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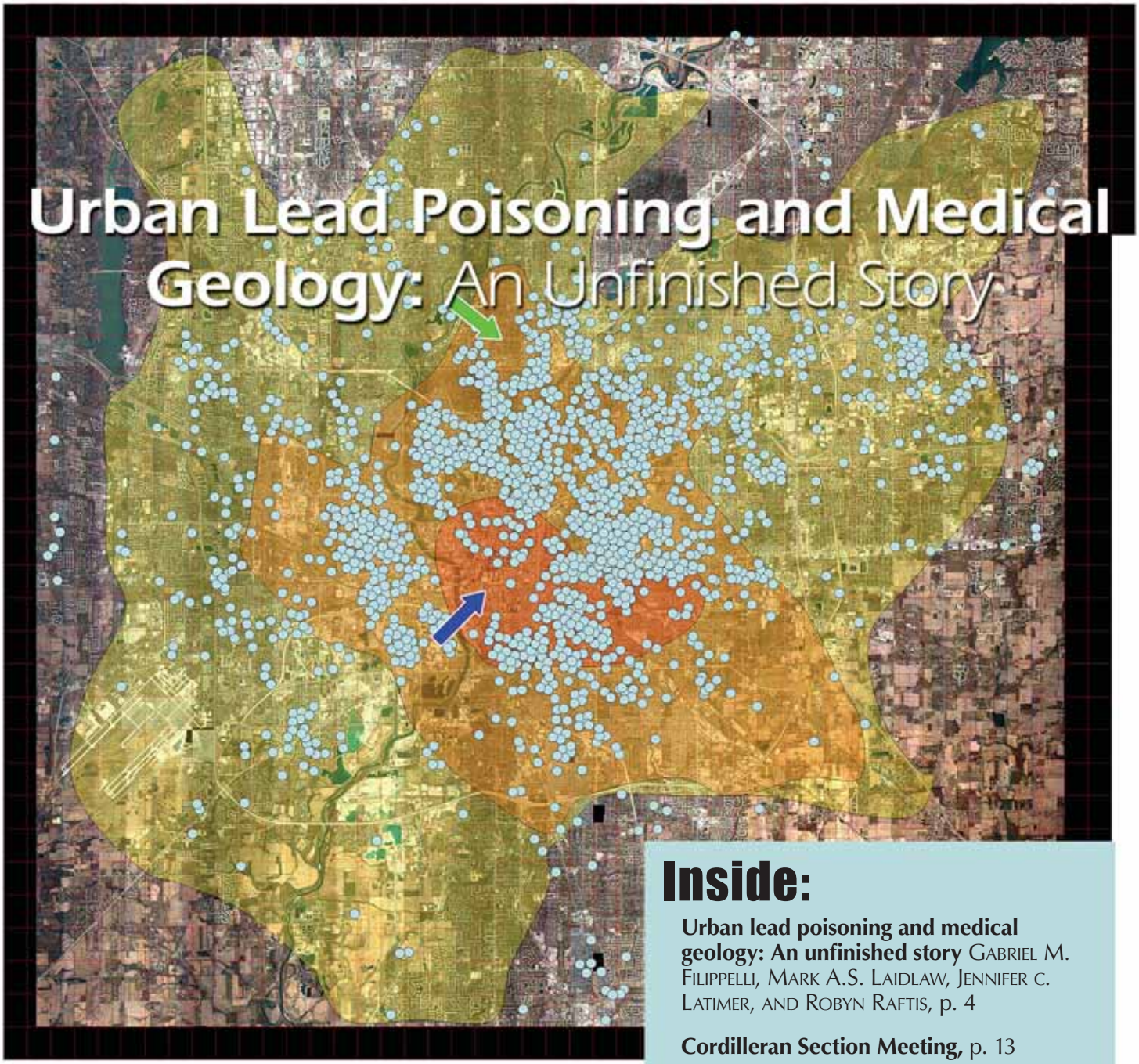
VOL. 15, NO. 1 A PUBLICATION OF THE GEOLOGICAL SOCIETY OF AMERICA JANUARY 2005



Urban Lead Poisoning and Medical Geology: An Unfinished Story

Inside:

GSA TODAY

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GSA TODAY (ISSN 1052-5173 USPS 0456-530) is published 11 times per year, monthly, with a combined April/May issue, by The Geological Society of America, Inc., with offices at 3300 Penrose Place, Boulder, Colorado. Mailing address: P.O. Box 9140, Boulder, CO 80301-9140, USA. Periodicals postage paid at Boulder, Colorado, and at additional mailing offices. Postmaster: Send address changes to *GSA Today*, GSA Sales and Service, P.O. Box 9140, Boulder, CO 80301-9140.

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Volume 15, Number 1

JANUARY 2005

Cover: Satellite infrared image showing the distribution of children considered lead poisoned (dots) along with the concentration of lead in surface soils (colored fields) from Indianapolis, Indiana, USA, supporting a link between exposure to diffuse soil lead and toxicity in urban youth. See "Urban lead poisoning and medical geology: An unfinished story" by Filippelli et al., p. 4–11.

SCIENCE ARTICLE

Urban Lead Poisoning and Medical Geology: An Unfinished Story

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ABSTRACT

The intersection between geological sciences and human health, termed *medical geology*, is gaining significant interest as we understand more completely coupled biogeochemical systems. An example of a medical geology problem largely considered solved is that of lead (Pb) poisoning. With aggressive removal of the major sources of Pb to the environment, including Pb-based paint, leaded gasoline, and lead pipes and solder, the number of children in the United States affected by Pb poisoning has been reduced by 80%, down to a current level of 2.2%. In contrast to this national average, however, about 15% of urban children exhibit blood Pb levels above what has been deemed "safe" (10 µg per deciliter); most of these are children of low socioeconomic-status minority groups. We have analyzed the spatial relationship between Pb toxicity and metropolitan roadways in Indianapolis and conclude that Pb contamination in soils adjacent to roadways, the cumulative residue from the combustion of leaded gasoline, is being remobilized. Developing strategies to remove roadway Pb at the source is a matter of public health and social justice, and constitutes perhaps the final chapter in this particular story of medical geology.

INTRODUCTION

The industrial age has seen a number of technological advances that have had unforeseen environmental and human consequences. The awareness of the severe neurotoxicity of lead (Pb) in humans, for example, provoked a number of regulatory measures, including phase-out of Pb as additives to gasoline, paint, water pipes, and solder, which significantly reduced the human exposure to Pb. The end product of these actions? A reduction in Pb poisoning of children by 80% since the late 1970s—now <2.2% of U.S. children between the ages of one and five are considered Pb-poisoned (National Health and Nutrition Examination Survey [NHANES], 2003).

By all usual accounts, the recent turnaround in national health statistics related to Pb poisoning implies a seamless and uniform industrial and governmental response to this threat and denotes the end of Pb as a human health risk. Sadly, such is not the case—many urban areas still exhibit high Pb poisoning rates in children under age six (the most vulnerable age interval for Pb toxicity; Koller et al., 2004), reaching values up to 29% of the 0.5–5 yr old population in New Orleans, Louisiana (Rabito et al., 2003), and even higher overseas (e.g., 78% of school children in Johannesburg, South Africa are considered Pb-poisoned; Mathee et al. [2002]). Childhood Pb poisoning continues to be a major public health problem in the United States, particularly for low-income, urban, African-American children (Roberts et al., 2001). The emission control and public health strategies used in the past have not been successful at overcoming this urban poisoning remnant (Agency for Toxic Substances and Disease Registry [ATSDR], 2002), and until we fully understand the anthropogenic, geologic, and socioeconomic web that results in the poisoning of urban youth, this remains an unfinished story in the annals of medical geology.

In this paper, we introduce the historical perspective of Pb use, particularly in leaded gasoline, and the findings that Pb has significant health impacts for humans. But more importantly, we discuss how integrating geologic factors, like soil, Pb geochemistry and cycling, and soil moisture and resuspension, into public health practices may help to ultimately eliminate Pb poisoning as a human health concern.

HISTORY

Lead toxicity has been known for centuries, but it was not until the industrial revolution that this issue became a widespread problem. Lead is a soft and workable metal easily extracted from galena ore, characteristics that were widely exploited by preindustrial populations. The Romans developed the first large-scale quarrying and working operations for Pb, exploiting the newly conquered Iberian Peninsula and its rich metal deposits to produce finished Pb used in containers, water pipes, and as a Pb-salt preservative for wines (in which application the Pb becomes very bioavailable); evidence of the global impacts of this quarrying effort are seen in Greenland ice core records (Hong et al., 1994; Rosman et al., 1997).

