude and ages, suggesting that plutons were more or less randomly emplaced in the exposed crustal section and that there was no along-strike migration of the arc with time. Figure 6A shows that the baseline apparent intrusive flux corresponds to a magmatic addition rate of ~10 km³/km • m.y., and that arc magmatism was punctuated by two episodes of higher magmatic volume and emplacement rates (magmatic flare-ups), one in the Jurassic (160–150 Ma) and the second, more dramatic one in the Late Cretaceous (100–85 Ma). The Late Cretaceous (100–85 Ma) magmatic episode is particularly important: ~78% of the California arc magmatic volume was emplaced within only 15 m.y. with a magmatic addition rate as high as 85 km³/km • m.y. All of the large (>1000 km²) plutons found along the eastern Sierra Nevada crest are 100–85 m.y. old (Coleman and Glazner, 1998). Magmatic flare-ups similar to the Late Cretaceous one in the California arc are known from other regions in the Cordillera (e.g., Pitcher, 1993), indicating that non-steady state magmatism may be a general feature of large-scale granitic magmatism in continental arc areas.

The arcs are intimately associated with subduction, and thus it is reasonable to suspect that higher convergence rates may imply faster turnaround times in the corner-shaped mantle wedge, faster devolatilization of the downgoing slab, and hence higher melt production in the mantle wedge. Figure 6B shows, however, that there is no apparent correlation between the known convergence rates (Page and Engebretson, 1985) and the

California arc's magmatic flux. In particular, the Late Cretaceous flare-up cannot be explained by the somewhat higher convergence rates at that time as compared to the 120–100 Ma period.

Magmatism in the California arc also cannot be directly correlated to the angle of convergence of subduction (Fig. 6C). Without minimizing the role of subduction and subduction-related basaltic magmatism in the evolution of this long-lived continental arc, an additional conceptual model that can explain both the flare-up and subsequent demise of granitic magmatism is needed.

ARC FLARE-UP CAUSED BY THRUSTING

I propose that the major Cretaceous flare-up of magmatism in the California arc was a consequence of lithospheric-scale underthrusting of North America beneath the arc. The xenolith data provide firsthand evidence for large-scale imbrications beneath the arc. The exposed terranes document a datable metamorphic foliation that is indicative of shortening and that predates the Late Cretaceous magmatic flare-up by ~15–25 Ma. The delay between the peak of thrusting and the peak of lower lithosphere en masse magmatism might be a consequence of the relaxation time needed for the geotherms to rebound (and then continue to increase) after initial thrusting (Glazner and Bartley, 1985). Typical thermal relaxation times for a 35-km-thick thrust sheet with the characteristics of the California arc are 10–25 m.y. The details of how and why the deeper crust and the mantle lithosphere of the North American craton melted so profoundly at 100–85 Ma are not known, but clearly the cratonic lithosphere must have been very melt fertile, possibly because of an abundance in volatiles. The link between magmatism and deformation in arcs has been questioned for decades (e.g., Bateman and Wahrhaftig, 1966).

However, studies of other segments of Cordilleran arcs where magmatism is thought to be intimately linked to shortening (e.g., Hollister and Crawford, 1986) typically, although not always, postulate that magmatism predates and triggers or enhances deformation in the middle to deep crust, in contrast to the hypothesis presented here.

This model does not negate the continuous additions of new water and melt from the mantle into the lower crust, but stresses the importance of intracrustal processes responsible for a major magmatic flare-up.

ARC SHUTDOWN DUE TO A MELT-DRAINED SOURCE REGION

Previous interpretations that call upon shallowing the subduction angle and inward migration of magmatism (Dickinson and Snyder, 1978) are undoubtedly correct at the scale of the western North American Cordillera. However, the data presented here refute the hypotheses that the top of the slab was subducted at depths as shallow as 35–60 km beneath the Sierra Nevada in early Cenozoic times (Dumitru, 1990), thus refrigerating the area and shutting the arc off. A mantle wedge continued to exist beneath the arc after its cessation at 80 Ma. The southern Sierra Nevada, in contrast, had been underthrust by a shallow forearc sequence and probably a true shallowly subducting slab during the Late Cretaceous (Malin et al., 1995). With convergence rates accelerating toward the Laramide, the magmatic shutoff in the central Sierra Nevada can be better explained by the hypothesis that continental mantle lithosphere and lower crust were melt-drained and became infertile after the Late Cretaceous flare-up, rather than by refrigeration. Thermodynamic calculations using the algorithm MELTS (Ghiorso and Sack, 1995) suggest that garnet-rich pyroxenites with the compositions of the San Joaquin xenoliths can only produce nephelinitic and other exotic magmas in the presence of water and are virtually infertile as dry assemblages at crustal temperatures. Thus, once granitoids were extracted during the Late Cretaceous flare-up, such residual assemblages were fundamentally unable to generate more granitic melts, even after subsequent hydration.

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DIALOGUE

To Merge or Not to Merge—That Is the Question: *A Case for Intersociety Collaboration*

Sharon Mosher, GSA President

When I first became president of GSA, one of my research colleagues said, “Good—with you as president of GSA and Marcia McNutt as president of the American Geophysical Union, maybe we can finally merge the two.” A tall order for a one-year term! This is not an uncommon sentiment, however. Past presidents of several large geoscience societies have expressed a long-term interest in merging geoscience societies, or at a minimum, developing much stronger collaborations. We waste our resources, in terms of people, time, and money, trying to tackle the same problems. Working together, we could accomplish so much more.

What are the overarching concerns of geoscience societies?

- Increasing public understanding and awareness of Earth and its processes.
- Publishing to meet geoscientists’ needs in an increasingly electronic world.
- Disseminating and promoting scientific research in a global setting and engaging geoscientists from all countries.
- Educating students and helping them with their research and professional development.
- Providing professional development for our members through short courses, field trips, and conferences.

Publications is an area where we really cannot continue to work in isolation. We need to combine all geoscience society journals published electronically into an aggregate on a single platform. Moreover, we need to ensure that all are online and interlinked. Readers want the ability to go seamlessly between journals. They want to be able to click on a reference in an article and be taken instantly to the referenced paper, regardless of the journal, or to search all of the geoscience journals for a specific topic. This sort of capability requires societies to cooperate technically and financially—a new world for financially and philosophically independent entities. Once that step is completed, we could merge our growing technological abilities to make journal articles interactive. We could publish 3-dimensional images, data sets, or maps with multiple layers that can be manipulated by the reader.

Other possibilities for collaboration involve rethinking our societies’ cultures or traditions. Societies will need to compromise or decide which way works best before they can work together effectively. Some of these barriers may be harder to overcome than the financial ones. It will also take mutual respect and a clear appreciation of why each society exists.

What steps are being taken to increase collaboration? Last spring, Robbie Gries, president of the American Association of Petroleum Geologists (AAPG), and I gave a combined talk entitled “GSA’s/AAPG’s Grand Challenge for the 21st Century—A friendly merger?” at the joint GSA Cordilleran Section and AAPG Pacific Section meeting. Although not seriously considering a merger, we did want to promote a merging of common efforts. Major progress in our efforts to cooperate has followed, and the Society of Exploration Geologists has joined these discussions. Equally encouraging, GSA’s 23 Associated Societies have formed a forum to cooperate in areas of mutual interest, including publications, education, public policy, outreach, and internationalization. And, of course, the American Geological Institute’s activities represent formal intersociety collaboration.

In the future, we should not ignore the other scientific societies. GSA is not the only organization concerned about evolution, the environment, energy, clean water, climate change, and other issues. Each scientific society has a different approach, but many of the problems are the same. GSA should continue to be an active member of the Council of Scientific Society Presidents, an excellent forum for communicating with other societies.

Intersociety collaboration is essential to the future of the geosciences. As we explore the scientific boundaries between disciplines, we need to continue that exploration to include collaboration on similar goals and missions. We may never merge, but perhaps, someday, we can speak with a common, united voice.



Jack Hess

Jack Hess to Be GSA’s Executive Director

GSA is very pleased to announce that Jack Hess will be its new executive director starting December 1, 2001.

Hess is currently on a two-year appointment as a legislative fellow in Senator Harry Reid’s office in Washington, D.C., where he works on radioactive waste, water, global climate change, renewable energy, and other science and technology related issues. He has been vice president for academic affairs for the Desert Research Institute, University and Community College System of Nevada, and acting vice president for finance and administration and executive director of the Division of Hydrologic Sciences of the Desert Research Institute. He received his Ph.D. in hydrogeology in 1974 from Pennsylvania State University, and in 1994, he completed the Stanford Executive Program in the Graduate School of Business at Stanford University.

Hess is a long-time, active member of GSA and has also been very active in the Hydrogeology Division, for which he served as chairman from 1995–1996. He is a strong supporter of all aspects of GSA activities. He brings an excellent member perspective to headquarters along with his extensive administrative, managerial, and financial skills.

About his new role, Hess says, “I am looking forward to working with the GSA membership, Council, and staff to meet the goals set forth in the Strategic Plan. I want to place particular emphasis on promoting geoscience in service of society and strengthening cooperation with other professional organizations.”

Hess is an excellent person to provide GSA leadership as an executive director; GSA is very pleased that he has accepted this position.

Denver 2002: Science at the Highest Level

Call for Proposals for Keynote Symposia and Topical Sessions

Proposal Deadline: January 17, 2002
Submit Session Proposals at www.geosociety.org.

The GSA Annual Meeting returns to Denver, the Mile High City and a favorite of many geoscientists, in 2002. You can help make this an exciting and successful meeting by submitting proposals for topical sessions and Pardee Symposia. Your participation is what will make this meeting *the* meeting of the year for earth scientists.

At the foot of the Rockies and at the edge of the Great Plains, Denver showcases diverse geology that appeals to all interests—from Proterozoic crystalline rocks of the Front Range, to Paleozoic Ancestral Rocky Mountain stratigraphy, to Laramide structure, to Tertiary precious metal deposits, to Tertiary-Quaternary geomorphology, plus numerous modern environmental issues. The Front Range of Colorado and environs have long been a focus of geoscience research, stirred by the discovery of immense precious metal deposits in Clear Creek and other nearby drainages in the mid-1800s. Denver, in the middle of the Front Range corridor, is a rapidly expanding, modern city with numerous museums and theaters and abundant shopping and dining establishments in the downtown area that meet virtually every taste.

Our theme highlights the success recent Denver GSA Annual Meetings have enjoyed in providing exceptionally energized, well-attended forums for a broad range of geoscience presentations, including technical sessions on cutting-edge topics in the emerging century.

We welcome proposals for Pardee Keynote Symposia and topical sessions. They must be sent electronically on or before **January 17, 2002**. The link can be found at www.geosociety.org.

Many session rooms in Denver will allow for combined oral and poster presentations to accommodate the use of these different presentation methods in a single session.

PROGRAM OPPORTUNITIES

The GSA 2002 Annual Meeting program structure offers opportunities for effective and dynamic program building and flexibility by allowing a mixture of invited and volunteered papers and different session formats. Joint Technical Program Committee (JTPC) representatives from the different GSA Divisions play a large role in program decisions. Descriptions of the various program options and guidelines are at www.geosociety.org. Please read these guidelines carefully before submitting a proposal. Two types of sessions may be proposed:

Pardee Keynote Symposia, made possible by a grant from the Joseph T. Pardee Memorial Fund, are *special events* of broad interest to the geoscience community. Topics appropriate for these symposia are those that: are on the leading edge in a scientific discipline or area of public policy; address broad, fundamental problems; are interdisciplinary; or focus on global problems. The primary criterion for selection is excellence. Selection is on a competitive basis with four to eight half-day, nonconcurrent sessions offered. All speakers will be invited; each convener is provided with a budget of \$2,000. We strive for a good mix of Pardee Keynote Symposia of interest to GSA and Associated Society members.

Topical sessions promote the exchange of timely or state-of-the-art information with respect to a focused topic and allow scheduling of interdisciplinary talks that bear on a specific topic. Organizers (advocates) may invite specific papers to ensure a successful and excellent session and are encouraged to solicit volunteered contributions. A maximum of four invited speakers may be allowed. An advocate may request more invitations if he or she can justify the larger number. However, sessions **must** include volunteered abstracts, which are solicited in *GSA Today* for all approved topical sessions. Advocates may request special formats. All requests are reviewed by the JTPC. All topical sessions must receive a minimum of 12 abstracts to be part of the technical program. Advocates are encouraged to submit their proposals as poster sessions to accommodate the growing technical program.

Oral and Poster General Sessions

Consisting entirely of volunteered papers, these sessions remain an important component of the GSA Annual Meeting. The number of abstracts received determines the number of general sessions in each discipline. The rejection rate for recent GSA Annual Meetings has been much less than 5%. The goal of the technical program chair and the JTPC representatives is to provide presenters the best possible opportunity for communicating new scientific information rather than to dictate what can or will be presented. Poster sessions have been expanded to allow presentation of more papers. To allow for well-attended, dynamic sessions, an effort will be made in scheduling to avoid overlap of poster and oral sessions in the same discipline.

Hot Topics

These popular, hour-long lunchtime forums, held Sunday through Wednesday, differ from technical sessions in that the focus is on discussion, with plenty of audience participation. Depending on the subject, a debate format is recommended, and panels are discouraged. Each session must have a moderator. Titles should be catchy and provocative. If you are interested in organizing one of

Denver 2002 Dates and Deadlines

2001

December 1 Field trip and short courses proposals due.

2002

January 17 Proposals due by midnight, MST. Electronic submission required.

April 1 Electronic abstract form will be at www.geosociety.org for active submission.

April First announcement in April issue of *GSA Today*.

June Second announcement, including registration and housing information, in June issue of *GSA Today*.

July 16 Electronic abstracts due by midnight, MST.

August 5 Technical Program schedule finalized.

September 1 All accepted abstracts will be posted at www.geosociety.org after September 1. Speakers and titles will be listed with links to those abstracts.

these sessions, contact the technical program chair, John Geissman.

Be a Part of Denver 2002

Topical session organizers have the ability to ensure a successful, excellent program with a limited number of invited speakers, and all geoscientists may contribute papers to sessions. The Pardee Keynote Symposia expand the opportunity

for high-profile sessions on important developments that have an impact on our science.

Help us make the GSA Annual Meeting increasingly dynamic and stimulating for all GSA and Associated Society members as well as one that appeals to a wide audience. We look forward to working with you. If you have any questions or concerns regarding the program, please call or e-mail one of us.

Rob Van der Voo

Annual Program Chair (2000–2002)
(734) 764-8322 voo@umich.edu

John Geissman

2002 Technical Program Chair
(505) 277-3433 jgeiss@unm.edu

Reminder: Call for Nominations Medals and Awards



Last month, we put out the call for nominations for the following medals and awards for 2002. Don't miss this chance to recognize your deserving colleagues for their contributions to the geosciences and to GSA. Make a note of the deadlines for nominations, and send them in!

For details on the awards and nomination procedures, see the October 2001 issue of *GSA Today*, go to our Web site at www.geosociety.org, or call (303) 357-1037. Materials and supporting information for any of the nominations may be sent to GSA, Grants, Awards, and Medals, P.O. Box 9140, Boulder, CO 80301-9140.

PENROSE MEDAL

Deadline: February 1, 2002

DAY MEDAL

Deadline: February 1, 2002

HONORARY FELLOWS

Deadline: February 1, 2002

YOUNG SCIENTIST AWARD (DONATH MEDAL)

Deadline: February 1, 2002

GSA PUBLIC SERVICE AWARD

Deadline: February 1, 2002

DISTINGUISHED SERVICE AWARD

Deadline: February 1, 2002

JOHN C. FRYE ENVIRONMENTAL GEOLOGY AWARD

Deadline: March 31, 2002

NATIONAL AWARDS

Nominations for the William T. Pecora Award, the National Medal of Science, the Vannevar Bush Award, and the Alan T.

Waterman Award are due **April 30, 2002**. Nominations for these awards should be sent to GSA, Grants, Awards, and Medals, P.O. Box 9140, Boulder, CO 80301-9140.

Reminder: Call for Committee Service

GSA is looking for candidates to serve on Society committees and as GSA representatives to other organizations beginning in July 2002. Candidates must be GSA Members or Fellows and must fully meet the requested qualifications. Graduate students are eligible to serve on GSA committees as full members and are encouraged to volunteer or nominate others for committee service. For complete information on committee service, current vacancies, and required qualifications, see the October 2001 issue of *GSA Today*.

The candidate nomination form and instructions are available at www.geosociety.org/aboutus/committees/index.htm, or from Member Services, (303) 447-2020, 1-888-443-4472, or member@geosociety.org.

Nominations received at GSA headquarters by **February 1, 2002**, on the official one-page form will be forwarded to the Committee on Nominations. *Council requires that the form be complete.*

The following have vacancies for 2002: 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 (formerly Continuing Education); Publications; Research Grants; Young Scientist Award; Representative to the North American Commission on Stratigraphic Nomenclature; and GSA Representatives to the Joint American Society of Civil Engineers–GSA–Association of Engineering Geologists.

Needed: Officer and Councilor Nominations

The GSA Committee on Nominations requests your help in compiling a list of GSA members qualified for service as officers and councilors of the Society. The committee requests that each nomination be accompanied by basic data and a description of the qualifications of the individual for the position recommended (vice president, treasurer, councilor). Nominations are due by **February 1, 2002**.

Please send nominations and back-up material to Administrative Services Dept., GSA, P.O. Box 9140, Boulder, CO 80301-9140.

Preliminary Announcement and Call for Papers

ROCKY MOUNTAIN SECTION, GSA

54th Annual Meeting • Southern Utah University, Cedar City, Utah • May 7–9, 2002

The GSA Rocky Mountain Section Meeting is sponsored by the Department of Physical Science, Southern Utah University, and by the Utah Geological Survey.

ENVIRONMENT

Cedar City lies conveniently along Interstate 15 in southwestern Utah, roughly 2½ hours by car north of Las Vegas, Nevada, and 3½ hours south of Salt Lake City. At an elevation of 5,800 feet, the area is within the transition zone between the Basin and Range and Colorado Plateau physiographic provinces. The structural styles and stratigraphy of both regions combine to produce some of the most exceptional and well-exposed geology in the western United States. A several-thousand-foot-thick sequence of upper Paleozoic through Mesozoic sedimentary rocks crops out a few miles to the south in and around Zion National Park. Near Cedar City and extending northeastward toward Cedar Breaks National Monument and Bryce Canyon National Park, these same units are overlain by Late Cretaceous and Paleocene sedimentary rocks, and by mid-Tertiary volcanic rocks derived from calderas to the north and west. Westward in the Great Basin, these units are overlain by Pliocene-Quaternary valley-fill deposits and a series of younger bimodal volcanic rocks formed during an episode of extensional tectonism that resulted in north-trending, basin-range faults.

The Mojave Desert environment extends into the Santa Clara and Virgin River Valleys near St. George (elevation 2,800 feet), a one-hour drive southward. A half-hour drive to the east from Cedar City leads to Utah's high plateaus with their lush forests, beautiful lakes, and elevations in excess of 10,000 feet. Cedar City owes much of its presence and size to the huge iron deposits of the nearby Iron Springs district. Historically, mineral wealth in adjacent areas has also been great. Petroleum resources are attracting renewed exploration attention. The water resources of southwestern Utah and adjacent regions of Nevada and Arizona increasingly come from groundwater, the development of which requires continued inquiry.

CALL FOR PAPERS

Papers are invited for technical sessions, symposia, theme sessions, and poster presentations. The technical sessions will provide 15 minutes for presentation and five minutes for discussion. Symposia conveners may assign more time to invited speakers. Two 35 mm carousel projectors (please bring your own trays), two screens, and an overhead projector will be provided for each oral session. Papers of regional interest to earth and environmental scientists in the Rocky Mountain area, as well as those of general interest will be considered for the program.

Poster presentations are encouraged and will be allowed at least three hours of display time. Authors must be present for at least two hours.

ABSTRACTS

Abstracts deadline: February 4, 2002

Abstracts for all sessions must be submitted online at www.geosociety.org. If you cannot submit your abstract electronically, contact Nancy Carlson, (303) 357-1061, ncarlson@geosociety.org.

FIELD TRIPS

Premeeting and postmeeting field trips will be offered. Unless otherwise noted, all field trips will begin and end in Cedar City. For details about particular field trips, contact the field trip leaders listed below or the field trips coordinator, Peter D. Rowley, (435) 865-5928, prowley@accesswest.com. We hope there will be a strong linkage between symposia and related field trips.

Premeeting

1. **Structural Development and Paleoseismicity of the Hurricane Fault, Southwestern Utah and Northwestern Arizona.** Sun. and Mon., May 5–6. William R. Lund, Utah Geological Survey, Cedar City, Utah, (435) 865-8126, lund@suu.edu; Wanda J. Taylor, University of Nevada, Las Vegas, Nev. Two-day trip.
2. **Influences of Proterozoic and Laramide Structures on the Miocene Strain Field of the North Virgin Mountains, Arizona.** Departing Las

Vegas on Sun., May 5, and arriving Cedar City the evening of Mon., May 6. Mark Quigley, (505) 277-6546, mquig@unm.edu, and Karl E. Karlstrom, both of the University of New Mexico, Albuquerque, N.Mex. Two-day trip.

3. **The Navajo Aquifer System in Southwestern Utah.** Mon., May 6. Kimball E. Goddard, (801) 908-5033, kgoddard@usgs.gov; and Victor Heilweil, and others, Utah District, Water Resources Division, U.S. Geological Survey, West Valley City, Utah. One-day trip.
4. **Volcanology and Mineral Resources of the Marysvale Volcanic Field, Southwestern Utah.** Mon., May 6. P.D. Rowley, Geologic Mapping, Inc., New Harmony, Utah, (435) 865-5928, pdrowley@accesswest.com; C.G. Cunningham, U.S. Geological Survey, Reston, Va.; J.J. Anderson, New Harmony, Utah; T.A. Steven, Lakewood, Colo.; and J.B. Workman, U.S. Geological Survey, Denver, Colo. One-day trip.
5. **National Association of Geoscience Teachers: The Geology of the Grand Staircase in Southern Utah—A Road Log and Guide for Public School Teachers.** Sun. and Mon., May 5–6. Larry E. Davis, College of St. Benedict-St. John's University, Colledgeville, Minn., (320) 363-3328, ldavis@csbsju.edu; and Robert L. Eves, Southern Utah University, Cedar City, Utah. Two-day trip.

Postmeeting

6. **Associated Miocene Laccoliths, Gravity Slides, and Volcanic Rocks, Pine Valley Mountains and Iron Axis, Southwestern Utah.** Fri., May 10. David B. Hacker, (330) 675-8831, dhacker@kent.edu; and Daniel K. Holm, Kent State University, Warren and Kent, Ohio. One-day trip.
7. **Geology and Hydrology of the Virgin Valley Region, Southeastern Nevada and Adjacent States.** Fri., May 10. Gary L. Dixon, Southwest Geology, Inc., Blackfoot, Idaho.

(208) 782-2056, gldixon@ida.net; Michael Johnson, Virgin Valley Water District, Mesquite, Nev.; and Michael Winters, Virgin Valley Water District, Nev. One-day trip.

8. **Late Cretaceous Marine and Brackish Water Strata in Grand Staircase–Escalante National Monument, Utah.** Fri., May 10. T.S. Dyman, U.S. Geological Survey, Denver, Colo., (303) 236-5730, dyman@usgs.gov; W.A. Cobban, U.S. Geological Survey, Denver, Colo.; L.E. Davis, St. Johns University, Collegeville, Minn.; R.L. Eves, Southern Utah University, Cedar City, Utah; G.L. Pollock, Bryce Canyon Natural History Association, Bryce Canyon, Utah; J.D. Obradovich, U.S. Geological Survey, Denver, Colo.; A. Titus, Grand Staircase–Escalante National Monument, Kanab, Utah; K.I. Takahashi and T.C. Hester, U.S. Geological Survey, Denver, Colo.; and D. Cantu, Bryce Canyon Natural History Association, Bryce Canyon, Utah. One-day trip.

SYMPOSIA

1. **Recent Investigations of Basin and Range Paleoseismology.** Michael N. Machette, U.S. Geological Survey, (303) 863-8612, machette@gldvxa.cr.usgs.gov.
2. **Paleontological Research in Grand Staircase–Escalante National Monument and Surrounding Area.** Alan L. Titus, Grand Staircase–Escalante National Monument, Bureau of Land Management, (435) 644-4332, atitus@ut.blm.gov; Jeffrey G. Eaton, Weber State University, (801) 626-6225, jeaton@weber.edu.
3. **National Association of Geoscience Teachers Session I: Field Trips—Their Importance in Undergraduate Education.** Larry E. Davis, College of St. Benedict–St. John's University, (320) 363-3328, ldavis@csbsju.edu.
4. **National Association of Geoscience Teachers Session II: Higher Education, K–12 Partnerships, and Mentorships.** Larry E. Davis, College of St. Benedict–St. John's University, (320) 363-3328, ldavis@csbsju.edu.
5. **Rock Stars of the Colorado Plateau: The Geo-Giants Upon Whose Shoulders We Stand.** Steven H. Heath, Southern Utah University, (435) 586-9334, heath@suu.edu.
6. **P³: Proterozoic Paleogeography and Paleoclimate.** Paul K. Link, Idaho State University, (208) 282-3365, linkpaul@isu.edu; and Carol Dehler, Utah State University, Department of Geology.

THEME SESSIONS

1. **Undergraduate Research Poster Session.** (*Sponsored by the Council on Undergraduate Research—Geoscience Division.*) This session will showcase senior theses and other undergraduate research projects. A student must be listed as the lead author and be the major preparer of the poster. For further information, contact Kim Hannula, (970) 247-7463, hannula_k@fortlewis.edu, Fort Lewis College, Durango, CO 81301.
2. **National Cooperative Geologic Mapping Program—New Maps, New Research, New Discoveries.** Grant C. Willis, Robert F. Biek, and Douglas A. Sprinkel, Utah Geological Survey, (801) 537-3355, nrugs.gwillis@state.ut.us.
3. **Gemstone and Semiprecious Minerals and Host Rocks in the Western United States.** W. Dan Hausel, Wyoming Geological Survey, (307) 766-2286, dhause@wsgs.uwyo.edu.
4. **Groundwater Recharge Processes in the Arid Southwest.** Kimball E. Goddard, U.S. Geological Survey, Water Resources Division, (801) 908-5033, kgoddard@usgs.gov.
5. **Groundwater Flow Systems in the Desert Southwest.** Peter D. Rowley, Geologic Mapping, Inc., (435) 865-5928, pdrowley@accesswest.com.
6. **Volcanology and Mineral Resources of the Great Basin and the Colorado Plateau Transition Zone.** John J. Anderson, retired, Kent State University, (435) 867-8553, jjau@accesswest.com.
7. **Cenozoic Landscape Evolution of the Colorado Plateau and the Basin-and-Range Transition Zone.** Joel L. Pederson, Utah State University, (435) 797-7097, bolo@cc.usu.edu.
8. **Connections: Correlation of Devonian Strata in the Western Cordillera.** David K. Elliott, Northern Arizona University, (928) 523-4561, david.elliott@nau.edu; and Carol Dehler, Utah State University, (435) 797-7235, chuarria@cc.usu.edu.
9. **The Role of Lateral Crustal Flow in Shaping Surface Strain Patterns in**

Tectonically Extended Regions.

R. Ernest Anderson, U.S. Geological Survey, (303) 236-1827, anderson@usgs.gov.

SHORT COURSE

A short course for the Cedar City meeting has not been established at this time.

ROY J. SHLEMON MENTOR PROGRAM IN APPLIED GEOLOGY

Workshop for graduate and advanced undergraduate students about professional opportunities and challenges in the real world. Free lunch provided. Registration required. Contact GSA's Karlon Blythe, kblythe@geosociety.org. *Meeting registration is not required to attend only this workshop.*

STUDENT SUPPORT

The GSA Rocky Mountain Section has travel grants available for GSA Student Associates who are presenting oral or poster papers as authors or co-authors. Students must be currently enrolled to be eligible. Rocky Mountain Section students should contact Kenneth E. Kolm, Colorado School of Mines, kkolm@mines.edu, (303) 273-3932.

Awards will be given for the best oral and poster student papers at the meeting. Awards will be based on the quality of both the research and presentation. To be eligible, a student must be the lead author and presenter of the work. The abstract must be clearly identified as a student paper.

EXHIBITS

Exhibits representing education, research, and industry will be displayed at the meeting site. For further information, contact Fred Lohrengel, lohrengel@suu.edu, (435) 586-7941.

ADDITIONAL INFORMATION

Information concerning registration, accommodations, and activities will appear in the February 2002 issue of *GSA Today* and at www.geosociety.org. Requests for additional information or suggestions should be addressed to the general chair, Robert L. Eves, eves@suu.edu, (435) 586-1934.

GSA is committed to making all events at the 2002 meeting accessible to all people interested in attending. You can indicate special requirements (wheelchair accessibility, etc.) on the registration form.

Preliminary Announcement and Call for Papers

CORDILLERAN SECTION, GSA

98th Annual Meeting • Oregon State University, Corvallis, Oregon • May 13–15, 2002



<http://terra.geo.orst.edu/users/gsa2002>

This meeting will be held at the LaSells Stewart Center and CH2M Hill Alumni Center at Oregon State University. Participating organizations include the Northwest Energy Association (NWEA) of the American Association of Petroleum Geologists, the Oregon and Washington Chapters of the Association of Engineering Geologists (AEG), the Cordilleran Section of the Paleontological Society (PS), and the National Association of Geoscience Teachers (NAGT). The meeting chair is Bob Yeats, (541) 737-1226, yeatsr@geo.orst.edu. Coordinators for participating societies are Jack Meyer, NWEA, h2m@nwnatural.com; Scott Burns, AEG, (503) 725-3389, burnss@pdx.edu; Jeff Myers, PS, (503) 838-8365, myersj@wou.edu; and Peter Wampler, NAGT, (541) 758-8418, wamplerp@geo.orst.edu.

CALL FOR PAPERS

Abstracts deadline: February 7, 2002

Papers are invited for theme and general sessions in both oral and poster format. Volunteered abstracts will be considered for any of the theme sessions listed below or any general discipline listed on the GSA abstract form. Additional theme sessions are invited; contact the technical program chair, Andrew Meigs, (541) 737-1214, meigsa@geo.orst.edu. You may submit only one volunteered abstract as first author or presenter.

Abstracts for all sessions must be submitted using the electronic submissions form at the GSA Web site, www.geosociety.org. You may check your abstract online as soon as you have submitted it (abstracts are password protected) and revise it up until the abstract deadline. Co-authors will receive by e-mail their abstract ID number and password, giving them access to their abstract. If you have problems, contact Nancy Carlson at ncarlson@geosociety.org.

TECHNICAL PROGRAM

The technical program chair is Andrew Meigs, (541) 737-1214, meigsa@geo.orst.edu.

Symposium

1. **Paleogeodesy: Unraveling Displacement Fields in Magmatic Arcs: A Symposium in Honor of Othmar Tobisch.** Brendan McNulty, (310) 243-3412, bmcnulty@csudh.edu.

Theme Sessions

1. **Presenting Geology to the Public in National and State Parks and Other Areas.** (Cosponsored with NAGT.) Bob Lillie, (541) 737-1242, lillier@geo.orst.edu.
2. **The Evolving Pacific Northwest Landscape: Geomorphic and Ecologic Controls, Constraints, and Conundrums in the Quaternary.** Gordon Grant, (541) 750-7328, Gordon.Grant@orst.edu.
3. **Constraints on Cretaceous Paleogeography of the Western Cordilleran Margin.** Bernie Housen, (360) 650-6573, bernieh@cc.wvu.edu.
4. **Public Policy, Floods, Aquifers, and River Dynamics in the Willamette Basin, Oregon.** (Cosponsored with AEG.) Jim O'Connor, (503) 251-3222, oconnor@usgs.gov.
5. **Architecture of Cascadia: A Synthesis of New Geologic and Geophysical Mapping in the Forearc.** (Cosponsored with NWEA.) Ray Wells, (650) 329-4933, rwells@usgs.gov.
POSTERS
6. **Hazards and Risks from Cascade Volcanoes.** (Cosponsored with AEG.) Britt Hill, (210) 522-6087, bhill@swri.edu.
7. **Uplift, Erosion, and Topography of a Steady-State Orogenic Belt: The Olympic Mountains of Washington.** Mark Brandon, (203) 432-3135, mark.brandon@yale.edu.
8. **Debris Flows: Theory and Practice.** (Cosponsored with AEG.) Dick Iverson, (360) 993-8920, riverson@usgs.gov.

9. **Unraveling the Tertiary Stratigraphy and Structure of the Pacific Northwest and Its Implications for Hydrocarbon Occurrence and Underground Gas Storage.** (Cosponsored with NWEA and AAPG.) Jack Meyer, h2m@nwnatural.com.
10. **Engineering Geology Case Histories: State of the Art and State of Practice in the Pacific Northwest.** (Cosponsored with AEG.) Scott Burns, (503) 725-3389, burnss@pdx.edu.
11. **Coastal Paleodune Landscapes.** (Cosponsored with AEG.) Curt Peterson, (503) 725-3375, petersonc@pdx.edu.
12. **Active Tectonics of Cascadia: Geodesy.** Herb Dragert, (250) 363-6447, dragert@pgc.nrcan.gc.ca.
13. **Active Tectonics of Cascadia: Continental Shelf and Slope and Accretionary Prism.** Chris Goldfinger, (541) 737-5214, gold@oce.orst.edu.
14. **Active Tectonics of Cascadia: Deformation Across the Plate Margin Onshore.** Ray Weldon, ray@newberry.uoregon.edu.
15. **Submarine Volcanism and Hydrothermal Vents in the Northeast Pacific.** Bill Chadwick, (541) 867-0179, chadwick@pmel.noaa.gov.
16. **Terrestrial Paleontology of the Pacific Northwest.** (Cosponsored with PS.) Jeff Myers, (503) 838-8365, myersj@wou.edu.
17. **Decadal Symposium on the Geology of Washington: In Honor of Rowland W. Tabor.** Eric Cheney, (206) 543-1163, vaalbara@u.washington.edu.
18. **Pacific Northwest Geology East of the Cascades: Symposium in Honor of George Walker.** Martin Streck, (503) 725-3379, streckm@pdx.edu.
19. **Applications of Geographic Information Systems in Geology and Geophysics.** Dawn Wright, (541) 737-1229, dawn@dusk.geo.orst.edu.

20. **Jurassic Tectonics and Magmatism in Outboard Terranes from Northern California to Washington.** Greg Harper, (518) 442-4476, gdh@csc.albany.edu.
21. **Groundwater-Surface Water Interactions.** Roy Haggerty, (541) 737-1210, haggertr@geo.orst.edu.
22. **Environmental Cleanup: Use of Hydrogeological and Biological Principles and GIS.** (*Cosponsored with AEG.*) John Kuiper, (503) 639-3400, john.kuiper@agraus.com.
23. **Natural Hazard Monitoring and Warning Systems.** Mark Darienzo, (503) 378-2911, ext. 237, mdarien@oem.state.or.us.
24. **Invertebrate Paleontology: Symposium in Honor of Ellen J. Moore.** (*Cosponsored with PS.*) Elizabeth Nesbitt, (206) 543-5949, lnesbitt@uwashington.edu.
25. **Quaternary Paleoclimates Inferred from Eolian Deposits in the Western United States.** Mark Sweeney, (509) 335-5987, sweeney@wsunix.wsu.edu.
26. **Surface Effects of the Nisqually, Washington, Earthquake of February 28, 2001.** Tim Walsh, (360) 902-1432, tim.walsh@wadnr.gov.
27. **Catastrophic Glacial Outburst Floods in the Pacific Northwest.** Pat Spencer, (509) 527-5222, spencerp@whitman.edu.
28. **Innovations in Earth Science Education: Dorothy LaLonde Stout Memorial Symposium.** (*Cosponsored with NAGT.*) Peter Wampler, (541) 758-8418, wamplerp@geo.orst.edu.
29. **Undergraduate Research Poster Session.** (*Sponsored by Council on Undergraduate Research.*) Karen Grove, (415) 338-2617, kgrove@sfsu.edu.
30. **Volcanic Arcs and Ores: Links of Magmatic Gases with Porphyry Copper and Epithermal Gold Deposits.** John Dilles, (541) 737-1245, dillesj@geo.orst.edu.
31. **The Joseph Vance Symposium: Contributions to Tectonics and Fission-Track Dating in the Pacific Northwest.** Mark Brandon, (203) 432-3135, mark.brandon@yale.edu.

FIELD TRIPS

The field trip chair is George Moore,

(541) 737-1244, mooreg@geo.orst.edu. Field trips will precede, be concurrent with, and follow the meeting, with a comprehensive field trip guide published by the Oregon Department of Geology and Mineral Industries. Trips start and end in Corvallis, except as noted.

1. **Tectonics and Magmatism at a Propagating Rift in the Oregon High Cascades.** Ed Taylor, (541) 737-1232, taylore@geo.orst.edu.
2. **Paleodune Age, Origin, and Archaeology, Central Oregon Coast.** Curt Peterson, (503) 725-3375, petersonc@pdx.edu.
3. **Sweet Home, Oregon, Oligocene Flora Field Study for K-12 Teachers.** (*Cosponsored with NAGT.*) Larry Enochs, (541) 737-1305, enochsl@orst.edu.
4. **Upper Willamette Watershed Integrated Environmental Field Study for K-12 Teachers.** (*Cosponsored with NAGT.*) Steve Taylor, (503) 838-8398, taylors@wou.edu.
5. **Hydrogeology of the Upper Deschutes Basin, Central Oregon: A Young Cascade Arc-Adjacent Basin.** Dave Sherrod, (808) 967-8831, dsherrod@usgs.gov.
6. **Landslides at Kelso, Washington, and Portland, Oregon.** (*Cosponsored with AEG.*) Scott Burns, (503) 725-3389, burnss@pdx.edu.
7. **Geomorphology and Hydrology Research in the H.J. Andrews Forest Watershed.** Julia Jones, (541) 737-1224, geojulia@home.com.
8. **Miocene Molluscan Fossils and Stratigraphy, Newport, Oregon.** (*Cosponsored with PS.*) Ellen Moore, (541) 758-0314, ellen.moore@cmug.com.
9. **Engineering Geology of Selected Dams in the Eastern Cascades, Oregon.** (*Cosponsored with AEG.*) David Scofield, (503) 635-4253, scofield@teleport.com.
10. **Elastic and Permanent Strain Recorded by River Terraces of the Clearwater Basin and Kalaloch Coast, Olympic Mountains, Washington.** Mark Brandon, (203) 432-3135, mark.brandon@yale.edu.
11. **Josephine and Coast Range Ophiolites, Oregon and California.** Greg Harper, (518) 442-4476, gdh@csc.albany.edu.

12. **Bimodal Volcanism and Tectonism of the High Lava Plains, Oregon.** Martin Streck, (503) 725-3379, streckm@pdx.edu.
13. **Geomorphology and Quaternary Geology of the Lower Deschutes River, Oregon.** (Raft trip.) Jim O'Connor, (503) 251-3222, oconnor@usgs.gov.
14. **Paleobotany and Stratigraphy of the Eocene-Oligocene Sequence Near Eugene.** (During meeting.) Jeff Myers, (503) 838-8365, myersj@wou.edu.
15. **Afternoon Trip to Winery Near Corvallis.** (During meeting.) George Moore, (541) 737-1244, mooreg@geo.orst.edu.

SHORT COURSES

The short courses chair is Bob Lillie, (541) 737-1242, lillier@geo.orst.edu.

1. **Parks and Plates: How Earth's Dynamic Forces Shape Our National Parks.** Bob Lillie, (541) 737-1242, lillier@geo.orst.edu.
2. **GIS Applications in the Earth Sciences.** Michael Wing, (541) 737-4009, michael.wing@orst.edu.
3. **Integrating Geology and Geophysics on PC Workstations: 3-D Seismic Imaging.** Alejandro Garcia, (713) 464-6188, agarcia@seismicmicro.com.