By far the largest use of Pb has occurred in the industrial era, where two new applications of Pb were found in the twentieth century: Pb-based paints and tetraethyl/methyl additives to gasoline. Lead-based paints, which contain up to 15% Pb, are extremely durable and flexible, and their use expanded dramatically during the 1920s (Fig. 1). The production and use of Pb for gasoline additives was spurred by the need to control the explosion of gasoline in cylinders of internal combustion engines. Thomas Midgely, an engineer for General Motors and DuPont, perfected the formulation of Pb additives in the 1920s, but the peak in Pb use for this application follows the trend in automobile use in America, with a peak closer to 1970 (Fig. 1). Midgely (ironically, also the inventor of Freon®, the chlorofluorocarbon chemical implicated in stratospheric ozone loss) first developed an effective anti-knock additive using plant biomass–produced alcohol, but as this additive could be produced by any farmer and was not patentable, he was told to continue searching, eventually finding that adding ~2% Pb oxides to gasoline works well. An early warning sign went up when scores of workers were severely poisoned in the 1920s by Pb toxicity in plants producing tetraethyl Pb additives, although a multi-pronged industrial cover-up limited public awareness of this situation (Markowitz and Rosner, 2002). The

GSA Today; v. 15; no. 1; doi: 10.1130/1052-5173(2005)015<4:ULPAMG>2.0.CO;2

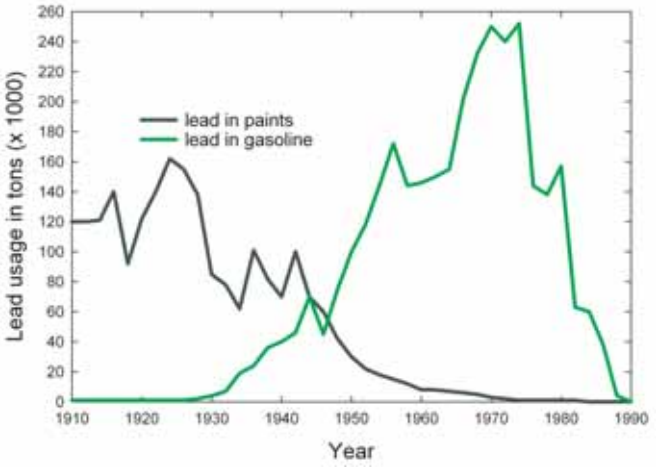

Figure 1. History of Pb usage in paints and gasoline during most of the twentieth century, showing the early dominance of Pb-based paints followed by the boom in transportation resulting in a high use of leaded gasoline (after Mielke, 1999). The decline after the mid-1970s was due to controls put into place to eliminate leaded gasoline.

dawn of the automobile age shelved concerns of the environmental impacts of tetraethyl Pb as affordable transportation dramatically altered the American landscape of the twentieth century.

Just how much the use of tetraethyl and other Pb impacted our environment began to be discerned in the 1950s in a laboratory at the California Institute of Technology. There, an isotope geochemist named Clair Patterson was carefully examining earth materials using new methods of mass spectrometry, with a goal of understanding the age of Earth (which, remarkably, he pinned at 4.55 Ga in 1963, nearly identical to modern estimates). He used radiogenic Pb isotopes for this work, and soon found that Pb isotopic ratios were excellent tools for fingerprinting source regions of sedimentary rocks and water bodies. One persistent problem he had in these efforts was the prevalence of contamination by anthropogenic Pb sources. Turning his considerable talents to this problem of contamination ended up being one of the great stories in medical geology. Patterson found that Pb resulting from human activity was everywhere, including water, soil, arctic ice, and most troubling, in people. Indeed, the development of Pb isotopic techniques has significantly enhanced our understanding of sources of additional Pb to the environment and cycling of Pb in soils (Deboudt et al., 1999; Sañudo-Wilhelmy and Gill, 1999; Kurkjian and Flegal, 2003) and in human tissues (Graziano et al., 1996; Gwiazda and Smith, 2000; Manton et al., 2000; Rothenberg et al., 2001). Showing an academic bravery just short of foolishness, Patterson not only published his troubling findings of Pb contamination and potential poisoning in humans in peer-reviewed scientific journals (e.g., Settle and Patterson, 1980), but he also raised the alarm to regulators, industries, and lawmakers, pointing out that the sources of this contaminant were clear and could be completely eliminated. After many well-documented attacks on his credibility, funding, and job by industry advocates (see Bill Bryson's 2003 book, *A Short History of Nearly Everything*, for an excellent recounting), he succeeded in convincing lawmakers to eliminate Pb use in pipes, solder, and finally, in 1986, gasoline. As a measure of the value that the geological community placed on these efforts, the Geochemical Society's Environmental Geochemistry Medal is named in honor of Patterson.

LEAD AND HUMAN HEALTH

In part due to Patterson's crusade, new sources of Pb to the environment have been virtually eliminated in the United States and are being reduced and/or eliminated in many other countries as well. The net impact of this elimination can best be measured from a human health standpoint by the concentration of Pb in blood serum samples (venous blood Pb level). A portion of the Pb ingested via soil or water and/or inhaled is absorbed in the intestine and incorporated in the body. Inhalation is a minor uptake pathway and ingestion via water has largely been reduced with the replacement of Pb water pipes and water tanks with non-Pb alternatives. However, Pb in soil and dust continues to be a major source of exposure (Koller et al., 2004). Based on clinical trials, the portion of ingested Pb that is taken up in the body is typically less than 5% for adults, whereas it is as high as 50% for children due to their less-developed gastrointestinal pathway (Ziegler et al., 1978; Maddaloni et al., 1998).

Due to similar charges and ionic radii, Pb is utilized in biological processes much like Ca, including as a critical component of converting the electrical neural signal into a chemical signal and as a component of hydroxyapatite in the production of bone material. When engaged in the former process, Pb does not function as a neurotransmitter, effectively creating permanent neural differentiation defects resulting in mental retardation, learning disorders, and attention deficit hyperactivity disorder (ADHD). Because of their high ingestion efficiency and the rapid neural differentiation during early brain and nervous system development, children are especially vulnerable to the permanent effects of Pb poisoning. When Pb is incorporated in bone material, the bone becomes a long-term source of Pb to the biological system—bone is regenerated on monthly to yearly timescales, leaking additional Pb into the system. For this reason, children treated by medical interventions like blood chelation may continue exhibiting toxic levels of Pb in their blood (Roberts et al., 2001). In summary, persistent elevated Pb concentration in children can create a cascade of severe and permanent mental, behavioral, and physiological problems.

The health standards for Pb levels in blood have been revised steadily downward over the years as medical research has determined toxicological effects of Pb even in low quantities. The U.S. Centers for Disease Control and Prevention (CDC) in 1991 chose 10 μg/dL as an initial screening level for Pb in children's blood, although some research suggests that levels even lower than this can cause some toxicological effects (Bernard, 2003; Brown and Meehan, 2004). The persistent presence of Pb in children is a public health issue of a first order. As noted earlier, as a U.S. national average, 2.2% of children under the age of 6 exhibit blood Pb levels above this screening level, although this value is often above 15% among urban youth. In a summary from a national health survey, Brody et al. (1994) state "the exposure to Pb at levels that may adversely affect the health of children remains a problem

especially for those who are minority, urban, and from low-income families. Strategies to identify the most vulnerable risk groups are necessary to further reduce Pb exposure in the United States." Factors affecting children in this socioeconomic class include poor nutrition with the potential for pica behavior (a subconscious desire to ingest soil and dust to overcome nutritional deficits), inadequate pediatric health care, poor home maintenance with a high percentage of rental housing, a significant proportion of urban housing with high dust and dirt exposure, and relatively low awareness of the links between health and behavior.

In this paper, we use the city of Indianapolis, Indiana, a typical older midwestern United States city, to explore in detail the continuing sources and the pathways for exposure that face urban youth. Indianapolis is the 12th largest city in the country, with diversity reflecting the national average (25% African-American and Hispanic), a significant proportion of pre-1940s housing (with Pb-based paint use), and a large interstate transportation connection downtown with a clear history of leaded gasoline use. Additionally, Indianapolis has excellent public health records from which to extract the distribution of Pb-poisoned children. Combining information about point sources of environmental contamination, a sampling technique designed to determine more diffuse sources of soil Pb, seasonality studies, and public health data, we demonstrate the ongoing impact that past Pb contamination has on the population, and provide several recommendations for determining and predicting Pb contamination and poisoning.

METHODS

All soil samples used in this study were collected from amalgamated sampling techniques (a 10 m grid with pooled surface samples of the upper 5 cm of soil). Samples were sieved to 63 microns to minimize the effect of grain size variations in Pb concentration. Dried soils were ashed at 550 °C and digested for 2 h in warm (90 °C) 3N trace metal grade hydrochloric acid. Supernatants were diluted with ultra-pure water (Milli-Q) and analyzed via inductively coupled plasma–atomic-emission spectrometry. All digestions were run with National Institute of Standards and Technology (NIST) soil standards for reference. Replicates were also run for all analyses, with typical analytical reproducibility of ~2%. Additional details and results for a number of other trace metals can be found in Laidlaw (2001).

ROADWAY SOURCES OF Pb

The aerosolized combustion products (containing Pb) from the burning of leaded gasoline in internal combustion engines initially deposit within ~50 m of a roadway if no obstructions are present (Fig. 2). The fate of deposited Pb then depends on the conditions of the depositional area. Although intersections of busy streets may have received over one metric ton of Pb per year (Mielke et al., 1997), their impervious surfaces lead to continual runoff of Pb-enriched particulates down storm drains (and from there into treatment plants or directly into rivers). If the particulate Pb is deposited instead on a grassy fringe, like a front yard or park, the Pb can be effectively retained. In such a setting, the insolubility of Pb leads to surface peaks in Pb concentration of soils (Fig. 3); in relatively undisturbed soils, this surface Pb enrichment may be the product of decades of Pb deposition from gasoline and may reach levels above 1000 ppm (Mielke, 1999; Mielke et al. 2003).