ROY SHLEMON MENTORING PROGRAM IN APPLIED GEOLOGY

Workshop for graduate and advanced undergraduate students about professional opportunities and challenges in the real world. Free lunch provided. Registration required. Contact GSA's Karlon Blythe, kblythe@geosociety.org. Local coordinator: Scott Burns, (503) 725-3389, burnss@pdx.edu. *Meeting registration is not required to attend only this workshop.*

STUDENT AWARDS AND SUPPORT

The GSA Cordilleran Section has funds available for partial support of Student Members or Associates who are presenting papers or posters. Apply to Section secretary Joan Fryxell, (909) 880-5311, jfryxell@csusb.edu. Applications should certify that the student is a GSA Student Member or Student Associate of the Cordilleran Section as of January 31, 2002, and *must be received by February 28, 2002.*

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The GSA Cordilleran Section will present cash awards for best and honorable-mention undergraduate and graduate papers, both oral and poster. The student must be both first author and presenter, must be a GSA Student Member or Student Associate, and must be registered for the meeting.

EXHIBITS

Exhibits will be located in the lobby of the LaSells Stewart Center close to the registration desk, all poster sessions, and one of the oral sessions, and close to the pass-through to the adjacent CH2M Hill Alumni Center. The exhibits chair is Cy Field, (541) 737-1219, fieldc@geo.orst.edu.

REGISTRATION

Preregistration deadline: April 5, 2002

Cancellation deadline: April 12, 2002

GSA Headquarters will handle registration. For electronic registration, go to the GSA Web site, www.geosociety.org, for forms beginning in January 2002. Onsite registration will be available at the LaSells Stewart Center. Registration chair is Jeff Templeton, (503) 838-8858, templej@wou.edu.

ACCOMMODATIONS

Blocks of rooms have been arranged at several Corvallis motels, with a free shuttle to and from the conference site. Housing registration for these rooms can be made through the 2002 Cordilleran GSA Web site, <http://terra.geo.orst.edu/users/gsa2002>. Identify yourself as a GSA meeting participant and use the password GSA. Housing reservation deadline for GSA rates is April 12, 2002. The housing coordinator is Roger Nielsen, (541) 737-3023, nielsenr@geo.orst.edu.

ADDITIONAL DETAILS

Information about social events (winery visit, trip to Oregon coast) and business meetings will be published in the February 2002 issue of *GSA Today*. See also the convention Web site at <http://terra.geo.orst.edu/users/gsa2002>, or see www.geosociety.org.

GSA is committed to making all events at the 2002 meeting accessible to all people interested in attending. You can indicate special requirements (wheelchair accessibility, etc.) on the registration form.

2002 GSA Section Meetings

CALL FOR PAPERS

NORTHEASTERN SECTION

March 25–27, 2002

Sheraton Springfield, Springfield, Mass.

Information: Sheila Seaman, (413) 545-2822, sjs@geo.umass.edu.

Abstract deadline: December 18, 2001

SOUTHEASTERN AND NORTH-CENTRAL SECTIONS

April 3–5, 2002

Hyatt Regency Hotel and Lexington

Civic Center, Lexington, Ky.

Information: John D. Kiefer, kiefer@kgs.mm.uky.edu;

James C. Cobb, cobb@kgs.mm.uky.edu,
(859) 257-5500.

Abstract deadline: December 19, 2001

SOUTH-CENTRAL SECTION

April 11–12, 2002

Sul Ross State University Center, Alpine, Texas

Information: Kevin Urbanczyk, (915) 837-8110,
kevinu@sulross.edu.

Abstract deadline: January 5, 2002

ROCKY MOUNTAIN SECTION

May 7–9, 2002

Southern Utah University Campus, Cedar City, Utah

Information: Robert Eves, (435) 586-1934,
eves@suu.edu.

Abstract deadline: February 4, 2002

CORDILLERAN SECTION

May 13–15, 2002

Oregon State University, Corvallis, Ore.

Information: Robert S. Yeats, (541) 737-1226,
yeatsr@geo.orst.edu.

Abstract deadline: February 7, 2002

Students: Mark Your Calendars for the Shlemon Workshops at Spring 2002 Section Meetings



you're interested in pursuing a career in applied geoscience, you'll find these workshops valuable, informative, fun, and filling (lunch is included). The workshops extend the mentoring reach of individual professionals from applied geology to advanced undergraduate and graduate students attending GSA Section Meetings. Mentors interact with student members, discussing the opportunities and realities of employment outside academia.

Mark your calendar with the dates for the 2002 Section Meeting closest to you (see Call for Papers calendar, this page), and watch for announcements in *GSA Today* pertaining to each Section's Roy J. Shlemon Mentor Program in Applied Geology.

COMMENTARY

Anthropic Rocks: Made, Modified, and Moved by Humans

James R. Underwood Jr., Professor Emeritus of Geology, Kansas State University

Each year, humans produce immense quantities of rock, e.g., brick, tile, concrete, and glass; they modify large volumes of rock by quarrying, shaping, crushing, polishing, and inscribing; and they move massive amounts of rock across continents and oceans and up and down mountains. I propose that those rocks that show the distinctive influence of humans be designated anthropic rocks and be considered a fourth basic class.

In western Iran, ancient inscriptions on a steep limestone cliff face depict in bas-relief and in trilingual texts the homage paid to Darius the Great by his defeated adversaries 2300 years ago. On the modern beaches of Libya, the coarse-sediment fraction comprises wave-rounded pieces of marble and mosaic tile from eroded ancient Roman seaside villas and cities together with pieces of modern cement-block building material derived from Libyan structures of today. In Alexandria, Virginia, twenty-first century vehicles bump along streets paved with ballast rocks brought to American shores by the sailing ships of yesterday. From place to place along the rail lines from central Texas to Texas Gulf Coast ports, massive blocks of distinctive pink granite lie where they fell off railway flatcars as the rocks were being transported to the construction sites of jetties and breakwaters. In the vast plains of central Iraq, traversed by the Tigris and Euphrates rivers, innumerable hills (tells) mark the sites of ancient villages built of sun-

dried brick and later buried by the persistent, ever-blowing sand and silt of the desert. Common in cities and towns of today is the sight of dump trucks, loaded with debris from demolished structures, en route to a recycling plant or to a landfill. These and countless other occurrences testify to the abundance, variety, and widespread presence of anthropic rocks: rocks made by humans (anthropogenic rocks); rocks modified by humans (anthropotechnic rocks); and rocks moved by humans (anthropokinetic rocks).

Anthropogenic rocks, those made by humans, have been referred to as artificial rocks, as pseudo-rocks, and as synthetic rocks, suggesting that anthropogenic rocks somehow are unnatural. But are not the building materials and buildings made by humans in the course of their daily, routine activities analogous to, for example, great coral reef masses built by a complex community of invertebrates? Anthropogenic rocks, however, are unique in several ways: (1) they result from processes that can be observed and are well understood; (2) materials of which they are composed can be derived locally or can be brought from distant sources; (3) their volume and rate of production are great; and (4) once made, anthropic rocks can be used locally or moved great distances—even to higher elevations—relatively rapidly.

As humans continue at an increasing pace the inexorable cycle of construction, demolition, and construction, more and more materials made or modified or transported by humans will become involved in surficial geological processes of weathering, transport, and deposition. I suggest that the materials that bear the unique imprint of human activity constitute an ever-growing and distinct class of rocks, anthropic rocks, and that these rocks are as “natural” as traditional igneous, sedimentary, and metamorphic rocks.

As world population increases, more and more people will live in cities, where cycles of building, demolishing, and rebuilding are concentrated. There, more and more rocks of all kinds,

including anthropic rocks, will be involved, and a terminology to use in recording their presence and in describing them will be useful.

Recognizing anthropic rocks as a separate class results in several advantages.

- It brings an enhanced awareness and understanding of such materials.
- It enhances communication, both oral and written, especially in the preparation of geologic maps and reports.
- It increases awareness of the role of humans in modifying the surface of Earth and its materials.
- It is a logical step in the same sense as was recognition of metamorphic rocks in the nineteenth century as rocks that originated in ways and in environments other than those of the rock classes then recognized.

A basic goal of geologic field studies and associated laboratory analysis is the determination of the geologic history of the area and of the materials under study. Today, part of that history may be represented in the study area by anthropic rocks, and their recognition and interpretation may provide insight to a significant part of that geologic history.

Finally, classifications and special terms are useful only if they enhance understanding and communication. In the present discussion, two basic but separate issues arise: (1) the concept of anthropic rocks as a basic and distinct class of rocks, i.e., those rocks that reflect, in whatever way, the influence of humans; and (2) the terms suggested to designate them. *The concept is much more important than the terms.*

Further Reading

Underwood, J.R. Jr., 2001, Anthropic rocks as a fourth class: Environmental & Engineering Geoscience, v. 7, no. 1, p. 104–110, and references therein.

Comments on this issue may be sent to jhammann@geosociety.org or GSA Today, P.O. Box 9140, Boulder, CO 80301-9140.



GSA Foundation Update

Donna L. Russell, Director of Operations

As we approach the end of 2001, it's a good time to turn our attention to the benefits that planned giving can bring to GSA members and the Foundation. Janet Doolin, a consultant on planned giving, has written a good article on charitable gift annuities that I share with you here.

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Janet Doolin, J.D., is a consultant to nonprofits and foundations in Colorado and nationally and consults with the GSA Foundation. Janet serves on the faculty at Regis University, Denver, Colorado, in the Master for NonProfit Management Program.

Focus on a Foundation Fund: Shirley J. Dreiss Memorial Fund

In 1994, following the sudden death of Shirley J. Dreiss, the Hydrogeology Division approved the establishment of the Dreiss Memorial Fund to support the Division's Distinguished Lecturer. Income from the fund is used to pay a portion of the expenses of the Division's Birdsall lecture series. With the additional support from the Dreiss Fund, the lecturer series was renamed the Birdsall-Dreiss Distinguished Lecture Series.

Following her Birdsall Lecture tour in 1992, Shirley Dreiss commented, "As the Birdsall Lecturer...I was struck by the variety and vitality of the programs that I visited. Much of the variety stems from the fact that most hydrogeology groups are relatively small, so programs very much reflect the interests and expertise of individuals. Undoubtedly, a good bit of the variety also results from the fact that hydrogeology is still a young field with diverse, wide-open research areas."

The fund has grown since its establishment, with net assets at the end of June 2001 of \$26,946. The 2001 Distinguished Lecturer is Steven E. Ingebritsen, and Graham Fogg has been appointed the 2002 Distinguished Lecturer.



Most memorable early geologic experience

A near head-on collision along a narrow mountain road in Nevada with an elderly and very angry mining engineer from Arizona, whose name was Prescott.

—David A. Phoenix

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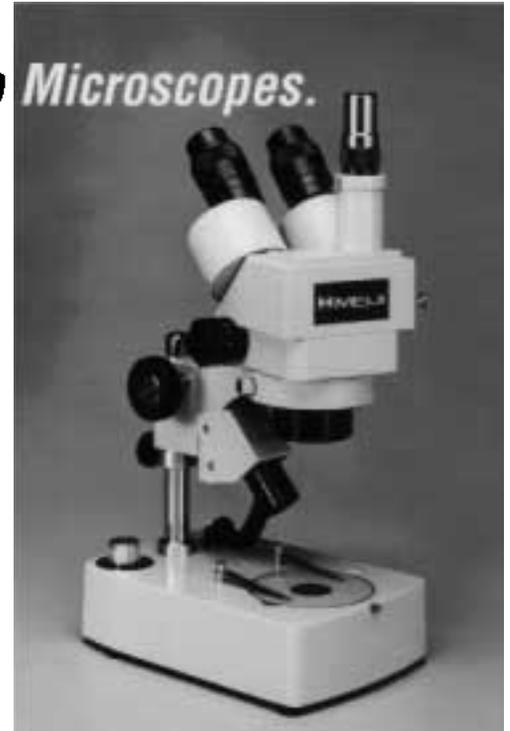
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Ed. note: This is the first of three articles about emergency management and its relevance to earth scientists.

As the public interest increases in several aspects of humans and their relationship with our environment, emergency management (EM) has moved toward the forefront. Natural hazards and the periodic disasters they cause are popular in the media and easily attract public attention: they're photogenic, command immediate action, and can be encapsulated to fit the headline-news format. The potential impact of climate change and the associated political implications are common topics in a typical news cycle. The events of September 11, 2001, highlighted another unfortunate reality in EM: Terrorism is a real concern that must be incorporated into emergency management programs, but it cannot be allowed to push other EM concerns off the table.

This, along with the phenomenon of "name" actors playing emergency management professionals in recent major motion pictures, may have heralded EM's "arrival." A significant change is under way in EM—one that offers collaboration and employment opportunities that traditionally have been scarce at best and not necessarily desirable where present.

Emergency management is a descendant of numerous attempts to address local and regional hazard vulnerability, and in a broader sense, of the nuclear age and the Cold War. The Civil Defense Act of 1950 was the United States' first large-scale attempt at civilian preparedness. For most of the ensuing 50 years, EM drew its practitioners from the ranks of civil defense and the military. Passage of national legislation, along with state laws requiring formal emergency plans, has helped EM become a specialty. Federal milestones include the Disaster Relief Act (1950) and its amendments (1969, 1974), the Stafford Disaster Relief and Emergency Assistance Act (PL 93-288, as amended), creation of the Federal Emergency Management Agency (FEMA) in 1979, and development of the Federal Response Plan. Most large and many intermediate-size cities have full-time emergency managers and supporting staff. As the needs for the

profession have grown, so have the qualifications and credentials. A range of subject-specific training programs and higher-education degree programs have been developed as well (the topic of Part II of this series). Businesses and institutions employ business contingency and/or continuity planners to maintain delivery of services and financial viability during minor interruptions and major disasters.

In order to prevent or lessen the impacts of natural and human-made disasters, an effective emergency manager must be able to coordinate diverse groups,

Emergency Management: What It Is and WHY WE Should Care

Jeffrey N. Rubin, Tualatin Valley Fire & Rescue, Oregon City, Ore.

communicate across a broad spectrum of interests, and work closely with the various agencies that will implement important portions of emergency plans. It is for this reason that many emergency managers' job titles bear the eponym "coordinator." Much of emergency management is an ongoing process, with four major components forming an integrated cycle.

Mitigation, the most cost-effective component of emergency management, reduces or minimizes exposure to hazards, lessening their overall impact. Although most effective before something happens, mitigation is often initiated during recovery from a disaster (e.g., structures are repaired, rebuilt to higher safety and security standards, or relocated to safer ground). Mitigation efforts include:

- ❖ Building codes and retrofitting
- ❖ Non-structural improvements (i.e., protecting building contents as opposed to the structures themselves)
- ❖ Land-use controls
- ❖ Flood-plain buyouts
- ❖ Levees and stream channel modifications
- ❖ Slope stabilization
- ❖ Improving chemical storage facilities or reducing hazardous inventory
- ❖ Public education and other prevention programs

The FEMA-funded Project Impact was created to generate public-private partnerships at the local level to "build disaster-resistant communities." Although the program's title has been discontinued, 2001 grants are still being administered and it's likely that FEMA will retain some type of mitigation partnership program.

Preparedness picks up where mitigation leaves off: For hazards that cannot be mitigated, preparedness should minimize disaster impact and generate effective response. Preparedness includes:

- ❖ Disaster and contingency plans
- ❖ Government and business continuity of operations plans
- ❖ Warning and emergency communications systems
- ❖ Evacuation plans with predesignated routes
- ❖ Equipment upgrades
- ❖ Mutual aid agreements
- ❖ Training and exercises
- ❖ Public information and education

Response is the mostly reactive phase of EM, addressing emergency needs once an incident has occurred. Response includes:

- ❖ Warning system activation (sirens, TV and radio broadcasts)
- ❖ Emergency medical, fire, police
- ❖ Activation of emergency operations centers
- ❖ Mutual aid (local, state, federal, including National Guard and specialized teams)

❖ Disaster declarations and implementation of emergency statutes

❖ Chemical release containment

Recovery starts while response is still going on. Along with shelters and financial assistance to individuals (low-interest loans, grants, insurance settlements), components include:

❖ Debris removal, including demolition of unsafe structures

❖ Longer-term temporary housing

❖ Continuity of government, business

❖ Economic aid to offset business losses

❖ New land-use controls (e.g., floodplain easements, reforestation)

❖ Re-establishment of essential services

❖ Health and safety education

Further Reading

Drabek, T.E., and Hoetmer, G.J., editors, 1991, *Emergency management: principles and practice for local government*: Washington, D.C., International City/County Management Association, 368 p.

Mileti, D.S., 1999, *Disasters by design*: Washington, D.C., National Academy Press, 351 p.

Waugh, W.L. Jr., 2000, *Living with hazards, dealing with disasters*: An

introduction to emergency management: Armonk, New York, M.E. Sharpe, 229 p.

Selected Web Sites

❖ Federal Emergency Management Agency, www.fema.gov (see also links to Federal Response Plan and Project Impact)

❖ National Emergency Management Association, www.nemaweb.org

❖ International Association of Emergency Management, www.iaem.org

❖ Institute for Business and Home Safety, www.ibhs.org/ibhs2

❖ Disaster Recovery Institute International, www.drii.org

❖ Association of Contingency Planners, www.acp-international.com

❖ University of Colorado Natural Hazards Center, www.Colorado.edu/hazards

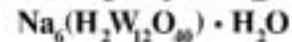
❖ U.S. Geological Survey Earthquake Hazard Program, <http://earthquake.usgs.gov>

❖ Western States Seismic Policy Council, www.wsspc.org

❖ Northwest Fire Watch, www.govlink.org/nwfw

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Opportunities to serve as a Congressional Science Fellow are rare, and the experience is unique. If you are interested in working with national leaders to help shape science and technology policy on Capitol Hill, this position may be a good fit for you.

The Congressional Science Fellow will be selected from top competitors early in 2002. Candidates must be **GSA Members** who possess either a Ph.D. in the earth sciences or a related field, or a master's degree in the earth sciences (or a related field) plus at least five years of professional experience.

If you have this professional background, are experienced in applying scientific knowledge to societal challenges, and want to help shape the future of the geoscience profession, put your expertise, experience, and passion for science to work where it counts! The fellowship is open to U.S. citizens or permanent residents of the U.S. **The deadline to apply is February 1, 2002.**

For application information, check the Web site at www.geosociety.org/science/csff/index.htm, or contact Karlon Blythe, Program Officer, GSA Headquarters, (303) 447-2020, kbllythe@geosociety.org.

Apply for GSA's GSA-U.S. Geological Survey Congressional Science Fellowship

2002-2003



Call for Applications

GSA GRANTS SUPPORT STUDENT RESEARCH

Leah J. Carter, Program Officer, Grants, Awards, and Medals

The general research grants program provides partial support of master's and doctoral thesis research in earth science for graduate students at universities in the United States, Canada, Mexico, and Central America. GSA strongly encourages women, minorities, and persons with disabilities to participate fully in this grants program. **APPLICANTS MUST BE MEMBERS OF GSA TO APPLY.** Funding for this program is provided by a number of sources, including GSA's Penrose and Pardee endowments, the National Science Foundation, industry, individual GSA members through the GSA Foundation's GEOSTAR and Research Grant funds, and numerous dedicated research funds that have been endowed at the GSA Foundation by members and families.

Applications must be on current GSA forms available in geology departments in the United States and Canada, or from the Program Officer, Grants, Awards and Medals, GSA, P.O. Box 9140, Boulder, CO 80301-9140, lcarter@geosociety.org. Application forms, appraisals, and information are available on GSA's Web page, www.geosociety.org. Evaluations from two faculty members are required on GSA appraisal forms. Applications and appraisals may be downloaded from the Web but will not be accepted by e-mail or facsimile. The deadline is February 1 each year for grants awarded in April. In 2001, 583 proposals were received and 224 were funded, with more than \$400,000 awarded.

SPECIALIZED GRANTS

The Committee on Research Grants selects recipients of special named awards from applicants to the general research grants program; the same application forms are used, and they must also be postmarked by February 1. It is not necessary for applicants to indicate that they wish to be considered for a specialized grant. The committee considers all

qualified applicants when selecting recipients for special awards.

The **Gretchen L. Blechschmidt Award** supports research by women interested in achieving a Ph.D. in the geological sciences and a career in academic research, especially in the fields of biostratigraphy and/or paleoceanography, and who have an interest in sequence stratigraphy analysis, particularly in conjunction with research into deep-sea sedimentology.

The **John T. Dillon Alaska Research Award** supports research that addresses earth science problems particular to Alaska, especially field-based studies dealing with structural and tectonic development, and those that include some aspect of geochronology (either paleontologic or radiometric) to provide new age control for significant rock units in Alaska.

The **Robert K. Fahnstrock Memorial Award** is made annually to the applicant with the best application in the field of sediment transport or related aspects of fluvial geomorphology.

The **Lipman Research Award** promotes and supports graduate research in volcanology and petrology.

The **Bruce L. "Biff" Reed Award** is for graduate students pursuing studies in the tectonic and magmatic evolution of Alaska and also can fund other geologic research.

The **Alexander Sisson Award** supports research for students pursuing studies in Alaska and the Caribbean.

The **Harold T. Stearns Fellowship Award** is awarded annually in support of research on one or more aspects of the geology of Pacific islands and of the Circum-Pacific region.

The **John Montagne Fund** is awarded annually in support of Quaternary and geomorphology research.

DIVISION GRANTS

Nine GSA divisions award grants for outstanding student research within the respective division's field of interest. The Committee on Research Grants will select candidates from the general research grant applicants for awards by the Geophysics (**Allan V. Cox Award**), Hydrogeology, Sedimentary Geology, and Structural Geology and Tectonics Divisions. For the following awards, contact the respective division secretary for more information, guidelines, and/or forms.

The Archaeological Geology Division awards the **Claude C. Albritton, Jr., Scholarships** for graduate students in the earth sciences and archaeology.

The Coal Geology Division awards the **A. L. Medlin Scholarship Award** and a **Field Research Award** to students who submit the best proposals of research projects in the field of coal geology.

The Planetary Geology Division offers two **S. E. Dwornik Student Paper Awards** in the field of planetary geology annually.

The Quaternary Geology and Geomorphology Division awards the **J. Hoover Mackin** and **Arthur D. Howard Research Grants** to support graduate student research on Quaternary geology or geomorphology. The deadline for applications is February 1 for grants awarded in April.

The Engineering Geology Division offers the **Roy J. Shlemon Scholarship Awards**.

SECTION GRANTS FOR UNDER-GRADUATE AND GRADUATE STUDENTS

Recipients of graduate research grants from the South-Central Section are selected from applicants to the GSA general research grants program who are

recommended by the Committee on Research Grants to the management board of the section for final selection. Eligibility is restricted to graduate students attending a college or university within the geographic area of the section.

The South-Central Section also awards grants to undergraduate students; application forms are available from the section secretary. The deadline for spring applications is **March 15, 2002**, and for fall 2002, the deadline is **October 15, 2002**.

The North-Central Section awards grants to undergraduate students within the geographic boundary of the section. For further information and deadlines, contact the section secretary.

The Southeastern Section awards grants for both undergraduate and graduate student members of GSA who are enrolled in institutions within the geographical boundaries of the section. Application forms and deadline information can be obtained from the section secretary.

The Northeastern Section offers research grants for undergraduate students who are enrolled at institutions within the section's region and who are GSA Student Associates. Contact the section secretary for application forms. Applications must be postmarked by **February 12, 2002**, for grants awarded in April.

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GSA Student Associate Member Travel Grants

The GSA Foundation has awarded \$4,500 in grants to each of the six GSA Sections. This money, when combined with equal funds from the Sections, is used to assist GSA undergraduate Student Associates and GSA Student Members in traveling to GSA meetings. For information and deadlines, contact your section's secretary:

Cordilleran	Joan E. Fryxell (909) 880-5311 jfryxell@csusb.edu
Rocky Mountain	Kenneth E. Kolm (303) 273-3932 kkolm@mines.edu

North-Central	Robert F. Diffendal Jr. (402) 472-7546 rfd@unl.edu
Northeastern	Stephen G. Pollock (207) 780-5350 pollock@usm.maine.edu
South-Central	Elizabeth Y. Anthony (915) 747-5483 eanthony@geo.utep.edu
Southeastern	Donald W. Neal (252) 328-4392 neald@mail.ecu.edu

BOOK REVIEW

Confronting Catastrophe: New Perspectives on Natural Disasters

David Alexander, Oxford University Press, 2000, 282 p., \$25.00 (softcover).

The nature of geology requires geologists to be aware of the physical world around them. The author expands on this concept in a useful introduction to an important topic, weaving a broad array of disciplines into a discussion of natural hazards and how various segments of the human race respond to them. The book is a call for a new, holistic method of examining disasters, employing a "non-disciplinary" (versus interdisciplinary) approach that requires better data but perhaps less reliance on inductive modeling. This leads to discussion of a series of issues: catastrophism versus uniformitarianism, the positive and negative roles of technology in disasters, the differences among disparate nations and cultures in disaster perception, preparedness, and response, and the disproportionate impact of disasters on the poor. The reference list, a manifestation of the book's breadth and theme, almost justifies the purchase price by itself. The reader is provided with more than 700 (my estimate) relevant and current references from geology, geography, sociology, anthropology, economics, history, emergency management, fire and emergency medical services, and several other sources.

Readers will have little doubt as to the author's opinions on the subject matter as well as other broad political, social, and economic issues. This is not necessarily a detriment: The author, a geologist and emergency management consultant, has extensive experience and considerable knowledge on the topics at hand and makes it pretty clear when he is venturing into commentary. The several digressions—most commonly in the form of parenthetical one-liners—into more remotely related policy and politics, however, can become tiresome and even distracting, regardless of whether the reader agrees with the author.

All in all, the author has a rich vocabulary and a fluid variety of expression. There are numerous foreign phrases but only a few are undefined; typographical errors are few. Presbyopic readers still in denial may wish the text had been set in slightly larger print at the expense of a few more pages.

As natural hazards yield progressively costlier disasters, and earth scientists are expected to help develop solutions to enormous environmental problems, this book provides a much-needed approach as well as an excellent reference base. Those interested in delving into the world of natural disaster and those already involved in it have an addition to their reading list; the price makes it affordable for most budgets.

*Jeff Rubin
Tualatin Valley Fire & Rescue
Oregon City, Ore.*

The Biggs Award

Congratulations to Eric B. Grosfils, associate professor in the Geology Department of Pomona College, who has been named the 2001 Biggs Award recipient.

The Biggs Award encourages and rewards excellence in teaching among college-level professors of earth science who are in the early stages of their careers. The award is made possible through support from the Donald and Carolyn Biggs Fund, the GSA Geoscience Education Division, and GSA's Science, Education, and Outreach Programs.

Earth science instructors and faculty members from any academic institution engaged in undergraduate education who have been teaching full time for 10 years or fewer are eligible. (Part-time teaching is not counted in the 10-years-or-fewer requirement.)

For more information, contact Leah Carter at lcarter@geosociety.org, (303) 357-1037.

for Excellence in Earth Science Teaching

GSA Offers Awards in Geomorphology and Micropaleontology

Two of GSA's most prestigious awards supporting research are made possible by the generosity of the late W. Storrs Cole. Qualified GSA Members and Fellows are urged to apply.

The Gladys W. Cole Memorial Research Award provides support for the investigation of the geomorphology of semiarid and arid terrains in the United States and Mexico. GSA Members and Fellows between the ages of 30 and 65 who have published one or more significant papers on geomorphology are eligible for the award. While the funds may not be used for work that is already finished, recipients of previous awards may reapply if they need additional support to complete their work. The 2002 award is for \$9,500.

The W. Storrs Cole Memorial Research Award supports research in invertebrate micropaleontology. This award carries a stipend of \$8,700 in 2002 and will go to a GSA Member or Fellow between the ages of 30 and 65 who has published one or more significant papers on micropaleontology.

For application forms or for more information, contact Leah Carter, Grants, Awards, and Medals, GSA, P.O. Box 9140, Boulder, CO 80301-9140, lcarter@geosociety.org. Application forms are also available at www.geosociety.org.

Applications must be mailed and must be postmarked on or before **February 1, 2002**. Applications sent by facsimile or e-mail will not be accepted. Results will be reported to each applicant in April 2002.

ANNOUNCEMENTS

MEETINGS CALENDAR

2002

- March 6-9 Karst Frontiers: Florida and Related Environments, Gainesville, Florida. Information: www.karstwaters.org or John Mylroie, (662) 325-8774, fax 662-325-9423, mylroie@geosci.msstate.edu. (*Abstract deadline: December 1, 2001.*)
- May 26-29 Geological Association of Canada and Mineralogical Association of Canada Annual Meeting: Saskatoon 2002—The Making of a Continent's Interior, University of Saskatchewan, Saskatoon, Saskatchewan. Information: fax 306-966-8593, mel.stauffer@usask.ca, www.usask.ca/geology.
- May 31-June 3 8th ESF-IMPACT Workshop on Impact tectonism, Mora, Sweden. Information: Herbert Henkel, Dept. of Land and Water Technology, Royal Institute of Technology, SE-100 44 Stockholm, Sweden, +46-8-790-86-04, fax +46-8-790-73-43, herbert@geomatics.kth.se; Ilka von Dalwigk, Dept. of Geology and Geochemistry, Stockholm University, S-106 91 Stockholm, Sweden, +46-8-16-47-57, fax +46-8-674-78-97, ilka@geo.su.se; www.geo.su.se/geologi/impact/index.htm. (*Deadline to indicate interest: November 26, 2001; abstracts deadline: February 25, 2002.*)
- June 3-7 Zeolite '02: 6th International Conference on the Occurrence, Properties, and Utilization of Natural Zeolites, Thessaloniki, Greece. Information: <http://icnz/lanl.gov/zeo2002.html>.
- June 18-20 1st International Symposium on Solid-Liquid Separation, Falmouth, Cornwall, UK. Information: www.min-eng.com.sl02.html, bwills@min-eng.com. (*Abstracts deadline: December 31, 2001.*)
- June 19-22 Council on Undergraduate Research National Conference: Undergraduate Research for All, Connecticut College, New London, Connecticut. Information and online registration: www.cur.org/conferences.html.

2003

- October 5-10 The XII International Mineral Processing Congress, Cape Town, South Africa. Information: www.impc2003.org.za.

AWG Awards Chrysalis Scholarships

The Association for Women Geoscientists (AWG) gives financial aid to exemplary women graduate students in the geosciences who have experienced an interruption at some time in their formal education and are in the final stages of writing their theses. The two highest Chrysalis Awards for 2001 went to Gwyneth Jones, University of Washington, and Alexandra Arnott, Dalhousie University, Nova Scotia. Additional scholarships were awarded to Christy L. Barry, Northeastern Illinois University, Claudia Borchert, University of New Mexico, and GSA member **Josette Stanley**, University of Northern Colorado.

For information about the 2002 awards, contact: Chrysalis Scholarships, Association for Women Geoscientists, P.O. Box 280, Broomfield, CO 80038-0280, www.awg.org; or e-mail [Cathy Skokan, cskokan@mines.edu](mailto:Cathy_Skokan@mines.edu).



Farouk El-Baz

About People

GSA Fellow Farouk El-Baz, research professor and director of the Center for Remote Sensing at Boston University, received the 2001 American Muslim Achievement Award. The award, which recognizes members of the Muslim community who have made outstanding contributions to their fields or the community, was initiated by the Islamic Center of Southern California in 1970.

El-Baz is a renowned geologist whose research resulted in outstanding contributions in a number of fields. He participated in the training of astronauts and in the selection of landing sites for the Apollo missions to the Moon. His research sparked the use of satellite images to study the origins and evolution of desert landscapes and the application of remote sensing technologies to the exploration for groundwater resources in arid lands. His work also led to the use of advanced technology in archaeological investigation, including the preservation of historic sites.

Through the generosity of El-Baz, the GSA Quaternary Geology and Geomorphology Division established the Farouk El-Baz Award for Desert Research. The award provides an annual cash award for outstanding work in this field by earth scientists.

The multifaceted, nonprofit Islamic Center of Southern California disseminates proper information about Islam and Muslims to U.S. citizens. Its American Muslim Achievement Award serves to encourage young people in the pursuit of excellence by highlighting the accomplishments of role models.

Position Announcements

The following employers were among those that participated in GSA's Employment Interview Service at the GSA Annual Meeting in Boston.

GEOSCIENCE EDUCATION BOWLING GREEN STATE UNIVERSITY

The Department of Geology invites applications for a tenure-track position at the assistant professor level beginning August 2002. The position requires a faculty member with a primary research interest in geoscience education. We are seeking a creative and enthusiastic individual to develop and teach innovative undergraduate geoscience courses. Applicants whose interests complement the department's research strengths are preferred. Opportunities to teach upper-level courses in the applicant's geological specialty, as well as a graduate-level course in pedagogy for geology graduate students, will be available.

The successful applicant will be expected to establish a productive research program at BGSU in some area of geoscience education such as curriculum design, assessment, integration of technology, distance learning, K-12 teacher training reform, service learning, or community outreach. Research collaborations with the department's faculty, other science faculty, and faculty in BGSU's College of Education and Human Development are strongly encouraged. Evidence of success in research includes externally funded grants in geoscience education, peer-reviewed publications, or development of successful community outreach programs.

Applicants are required to have a Ph.D. in geology or related field, or a Ph.D. in science education and an M.S. in geology or related field, at the time of employment. Candidates should send a letter of application, curriculum vitae, statements of research and teaching interests and goals, and three current and original letters of recommendation to: Chair, Faculty Search Committee, Department of Geology, Bowling Green State University, Bowling Green, OH 43403. Finalists will be required to provide a transcript for the highest degree. Applications must be postmarked by January 2, 2002. Bowling Green State University is an Equal Employment Opportunity/Affirmative Action employer and encourages applications from women, minorities, veterans, and persons with disabilities.

Additional information regarding the Department of Geology may be found at <http://geosrv01.bgsu.edu>.

GUSTAVUS ADOLPHUS COLLEGE PALEONTOLOGY/SEDIMENTARY GEOLOGY

Gustavus Adolphus College, a coeducational, private, Lutheran (ELCA), residential, national liberal arts college of 2,500 students, invites nominations and applications for the tenure-track position of assistant professor of geology to begin September 1, 2002.

Responsibilities include courses in paleontology, historical and/or physical geology, and possibly sedimentary geology, with the opportunity of developing one or more courses in the area of expertise. The candidate is expected to engage in an active research program and to generate and supervise senior theses.

We seek candidates who have completed their Ph.D. The successful candidate will be a broadly trained earth scientist with specialization in paleontology and/or sedimentary geology, with a sincere interest in undergraduate teaching.

To apply, send letter of application, curriculum vita, statements of teaching philosophy and research interests, and three to five professional references to: Dr. James Welsh, Chair, Geology Department Search, Gustavus Adolphus College, 800 West College Avenue, St. Peter, MN 56082-1498; (507) 933-7335; welsh@gustavus.edu. Review of applications will begin on December 31, 2001, and continue until the position is filled.

It is the policy and practice of Gustavus Adolphus College to provide equal educational and employment opportunities for all. We specifically encourage applications from women, minorities, and persons with disabilities. Additional information about the Gustavus Geology Department can be found online at www.gustavus.edu/oncampus/academics/geology/geology.cfm.

EXCITING PROFESSIONAL OPPORTUNITIES WITH THE IT GROUP

The IT Group addresses the infrastructure and environmental needs of both private and public sector clients as a leading provider of diversified services, including engineering, consulting, facilities management, water, construction, remediation, liability transfer, and information management. We have several opportunities for the following:

Geologist/Hydrogeologist. The position provides hydrogeologic technical support on environmental projects. Responsibilities include performing aquifer tests; supervising test boring programs and the installation of groundwater monitoring wells (direct supervision of sub-contracted drilling personnel); collecting environmental samples; and preparing reports, SOVs and work plans. Must also interpret field geologic data and present results/recommendations to project management in a responsible manner.

Requirements include a B.S. in geology with some practical experience in the environmental field (e.g., internship) a plus. Must be able to obtain OSHA 919.120 certification. Extensive travel on short- and long-term projects likely. Must be able to work in all types of weather under a variety of health and safety protocols.

We offer competitive salaries, competitive health, life, disability insurance, a flexible benefits program including 401(k) and a tuition reimbursement.

Interested candidates should submit their resume indicating position to Scott McGuigan at collegerecruiting@theitgroup.com or The IT Group, Inc., 2790 Mossidge Boulevard, Monroeville, PA 15146-2792. EOE, M/F/D/V.

MICHIGAN STATE UNIVERSITY GEOLOGICAL SCIENCES

STRUCTURAL GEOLOGY OR GEODYNAMICS

The Department of Geological Sciences announces an academic year, tenure-track position in structural geology or geodynamics beginning August 16, 2002. This position is at the assistant professor level. Applicants must show promise of an outstanding research program and be committed to excellence in teaching at both the undergraduate and graduate levels.

Applicants should have expertise in quantitative aspects of crustal deformation at a variety of scales, and be able to interface with existing programs in lithospheric tectonics, fluid flow, and subsurface characterization. Areas of expertise could include basin formation and evolution, modeling of crustal deformation, fracture processes, geodynamics of the lithosphere, and neotectonics. Preference will be given to applicants whose research involves quantitative analysis of deformation processes using field and geophysical data. The successful candidate will be expected to work closely with solid-earth geoscientists and hydrogeologists within the department and teach courses in general and structural geology.

This position supports the department's strong interdisciplinary emphasis that includes linkages with the Departments of Geography, Physics, and Civil and Environmental Engineering.

Additional information on the department can be obtained on our Web page at www.glg.msu.edu. Interested applicants should forward a curriculum vita; official transcripts; statement of teaching and research interests; and names, addresses, telephone numbers, and e-mail addresses of three references to: Dr. Michael A. Velbel, Chair, Department of Geological Sciences, Michigan State University, 206 Natural Science Building, East Lansing, MI 48824-1115.

Application deadline: January 4, 2002. Candidates will be interviewed at the AGU annual meeting. Michigan State University is an Affirmative Action/Equal Opportunity Institution. Persons with disabilities have the right to request and receive reasonable accommodation.

DICKINSON COLLEGE MINERALOGY/PETROLOGY

The Geology Department of Dickinson College invites applications for a tenure-track position primarily in mineralogy and petrology to begin fall 2002. The successful candidate will be a broadly trained geoscientist with teaching interests centered in the liberal arts tradition. Demonstrated success in student-faculty undergraduate research is highly desirable. Teaching responsibilities

include two lectures and labs per semester in the areas of mineralogy, igneous and metamorphic petrology, or other related areas of expertise, and a topical introductory course of the successful candidate's design will also be required. The position requires a Ph.D. and will be filled at the assistant professor level. Current three faculty have expertise in structural geology, geomorphology, sedimentology, paleontology, aqueous geochemistry, oceanography, and hydrogeology. Our curriculum emphasizes project-based learning with a strong field component centered in the Folded Appalachians, Blue Ridge, and Mesozoic lowlands of PA. The department is housed in a recently renovated building with excellent analytical (XRD, XRF, and SEM-EDS) and computing facilities. The college and department are dedicated to academic excellence in providing a global education for its students. Opportunities are available for science students and faculty to travel and teach at Dickinson's centers abroad. More information can be found on the college and department web pages at www.dickinson.edu/departments/geol/. Dickinson College is a highly selective, private liberal arts college in south-central PA within easy drive of the New York-Washington, D.C., metro corridor. Dickinson is an equal opportunity/affirmative action employer and strongly encourages minorities and women to apply. Applications including a cover letter describing teaching and research interests, curriculum vitae, and addresses for three referees should be sent to Dr. Jeff Niemitz, Chair, Department of Geology, Dickinson College, P.O. Box 1773, Carlisle, PA 17013-2896 no later than December 1, 2001.