The roadway Pb generally is partitioned into the highly bioavailable carbonate, iron, and manganese hydroxide soil fractions, while the natural Pb in soils is speciated in the residual, or non-bioavailable fractions (Chlopecka et al., 1996; Lee et al., 1997). Lead is associated with the smallest particles, the clay grain size fraction in urban soils (Dong et al., 1984). Therefore, dust originating from urban soils contaminated by anthropogenic Pb is more toxic than naturally occurring dust and is more potent and concentrated than would be expected from simple measurements of the Pb content of the soil (Young et al., 2002).

DIFFUSE SOIL Pb AND CHILDREN'S HEALTH—A CASE STUDY FROM INDIANAPOLIS

The original sources of Pb to the environment were distinct sources, including Pb-based paints, gasoline-emitted Pb, and Pb emitted from smelters. As detailed above, Pb does not originally deposit far from its source, and its geochemical characteristics promote rapid sequestration onto surface soil particulates (usually via surface complexation of Pb and Pb oxides with soil organic matter). But an analysis of many urban areas reveals that these point sources have, to some extent at least, been redistributed to produce regions of Pb enrichment. Several factors can lead

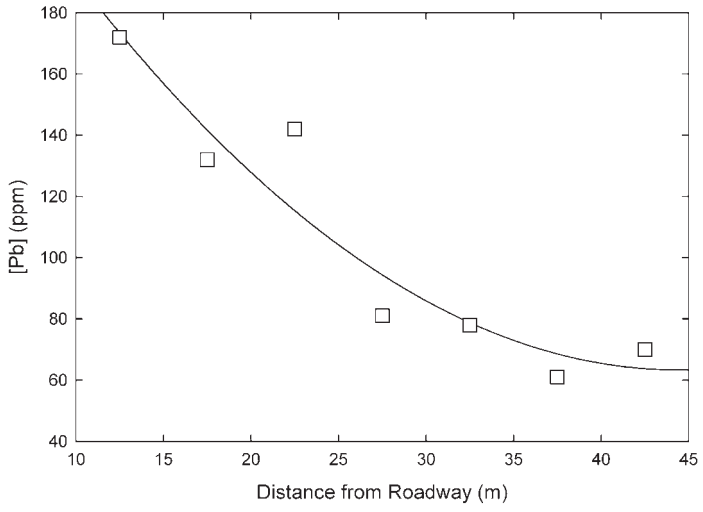

Figure 2. The exponential decay of Pb in surface soils as a function of distance from a roadway source along a suburban street in Indianapolis, Indiana (Kessler Boulevard). This curve is typical of the roadway effect, showing both the rapid deposition of Pb in exhaust particulates from the combustion of leaded gasoline and the persistence of this Pb in surface soils (leaded gasoline use stopped ~20 yr ago). A second-order regression fits data the best, yielding a correlation coefficient (r^2) of 0.902. Symbol size is larger than error bars on both axes.

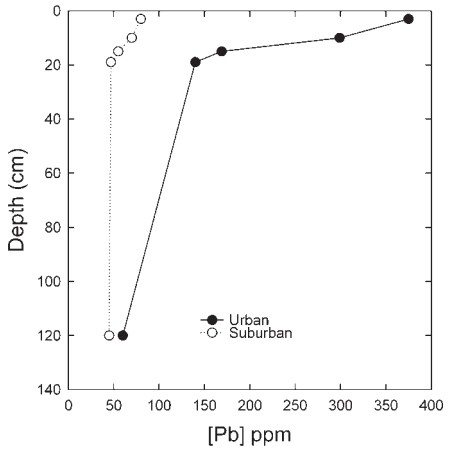

Figure 3. Concentration of Pb as a function of depth from two soil cores in Indianapolis, displaying the surface peak in both an urban and suburban settings far from direct sources of Pb deposition (e.g., painted structures or roads). This plot shows a soil background level of 50 ppm Pb (consistent with geological materials) and the surface retention of Pb, but also displays the ambient diffuse soil Pb enrichment in urban versus suburban areas. Sampling locations are in Laidlaw (2001).

to redistribution of Pb-enriched particles and soil—this issue will be addressed more completely in the next section—but the recurrence of a general urban enrichment of soil Pb has been documented in many regions (e.g., Mielke et al., 1983), and the potential impacts of this urban contamination were presaged by the classic quote by Clair Patterson (NAS, 1980), "Sometime in the near future it probably will be shown that the older urban areas of the United States have been rendered more or less uninhabitable by the millions of tons of poisonous industrial Pb residues that have accumulated in cities during the past century." To explore this generalized urban enrichment, termed *diffuse soil Pb*, and evidence of its potential human health impact, we first show the pattern of diffuse soil Pb in Indianapolis, then the link between soil Pb and children's blood Pb levels.

One of the characteristics of Pb distribution in the surface soils of cities is a distinct decrease in concentration from the city center to suburban surroundings (Mielke, 1999), a legacy both of Pb deposition, redistribution, and smearing of original point sources, and less Pb deposition in newer suburban neighborhoods due to recent Pb controls. This urban-suburban gradient can be illustrated by examining diffuse soil Pb along an urban roadway transect (Washington Street) versus one in the suburbs (East Kessler Blvd.) of Indianapolis. Washington Street, the route of the National Road (U.S. 40) in Indianapolis, experiences high local traffic loads and is bordered by very old urban neighborhoods. In contrast, the suburban East Kessler Boulevard was developed from a country road to a suburban thoroughfare in the 1970s, during a time when the use of leaded gasoline was declining significantly (Fig. 1). In the reference year 1980 (the official phase-out of leaded gas was 1986, although most vehicles were running on unleaded fuel by 1981), East Kessler Boulevard experienced a relatively high daily traffic load, but only ~50% that of Washington Street at the westernmost intersection. A comparison of the Pb loading from roadway sources along these two streets reveals three main factors of roadway Pb deposition. First, the decrease in Pb concentration away from the roadway is manifest in both higher and lower traffic volume settings (Fig. 4). Second, although leaded gasoline use spanned a relatively short time along the suburban roadway, the legacy of this deposited roadway Pb remains, attesting to the immobility of Pb after deposition. Finally and most critically, the urban roadway example shows both the impact of the long-term Pb loading from leaded gasoline close to the roadway as well as the diffuse soil Pb that blankets urban regions (Fig. 4). In other words, even at distances from the roadway beyond where direct Pb deposition occurs (and far away from structures using Pb-based paint), the background level for Pb is significantly higher in the urban transect (~500 ppm) than in the suburban transect (~60 ppm). This urban-suburban gradient is one overriding factor affecting the amount of Pb loading to individuals, a factor that we will next assess on a larger scale and with respect to human health.

Children's Blood Pb Levels and Diffuse Soil Pb

In many urban areas of older cities, large segments of children below the age of six have venous blood Pb levels exceeding the action level of 10 µg/dL (e.g., Mielke, 1999)—such is the case in Indianapolis. The actual distribution of blood Pb levels exceeding action limits is getting more difficult to obtain due to privacy issues, but in the past, blood Pb values could be collected from health department records down to the level of a street address, providing an outstanding way to examine the environmental factors in human health. The address-level distribution of blood Pb levels exceeding action limits in Indianapolis from 1992 to 1994 is informative. Much of the higher blood Pb values are concentrated in urban areas, particularly downtown. In contrast, very

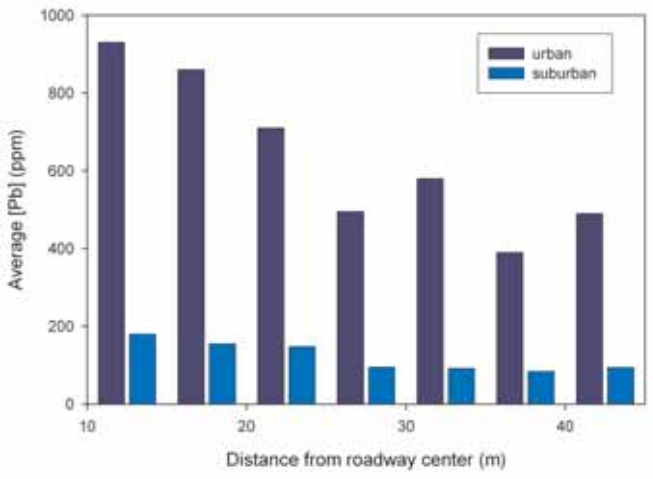

Figure 4. Average Pb concentrations in surface soil as a function of distance from the roadway using the urban Washington Street and suburban East Kessler Boulevard transects. The decrease away from the roadway source is apparent, but more importantly, there are significantly higher values in the urban transect, even at distances up to 42.5 m from the road center, beyond the range of direct deposition of Pb particulates from the combustion of leaded gasoline. Additionally, the significant near-roadway loading of surface soils in the urban transect is reflective of higher daily traffic volumes and the much greater duration of the urban roadway as an important traffic artery.

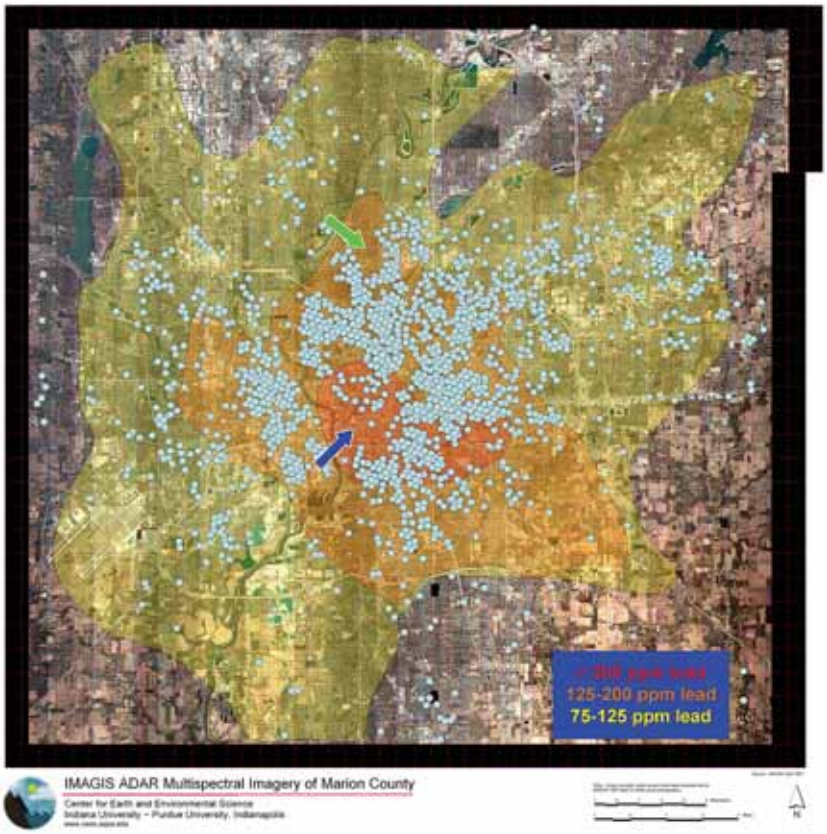

Figure 5. Satellite infrared image of Indianapolis, central Indiana (the boundaries are the Marion County borders—the city of Indianapolis officially extended its boundaries to those of the county in 1970). The concentration of diffuse soil Pb in surface soils of Indianapolis (colored regions) displays a characteristic pattern of urban enrichment trending toward background values in suburban and agricultural regions. The overprint of high diffuse soil Pb presented here corresponds roughly to the distribution of elevated blood Pb levels in children, displayed as circles for the distribution of children's venous blood samples exhibiting Pb concentrations above the level of concern (10 µg/dL) from 1992 to 1994 in Indianapolis. Most elevated blood samples are from the downtown region (significant overlap of multiple positive results occur in this region), with some additional scattered positive results ranging toward the older suburban development to the west and the east. These trends in positive samples are not dominantly controlled by population density, as the northern corridor and northeast portion of Indianapolis have population densities similar to those in the central urban region. The arrows point to regions with high diffuse soil Pb but low incidence of Pb poisoning, at apparent odds with the direct link between soils and blood. As with all epidemiological processes, a number of factors act as filters between potential exposure and toxicology, like socioeconomic status, age, population distribution, etc. In the case of the blue arrow, the lack of Pb poisoning is due to the lack of habitations in this industrial corridor, while the green arrow highlights a main street that displays a socioeconomic divide between poverty-line neighborhoods in the near-urban area and upper-middle and upper-class neighborhoods in the northern suburban area.

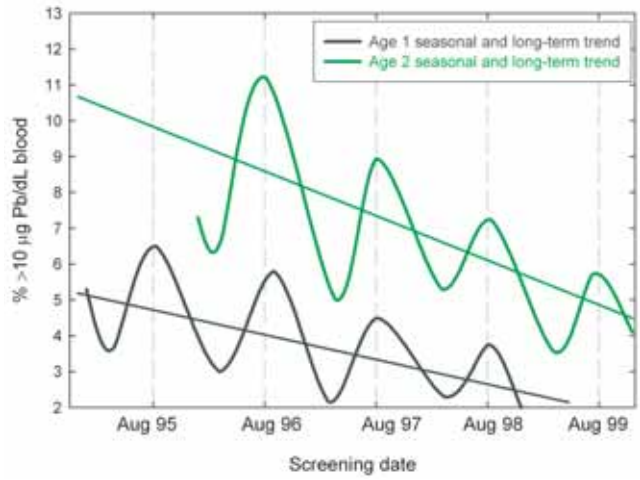

Figure 6. Seasonal patterns in children's blood Pb levels from New York State, showing summer peaks and a general decline from 1995 to 1999 (after Haley and Talbot, 2004). Note the generally higher levels of Pb poisoning in two-year-olds ("Age 2"), who are generally more mobile with consequently greater hand exposure to Pb-contaminated surfaces and more access to the outdoors.

few incidences of blood Pb poisoning are found in the newer suburban areas to the west, north, south, and northeast sides of the city (Fig. 5). Because these are individual blood Pb data, population density plays some role in the distribution; for example, rural farmlands on the city outskirts have few incidences. But based on the 1999–2000 U.S. Census (Laidlaw, 2001), the population density per census tract in the newer suburban areas with few blood Pb poisoning incidences is comparable to the urban and near-urban areas with a high incidence.

To explore the concept of diffuse soil Pb (i.e., Pb now present far away from its initial depositional area) and its potential role in affecting children's health (e.g., Lanphear et al., 1998), we carefully selected sampling locations throughout Indianapolis. Our sampling criteria included soil >50 m from roadways and from structures (which might have contributed Pb-based paint), and was augmented by aerial photographic records over Indianapolis from several time slices (1940, 1970). The purpose of these aerial photographs was to rule out the potential for inadvertently sampling soils from disturbed, excavated, or filled areas that might have surface Pb contents characteristic of artificial materials rather than ambient soil. As one can imagine in a rapidly developing urban area, these criteria narrowed acceptable sites to only ~100 distinct sites (because of tillage, even the agricultural sites were excluded). Many of the acceptable sites were in parks, cemeteries, and very large lawns. Analyses were also carried out to determine whether soil source material showed any inherent Pb variation. The soil in Marion County (the area surrounding and including Indianapolis) is glacial outwash, till, and alluvium with a variety of lithologies including limestone, shale, and

granite. No trend was found between Pb content and soil composition across Marion County (Laidlaw, 2001), and thus we suggest that soil mineralogy is a minor control on the Pb distributions presented here.

In contrast to roadway and house-side soil sampling, which might exhibit Pb concentrations above 1000 ppm, the highest soil Pb concentrations in our study were below 500 ppm. The lowest Pb concentrations averaged ~50 ppm, which is a typical value for soils in this region based on a comparison to selected rural sites (Fig. 3; Laidlaw, 2001) and which we consider here the geological background value. As expected, the highest soil Pb concentrations were centered directly over the old urban and industrial areas of Indianapolis (Fig. 5), where the diffuse soil Pb content averaged ~200 ppm. Beyond this central hot spot, Pb concentrations decreased systematically toward the suburban outskirts of the city, ultimately falling to background values in the rural fringes of the city (Fig. 5). The central peak is consistent with the long history of Pb use in the downtown area, but the generally high values even away from point sources support the argument of a redistribution of Pb over time. This is a common feature of urban Pb distribution (e.g., Mielke, 1999), and it is likely related to the wind-driven redistribution of fine Pb-enriched particulates in a statistically consistent pattern (e.g., a two-dimensional exponential decay curve) over decades.

Combining the distribution of soil Pb with that of children's blood Pb poisoning reveals several important characteristics of diffuse soil Pb as a potential contributor to children's health problems. First, the similarity in the distribution of elevated soil and blood Pb values downtown reveals the potential for diffuse soil Pb to be an additional and important factor in children's blood Pb levels. Second, population patterns definitely have some influence on the health distribution data. For example, some areas downtown have perhaps the highest concentration of diffuse soil Pb but surprisingly few incidences of Pb poisoning (blue arrow on Fig. 5); in this case, this is because this region is an industrial area with no housing. In another case, the lack of correlation between soil Pb and blood Pb corresponds with a very high socioeconomic status in a wealthy northside neighborhood (green arrow on Fig. 5).

Although many factors influence the relationship between geology and human health in the story of Pb, it is clear from the lack of closure on this issue that we do not yet understand all of the contributing factors. Furthermore, the generalized approach presented above provides a reference point for further work, but does not integrate health data and geologic data well, nor does it present clear recommendations that geologists can make to health specialists in further reducing this public health hazard beyond the incredibly costly and disruptive solution of removing all of the contaminated surface soil in urban areas and replacing it with clean fill. Several bridging efforts are now being pursued to help further medical geology in the context of eliminating childhood Pb poisoning. Beyond simply documenting Pb distribution and its public health implications, current research is also examining more closely Pb as a toxicological agent with predictable behavior. For example, isotopic techniques have been utilized to closely examine the entry mechanisms of Pb into the body and the cycling of Pb within the body (e.g., Maddaloni et al., 1998; Gwiazda and Smith, 2000), with a goal of pinpointing the source of Pb toxicity in individuals and thus more closely coupling prevention and treatment. Another new tool of promise in accurately assessing Pb poisoning is predictive modeling of children's blood Pb levels using climatologic data.