ASSISTANT PROFESSOR STRUCTURAL GEOLOGY/TECTONICS FRANKLIN & MARSHALL COLLEGE

We seek candidates for an entry-level tenure-track appointment in the Department of Geosciences, beginning in the fall of 2002. The successful candidate will teach structural geology, an introductory course (environmental geology, physical geology or oceanography), and courses in his or her field of expertise. We seek a structural geologist/tectonicist who will bring additional strength to our program in an area such as geodynamics, earth systems science, paleoclimatology, or marine tectonics. Applicants should have a Ph.D., an ongoing research program, and some teaching experience. The successful candidate will be committed to undergraduate teaching, research, and active involvement in a dynamic department in a residential college setting. For additional information see www.fandm.edu/departments/geosciences/geosciences.html. Please send a letter of application, including a statement of teaching and research interests and a description of strengths you would bring to the department, plus vita, graduate and undergraduate transcripts, and three letters of recommendation to: Dr. Carol B. de Wet, Chair, Department of Geosciences, Franklin & Marshall College, Lancaster, PA 17604-3003. (C_deWet@acad.fandm.edu) Review of applications began October 25, 2001.

Franklin & Marshall College is a highly selective, private liberal arts college with a demonstrated commitment to cultural pluralism through the hiring of women and minorities (EOE/AA). All interested individuals are encouraged to apply.

ASSISTANT PROFESSOR, UMKC GEOSCIENCES

The Department of Geosciences, University of Missouri—Kansas City invites applications for a tenure-track assistant professor for an expanding environmental studies program. Research and teaching specialty: climatology, paleoclimatology, earth system science, or related fields. The ideal candidate would possess a research specialty that complements existing departmental strengths. Candidates would be expected to raise grants in support of their research, to teach introductory, intermediate, and graduate courses on the environment and the geosciences, to support graduate students, and to carry out service activities, including interaction with the Kansas City community. A full description of the department and an expanded description of the position can be accessed through www.umkc.edu. Interested persons should send a letter that includes a statement of teaching philosophy and research interests, transcripts, teaching evaluations,

course syllabi, curriculum vitae, and names of three references to: Assistant Professor Search Committee, Department of Geosciences, University of Missouri—Kansas City, 5110 Rockhill Road, RHFH 420, Kansas City, MO 64110. Review of applications will begin November 10, 2001, and will continue until the position is filled. The University of Missouri—Kansas City is an AA/EO/ADA employer and does not discriminate in employment or the provisions of services on the basis of disability.

**CASE WESTERN RESERVE UNIVERSITY
TWO TENURE-TRACK FACULTY POSITIONS:
GEOCHEMISTRY AND NEOTECTONICS**

The Department of Geological Sciences at Case Western Reserve University anticipates filling two positions within the next two years. We seek candidates that will help bridge existing strengths in geochemistry, planetary materials, and surficial processes. For the geochemistry position, the department seeks candidates who develop and use unique applications of geochemical analyses across a broad spectrum of processes. For the neotectonics position, we seek candidates who are working on lithospheric dynamics or mechanical processes of materials under deformation and have an active field component to this work. Candidates for both positions will be expected to develop a vigorous research program that involves both graduate and undergraduate students and who are committed to exceptional undergraduate instruction in both introductory and disciplinary classes. Apply by December 15 by sending an application letter, curriculum vitae, a statement of research and teaching interests, and the names, addresses, telephone numbers, and e-mail addresses of three references to Prof. Gerald Matisoff, Chair, Department of Geological Sciences, Case Western Reserve University, Cleveland, OH 44106-7216. CWRU is an equal opportunity employer and is committed to diversity and equality in education and employment.

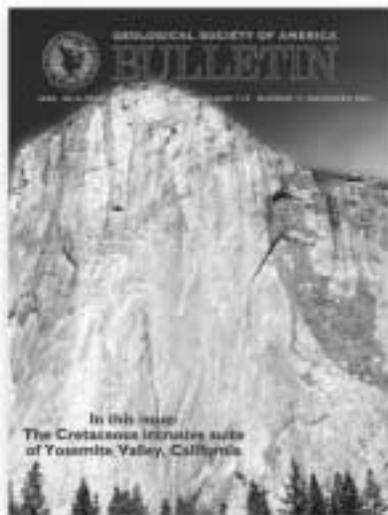
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Positions Open

OKLAHOMA STATE UNIVERSITY SCHOOL OF GEOLOGY

ENDOWED CHAIR IN EXPLORATION GEOPHYSICS

The School of Geology at OSU invites applications for the position of an endowed professor with tenure in exploration geophysics. The salary and startup package are highly competitive. The target starting date of appointment is August 2002.

Individuals seeking this position must possess a Ph.D. and have an extensive research record in geophysics. Candidates with industry experience are welcome to apply. The successful candidate should have skills in a wide array of exploration geophysical techniques, including acquisition, processing, and interpretation of 2-D and 3-D seismic data, gravity, and magnetics. Additionally, a thorough working knowledge of current geophysical software is essential. The ideal candidate should be able to solve problems through integration of geological, petrophysical, and reservoir engineering data.

The successful applicant will be expected to work with existing faculty to develop a quality geophysics program. This program should produce highly competitive graduates who are comfortable with geophysics and high technology and who work effectively as part of an interdisciplinary team. Duties will include the development of externally funded research grants and contracts, the publication of articles in refereed journals, a commitment to high-quality undergraduate and graduate education, and advisement of graduate students.

Interested candidates should submit an application, curriculum vitae, statement of research interests (including future research pursuits), statement of teaching interests (including new courses), transcripts, and the names and addresses of three references. For full consideration, applications must be received by January 15, 2002; however, applications will be accepted until the position is filled.

OSU is a comprehensive land grant university with approximately 22,000 students. The School of Geology has a long and proud tradition of ties with the petroleum industry. The School of Geology consists of 9 full-time faculty as well as approximately 40 undergraduates, and 40 graduate students.

Please send all materials to: Geophysics Chair Search, School of Geology, Oklahoma State University, 105 Noble Research Center, Stillwater, OK 74078-3031. For more information on the OSU School of Geology, please visit our Web site at www.okstate.edu/geology/geology.html. OSU IS AN AFFIRMATIVE ACTION/EQUAL EMPLOYMENT OPPORTUNITY EMPLOYER, COMMITTED TO MULTICULTURAL DIVERSITY.

FACULTY POSITION ENVIRONMENTAL CHEMISTRY/GEOCHEMISTRY MCMASTER UNIVERSITY

The Department of Chemistry and the School of Geography and Geology at McMaster University invite applications for a joint tenure-track position in the area of environmental geochemistry, environmental analytical chemistry, or environmental chemistry. The successful candidate will be appointed at the level of assistant professor and must hold a Ph.D. degree in chemistry or geochemistry, preferably with relevant postdoctoral experience. Candidates will be expected to develop a strong research program and to participate in the teaching of analytical chemistry and geochemistry courses at both the undergraduate and graduate levels. The position will be available beginning July 1, 2002. McMaster University is committed to employment equity and encourages applications from qualified men and women, members of visible minorities, aboriginal peoples, and persons with disabilities. In accordance with Canadian immigration requirements, Canadian citizens and permanent residents will be considered first for this position.

Applicants should send a curriculum vita, a research proposal and a statement of teaching philosophy to the address below. The evaluation of candidates will begin on December 1, 2001, and will continue until the position is filled. Applicants should also arrange for letters from three referees to be sent to the attention of: Dr. Brian E. McCarry, Chair, Environmental Geochemistry Search Committee, Department of Chemistry, McMaster University, Hamilton, Ontario, Canada, L8S 4M1, e-mail: mccarry@mcmaster.ca, phone: +1 (905) 525-9140, ext. 24192.

CURATOR OF VERTEBRATE PALEONTOLOGY/ASSISTANT PROFESSOR UNIVERSITY OF COLORADO AT BOULDER

The University of Colorado at Boulder invites applications for a joint, tenure-track appointment as curator of Vertebrate Paleontology in the University Museum and assistant professor in the Department of Geological Sciences. Primary responsibilities will be to develop a vigorous, externally funded research program, curate the vertebrate paleontology collections, and teach courses in the Museum and Field Studies Program and in Geological Sciences. Preference will be given to candidates conducting specimen-based research on Tertiary vertebrates. Research areas of interest include, but are not limited to, vertebrate paleoecology, evolution, and systematics. Applicants must have a Ph.D. or equivalent degree in biology, geology or a related field. Please send a curriculum vitae, representative publications, statements of research, teaching, and curatorial experience, and three letters of reference to Dr. Dena M. Smith, Search Committee, UCB 218, University Museum, University of Colorado, Boulder, CO 80309; phone: (303) 735-2011; fax: 303-492-4195; email: dena.smith@colorado.edu. Applications must be post-marked by November 30, 2001. The University of Colorado is committed to diversity and equality in education and employment.

ASSISTANT PROFESSOR/PETROLOGIST SAN DIEGO STATE UNIVERSITY

The Department of Geological Sciences at San Diego State University invites applications for a tenure-track assistant professor position in the general areas of igneous, metamorphic, or sedimentary petrology starting fall 2002. A Ph.D. is required at the time of appointment. Experience in and/or commitment to working in a multicultural environment with large numbers of students of diverse backgrounds and learning styles is highly desirable. The College of Sciences has a large number of federally funded minority training programs (e.g., MARC, MBRS, McNair Scholar), and SDSU is ranked 10th in the nation in conferring baccalaureate degrees to minorities.

We seek outstanding applicants with the potential to establish vigorous, externally funded research programs involving M.S. and B.S. students. We are particularly interested in multidisciplinary scientists with field-based interests who will establish collaborations with other research programs in the department. Teaching responsibilities will include both undergraduate and graduate courses in the individual's field of expertise. Starting salary range will be dependent on experience.

The department offers a wide range of analytical instrumentation housed in a newly opened science laboratory building. Excellent computing facilities support the department. You may visit the department at <http://www.geology.sdsu.edu>.

Please send a letter of application describing teaching and research interests, curriculum vitae, and the names, addresses, and telephone numbers of three references to

Gary H. Girty, Department of Geological Sciences, San Diego State University, San Diego, CA 92182-1020, by January 15, 2002. Inquiries may be e-mailed to ggirty@geology.sdsu.edu. SDSU is an equal opportunity title IX employer and does not discriminate against persons on the basis of race, religion, national origin, sexual orientation, gender, marital status, age, or disability.

NORTHERN ILLINOIS UNIVERSITY

The Department of Geology and Environmental Geosciences anticipates filling a single position, in one of the two areas described below, to begin in August 2002. The successful applicant will be expected to establish and/or maintain a vigorous externally funded research program, supervise Ph.D. and M.S. students, and have a commitment to excellence in teaching at both the undergraduate and graduate levels. A Ph.D. is required at the time of appointment. The department offers programs leading to the B.S., M.S., and Ph.D. degrees, and currently has 14 faculty members, whose research and teaching interests are described on our Web site at <http://jove.geol.niu.edu>. Applicants must submit a letter of application, curriculum vitae, statement of teaching and research interests, and names, addresses, and e-mail addresses of at least three referees to: Search Committee Chair, Department of Geology and Environmental Geosciences, Northern Illinois University, DeKalb, IL 60115. For equal consideration, applications must be received by December 10, 2001. Women and minorities are especially encouraged to apply. NIU is an equal employment opportunity/affirmative action institution.

Mineralogy or Biomineralogy. NIU solicits applications for a tenure-track appointment in mineralogy. We are particularly interested in applicants from the areas of biomineralogy, mineral-surface studies, and other areas of mineralogy and who have a clearly defined need for or an established record of utilization of synchrotron facilities. NIU is part of the CARS research consortium at the nearby Advanced Photon Source of Argonne National Laboratory. We expect the successful applicant to develop multidisciplinary research that integrates with one or more of our existing program strengths in biogeochemistry, environmental geochemistry, hydrogeology, global change, or igneous petrology. Appointment will be at the assistant professor level or at the associate professor level for a candidate with established external funding and a demonstrable record of synchrotron-based research. See application details above.

Carbonate Geology. NIU solicits applications for a tenure-track appointment in carbonate geology. We encourage applications from candidates in the areas of sedimentology, stratigraphy, and global environmental-climatic change. Preference will be given to those who have interests in sequence stratigraphy or geochemistry and geochronology, especially where those interests have applications in the petroleum or environmental-consulting industries or in records of environmental change. We expect the successful applicant to develop multidisciplinary research that integrates with departmental strengths in global change, environmental studies, or biogeochemistry/geobiology. Appointment will be at the assistant professor level. See application details above.

COLGATE UNIVERSITY—ASSISTANT PROFESSOR

The Geology Department at Colgate University is seeking applications for a visiting assistant professor position in the field of structural geology and tectonics for the period of January 2002 through spring/summer of 2003. Consideration may also be given to applicants interested in only part of this three-semester period. We are seeking an individual with a Ph.D. who is committed to excellence in research and teaching at the undergraduate level. The area of specialization is open. The successful applicant will teach one course in structural geology each spring and other courses at the introductory and upper level. A willingness to participate in the Geology Department's summer field course, involve students in research, and contribute to other all-university programs, such as the Scientific Perspectives core, is expected.

Colgate University is a highly selective undergraduate liberal arts college with 2,800 students. The Geology Department comprises nine faculty, a lab instructor, and a technician. The Geology Department maintains a Web page at: <http://departments.colgate.edu/geology>.

Colgate University is an equal opportunity employer and applications from women and minorities are encouraged. Review of applications will begin immediately with on-campus interviews.

Applications containing the names of three professional references and statements of teaching philosophy and

research interests should be sent to: Dr. Charles E. McClellan, Acting Chair, Department of Geology, Colgate University, 13 Oak Drive, Hamilton, NY 13346.

**ASSISTANT PROFESSOR (SURFACE PROCESSES)
DEPARTMENT OF GEOLOGY & GEOPHYSICS
LOUISIANA STATE UNIVERSITY**

The Department of Geology and Geophysics at Louisiana State University invites applications for a tenure-track assistant professor position to begin fall semester of 2002. A position at the associate professor level may be considered for an exceptional candidate. Required qualifications: Ph.D. at the time of appointment; must be an outstanding, quantitative geoscientist with demonstrated expertise in surface processes, with specialization in one of the following areas: (1) quantitative geomorphology; (2) clastic sedimentology; (3) Quaternary paleoclimatology; (4) biogeochemistry; or (5) surface-water hydrogeology. Additional qualifications desired: postdoctoral experience.

Responsibilities: contributes to our undergraduate and graduate teaching programs and develops courses in his or her area of specialization; develops a strong research program, including supervision of graduate student research, active publication in national or international highly ranked journals; generates external funding.

The department consists of 20 faculty members covering a wide range of expertise. In support of our faculty and students we have many well-equipped analytical and computational laboratories. Geology and geophysics has strong support from the LSU administration as evidenced in our selection as one of the 12 priority departments at the university. For more information about our department, see our Web site at <http://www.geol.lsu.edu>.

The review process will begin December 1, 2001, and will continue until candidate is selected. Interested persons should send a copy of their vita, a statement of their research and teaching interests, and the names, addresses, and phone numbers of at least three references to: Chair, Surface Processes Search Committee, Department of Geology and Geophysics, Louisiana State University, Ref. Log #0397, Baton Rouge, LA 70803.

LSU is an Equal Opportunity/Equal Access Employer.

TEXAS A&M UNIVERSITY

The Department of Geology and Geophysics at Texas A&M University invites applications for two entry-level, tenure-track faculty positions beginning fall of 2002.

Environmental/Engineering Geology. We seek a researcher interested in fundamental questions concerning societal interactions with geologic systems, such as water resources; biogeochemistry and ecosystem functioning; fluvial geomorphology; or urban development. The candidate will join a dynamic program with expertise in hydrogeology, biogeochemistry, near-surface geophysics, engineering geology, and neotectonics, as well as many other geoscience areas. This position is funded through a major, campus-wide, interdisciplinary research program, The Sustainable Coastal Margins Program (SCMP; <http://scmp.gerg.tamu.edu>).

Responsibilities for this position include the development of an outstanding, externally funded, research program, involvement in the SCMP program, and a commitment to undergraduate and graduate teaching. Submit a curriculum vita, reprints, a summary of research and teaching interests, and the names, postal and e-mail addresses of three or more references to: Dr. Bruce Herbert, Environmental/Engineering Search Committee Chair, Geology and Geophysics, Texas A&M University, College Station, TX 77843-3115. Review of applications will start on Dec. 1, 2001.

Paleobiology, Biotic Response to Global Change. We seek an individual to develop an outstanding research and teaching program that will complement interdisciplinary research in paleoecology, paleoclimatology, and paleoceanography within the College of Geosciences, including the Depts. of Geology and Geophysics, Oceanography and the Ocean Drilling Program. Research areas of particular interest include, but are not restricted to: paleoecology, taphonomy, paleoceanography and paleoclimatology, paleoproductivity, molecular paleobiology and the biogeochemistry of ancient environments, and evolutionary theory.

Applicants must hold a Ph.D. in geology or related field, and demonstrate research productivity in the form of publications and current or potential external funding. Submit a curriculum vita, reprints, statement of research interests, and the names, postal, and e-mail addresses of three references to: Dr. Anne Raymond (raymond@geo.tamu.edu), Paleobiology Search Committee Chair, Dept. of Geology & Geophysics, Texas A&M University, College Station, TX 77843-3115 USA. Review of applications will begin on Jan. 10, 2002, and continue until the position is filled.

Texas A&M University, a land-, sea- and space-grant institution, is located in College Station, Texas, a dynamic

community of 140,000 people. Texas A&M University is an affirmative action/equal opportunity employer committed to excellence through diversity and compliance with the Americans with Disabilities Act. Departmental facilities and programs can be reviewed at our Web site (<http://geoweb.tamu.edu>).

**ASSISTANT PROFESSOR, GEOPHYSICS
UNIVERSITY OF KANSAS**

The Department of Geology at the University of Kansas invites applications for a tenure-track assistant professorship in geophysics, to be appointed August 18, 2002, or later. We are seeking an individual with a Ph.D. in geophysics or a closely related field whose specialty is seismology or some area of near-surface geophysics. For application information, contact Prof. Don Steeples, Department of Geology, University of Kansas, 1475 Jayhawk Blvd., Room 120, Lawrence, KS 66045-7613 (tel.: 785-864-2730; e-mail: don@ku.edu). Review of completed applications begins January 2, 2002, and will continue until the position has been filled. Position contingent upon budgetary approval. The university is committed to increasing the ethnic and gender diversity of its faculty. We strongly encourage women and minority candidates to apply. EO/AA employer. For a complete position description, please visit our Web site at <http://www.geo.ku.edu>.

**UNIVERSITY OF WEST FLORIDA
ASSISTANT PROFESSOR
HYDROGEOLOGY/HYDROGEOLOGY**

The Department of Environmental Studies, University of West Florida, invites applications for a tenure-track position in hydrogeology/hydrogeomorphology, beginning August 2002. We seek candidates with expertise in applied groundwater hydrology or water/land surface interactions. Interest in environmental issues is highly desirable. Applicants should have an appreciation for undergraduate education and will be expected to teach classes in geology, geomorphology, and hydrology. Applicants are expected to develop an active research program and should be committed to peer-reviewed publication. A Ph.D. in geology or geography at the time of appointment is required. Salary commensurate with qualifications and experience.

The Department of Environmental Studies offers a major in environmental studies and minors in geography and environmental studies. More than 135 majors specialize in natural science and environmental policy tracks. A geography track is being developed. The department is housed in a renovated building with new research and teaching facilities. The department maintains the university-wide Geodata Center, which has extensive GIS capabilities. For more information on the department see <http://uwf.edu/environmental/>.

Candidates are requested to submit a statement of research and teaching interests and experience, a curriculum vitae, and three letters of reference by December 17, 2001. Inquiries may be made at lieb@uwf.edu or at phone (850) 474-2065.

Apply: Dr. Johan Liebens, Department of Environmental Studies, University of West Florida, 11000 University Parkway, Pensacola, FL 32514.

The University of West Florida is an Equal Opportunity/Access/Affirmative Action Employer.

**GEOCHEMISTRY/PETROLOGY
OF THE LITHOSPHERE
BOSTON UNIVERSITY**

The Department of Earth Sciences at Boston University invites applications for a tenure track faculty position at the assistant professor level, to begin September 1, 2002.

We seek a scientist to build a vibrant research and teaching program emphasizing geochemical and petrologic approaches to solving tectonics problems, with interests in the composition and evolution of the continental and/or oceanic lithosphere. The scientist may utilize methods based on one or more of the following: (1) isotope geochemistry and/or geochronology; (2) igneous and/or metamorphic petrology and geochemistry; (3) experimental petrology or geochemistry; and (4) field geology. The new faculty member will complement existing strengths in lithosphere deformation and geochemistry, tectonics, geophysics, low-temperature geochemistry, and marine and surface processes.