CLIMATIC FACTORS AND A BLOOD Pb PREDICTIVE MODEL FOR HEALTH CARE RESEARCH

Several studies have identified a seasonal trend in blood Pb levels, with average monthly blood Pb levels of children from urban areas increasing significantly in summer months (Rabinowitz and Needleman, 1982; Hwang and Wang, 1990; Johnson et al., 1996; Mielke and Reagan, 1998; Yiin et al., 2000; Johnson and Bretsch, 2002; Haley and Talbot, 2004), perhaps partly due to increased exposure to Pb-based paint on window sills and through increased contact with soils containing Pb during the summer. A positive in this trend is that, overall, children's blood Pb values continued to decrease through the 1990s, but the seasonal trend in values seen in comprehensive studies is still a striking feature (Fig. 6). Summer increases of children's blood Pb levels were so prominent over many years in Syracuse, New York, that the researchers concluded that the phenomena was probably caused by the interaction between climate and soils (Johnson et al., 1996; Johnson and Bretsch, 2002), leading to enhanced dust Pb loading to children. An intriguing alternative hypothesis for blood Pb seasonality is internal, whereby bone material is increasingly recycled during summer months, releasing stored Pb to the blood stream (Rothenberg et al., 2001). Additionally, the increased amount of time that children spend outdoors in the summer when school is out may lead to increased exposure to Pb in soil.

To better constrain this possible climate–soil–human health link, we have been investigating in detail variations in children's blood Pb levels as a function of climate and soil factors in several urban areas. The ultimate goal of this effort is to develop a predictive model whereby a medical researcher can make an accurate diagnosis of Pb poisoning based on seasonal and weather-related factors as well as blood Pb level data. With a focus on Indianapolis (ongoing analyses are also being conducted in several other cities, with similar results as those presented here), we used a number of climatologically independent variables, including average monthly soil moisture, particulate matter <10 microns in size (PM10), wind speed, and temperature obtained from state and federal government data sources. We also used blood Pb databases obtained from local and state governmental sources and averaged them monthly (Fig. 7).

Based on this multiple regression model, and unpublished results from several other American cities, we believe that the seasonality in children's blood Pb levels (Fig. 7) is controlled by exposure to Pb dust originating from contaminated soils and suspended in the air when several weather-related environmental conditions are present:

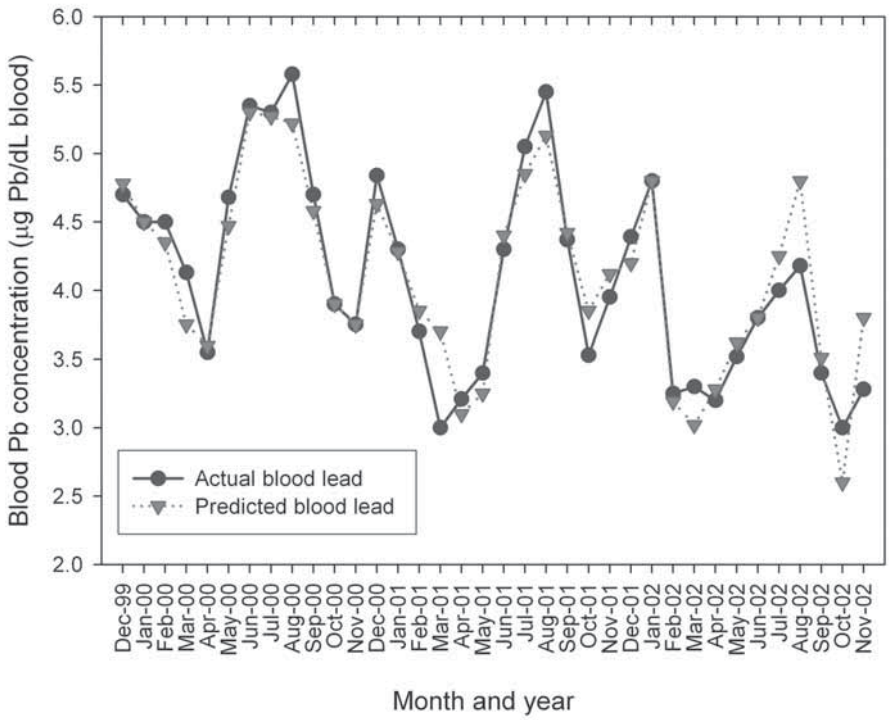

Figure 7. Best-fit model results to predict blood Pb levels (BLLs) in children from Indianapolis compared to actual monthly average BLLs. This type of effort can be used to better treat Pb poisoning from a public health perspective by providing clinicians with predicted trends of BLLs (functionally calculated as a percent deviation from the mean) at a given blood sampling event, allowing them to calculate the potential increase or decrease with time given normal exposure. Twelve separate multiple linear regression models, not presented in this paper, were modeled and differed only in the dependent variable. The independent variables for each model consisted of soil moisture, wind speed, particulate matter <10 microns in size (PM10), temperature, atmospheric Pb, interaction variables, and monthly dummy variables (M1 to M11). The time period of the regression consisted of 36 months between December 1999 and November 2002. The dependent variables for the models included monthly child blood Pb data from (1) a variety of subregions in Indianapolis, (2) a variety of BLLs, and (3) a variety of ages (i.e., 0–1.0, 1.01–2.0, 2.01–3.0, 3.01–4, 4.01–5, and 5.01–7.0 yr). The blood Pb database totals during this time interval included a monthly child blood Pb data set of 15,969 children. The outcome variable, children's average monthly city blood Pb concentration, was regressed against the average monthly independent variables soil moisture, PM10, wind speed, temperature, interaction variables, and monthly dummy variables using backward elimination procedures. The dominant wind direction in Indianapolis is east-southeast (Laidlaw, 2001), but in our initial analysis, wind direction had no predictive application for blood Pb values. This model indicates that the variables or interaction variables including soil moisture, wind speed, PM10, temperature, and the monthly dummy variables for March through September explain 87% of the variation in the response variable, monthly average child BLL concentration (correlation coefficient, r^2, = 0.87; number of individuals = 15,969).

high temperature, low soil moisture, and elevated atmospheric PM10. When temperature is high and evapotranspiration is maximized, soil moisture becomes low, and the generation of soil dust is maximized. Under these combined weather conditions, Pb-enriched PM10 dust disperses in the urban environment and is manifest by elevated Pb dust loading. In this case, exposure is via increased dust loads in homes and on contact surfaces, with ingestion as the uptake mechanism. Although further work using detailed tracking of Pb, possibly involving Pb isotopic studies as outlined above, may help to elucidate the connection between seasonality and blood Pb values, we argue that the ability of geochemical and meteorological factors to predict blood Pb supports our supposition that external loading and exposure drives much of the blood Pb concentrations.

In addition to the development of hypotheses related to the incorporation of Pb into children's systems, a promising result of these modeling analyses is the ability to predict toxicity in a given population. In other words, through easily collected atmospheric and soil data, a health researcher can determine the expected variation in blood Pb levels of the general population and, if performed in more detail using the subset of children's age, the expected variation in a given young patient. This is particularly important when attempting to treat blood Pb poisoning using discrete venous sampling events—a "safe" level measured in the spring under conditions of high soil moisture could become a poisonous level in the same patient just several months later when atmospheric conditions increase ambient Pb loading.

CONCLUSIONS AND RECOMMENDATIONS

The controls placed on the use of Pb have been incredibly successful in lowering the general loading of Pb to the environment and have resulted in impressive and positive human health benefits. Nevertheless, we continue to be faced with the legacy of Pb deposition, particularly in urban environments. As a result of this environmental and geological situation, over 400,000 children in the United States between the ages of one and five are still poisoned by Pb (NHANES, 2003), many of them from lower socioeconomic minority households. In this paper, we highlighted the persistence of Pb in surface soils as a potential route for the continued poisoning of urban youth, with socioeconomic status being a large contributor to the problem in areas with high ambient soil Pb. Although education and remediation seems to show continuing health benefits, it is likely that we will have to adopt another strategy, including soil Pb and soil dust exposure, to get over the final hurdle and eradicate Pb poisoning in this country. This strategy might include

funded programs focused on aggressive landscaping of urban soils that are implicated in Pb poisoning, including mulching, geotextile barriers, dilution of soil Pb with added clean top soil, or construction projects like decking installation to remove children and their homes from exposure to Pb-enriched dust and soils. By collecting data and designing studies that more directly inform the health sciences community, particularly with the application of spatially-referenced studies and Pb isotopic techniques, researchers in the field of medical geology may have an important part to play in improving the short and long-term health of urban youth.

ACKNOWLEDGMENTS

We would like to thank the early and continued inspiration from H. Mielke and D. Johnson, students in a variety of courses at Indiana University–Purdue University Indianapolis who have contributed intellectually and physically to this work, and David Bivin for statistical assistance, including the suggestion of the monthly dummy variables to increase modeling significance. Reviews by W. Berry Lyons, Thomas Ziegler, Jeff Chiarenzelli, Samuel Bowring, and Gerry Ross improved this manuscript substantially.