The successful applicant will be expected to supervise graduate thesis work in M.A. and Ph.D. programs, maintain an externally funded research program, and teach at all levels in the Earth Sciences curriculum. Interaction is encouraged with the Departments of Geography, Chemistry, and Physics, the Center for Remote Sensing the Center for Energy and Environmental Studies, and the B.U. Marine Program. For more information about the department, see <http://www.bu.edu/ES>.

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NICHOLAS SCHOOL OF THE
ENVIRONMENT AND EARTH SCIENCES
DUKE UNIVERSITY

**Graduate Assistantships in
Earth & Ocean Sciences**



Undergraduate and graduate students interested in pursuing graduate studies leading to the M.S. or Ph.D. degree are invited to apply for admission to the graduate program in the Division of Earth and Ocean Sciences (EOS) in the Nicholas School of the Environment and Earth Sciences at Duke University. Research and Teaching Assistantships with full tuition waiver are available and are awarded on a competitive basis. EOS faculty are an active research group of 14 geologists, geophysicists and oceanographers involved in a broad range of investigations in the general areas of Climate Change, Solid Earth Processes, and Surficial Processes. Additional interdisciplinary research opportunities are available through joint studies with other faculty in NSOEEs, Biological Anthropology and Anatomy, Biology, and Civil and Environmental Engineering. For more information, see <http://www.eos.duke.edu>.

To request an application, please contact:

Director of Graduate Studies
Division of Earth and Ocean Sciences
Nicholas School of the Environment
and Earth Sciences
Duke University
Durham, North Carolina 27708
(919) 681-8077 Phone
(919) 684-5833 Fax
dgs_eos@env.duke.edu

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A Ph.D. at the time of appointment is required. Applicants should send a curriculum vitae, a statement of research and teaching interests, and the names and addresses of at least three referees to: Search Committee Chair, Department of Earth Sciences, Boston University, 685 Commonwealth Ave., Boston MA 02215, USA; email: earth@bu.edu. Review of applications will begin on December 1, 2001. Boston University is an equal opportunity/affirmative action employer.

ASSISTANT PROFESSOR—SKIDMORE COLLEGE

The Skidmore College Department of Geosciences invites applications for a tenure-track appointment at the assistant professor rank beginning September 1, 2002. Ph.D. required. Applicants should be broadly trained in the geosciences with expertise in environmental geology, geomorphology, and hydrogeology. Interests in climatology, limnology, and soil science are a plus. Teaching responsibilities include introductory geoscience courses, upper level courses in geomorphology and environmental geology, as well as the development of new courses in support of the college's Geosciences, Environmental Studies and Liberal Studies programs. The successful candidate is expected to demonstrate excellence in teaching, to maintain an active program of research and publication, to mentor student research in appropriate geoscience and environmental studies areas, and to participate in college service and student advising. Review of applications will begin February 1, 2002, and continue until the position is filled. Applications should include a curriculum vitae and a concise statement of your teaching, research and career goals. Send these materials and three letters of reference to: Eleanor Hutchins, Secretary, Department of Geosciences, File #GS, Skidmore College, 815 N. Broadway, Saratoga Springs, NY 12866.

Skidmore College encourages applications from women and men of diverse racial, ethnic, and cultural backgrounds.

**VISITING ASSISTANT PROFESSOR
SKIDMORE COLLEGE**

The Skidmore College Department of Geosciences invites applications for a two-year appointment at the visiting assistant professor rank beginning September 2, 2002. Ph.D. or ABD in geology required. Applicants should be broadly trained in the geosciences with expertise in mineralogy and petrology. Expertise in GIS and an interest in low temperature or environmental geochemistry are a plus. Teaching responsibilities include introductory geosciences courses, and upper level mineralogy/petrology and structural geology courses, as well as participation in the college's Environmental Studies and Liberal Studies programs. The successful candidate is also expected to mentor student research in appropriate geoscience areas. Review of applications will begin February 1, 2002, and continue until the position is filled. Applications should include a curriculum vitae and a concise statement of your teaching, research, and career goals. Send these materials and at least three letters of reference to: Eleanor Hutchins, Secretary, Department of Geosciences, File #GS, Skidmore College, 815 N. Broadway, Saratoga Springs, NY 12866.

Skidmore College encourages applications from women and men of diverse racial, ethnic, and cultural backgrounds.

**OREGON STATE UNIVERSITY
ASSISTANT PROFESSOR
PHYSICAL GEOGRAPHY/REMOTE SENSING**

Corvallis, Oregon. The Department of Geosciences seeks to hire an ASSISTANT PROFESSOR IN PHYSICAL GEOGRAPHY/REMOTE SENSING (9-month, tenure-track). Candidates must have a Ph.D. in geography or closely related field, a commitment to teaching excellence, and an active research agenda. This position must complement departmental teaching and research programs in geography and geology. We seek a dynamic individual pursuing research on the cutting edge of hyperspectral and/or high spatial resolution imagery applied, but not limited to, one of the following four research areas: natural resources, including biogeography, water resources, or land-use planning; geographic information sciences; earth systems history; or volcanic studies, including risk assessment. Teaching responsibilities include remote sensing, physical geography research techniques, and a mix of related graduate and undergraduate courses. Some GIS skills would be helpful but are not required.

Submit a letter of application describing your research interests, teaching experience, qualifications for this position, CV, and the names of three referees (with contact information) to: Chair, Assistant Professor Search Committee, Dept. of Geosciences, 104 Wilkinson Hall, Corvallis,

OR 97331-5506. Fax: 541-737-1200, voice: 541-737-1201, e-mail: peterson@geo.orst.edu. For full consideration, apply by December 15, 2001.

Oregon State University is an Affirmative Action/Equal Opportunity Employer and has a policy of being responsive to the needs of dual career couples.

**FACULTY POSITION
IN STRATIGRAPHY/SEDIMENTOLOGY
WASHINGTON UNIVERSITY, ST. LOUIS**

Washington University in St. Louis announces a tenure track position at the assistant professor level in the fields of stratigraphy and sedimentology to begin in fall 2002. Under special circumstances, an outstanding candidate may be considered for appointment at a higher level. The successful candidate will be a creative individual who uses field, laboratory, and analytical techniques to investigate modern and ancient sedimentary rocks and processes. Areas of interest might include, but are not limited to: sequence stratigraphy and its relationship to tectonic subsidence, eustasy, and sediment flux; sedimentary rocks as recorders of climate change; or environmental geology as deduced from sedimentary strata. Candidates should demonstrate promise of excellence in both teaching and research and must have been awarded a Ph.D. at time of appointment. Send resume, statement of future research interest, and names and contact information for at least three references to: Robert Tucker, Search Committee Co-Chair, Department of Earth and Planetary Sciences, Washington University, Campus Box 1169, One Brookings Dr., St. Louis, MO 63130, or via e-mail: SS-FacSearch@levee.wustl.edu. EO/AA employer. Employment eligibility verification required upon employment. Consideration of applicants will begin on December 31, 2001, and continue until the position is filled.

**ASSISTANT PROFESSOR (SEDIMENTARY GEOLOGY)
LOUISIANA STATE UNIVERSITY**

The Department of Geology and Geophysics at Louisiana State University invites applications for a tenure-track assistant professor position to begin fall semester of 2002. A position at the associate professor level may be considered for an exceptional candidate. The successful candidate must have a Ph.D. in geology or related field at the time of appointment, postdoctoral experience is preferred.

We are looking for an outstanding, process-oriented, quantitative geoscientist with demonstrated expertise in the area of sedimentary geology. LSU has traditional strengths in sedimentology-stratigraphy and demonstrated commitments to continue these strengths. Two recent hires in sedimentology at LSU are new NSF Career Awardees.

The successful candidate is expected to contribute to our undergraduate and graduate teaching programs and develop courses in his or her area of specialization. Development of a strong research program, including supervision of graduate student research, active publication in national or international highly ranked journals and the generation of external funding, is required.

The department consists of 18 faculty members covering a wide range of expertise. In support of our faculty and students we have many well-equipped analytical and computational laboratories. Geology and geophysics has strong support from the LSU administration as evidenced in our selection as one of the 12 priority departments at the university.

For more information about our department, see our Web site at <http://www.geol.lsu.edu>.

The review process will begin November 15, 2001. The search will be continued until a suitable candidate is found. Interested persons should send a copy of their vita, a statement of their research and teaching interests, and the names, addresses, and phone numbers of at least three references to: Chair, Sedimentary Geology Search Committee, Department of Geology and Geophysics, Louisiana State University, Ref. Log #0303 Baton Rouge, LA 70803. LSU Is An Equal Opportunity/Equal Access Employer.

COMPUTATIONAL SCIENCE—BRYN MAWR

Tenure-track position, at the rank of assistant professor. The candidate should be a scientist who uses computer modeling as a primary research tool. The successful candidate will be expected to teach a course in scientific computation, courses in algorithm design for scientific problem solving, including numerical model development and applications, as well as introductory and advanced courses in his or her scientific field of specialty. The candidate will also be expected to develop an active, funded research program involving undergraduate and graduate students. The position will be hosted by one of the college's natural science departments (Biology, Chemistry, Geology, or Physics), depending on the successful candidate's area of expertise. A Ph.D. at the time of appointment is required. For information specific to the position in geology, please

visit www.brynmawr.edu/geology/compsscjob.htm.

Bryn Mawr is a liberal arts college for women with coeducational graduate programs in sciences, some humanities, and social work. The college supports faculty excellence in both teaching and research, and provides a rigorous education in the context of a diverse and pluralistic scholarly community. Located 11 miles west of Philadelphia, Bryn Mawr participates in consorsial programs with the University of Pennsylvania, Haverford, and Swarthmore Colleges. Bryn Mawr College is an equal opportunity, affirmative action employer. Applications from women and minorities are especially encouraged. Applications should include CV, a description of research interests, teaching philosophy and experience, and current letters from at least three professional references.

Applications should be sent to: Trisha Picciarelli, Computational Science Search, Park Science Building, Bryn Mawr College, 101 North Merion Avenue, Bryn Mawr, PA 19010-2899.

Review of applications will begin November 19, 2001.

**GEOLOGY INSTRUCTOR
GROSSMONT-CUYAMACA
COMMUNITY COLLEGE DISTRICT**

The Grossmont-Cuyamaca Community College District, located in El Cajon, Calif., is currently accepting applications for a full-time, tenure track geology instructor beginning fall 2002. Applications are required and may be obtained at www.gcccd.net/hr/academic.htm. Applications must be received by 01/18/02. AA/EEO/Title IX Employer.

**ASSISTANT/ASSOCIATE PROFESSOR GEOLOGY
GEORGIA COLLEGE AND STATE UNIVERSITY**

The Department of Biological and Environmental Sciences at Georgia College and State University seeks candidates in the area of environmental geology/sedimentology/hydrology. A Ph.D. in geology, sedimentology, hydrology, or related field is required for this tenure-track position. The successful candidate will play a role in the development of the environmental science degree program and will teach introductory courses in geology, environmental science, and GIS, as well as upper level courses in sedimentology, hydrology and other subjects specific to their research. Effective teaching, scholarship, and university/community service are required for promotion and tenure. Starting salary will be commensurate with qualifications/experience. Starting date is August 2002. Review of applications will begin November 12, 2001, and will continue until the position is filled. Submit letter of application, curriculum vitae, copies of transcripts, and the names of three references to: Dr. Alfred J. Mead, Geology Search Committee, Department of Biological and Environmental Sciences, CBX 081, Georgia College & State University, Milledgeville, GA 31061. GC&SU, Georgia's Public Liberal Arts University, is an Equal Opportunity/Affirmative Action Institution.

SURFICIAL GEOLOGIST—OHIO UNIVERSITY

The Department of Geological Sciences at Ohio University invites applications for a tenure-track appointment at the assistant professor level in surficial geology to begin in September 2002. We are seeking an individual who is committed to both research and teaching, and is qualified to develop courses in surficial geology (such as geomorphology, soil chemistry, soil/clay mineralogy, and Quaternary geology) that will expand and complement our existing strengths in hydrology, sedimentology, environmental geology, and geophysics. Expertise in applied areas such as hillslope or floodplain geomorphology is particularly desirable, although all areas of surficial geology will be considered. Excellence in teaching at both the undergraduate and graduate level and supervision of M.S. student research must be complemented by the development of a strong personal research program supported by external funding. The successful applicant will possess a Ph.D. in geological sciences and must show demonstrated potential for teaching and research in some aspect of surficial geology.

Applicants should send a vita, a description of research interests, a statement of teaching philosophy, and the names and addresses of three referees to: Dr. Mary W. Stoertz, Search Committee Chair, Department of Geological Sciences, 316 Clippinger Laboratories, Ohio University, Athens, Ohio 45701-2979. Applications should be received before December 31, 2001, but will be considered until the position is filled. Ohio University is an affirmative action/equal opportunity employer. Women and minorities are especially encouraged to apply. For further information concerning the department and its faculty, visit the Ohio University Web site at www.ohiou.edu.

**FACULTY POSITIONS IN TECTONICS-GEOPHYSICS,
CLIMATE CHANGE, AND ATMOSPHERIC DYNAMICS
PURDUE UNIVERSITY**

The Department of Earth and Atmospheric Sciences, Purdue University, seeks to fill two tenure-track positions

as part of a focused effort aimed at the following three areas of study: climate change, atmospheric dynamics, and tectonics-geophysics. The positions are offered at the level of assistant professor, but exceptionally qualified candidates at the associate professor level will also be considered. We are particularly interested in applicants who can enhance current activities as well as initiate new collaborative research in these areas.

Areas of research specialization may include, but are not limited to: *tectonics-geophysics*—imaging the crust and/or upper mantle with seismic and remote sensing methods, exploration geophysics, earthquake source processes, paleoseismology, crustal/lithospheric deformation models, thermochronology, and deformational processes in orogenic belts; *climate change*—temporal and/or spatial variability in climate systems, quantitative assessment of feedbacks between the atmosphere and land, ocean, or ice surfaces, and the role of clouds, aerosols and/or biogeochemical impacts on climate; *atmospheric dynamics*—interactions between atmospheric dynamics and thermodynamics over the full range of spatial and temporal scales.

The EAS Department is a growing multidisciplinary department that consists of 27 faculty with a broad range of interests in the geosciences. Our most recent faculty additions have been in the areas of biogeochemistry, neotectonics, and global climate modeling. The department is committed to sustaining a vital and innovative research and teaching program that crosses all areas of the earth sciences. We offer opportunities to contribute to and strengthen ongoing programs in atmospheres, oceans, and climate; solid-earth geophysics; geochemistry; and tectonics. Examples of these and other programs can be found on our Web page at www.eas.purdue.edu. Specific questions regarding this announcement may be addressed to search@eas.purdue.edu.

Candidates should possess a Ph.D. degree in some area of atmospheric, oceanic or solid-earth sciences. The successful applicant will establish a vigorous externally funded research program and teach courses at both the undergraduate and graduate levels. Applicants should send their curriculum vitae, statement of research and teaching interests, and the names of at least three references to: Chair, Faculty Search Committee, Dept. of Earth

& Atmospheric Sciences, 1397 Civil Engineering Building, Purdue University, West Lafayette, IN 47907-1397 USA.

Consideration of applications will begin November 1, 2001, and the search will continue until the positions are filled. However, applicants are advised that the initial screening process will have been completed before January 15, 2002. The department encourages applications from women and minorities. Purdue is an equal opportunity/affirmative action employer.

TENURE-TRACK POSITION IN GEOMORPHOLOGY MIAMI UNIVERSITY

The Department of Geology at Miami University invites applications for a tenure-track faculty position at the assistant professor level, beginning August 2002. Applicants must have a Ph.D. degree at the time of appointment. The successful applicant will be expected to teach effectively at the undergraduate and graduate levels, supervise student research at the undergraduate, M.S. and Ph.D. levels, and initiate and maintain a vigorous, externally funded research program.

We are seeking an outstanding candidate who is undertaking significant field and/or laboratory based research. The particular research emphasis should complement current program strengths. Thus, areas of emphasis may include, but are not limited to active tectonics, remote sensing, Quaternary geology, and climate change.

The successful applicant will join an active department that consists of 10 faculty members, two technical staff members, 50 undergraduate majors and 20 graduate students. The department maintains active research programs in environmental geology, hydrogeology, low-temperature geochemistry, geomicrobiology, sedimentology and stratigraphy, mineralogy, igneous petrology, volcanology, isotope geochemistry, structural geology, and tectonics. Included among departmental instrumentation are: DC plasma spectrometer, thermal ionization mass spectrometers (new multi-collector to arrive spring 2002), HPLC ion chromatograph, atomic force/scanning tunneling microscope, single-crystal and powder x-ray diffractometers (including a new CCD diffractometer), single-crystal x-ray cameras, electrophoretic mobility analyzer, and cathode luminescope. The department also owns a truck-mounted hollow-stem auger drilling rig. Please visit www.muohio.edu/geology/ for additional information.

Miami University, with 16,000 students, is located in a small-town setting within a one-hour drive of Cincinnati and Dayton. Interested candidates should submit a packet containing a letter of application, curriculum vitae, statement of teaching and research objectives and accomplishments, transcripts, and arrange three letters of reference to be sent to: Geomorphology Search Committee, Department of Geology, Miami University, 114 Shideler Hall, Oxford, OH 45056 (fax: 513-529-1542). Applications will be accepted until January 11, 2002, or until the position is filled.

We encourage applications from women, members of ethnic minorities, and individuals with disabilities. Miami University offers equal opportunity in employment and education.

ASSISTANT PROFESSOR—MILLS COLLEGE GEOCHEMISTRY/ENVIRONMENTAL GEOLOGY

Mills College seeks applications for a tenure-track assistant professor in geochemistry or environmental geology, starting fall 2002. The successful candidate will join the Department of Chemistry & Physics and will support a new major in environmental science. Teaching duties will include introductory courses in environmental science, geology, and chemistry, as well as upper division courses in environmental science. Applicants must be committed to undergraduate education and demonstrate the potential to develop a productive research program involving undergraduates. A Ph.D. in geology, chemistry, geochemistry, or a related area is required, and postdoctoral experience is preferred. Send a cover letter which details teaching interests and research plans, a CV, and the names of at least 3 references to Elisabeth Wade, Environmental Science Search Chair, Department of Chemistry & Physics, Mills College, Oakland, CA 94613 by December 3, 2001. For more information, contact ewade@mills.edu. Located in the San Francisco Bay Area, Mills College is a selective liberal arts college for women with coeducational graduate programs (see www.mills.edu). Persons of color and those committed to working in a multicultural environment are encouraged to apply. AA/EOE.

MURRAY CHAIR IN APPLIED CLAY MINERALOGY INDIANA UNIVERSITY, BLOOMINGTON

The Department of Geological Sciences at Indiana University in Bloomington, Indiana, invites applications for a

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The University of Texas at Austin Two Faculty Positions

The Department of Geological Sciences at the University of Texas at Austin seeks to fill two positions in the general areas of the Hydrologic Cycle.

HYDROLOGY. This position is in the general area of hydrology to compliment our growing program in physical, biological, and chemical hydrogeology. The specific area of research is open, but we are interested in a scientist with a research background in (1) groundwater/surface water interactions or (2) reaction-transport modeling on a variety of scales. The candidate will be expected to teach an undergraduate course in surface water hydrology and to help with the hydrogeology field methods course, as well as courses in his/her own specialty. While appointment at the tenure-track assistant professor level is anticipated, candidates at all ranks will be considered.

REMOTE SENSING. This position is the second of three faculty positions in Global Change/Earth System Science. We are seeking an individual who uses remotely sensed observations to study surface processes linked to the hydrological cycle and relationships with global change. Examples of research areas include surface water hydrology, soil moisture, groundwater, sedimentation and

erosion, biosphere-atmosphere interaction, and ice sheet processes. Appointment at the assistant level is anticipated.