REFERENCES CITED

Agency for Toxic Substances and Disease Registry [ATSDR], 2002, Pediatric environmental health: Case studies in environmental medicine: Atlanta, Georgia, ATSDR Publication no. ATSDR-HE-CS-2002-0002, 88 p.

Bernard, S.M., 2003, Should the Centers for Disease Control and Prevention's childhood lead poisoning intervention level be lowered?: American Journal of Public Health, v. 93, p. 1253–1260.

Brody, D.J., Pirkle, J.L., Kramer, R.A., Flegal, K.M., Matte, T.D., Gunter, E.W., and Paschal, D.C., 1994, Blood lead levels in the U.S. population. Phase 1 of the Third National Health and Nutrition Examination Survey (NHANES III, 1988 to 1991): Journal of the American Medical Association, v. 272, p. 277–283, doi: 10.1001/jama.272.4.277.

Brown, M.J., and Meehan, P.J., 2004, Health effects of blood lead levels lower than 10 μg/dL in children: American Journal of Public Health, v. 94, p. 8–9.

Bryson, B., 2003, A short history of nearly everything: New York, Broadway Books, 560 p.

Chlopecka, A., Bacon, J.R., Wilson, M.J., and Kay, J., 1996, Forms of cadmium, lead, and zinc in contaminated soils from southwest Poland: Journal of Environmental Quality, v. 25, p. 69–79.

Deboudt, K., Flament, P., Weis, D., Mennessier, J.P., and Maquinghen, P., 1999, Air pollution sources assessment using the lead isotopic signature technique: The Science of the Total Environment, v. 236, p. 57–74, doi: 10.1016/S0048-9697(99)00286-7.

Dong, A., Chesters, G., and Simsiman, G.V., 1984, Metal composition of soil, sediments, and urban dust and dirt samples from the Menomonee River Watershed, Wisconsin, U.S.A.: Water, Air, and Soil Pollution, v. 22, p. 257–275, doi: 10.1007/BF00159348.

Graziano, J.H., Blum, C.B., Lolacono, N.J., Slavkovich, V., Manton, W.I., Pond, S., and Moore, M.R., 1996, A human in vivo model for the determination of lead bioavailability using stable isotope dilution: Environmental Health Perspectives, v. 104, p. 176–179.

Gwiazda, R., and Smith, D.R., 2000, Lead isotopes as a supplementary tool in the routine evaluation of household lead hazards: Environmental Health Perspectives, v. 108, p. 1091–1097.

Haley, V.B., and Talbot, T.O., 2004, Seasonality and trend in blood lead levels of New York State children: BMC Pediatrics, v. 4, p. 8, doi: 10.1186/1471-2431-4-8.

Hong, S., Candelone, J.-P., Patterson, C.C., and Boutron, C.F., 1994, Greenland ice evidence of hemispheric lead pollution two millennia ago by Greek and Roman civilizations: Science, v. 265, p. 1841–1843.

Hwang, Y.-H., and Wang, J.-D., 1990, Temporal fluctuation of the lead level in the cord blood of neonates in Taipei: Archives of Environmental Health, v. 45, p. 42–45.

Johnson, D., and Bretsch, J., 2002, Soil lead and children's BLL Levels in Syracuse, NY, USA: Environmental Geochemistry and Health, v. 24, p. 375–385, doi: 10.1023/A:1020500504167.

Johnson, D., McDade, K., and Griffith, D., 1996, Seasonal variation in pediatric blood levels in Syracuse, NY, USA: Environmental Geochemistry and Health, v. 18, p. 81–88.

Koller, K., Brown, T., Spurgeon, A., and Levy, L., 2004, Recent developments in low-level lead exposure and intellectual impairment in children: Environmental Health Perspectives, v. 112, p. 987–994.

Kurkjian, R., and Flegal, R.A., 2003, Isotopic evidence of the persistent dominance of blood lead concentration by previous gasoline lead emission in Yerevan, Armenia: Environmental Research, v. 93, p. 308–315, doi: 10.1016/S0013-9351(03)00066-5.

Laidlaw, Mark, 2001, Distribution and sources of metals in soils of Marion County, Indiana [M.S. Thesis]: Indianapolis, Indiana University, 175 p.

Lanphear, B.P., Matte, T.D., Rogers, J., Clickner, R.P., Dietz, B., Bornschein, R.L., Succop, P., Mahaffey, K.R., Dixon, S., Galke, W., Rabinowitz, M., Farfel, M., Rohde, C., Schwartz, J., Ashley, P., and Jacobs, D.E., 1998, The contribution of lead-contaminated house dust and residential soil to children's blood lead levels. A pooled analysis of 12 epidemiologic studies: Environmental Research, v. 79, p. 51–68, doi: 10.1006enrs.1998.3859.

Lee, P.-K., Touray, J.-C., Bailiff, P., and Ildefonse, J.-P., 1997, Heavy metal contamination of settling particles in a retention pond along the A-71 motorway in Sologne, France: The Science of the Total Environment, v. 201, p. 1–15, doi: 10.1016/S0048-9697(97)84048-X.

Maddaloni, M., Lolacono, N., Manton, W., Blum, C., Drexler, J., and Graziano, J., 1998, Bioavailability of soil-borne lead in adults by stable isotope dilution: Environmental Health Perspectives, v. 106, p. 1589–1594.

Manton, W.I., Angle, C.R., Stanek, K.L., Reese, Y.R., and Kuehnemann, A.J., 2000, Acquisition and retention of lead by young children: Environmental Research, v. 82, p. 60–80, doi: 10.1006/enrs.1999.4003.

Markowitz, G., and Rosner, D., 2002, Deceit and denial: The deadly politics of industrial pollution: Berkeley, University of California Press, 428 p.

Mathee, A., Schirnding, Y.E.R., Levin, J., Ismail, A., Huntley, R., and Cantrell, A., 2002, A survey of blood lead levels among young Johannesburg school children: Environmental Research, v. 90, p. 181–184.

Mielke, H.W., 1999, Lead in the inner cities: American Scientist, v. 87, p. 62–69, doi: 10.1511/1999.1.62.

Mielke, H.W., and Reagan, P., 1998, Soil is an important pathway of human lead exposure: Environmental Health Perspectives, v. 106, supplement 1, p. 217–229.

Mielke, H.W., Anderson, J.C., Berry, K.J., Mielke, P.W. Jr., and Chaney, R.L., 1983, Lead concentrations in inner-city soils as a factor in the child lead problem: American Journal of Public Health, v. 73, p. 1366–1369.

Mielke, H.W., Dugas, D., Mielke, P.W. Jr., Smith, K.S., and Conzales, C.R., 1997, Associations between soil lead and children's blood lead in urban New Orleans and rural Lafourch Parish of Louisiana: Environmental Health Perspectives, v. 105, p. 950–954.

Mielke, H.W., Gonzales, C., Powell, E., Coty, S., and Shah, A., 2003, Anthropogenic distribution of lead, *in* Skinner, H.C.W., and Berger, A.R., eds., Geology and health: Closing the gap: New York, Oxford University Press, p. 119–124.

National Academy of Sciences [NAS], 1980, Lead in the human environment: Committee on lead in the human environment: Washington, D.C., National Academy of Sciences, p. 265–349.

National Heath and Nutrition Examination Survey [NHANES], 2003, Centers for Disease Control and Prevention, http://www.cdc.gov/nchs/about/major/nhanes/nhanes99-02.htm, Accessed 15 Aug. 2004.

Rabinowitz, M.B., and Needleman, H.L., 1982, Temporal trends in the lead concentration of umbilical cord blood: Science, v. 216, p. 1429–1431.

Rabito, F.A., Shorter, C., and White, L.E., 2003, Lead levels among children who live in public housing: Epidemiology (Cambridge, Massachusetts), v. 14, p. 263–268.

Roberts, J.R., Reigert, J.R., Eberling, M., and Hulsey, T.C., 2001, Time required for blood lead levels to decline in non-chelated children: Journal of Toxicology, Clinical Toxicology, v. 39, p. 153–160, doi: 10.1081/CLT-100103831.

Rosman, K.J., Chisholm, W., Hong, S., Candelone, J.-P., and Boutron, C.F., 1997, Lead from Carthaginian and Roman Spanish mines isotopically identified in Greenland ice dated from 600 B.C. to 300 A.D.: Environmental Science & Technology, v. 31, p. 3413–3416., doi: 10.1021/es970038k.

Rothenberg, S.J., Kondrashov, V., Manalo, M., Manton, W.I., Khan, F., Todd, A.C., and Johnson, C., 2001, Seasonal variation in bone lead contribution to blood lead during pregnancy: Environmental Research, v. 85, p. 191–194, doi: 10.1006/enrs.2000.4238.

Sañudo-Wilhelmy, S.A., and Gill, G.A., 1999, Impact of the Clean Water Act on the levels of toxic metals in urban estuaries: The Hudson River estuary revisited: Environmental Science & Technology, v. 33, p. 3477–3481, doi: 10.1021/es981130z.

Settle, D.M., and Patterson, C.C., 1980, Lead in albacore: Guide to lead pollution in Americans: Science, v. 207, p. 1167–1176.

Young, T.M., Heerman, D.A., Sirin, G., and Ashbaugh, L.L., 2002, Resuspension of soil as a source of airborne lead near industrial facilities and highways: Environmental Science & Technology, v. 36, p. 2484–2490, doi: 10.1021/es015609u.

Yiin, L., Rhoads, G., and Lioy, P., 2000, Seasonal influences on childhood lead exposure: Environmental Health Perspectives, v. 108, p. 177–182.

Ziegler, E.E., Edwards, B.B., Jensen, R.L., Mahaffey, K.R., and Foman, S.J., 1978, Absorption and retention of lead by infants: Pediatric Research, v. 12, p. 29–34.

Manuscript received 21 September 2004; accepted 1 November 2004. ✤

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JOINT MEETING

101st Annual Meeting of the Cordilleran Section, GSA, and 80th Annual Meeting of the Pacific Section, AAPG
Fairmont Hotel, San José, California

April 29–May 1, 2005

http://www.geosociety.org/sectdiv/cord/05cdmtg.htm

THEME: BAY, BASINS, BASEMENT, AND BEYOND

The 2005 annual meetings of the Cordilleran Section, GSA, and the Pacific Section, AAPG, will be held jointly at the Fairmont Hotel in San José, hosted by the Department of Geology, San José State University. Up-to-date information about the meeting can be found at www.geosociety.org/sectdiv/cord/05cdmtg.htm.

ENVIRONMENT

The city of San José is located at the southern tip of San Francisco Bay and is the third largest city in California and 11th largest in the United States. San José is nestled in a broad alluvial valley between the Santa Cruz Mountains to the west and the Diablo Range to the east. Long time residents still refer to the San José area as the "Valley of Heart's Delight," hearkening back to its agricultural roots and gentle climate, but it is widely known today as "Silicon Valley," where technology and innovation rule. San José is among the most culturally and ethnically diverse cities in North America, and one can find a rich tapestry of cultural sites and activities to explore and experience. Temperatures are mild in late April and early May (60–70 °F), and the area has tremendous recreational opportunities for all to enjoy. San José is served by most major airlines through Mineta–San José International Airport, which is just three miles from downtown. The meeting site is the spectacular Fairmont Hotel in the heart of downtown San José, adjacent to Plaza de Cesar Chavez. The Fairmont is on the VTA light rail line and is within easy walking distance of many restaurants, pubs, microbreweries, clubs, cinemas, galleries, and museums.

CALL FOR PAPERS

Papers are invited for a variety of topical sessions (oral and poster), including symposia, theme sessions, and general technical sessions. Authors interested in volunteering papers for symposia should contact the appropriate convener prior to submitting an abstract. Oral presentations in technical sessions will be 15 minutes in length, including three minutes for questions. All oral sessions will utilize a single digital projector and PowerPoint software. An overhead projector will also be available in each room. Use of 35 mm slides is discouraged and will only be accommodated by special arrangement with the technical program chair at an additional cost. Requests for slide projectors must be made one month prior to the meeting. Poster space will be 4' × 8' and authors are required to be present at their poster for at least two hours.

ABSTRACTS

Abstract deadline: February 1, 2005

Abstracts for all sessions should be submitted online at www.geosociety.org/sectdiv/cord/05cdmtg.htm. If you cannot submit your abstract electronically, contact Nancy Carlson, (303) 357-1061.

REGISTRATION

Standard Registration Deadline: March 28, 2005
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Registration Fees

	Standard		On-site	
	Full meeting	One day	Full meeting	One day
Professional Member	$125	$85	$160	$100
Professional Nonmember	$150	$100	$200	$125
Student Member	$45	$30	$60	$40
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K–12 Professional	$40	N/A	$50	N/A
Guest or Spouse	$40	N/A	$50	N/A
Field Trip/Short Course only	$25	N/A	$30	N/A

GSA Headquarters will handle registration. Please register online at www.geosociety.org/sectdiv/cord/05cdmtg.htm. If you need assistance, contact GSA Member Services, 1-888-443-4472, (303) 357-1000 option 3, or gsaservice@geosociety.org. Register early to qualify for lower fees.

On-Site Registration Schedule

Thursday, April 28	4–8 p.m.
Friday, April 29	7:30 a.m.–4:30 p.m.
Saturday, April 30	7:30 a.m.–4:30 p.m.
Sunday, May 1	7:30 a.m.–noon

ACCESSIBILITY AND CHEMICAL SENSITIVITY

GSA is committed to making its meetings accessible to all people interested in attending. Please indicate special requirements (wheelchair accessibility, etc.) on the registration form. The Fairmont Hotel is ADA compliant.

Additionally, please refrain from wearing scented products to the meeting, in order to allow participation by persons disabled by chemical sensitivities.

FIELD TRIPS

For further details on field trips, please contact either the trip leader or the field trip chair, Calvin Stevens, (408) 924-5029, stevens@geosun.sjsu.edu, or visit www.geosociety.org/sectdiv/cord/05cdmtg.htm.

Premeeting

1. **Seismic Hazard of the Front Range Thrust Faults, Santa Cruz Mountains.** 1 day, April 26. Drew Kennedy, Sanders & Associates, Geostructural Engineering, Inc., dKennedy@sandersgeo.com, (916) 729-8050; Chris Hitchcock, hitch@lettis.com. This one-day field trip will explore the thrust fault system along the northeastern topographic range front of the Santa Cruz Mountains. Recent geomorphic investigations of the thrust faults have

provided a greater understanding of their activity and, hence, their contribution to seismic hazards in the San Francisco Bay area. Deformed and offset late Quaternary alluvial fans and terraces, elevated topography, and micro-seismicity suggest that the faults, although not necessarily surface fault rupture hazards, likely accommodate a significant portion of the contractional strain across the region. The field trip will start at the north end of the thrust system near Daly City and work down the San Francisco Peninsula to near Los Gatos. Leave the Fairmont Hotel, San José, at 7:30 a.m.; return to San José at 5:30 p.m. Limit: 33. Cost: $83, includes lunch, transportation, and guidebook.

2. **Neoproterozoic Paleogeography of Southern Death Valley: Adding Some New Pieces to an Old Puzzle.** 3 days, April 26–28. Matt McMackin, San José State University, mcmackin@geosun.sjsu.edu, (408) 206-9521; Bennie Troxel; Lauren Wright; Martin Kennedy, martin.kennedy@exxon-sprint.com. This field trip will focus on possible reconstructions of Neoproterozoic paleogeography of the southern Death Valley region based on sections exposed in the Mesquite Mountains, Kingston Range, Black Mountains, and Silurian Hills. From the outcrops, our goal will be to evaluate diverse models for reconstruction and consider the impact of recent studies to better understand the events recorded by the Proterozoic section in southern Death Valley. Leave McCarran Airport, Las Vegas, at 8 a.m., Apr. 26; return to McCarran Airport, Las Vegas, at 4 p.m., Apr. 28. Overnight near Shoshone, California. Limit: 24. Cost: $200, includes meals, transportation, and guidebook. Motel accommodations available at additional cost.
3. **Point Lobos to Point Reyes: Evidence of ~180 km Offset of the San Gregorio and Northern San Andreas Faults.** 2 days, April 27–28. Kathleen Burnham, Stanford University, katb@pangea.stanford.edu, (510) 428-0464; Jean Moran, jeanm@stetsonengineers.com. We will examine granitic rocks, conglomerate, and trace fossils at Point Lobos and then drive ~180 km along the San Gregorio and northern San Andreas faults to Inverness. On day two, we will examine correlative rocks at Point Reyes, as well as a 15 ft (5 m) offset associated with the 1906 San Francisco earthquake. Participants are requested to refrain from the use of aftershave, hand lotion, hair tonic, cologne, or other fragranced personal products, as the field trip leader is disabled by chemical sensitivity. Leave the Fairmont Hotel, San José, at 7:15 a.m., Apr. 27; return to San José at 5:45 p.m., Apr. 28. Overnight at Olema Ranch campground ($8) or Golden Hinde Inn ($70 double occupancy), Inverness, California. Limit: 26. Cost: $200, includes snacks, lunches, dinner, transportation, and guidebook.
4. **Jurassic-Cretaceous Assembly of Central California.** 2 days, April 27–28. Russell Graymer, U.S. Geological Survey, rgraymer@usgs.gov, (650) 329-4988. Near the Cretaceous-Jurassic boundary, the western margin of North America in central California underwent a major tectonic event. Much of the basement rock that underlies the region was added to the continental crust, and the Sierra–Franciscan arc subduction system was initiated. On this trip, we will look at some of the Jurassic rocks that were added to the continent and discuss the tectonic environment in which they formed and the controls on the timing of their accretion. Leave the Fairmont Hotel, San José, at 7:30 a.m., Apr. 27; return to San José at 6 p.m., Apr. 28. Overnight at Auburn Travelodge, Auburn, California. Limit: 22. Cost: $108, includes lunches, transportation, hotel, and guidebook.
5. **Geology of Mount Diablo.** 1 day, April 28. Ron Crane, Consultant, roncrane@aol.com, (925) 837-6508. The geology, geologic history, origin, and development of Mount Diablo will be explained during a traverse across and to the top of Mount Diablo. Stops will be made at several places of geologic and scenic interest. Leave the Fairmont Hotel, San José, at 8 a.m., Apr. 28; return to San José at 6 p.m. Limit: 50. Cost: $54, includes lunch, transportation, and guidebook.
6. **An Extensive Paleocene Cold Seep System: Clastic Dikes, Carbonates, and Chemosynthetic Communities in the Moreno Formation, Panoche Hills, Western San Joaquin Valley.** 1 day, April 28. Hilde Schwartz, University of California–Santa Cruz, hschwartz@emerald.ucsc.edu, (831) 459-5429; Casey Moore, University of California–Santa Cruz, cmoore@es.ucsc.edu; James Sample, James.Sample@nau.edu, (928) 523-0881. This field trip will consist of at least two stops in the Panoche Hills (northern and southern) with a possible additional stop east of San Luis Reservoir, near Interstate 5. The objective will be to examine Moreno Formation clastic intrusions, carbonates, and fossils associated with the largest and best-exposed paleoseep system known. The seep system is ~800 m thick, at least 20 km long, and represents episodic migration and seafloor expulsion of fluids over at least 0.5 million years. Leave the Fairmont Hotel, San José, at 8 a.m., Apr. 28; return to San José at 6 p.m. Limit: 28. Cost: $55, includes lunch, transportation, and field guide.
7. **The Dirt on Wine, Geology, Soils, and Wine Quality in the Santa Clara Valley.** 1 day, April 28. Terry Wright, California State University–Sonoma, wrightw@sonoma.edu, (707) 479-0884. A one-day bus trip to several wineries in the Santa Clara Valley, including discussion and hands-on investigation of the geological setting, geology, and soil of Santa Clara Valley vineyards, plus wine tasting and lunch at a winery and a short hike to view the San Andreas fault. This trip is geared to wine lovers and geologists of all levels, but you must be 21 to attend. Leave the Fairmont Hotel, San José, at 8:30 a.m., Apr. 28; return to San José at 5 p.m. Limit: 25. Cost: $52, includes lunch, wine tasting, transportation, and field guide.