Successful candidates will join the newly formed Jackson School of Geosciences with a large and diverse community of geoscientists and superb research facilities and support. The candidates will be enthusiastic teachers, direct the research of MS and PhD students, and conduct vigorous externally funded research programs. The anticipated starting date for these positions is August 2002; a PhD is required at the time of appointment. Please see <http://www.geo.utexas.edu> for additional information. To apply, please send a curriculum vitae, statements of research and teaching interests, and the names and contact information for four references to: Faculty Searches, Department of Geological Sciences, The University of Texas at Austin, Austin, Texas 78712. Review of applications will begin December 1, 2001, and will continue until positions are filled. The University of Texas is an Equal Opportunity/Affirmative Action employer.



Grand Canyon enthusiasts enjoy the confluence of the Little Colorado River and the Colorado River. Photo by Joel L. Pederson.

GeoTrip

Geology of Grand Canyon—Lee's Ferry to Diamond Creek
April 21–28, 2002
8 days, 7 nights

Scientific Leader: Carol M. Dehler, Utah State University, Logan, Utah. Dehler has spent the last decade studying Grand Canyon geology, and she recently completed a dissertation on the Neoproterozoic Chuar Group. Her background is in sedimentology, stratigraphy, and sedimentary geochemistry, and her interests include the Proterozoic and Paleozoic evolution of the western United States and the history of the Colorado River.

Description

During this 226-mile journey down the Colorado River through Grand Canyon, participants will explore the famous rocks, sediment, and canyon between Lee's Ferry and Diamond Creek. Participants will make an in-depth study of Proterozoic crystalline basement rocks, Proterozoic and Phanerozoic strata, karst features, a spectrum of faults and folds, and Quaternary volcanic features and stream terraces via whitewater raft trips and side-canyon hikes. Special evening seminars will address Grand Canyon-related hot topics, such as the snowball Earth hypothesis, the supercontinent Rodinia, and the cutting of Grand Canyon. Additionally, the human history and diverse desert wildlife of Grand Canyon will add to the breadth of the trip.

Fees and Payment

\$2,050 for GSA Members; \$2,150 for nonmembers. A \$300 deposit is due with your reservation and is refundable through January 15, 2002, less a \$50 processing fee. The total balance is due February 21, 2002. Minimum: 12. We are holding 12 spaces. Any additional spaces will be based on availability. **Included:** river guidebooks; geologic guide; transportation by bus from Las Vegas to Lee's Ferry (via Page) and from Diamond Creek back to Las Vegas; waterproof bags for clothing; life jacket; camping gear, including two-person tent, sleeping bag and pad, and eating utensils; all meals, beginning with breakfast on April 21 and ending with lunch on April 28; and soft drinks while on the river. **Not included:** airfare to and from Las Vegas; meals in Las Vegas; meals and lodging in Page; and alcoholic beverages.

Registrants with Special Needs

GSA is committed to making GeoTrips accessible to all. If you require special arrangements or have special dietary concerns, please contact Edna Collis, GSA Headquarters, (303) 357-1034.

REGISTER TODAY!

Send a deposit to hold your reservation; please pay by check or credit card. You will receive further information and a confirmation of your registration within two weeks after your reservation is received.

Name _____

Institution/Employer _____

Mailing Address _____

City/State/Country/ZIP _____

Phone (business/home) _____

Guest Name _____

GSA Member # _____

	DEPOSIT PER PERSON	NO. OF PERSONS	TOTAL PAID DEPOSIT
Grand Canyon	\$300	_____	\$_____

TOTAL DEPOSIT \$_____

VISA MasterCard American Express Discover

Credit Card # _____ Exp. Date _____

Signature _____

MAIL OR FAX REGISTRATION FORM AND CHECK OR CREDIT CARD INFORMATION TO:
 2002 GSA GeoVentures, Member Services
 P.O. Box 9140, Boulder, CO 80301
 fax 303-447-1133 or 303-443-1510

MAKE CHECKS PAYABLE TO: GSA 2002 GeoVentures

Memories: GeoHostel—Geology of Glacier National Park



GeoVentures is the overall name for adult educational and adventure experiences of two kinds: GeoHostels and GeoTrips. Both are known for superior scientific leadership. Fees are moderate (relative to the destination, length, time of year, and number of participants). GeoHostels are usually five-day, campus-based programs, whereas GeoTrips are anywhere from one to three weeks in length, and the itinerary covers a wide variety of destinations.

The Glacier National Park GeoHostel gang. Leaders Robert Thomas and Sheila Roberts, of Western Montana College, Dillon, Montana, led 38 participants, ranging in age from 36 to 83 and representing a variety of interests and backgrounds, on this GeoHostel July 14–19, 2001. "I loved the trip," wrote Robert J. Monaghan of Kirkwood, Missouri. "It would have been difficult to have done better. It was my first (GeoHostel), and time permitting, I'd do another!" Photo by Sheila Roberts.



Kinematics and Vorticity of High-Strain Zones

April 16–21, 2002

Virginia Blue Ridge and Piedmont

Conveners: Christopher M. Bailey, College of William & Mary; Andy R. Bobyarchick, University of North Carolina, Charlotte; Dazhi Jiang, University of Maryland

Location: Blue Ridge and Piedmont provinces, north-central Virginia, approximately 120 km southwest of Washington, D.C. Lodging at the Graves Mountain Lodge, Madison County.

For complete information and itinerary details, see the September issue of *GSA Today* (also available for viewing or downloading at www.geosociety.org/pubs/gsatoday), or the forum's Web site, www.wm.edu/CAS/GEOLOGY/faculty/bailey/GSA/fieldforum/.

Cost: \$550 (\$400 for students), including guidebooks, handouts, meals, lodging (double occupancy), refreshments, and transportation to and from the Charlottesville airport.

Registration Applications and Information: Geologists with an interest in high-strain zones are encouraged to apply. We hope to attract a diverse group of field geologists, modelers, and experimentalists.

Contact: Christopher (Chuck) M. Bailey, Department of Geology, College of William & Mary, Box 8795, Williamsburg, VA 23187, (757) 221-2445, fax 757-221-2093, cmbail@wm.edu.





Earth Systems Science Faculty Position Rice University Department of Earth Science

The Rice Earth Science Department anticipates expanding in faculty, staff, and facilities. We wish to fill several tenure track positions in Earth Systems Science to complement existing strengths. We are particularly interested in hiring a biogeochemist/geomicrobiologist, a quantitative geomorphologist, a low-temperature geochemist whose research includes numerical modeling, or a sedimentologist/stratigrapher whose research addresses processes from dynamic and 3D perspectives.

Applications at all levels will be considered; those received by December 3, 2001 are assured of receiving fullest attention.

Please send a resume and names of four or more references to:

Search Committee Chair,
Earth Science Department, MS-126,
Rice University, PO Box 1892
Houston, TX 77251-1892

Information about the department can be found at
<http://terra.rice.edu>

Rice is an equal opportunity affirmative action employer.

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full-time tenured position at the rank of professor to fill the newly endowed Murray Chair in Applied Clay Mineralogy. We seek an outstanding individual with a solid record of scholarly achievement in some area of clay research including but not limited to industrial uses of clays, clay minerals as biohazards, and environmental or biomedical applications of clay minerals. Relevant industrial experience, strong communication skills, and high professional visibility is desirable. The successful candidate will be expected to conduct a strong program of research in applied clay mineralogy and to participate in teaching and other academic activities appropriate for a senior faculty member at Indiana University.

Indiana University is an outstanding research and teaching institution with approximately 37,000 students on the Bloomington campus. The Department of Geological Sciences currently has 16 full-time faculty and five part-time faculty shared with other Indiana University units and the Indiana State Geological Survey. The department's existing laboratory infrastructure (XRD, EPMA, AA, ICP, SIRMS, etc.) will be augmented in the near future with the completion of Indiana University's multidisciplinary Science Building housing state-of-the-art analytical equipment. The department has very strong undergraduate and graduate programs and an outstanding Geological Field Station in Montana. Currently, there are 44 graduate students in the master's and Ph.D. programs.

Questions concerning this position or the Department of Geological Sciences can be addressed to Mark Person, by phone (812-855-4404) or e-mail (maperson@indiana.edu). Applicants should send a letter of interest, a personal statement of teaching and research interests, current resume, and names and addresses of at least four references (including e-mail) to: Professor Mark Person, Malcolm and Sylvia Boyce Chair of Geosciences, Department of Geological Sciences, Indiana University, 1001 East Tenth Street, Bloomington, IN 47405-1405.

The review of applications will begin on November 1, 2001, and will continue until the position is filled. Indiana University, as an equal opportunity/affirmative action

employer, encourages candidacies of women and minorities.

FACULTY POSITION, REMOTE SENSING GEOSCIENTIST UNIVERSITY AT BUFFALO THE STATE UNIVERSITY OF NEW YORK

The Department of Geology at the University at Buffalo, a Research I University, invites applications for a tenure-track faculty position in remote-sensing geoscience starting in August 2002 at the rank of assistant or associate professor. The successful candidate will demonstrate a potential for research and teaching that will complement and integrate with our existing programs in volcanology and environmental geology. Existing research in the department includes studies of volcanoes, surficial processes, neotectonics, fractured rock systems, groundwater, and basin analysis, including oil and gas exploration. All these research programs presently involve remote sensing. The successful candidate may also wish to collaborate with the National Center for Geographic Information and Analysis and the Center for Computational Research at the University at Buffalo. Teaching duties will involve undergraduate and graduate level courses in the candidate's specialties, and will include introductory structural geology. Successful candidates must have a Ph.D. degree at the time of appointment. Apply with a statement of teaching and research goals and a curriculum vitae, including published research, grant support, and names of at least three references to: Chair, Search Committee, Department of Geology, 876 Natural Science Complex, University at Buffalo, The State University of New York, Buffalo, NY 14260-3050. More information about our department can be found at: <http://www.geology.buffalo.edu>. We will begin evaluating applicants December 15, 2001. The University at Buffalo is an Equal Opportunity Employer/Recruiter.

SEDIMENTARY GEOLOGY CALIFORNIA STATE UNIVERSITY, FULLERTON

The Department of Geological Sciences, California State University, Fullerton, invites applications for a tenure-track position starting August 2002. We anticipate filling this position at the rank of assistant professor, however candi-

dates with exceptional qualifications may be considered for appointment at a higher rank. The successful applicant will have the following credentials and capabilities: a Ph.D. in geology; a primary interest in teaching and achieving excellence in teaching; a vigorous, field-based research program in sedimentary geology that can involve undergraduate and graduate students.

Teaching responsibilities will include some of the following: physical geology, historical geology, sedimentation and stratigraphy, paleontology, advanced sedimentology/stratigraphy, and field geology, as well as upper division and graduate courses in the new faculty member's area of expertise. Research activities must result in publications in refereed journals.

CSU Fullerton is a large urban university dedicated to the preeminence of learning. Located 22 miles southeast of metropolitan Los Angeles, the city of Fullerton is renowned for its unique mix of residential, commercial and industrial, educational, and cultural environments that provide residents with an outstanding quality of life. The department has 10 full-time faculty with expertise in traditional and applied areas of geology. The nearby geological provinces provide abundant opportunities for field-based research, which the department emphasizes in its curriculum. We have about 50 undergraduate majors and a growing M.S. graduate program. Additional information is available from our Web page at <http://geology.fullerton.edu/>.

To apply, please send the following: a detailed curriculum vitae; a letter of application that explains how you meet the qualifications outlined above; a statement about teaching that includes a discussion of relevant course work and/or experience in preparation for teaching, a list of courses you would feel comfortable teaching, and a statement of your teaching philosophy; a statement of your future research plans and goals; letters of recommendation from at least three references familiar with your teaching and research activities and potential—referees must send their letters directly to the address below.

Send application to: Dr Brady P. Rhodes, Chair, Search Committee, Department of Geological Sciences, California State University, PO Box 6850, Fullerton, CA 92834-6850. Applications will be accepted until January 31, 2002. Applications received after this date will be reviewed only if the position is not filled from the original pool of applicants.

California State University, Fullerton, is an Affirmative Action/Equal Opportunity Employer. All personnel policies conform to the requirements of Executive Order 11246, the Americans with Disabilities Act (ADA) of 1990, Title IX of the Higher Education Amendments of 1972 and other federal regulations regarding nondiscrimination.

TENURE TRACK POSITION SAN FRANCISCO STATE UNIVERSITY ENGINEERING / ENVIRONMENTAL GEOLOGY

The Department of Geosciences at San Francisco State University invites applications for a tenure-track faculty position at the assistant professor level in engineering/environmental geology, beginning August 2002. The position requires a Ph.D. in geology and a strong commitment to excellence in teaching at the graduate and undergraduate levels. We seek someone to teach advanced-level engineering geology courses and general education courses in natural hazards or earth systems. We also seek someone with training in surficial processes or geophysics who can contribute to courses and advising in one of these areas. The successful applicant will be expected to maintain an active research program that involves graduate and undergraduate students. Preference will be given to those who have applied experience with a geotechnical or environmental firm, strong quantitative skills, teaching experience, and interdisciplinary interests that include other geoscience fields.

The Department of Geosciences includes geology, meteorology, and oceanography and consists of 13 faculty members from these fields. The department offers B.S. and B.A. degrees in geology, a B.A. degree in meteorology, and a M.S. degree in applied geosciences.

San Francisco State University, a member of the California State University system, serves a multicultural, ethnically diverse student body of 27,000 students, offering bachelor's degrees in 117 academic areas and master's degrees in 95 fields of study. Excellence in teaching is the university's primary mission, although SFSU faculty are expected to demonstrate continued professional achievement and growth through research, publications, and community involvement.

To apply, send a curriculum vitae, a statement of teaching and research interests, and names and addresses of three references to: Lisa White, Dept. of Geosciences, San Francisco State University, San Francisco, CA 94132. Applications should be received before January 15, 2002. San Francisco State University is an Equal Opportunity/Affirmative Action employer.

WATERSHED PROCESSES—DARTMOUTH COLLEGE

The Department of Earth Sciences at Dartmouth College invites applications for two open rank positions in the general area of watershed processes. Areas of interest include hydrology, coastal processes, aqueous and biogeochemistry, fluvial processes, physical and chemical weathering, and glacial processes. The successful candidate will be expected to continue Dartmouth's strong tradition in both undergraduate and graduate research and teaching and to interact with existing strengths within the department. We anticipate one of these positions being filled at the senior level.

Send curriculum vitae, description of teaching and research interests and objectives, reprints or preprints of up to three of your most significant publications, and the names, address (including street address), e-mail address and fax/phone numbers of at least three references to: Search Committee, Department of Earth Sciences, Dartmouth College, 6105 Fairchild Hall, Hanover, NH 03755, e-mail: earth.sciences@dartmouth.edu, Web pages: <http://www.dartmouth.edu/~earthsci>.

Review of applications began October 15, 2001, and continue until the positions are filled. The appointments will be effective July 1, 2002.

Dartmouth College is an equal opportunity/affirmative action employer, is committed to diversity, and encourages applications from women and minorities.

OPEN-RANK FACULTY SEARCH IN EARTH-SURFACE PROCESSES

UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN

The Department of Geology at the University of Illinois, Urbana-Champaign, invites applications and nominations for a full-time tenure-track or tenured faculty position in earth-surface processes, broadly defined. The position starts on August 21, 2002. Applicants at the assistant, associate, and full professor levels will be considered; rank and salary will be commensurate with qualifications. A Ph.D. is required.

If the appointment is made with tenure, it carries an endowment and the title of W. Hilton Johnson Professor (or Associate Professor) of Geology. To be considered for an appointment with tenure, the successful applicant must

have a distinguished record of scholarship and disciplinary leadership. The successful applicant, at any rank, must demonstrate an ability to establish a prominent, innovative, externally funded research program, and to achieve excellence in teaching.

Disciplines under consideration include, but are not limited to: neotectonics, paleoclimatology, geomorphology, glacial geology, Quaternary geology, and crust-atmosphere-ocean-biosphere interaction. Numerous units at the University of Illinois have ongoing programs covering a variety of observational, experimental, and numerical approaches in these and complementary disciplines.

Applicants should submit a vita, record of research funding, list of publications, research and teaching plan, and the names of at least three referees to: Earth-Surface Processes Search, Department of Geology, University of Illinois, 1301 West Green Street, Urbana, IL 61801.

Questions can be directed to Prof. Stephen Marshak (217-333-7705; smarshak@uiuc.edu). In order to ensure full consideration, applications must be received by November 15, 2001. Further information about the Department is available on the Web at: <http://www.geology.uiuc.edu/>. The University of Illinois is an Affirmative Action, Equal Opportunity employer. Women, minorities, and other designated classes are encouraged to apply.

FACULTY POSITION (OPEN-RANK) MINERAL SCIENCE

UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN

The Department of Geology at the University of Illinois, Urbana-Champaign, invites nominations and applications for an endowed open-rank tenured or tenure-track faculty appointment in mineral science. This is a full-time position, and an earned Ph.D. is required. Rank and salary will be commensurate with experience. To be appointed at a tenured level, the successful candidate must have demonstrated leadership of a vigorous, internationally recognized research program; at the assistant professor level, the successful candidate should have demonstrated clear potential to establish such a program. An appointment made with tenure will carry the title of R.E. Grim Associate Professor or Professor (depending on rank). The successful candidate must demonstrate an ability to build excellence

in our academic programs at all levels.

Applicants should submit a curriculum vita, a list of publications, a record of research funding, a description of research and teaching interests, and the names of at least three referees to: Mineral Science Search Committee, Department of Geology, University of Illinois, 1301 West Green Street, Urbana, IL 61801. Applications by e-mail, nominations of candidates, or questions concerning the position may be directed to the search committee chair, Prof. Jay Bass, (217) 333-1018; fax: 217-244-4996; j-bass@uiuc.edu.

The University of Illinois offers M.S. and Ph.D. degrees in geology and geophysics. The campus hosts prominent programs in materials research and condensed matter science, and is located close to the Advanced Photon Source synchrotron facility at Argonne, Illinois. For full consideration, applications should be received no later than December 15, 2001. The starting date is August 21, 2002, or as soon thereafter as possible. The University of Illinois is an Affirmative Action/Equal Opportunity employer. Women, minorities, and other designated classes are encouraged to apply.

RESEARCH GEOLOGIST OR RESEARCH HYDROLOGIST GS-12 OR GS-13 U.S. GEOLOGICAL SURVEY VACANCY NO. USGS-C-416D

The U.S. Geological Survey seeks applicants for a research geologist or research hydrologist position to work on probabilistic analysis of landslide hazards. Present focus is on analyzing precipitation-induced landslides in the Pacific Northwest, but opportunities exist for expanding later into other geographic and topical areas related to the interaction of hillslope hydrology and slope stability. Ideal candidates would have considerable experience conducting surface and subsurface field investigations of landslides and have sound understanding of landslide mechanics, processes, and trigger mechanisms, particularly hydrologic triggers. Successful candidates will have experience collecting, analyzing, and interpreting subsurface water data in the context of slope stability. Knowledge of and experience with application of GIS and probabilistic methods to landslide studies are also desirable. Applicants are sought

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VALDOSTA STATE UNIVERSITY DEPARTMENT HEAD

DEPARTMENT OF PHYSICS, ASTRONOMY AND GEOSCIENCES

The Department of Physics, Astronomy and Geosciences invites applications/nominations for a strong and energetic leader to serve as Head. This is a twelve-month, tenure track appointment beginning July 1, 2002 at the rank of Associate or Full Professor. This interdisciplinary department with 15 full-time faculty members, offers majors in Astronomy, Environmental Geography, and Physics; minors in Astronomy, Geography, Geology and Physics; and has a cooperative Engineering program with Georgia Institute of Technology. The department has a strong commitment to teaching, service to the region, and research with approximately one-third of its faculty having externally funded grants. The Department is active in the Council for Undergraduate Research, and has a strong tradition of original research involving faculty and undergraduates. The department is a charter member of the Southeastern Association for Research in Astronomy (SARA), which operates remotely a 0.9 meter telescope at Kitt Peak National Observatory, Tucson, AZ, and administers the VSU Planetarium, which provides programs for approximately 3000 school children annually. In cooperation with the Department of Biology, the department co-administers the Lake Louise Field Station, a 170-acre natural area used for outdoor classes, and faculty and student research in geography, geology, and biology.

The head's responsibilities include the administration of the department, curriculum development, mentoring of the faculty's professional development, and teaching undergraduate courses in area of expertise. Applicants must have a record of scholarly accomplishment, a PhD in one of the department's disciplines, and sufficient experience to warrant appointment to the rank of Associate or Full Professor.

Valdosta State University, located in Valdosta, GA, the Azalea city, is within two hours drive of Jacksonville, Gainesville and Tallahassee, FL and Macon, GA. Enrollment in this rapidly growing institution is approximately 9,000 students.

Submit letter of application, curriculum vitae, evidence of excellence in teaching and scholarship, and three letters of recommendation should be addressed to: Dr. Ronald Barnette, Acting Dean, College of Arts & Sciences, VSU, Valdosta, GA 31698. For more information visit our website at www.valdosta.edu/phy. Review of applications will begin Nov. 30, 2001.

VSU is an equal opportunity educational institution.



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with skills and experience in the following areas: (a) field investigations of landslides, including planning and conducting mapping, subsurface sampling, and field instrumentation; (b) applying physically based, time-dependent, geomechanical, and hydrological models to analysis of landslide processes; (c) applying probabilistic methods to field and numerically based studies to determine the probability of landslide occurrence, landslide runoff or related problems in landslide hazard assessment; and (d) GIS-based analyses of landslide hazard. This is a permanent position with starting salary ranging from \$53,962 (GS-12) to \$64,169 (GS-13). The position is located in Golden, Colorado. Applicants must meet minimum educational and experience requirements. Complete qualification information and application procedures for this position can be found on line at: <http://www.usajobs.opm.gov/>. US Citizenship is required. This vacancy opens 11-05-01 and closes 12-07-01. Applications, including college transcripts and a separate statement addressing knowledge, skills, and abilities must be submitted to: U.S. Geological Survey, MS-612, P.O. Box 25046, Denver, CO 80225, and must be received by 12-07-01. Contact: Office of Personnel 303-236-9568. The U.S. Geological Survey is an equal-opportunity employer.

**CALIFORNIA INSTITUTE OF TECHNOLOGY
POSTDOCTORAL FELLOWSHIPS
IN GEOLOGICAL AND PLANETARY SCIENCES**

The California Institute of Technology announces two fellowships in earth and planetary sciences: The O.K. Earl Postdoctoral Fellowship, and The Texaco Postdoctoral Fellowship.

These awards are from funds endowed by ORRIN K. EARL, JR., and by the TEXACO PHILANTHROPIC FOUNDATION. Each fellowship carries an annual stipend of \$40,000 and offers a research expense fund of \$1,000 per year and one-way travel to Pasadena. The duration of each appointment will normally be for two years, contingent upon good progress in the first year, and beginning with the 2001-2002 academic year. Fellows are eligible to participate in Caltech's health and dental program.

These fellowships have been established to support the research of scientists typically within two years after receipt of the Ph.D. The intent of the program is to identify and support innovative and creative work in the earth and planetary sciences, with particular emphasis on interdisciplinary work. Applicants with training in physics, chemistry, biology or computer sciences are urged to apply. The Caltech faculty is currently active in geobiology, geochemistry, geology, geophysics, petrology, seismology, environmental science and engineering, and atmospheric and planetary sciences. It is expected that each fellowship holder will be hosted by a division professor (designated by the division chairman) who will contribute to the fellowship support both financially and by providing intellectual guidance.

Application forms may be obtained by writing to Prof. E.M. Stolper, Chair, Division of Geological and Planetary Sciences, Mail Code 170-25, California Institute of Technology, Pasadena, California 91125, or send e-mail to: mmedley@gps.caltech.edu, or forms can be downloaded from our Website: <http://www.gps.caltech.edu/positions/>

Completed applications with references should arrive at Caltech by Thursday, December 20, 2001.

Fellowship candidates will automatically be considered for other available postdoctoral positions at Caltech in their fields of interest.

Caltech is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans, and disabled persons are encouraged to apply.

**RESEARCH SCIENTIST—PLANETARY SCIENCE
THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY**

The Space Physics Group of The Johns Hopkins University Applied Physics Laboratory invites applications for a senior-level staff position in planetary science. Candidates should possess the ability to lead programs in several areas of space physics research.

As part of a nationally recognized research and development organization, you will work with an existing planetary science group involved with ongoing planetary missions, including CONTOUR and MESSENGER, as well as the recently completed NEAR mission to asteroid 433 Eros. Will also lead research programs in planetary science involving space instrumentation, mission data analysis, and modeling, support major proposal efforts, and publish and present the results of your research.

Requirements include a strong publication record in planetary science, a Ph.D. in geology, geophysics, or the equivalent, and demonstrated communication skills. Although not required, experience in Mars geology/geo-

physics or icy satellites and a record of individual grant or mission support in these areas are a plus.

JHU/APL offers a comprehensive benefits package that includes a matching retirement program, educational assistance, and salaries commensurate with qualifications and experience.

Interested candidates should send a resume and cover letter that includes their qualifications, research interests and goals, a publication list, and three professional preferences.

The Johns Hopkins University Applied Physics Laboratory Attn: Nora R. Rogers, c/o Dr. Andrew Cheng, Planetary Science Director, Recruiter21@jhuapl.edu, fax 240-228-0112, 11100 Johns Hopkins Road, Laurel, MD 20723-6099.

To learn more about JHU/APL, please visit our Web site at <http://www.jhuapl.edu/>. EOE, M/F/V/D.

**KOTLOWSKI/BUREAU FELLOWSHIP
NEW MEXICO BUREAU OF GEOLOGY
& MINERAL RESOURCES, NEW MEXICO TECH**

The New Mexico Bureau of Geology & Mineral Resources (a division of New Mexico Tech) is seeking candidates for the newly established Kottowski/Bureau Fellowship. The fellowship, for an incoming Ph.D. candidate in the earth sciences at NMTech, offers a 12-month \$18,000 salary plus actual tuition costs (guaranteed for 1 year, renewable for 3 years). Additional funding is available to cover some field and laboratory expenses. Applicants can have interests in any earth or environmental science specialty, but will be expected to do a project that is either within the state or of particular interest to the state in conjunction with advisors from both the Bureau and the Department. Application deadline is February 1, 2002. Applicants will automatically be considered for other forms of support through the department. NMTech is a highly rated science and engineering school, located in Socorro, New Mexico, with 1,600 students and more than 60 professional earth-science faculty and staff shared between the academic division and the Bureau.

A more complete description of the fellowship, NMTech and the bureau is available on departmental and bureau Web pages (<http://www.ees.nmt.edu> and <http://geoinfo.nmt.edu>). In addition to applying for graduate admission to the department, a letter indicating your interest in this fellowship should be addressed to: Director, Bureau of Geology & Mineral Resources, New Mexico Tech, 801 Leroy Place, Socorro, NM 87801.

**MINERALOGIST/PETROLOGIST
EASTERN MICHIGAN UNIVERSITY**

The Department of Geography and Geology invites applications for a tenure-track faculty position at the assistant professor level in the field of geology, effective August 2002. A Ph.D. is required at the time of appointment.

We seek a creative candidate with expertise in mineralogy/petrology who is committed to excellence in undergraduate teaching. Teaching responsibilities will include mineralogy and a diverse array of undergraduate geology and earth science courses. Preference will be given to candidates with a record of research and publication. Strong computer skills and field experience are an asset.

Applicants should send a letter of application including a statement about how you meet the qualifications, your teaching and research interests, a detailed curriculum vitae that includes education, publications, experience; and the names, addresses, phone numbers, and e-mail addresses of at least three references familiar with your teaching and research potential. Send applications or requests for further information to: Posting #F 0207, Eastern Michigan University, 202 Boone Hall, Ypsilanti, MI 48197.

The selection process will begin January 1, 2002, and continue until the position is filled. Eastern Michigan University is an EO/AA employer. Women and minorities are encouraged to apply. For additional information about the department and the university, see our Web site: www.emich.edu/public/geo/welcome.html.

AMHERST COLLEGE—ASSISTANT PROFESSOR

The Department of Geology at Amherst College solicits applications for a tenure-track position at the level of assistant professor to begin in the fall of 2002. We seek a sedimentologist whose interests and expertise may also include stratigraphy, paleontology, paleoclimatology, marine geology, and/or oceanography.

The successful candidate will teach sedimentology and an additional upper-level course or courses that will strengthen our undergraduate major and complement the present departmental offerings in tectonics, structural geology, hydrogeology, aqueous geochemistry, petrology, and geophysics. All geology faculty teach at the introductory level as well. Preference will be given to candidates with a demonstrated interest in continued development and teaching of our introductory course in surficial earth systems and the environment. Geology faculty also supervise

undergraduate research projects annually.

Candidates must have an ongoing program of research. Amherst College provides competitive start-up funds in support of research. A Ph.D. is required and postdoctoral experience is desirable.

Submit a résumé, a brief statement of your research interests, transcripts, and three letters of recommendation to: Professor Tekla A. Harms, Chair of the Search Committee, Department of Geology, Amherst College, Amherst MA 01002-5000 (taharms@amherst.edu). Review of applications will begin on November 20, 2001, but applications will be accepted until a pool of qualified candidates is identified.

Amherst College is an equal opportunity/affirmative action employer. Women, minorities, and persons with disabilities are particularly encouraged to apply.

BAYLOR UNIVERSITY—STRUCTURAL GEOLOGY

The Department of Geology at Baylor University invites applications to fill a vacancy in structural geology, rank and salary negotiable. A Ph.D. in geology or a related discipline is required at the time of appointment. Responsibilities will include introductory and advanced instruction in structural geology, supervision of graduate research, and the development of an active research program. The successful candidate will be expected to support the graduate program in petroleum geology, regardless of their area of specialty. Applications for this tenure-track position will be reviewed beginning immediately, and will be accepted until the position is filled. To ensure full consideration, your application must be completed by November 30, 2001.

Applicants should submit a letter of application addressing qualifications and experience, a curriculum vitae, description of teaching and research interests, transcripts of academic work, and the names of three professional references to: Dr. Stacy Atchley, Department of Geology, P.O. Box 97354, Baylor University, Waco, Texas 76798-7354. Phone: (254) 710-2361. E-mail: stacy_atchley@baylor.edu. Fax: 254-710-2673. The Baylor Geology Web site is www.Baylor.edu/~Geology.

Baylor is a Baptist university affiliated with the Baptist General Convention of Texas. As an Affirmative Action/Equal Opportunity employer, Baylor encourages minorities, women, veterans, and persons with disabilities to apply.

**GEOMORPHOLOGY/SURFICIAL PROCESSES
FURMAN UNIVERSITY**

The Department of Earth and Environmental Sciences at Furman University invites applications for a tenure-track position at the assistant professor level for the fall 2002.

The required qualifications are a Ph.D. in geology or physical geography, the ability to develop a strong undergraduate research program, and some teaching experience. Experience using current ESRI software and an interest in applying GIS to geological, environmental, and ecological research is desired. Teaching duties would include earth systems, geomorphology, and an advanced course in area of expertise. The successful candidate would be expected to excel in teaching and to develop a strong research program involving talented undergraduates. The department currently consists of four faculty with specializations in watershed hydrology, biogeochemistry, structure and tectonics, mineralogy and petrology, and sedimentation. Furman University is a private liberal arts university with a strong emphasis on undergraduate research and teaching. Furman's location in the Piedmont region of South Carolina at the base of the Blue Ridge escarpment provides many opportunities for field tripping and research in fluvial processes, neotectonics, and landscape evolution, including human impact on the landscape.

Applicants should send a vita including experience, publications, statement of teaching philosophy and research interests, and names of three references. Applicants should discuss how their research could be applied in the undergraduate setting.

Applications and requests for more information should be sent to Kenneth A. Sargent, Dept. of Earth and Environmental Sciences, Furman University, Greenville, SC 29613, or e-mailed to ken.sargent@furman.edu. Furman University is an equal opportunity, affirmative action employer.

VADOSE ZONE/SURFACE PROCESSES

THE UNIVERSITY OF COLORADO AT BOULDER

The University of Colorado at Boulder invites applicants for a tenure-track position at the assistant professor level to begin fall 2002. We are interested in candidates who study chemical and/or physical processes in the vadose zone or at Earth's surface. Such processes include, but are not limited to, fluid and gas flow in porous media, solute or colloid transport, weathering, and mechanics of erosion. Candidates should use quantitative approaches in collecting and interpreting field and/or laboratory data. The successful

candidate will have a Ph.D. with a strong background in at least one of the following areas: multiphase flow, continuum mechanics, interfacial thermodynamics and kinetics involving soil water, or low-temperature mineralogy and crystal chemistry. Candidates will be expected to teach one lower-division geology class for non-majors, and upper-division undergraduate and graduate classes in his/her area of expertise. Applicants should submit a curriculum vitae, the names and addresses of at least three references, a statement of research goals that includes a brief summary of important scientific questions in their field, and a statement of undergraduate and graduate teaching plans. Applications should be sent to Chair, Vadose Zone/Surface Search, Department of Geological Sciences, 399 UCB, University of Colorado, Boulder, CO 80309. Applications will be reviewed beginning December 1, 2001, and the position will remain open until filled. The University of Colorado at Boulder is committed to diversity and equality in education and employment.

Services and Supplies

MINERAL SPECIMENS FOR RESEARCH, EDUCATION, AND FOR MINERAL COLLECTIONS. Our Web site at www.mineralminers.com is a virtual gallery displaying thousands of photographic images of unique mineral specimens from mining locations around the world. Also displayed are rare gemstones, mineral spheres, large decorator minerals, lapidary rough, and a variety of handcrafted mineral gift ideas. www.mineralminers.com—“Collector Quality at Miner’s Prices!”™

RECENT, RARE, AND OUT-OF-PRINT BOOKS. Find our online catalog at <http://home.earthlink.net/~msbooks> for books on geology, mining history, ore deposits, U.S. Geological Survey, and western Americana; e-mail: msbooks@earthlink.net. For free printed catalogs, send your request and area(s) of interest to MS Book and Mineral Company, P.O. Box 6774, Lake Charles, LA 70606-6774.

ENVIRONMENTAL AND ENGINEERING GEOPHYSICISTS required by Geo-Services International (UK) Ltd, Oxfordshire, UK. Apply to info@zetica.com. Visit www.zetica.com.

Opportunities for Students

Graduate Student Fellowships. Graduate Program of Hydrologic Sciences, University of Nevada, Reno. Applications are encouraged for three graduate teaching/research assistantships beginning July 1, 2002. Each position carries an annual stipend of \$14,000 including tuition and fees. One student will be selected in each of the following areas: groundwater hydrology, surface-water hydrology, and environmental geochemistry. Additionally, research assistantships are available in paleohydrology, groundwater and surface hydrology as well as scholarships and doctoral fellowships (three year) offered through UNR and the Desert Research Institute. Completed application packages are due January 10, 2002, and should be mailed to: Graduate Program of Hydrologic Sciences, Mail Stop 175, LMR 267, Reno, NV 89557-0180. Information on these opportunities in the Hydrologic Sciences Program can be found at www.hydro.unr.edu or by calling Ms. Sam Miller, Program Manager, at (775) 784-6469 or e-mail miller@unr.edu.

Graduate Student Opportunity in Sedimentology/Stratigraphy at Washington State University. The Department of Geology at Washington State University is pleased to offer an NSF-funded Ph.D. graduate assistantship to study how eustasy and/or climate fluctuations influenced the early evolution of metazoans in Early Cambrian carbonate and siliciclastic rocks. The field area, in the Northwest Territories, Canada, is rugged and remote so the successful candidate must be in good physical shape and enjoy working in small groups in such areas.

The WSU Geology Department offers expertise in sedimentology/stratigraphy/paleoclimatology, hydrogeology, volcanology, economic geology, structural geology and mineralogy. The Geoanalytical Laboratory (<http://www.wsu.edu/~geology/Pages/Services/Geolab.html>) housed in our department is well equipped for quantitative analysis of sediments.

For more information about this opportunity, contact Dr. Mike Pope, Dept. of Geology, Washington State University, Pullman, WA 99164-2812, (509) 335-5989, mcpoppe@wsu.edu.

2nd Rice Type Locale Field Trip: CUBA. Continent-Island Arc Collision. January 3-12, 2002. Rice University Department of Earth Science. The Department of



Earth Structure and Dynamics Faculty Position Rice University Department of Earth Science

The Rice Earth Science Department anticipates expanding in faculty, staff, and facilities. We wish to fill several tenure track positions in Earth Structure and Dynamics to complement existing strengths. We are particularly interested in hiring in the areas of earthquake seismology, global seismology and petroleum exploration seismology.

Applications at all levels will be considered; those received by December 3, 2001 are assured of receiving fullest attention.

Please send a resume and names of four or more references to:

Search Committee Chair,
Earth Science Department, MS-126,
Rice University, PO Box 1892
Houston, TX 77251-1892

Information about the department can be found at <http://terra.rice.edu>

Rice is an equal opportunity affirmative action employer.

Earth Science at Rice University will host a field trip to Cuba, examining a type example of a continent-island arc collision. Cuba not only has fascinating geology but also is beautiful. Before the Eocene, Cuba was part of the Caribbean plate, but after its collision with the Bahama Platform in Eocene time, Cuba became part of the North American plate. Cuba offers a wide variety of rock types and structures: ophiolites, serpentinites, island arc basalts, and eclogites; Jurassic/Cretaceous clastic sedimentary rocks and platform limestones; karst topography; Quaternary terraces and eolian deposits; and modern lagoons and reefs. There are also chaotic deposits related to the meteorite impact at Chicxulub, Yucatan, Mexico, that wiped out the dinosaurs and many other groups of plants and animals at the Cretaceous-Tertiary boundary. We will also visit a few tourist spots and have some time to roam the streets of Havana.

Undergraduate and graduate students of other universities who applied early (by October 15) for admission to the graduate program in the Department of Earth Science, Rice University, can also apply to attend this field trip. Student participants will receive a substantial subsidy from the department. Some room is available for faculty from other universities and colleges. For application to the graduate program and the field trip, see the departmental Web page at <http://terra.rice.edu> or contact Sandra Flechsig at sandraf@rice.edu.

Research Assistantships for M.S. Students in Environmental Geology, Akron, Ohio. Recently acquired grants in spatial analysis of constructed wetlands and fluid migration through karst terrane offer opportunities for M.S. students interested in environmental issues. We are looking for motivated students interested in evaluating the effectiveness of constructed wetlands for treating pollution from abandoned mines, farm runoff and other non-point sources. This EPA-sponsored project provides funding for two geology and two biology graduate students per year (including summer support). This project is field oriented and will require the student to travel extensively throughout

Ohio while collecting and analyzing geochemical and biologic data related to these wetlands. The student will also conduct spatial analysis, remote sensing and data analyses using Geographical Information System software. Interested applicants should contact Dr. David Steer (steer@uakron.edu) with a statement of interest and qualifications. An additional one to two students are sought to conduct field research on groundwater flow in the carbonate rocks of Ohio. The project is also funded by EPA and will address sinkhole development and delineation of karst regions by dye-tracing. For details, contact Dr. Ira Sasowsky (ids@uakron.edu) with a statement of interest and qualifications.

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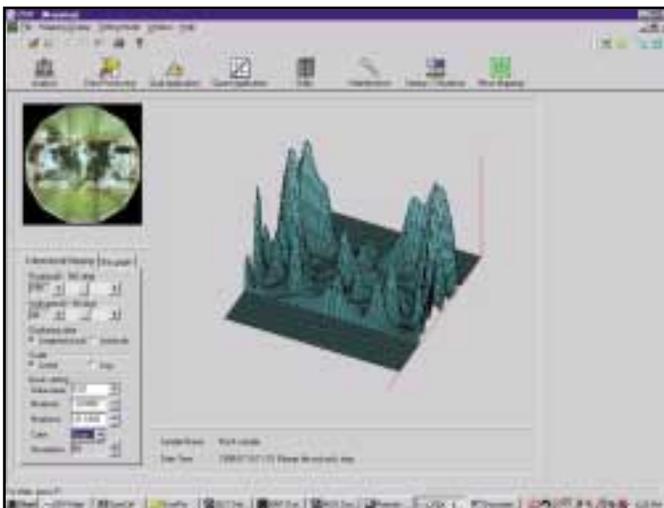
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