Postmeeting

8. **Microbialite Sediments in Death Valley.** 2 days, May 2–3. Thomas Anderson, Sonoma State University, andersot@sonoma.edu, (707) 664-2176; Russell Shapiro, rshapiro@gustavus.edu; Melissa Hicks, hicksm@unlv.nevada.edu. This two-day trip will serve as a field course on recognizing microbialites in the field. We will visit key

Proterozoic and Cambrian localities between Las Vegas and Tonopah in the Spring Range, Nopah Range, and Mount Dunfee areas. All the major types of microbialites (stromatolites, thrombolites, dendrolites, oncoids) will be observed, including calcimicrobial-archaeocyath reefs. Participants will be engaged in comparing the different fabrics and arguing the different models of microbialite genesis. The utility of microbialites for facies analysis and biostratigraphy will also be addressed. The field trip will begin and end in Las Vegas; participants will provide their own transportation to and lodging in Las Vegas and their own dinner and breakfast at the overnight stop in Beatty, Nevada. Leave Las Vegas Airport at 7 a.m., May 2; return to Las Vegas Airport at 9 p.m., May 3. Overnight at the Exchange Club, Beatty, Nevada. Limit: 20. Cost: $194, includes lunches, transportation, hotel (double occupancy), and guidebook.

9. **Miocene Volcano-Plutonic Systems, Southern Nevada: A Window into Upper Crustal Magmatic Processes.** 3+ days, May 1–4. Calvin Miller, Vanderbilt University, calvin.miller@vanderbilt.edu, (615) 322-2976; Jonathan Miller, San José State University, jsmiller@email.sjsu.edu; Jim Faulds, jfaulds@unr.edu. On this field trip, we will examine spectacular shallow to mid-crustal cross-sectional views of Miocene plutons and their erupted volcanic products in the Eldorado Mountains and surrounding areas of southern Nevada. The trip will focus on the Aztec Wash and Searchlight plutons and related volcanics, emphasizing evidence for transport processes and their influence on solidification history and eruptive behavior. Leave Las Vegas Airport at 8 p.m., May 1; return to Las Vegas Airport at 3 p.m., May 4. Overnight at the Super 8 Motel, Boulder City, Nevada. Limit: 23. Cost: $295, includes lunches, transportation, hotel (double occupancy) and guidebook.
10. **Late Neogene Transition from Transform to Subduction Margin East of the San Andreas Fault in Wine Country of the Northern San Francisco Bay Area.** 3 days, May 2–4. David L. Wagner, California Geological Survey (retired), dwagner@consrv.ca.gov, (916) 324-7380; Bob McLaughlin, U.S. Geological Survey, rjmcl@usgs.gov; Andrei Sarna-Wojcicki, asarna@usgs.gov. This three-day field trip will examine the geology and neotectonics of the Rodgers Creek–Healdsburg–Maacama right-stepping strike-slip fault system, associated sedimentary basins, and the evolution of volcanism in scenic Sonoma and Napa counties. Stops will focus on northern Coast Ranges volcanism, sedimentation patterns, active basin bounding strike-slip faulting, uplift of adjacent mountain ranges along thrust faults, and rates of deformation. Several spectacular vistas of the region (Taylor Mountain, Geyser Peak, and Mount St. Helena) will be accessed and the trip will wind down at a world class Napa Valley winery. Leave the Fairmont Hotel, San José, at 7:30 a.m., May 2; return to San José at 8:30 p.m. May 4. Overnight at the Doubletree Inn, Santa Rosa, California. Limit: 60. Cost: $310, includes meals, transportation, hotel (double occupancy), and guidebook.
11. **Large Dextral Offset across Owens Valley, California, from 148 Ma to 1872 A.D.** 3 days, May 2–4. Allen Glazner, University of North Carolina, afglazne@email.unc.edu, (919) 962-0689; John Bartley, jbartley@mines.utah.edu; David Greene, GreeneD@denison.edu; Jeffrey Lee, jeff@geology.cwa.edu; Drew Coleman, dcoleman@unc.edu; Andrew Kylander-Clark, akylander@umail.ucsb.edu. Although the dramatic 3300 m eastern escarpment of the Sierra Nevada was produced by normal faulting, field data indicate that dextral slip dominates the tectonics of eastern California. The 1872 Lone Pine earthquake produced more dextral slip than normal slip, and mapping of several pre-Cenozoic markers demonstrates 65 km or more of dextral slip since the Late Cretaceous. On this trip we will (1) examine neotectonic evidence for fault slip and strain partitioning; (2) trace the distribution and offset of pre-Cenozoic markers (e.g., dike swarms); and (3) discuss the implications of this slip for the tectonics of eastern California and unroofing of the southern Sierra Nevada. Leave the Red Roof Inn, Ontario, California, at 8 a.m., May 2; return to Ontario at 5 p.m. May 4. Overnight at White Mountain Research Station, Bishop, California. Limit: 40. Cost: $230, includes all meals except lunch on day 1, transportation, lodging at WMRS, and guidebook.
12. **Outcrop Geology of some Cretaceous and Tertiary Gas-Producing Strata of the Sacramento Basin.** 2+ days, May 1–3 (leave San José after close of convention). Douglas Imperato, Consulting Geologist, dpi@gte.net, (805) 963-2399; Tor Nilsen, nilsen@pacbell.net. This field trip will allow participants an opportunity to observe outcrops of some of the Cretaceous and Tertiary gas-producing strata of the Sacramento Valley. The first day will focus on the Forbes and Kione formations, which are productive in the northern part of the basin. On the second day, the trip will focus on outcrops of the productive Lathrop, Winters, Tracy, and Mokelumne River formations of the southern part of the basin. Depositional facies and stratigraphic relationships observed in outcrop will be related to regional depositional models for these formations. Leave the Fairmont Hotel, San José, at 5:30 p.m., May 1; return to San José at 5:30 p.m. May 3. Overnight at the Hallmark Inn, Davis, California. Limit: 44. Cost: $400, includes all meals except one dinner, transportation, hotel for two nights (single occupancy), and field guide.
13. **The Miocene Hydrocarbon Migration System: Clastic Intrusions and Carbonate Seep Structures in the Santa Cruz Area, California.** 1 day, May 2. Robert Garrison, University of California–Santa Cruz, regarris@cats.ucsc.edu, (831) 423-4401; Casey Moore, University of California–Santa Cruz, casey@es.ucsc.edu; Ivano Aiello, iaiello@mlml.calstate.edu. Miocene biosiliceous rocks in the Santa Cruz area, equivalent to the upper part of the Monterey Formation, contain some of the best-exposed carbonate cold seep structures in the world, as well as the largest known subaerially exposed hydrocarbon-fueled clastic intrusion. This trip will visit key coastal outcrops that reveal the shallow subsurface

structure of a hydrocarbon seep system. The trip ends with a wine tasting at the Bonny Doon Vineyard in the Santa Cruz Mountains. Leave the Fairmont Hotel, San José, at 8 a.m., May 2; return to San José at 5 p.m. Limit: 36. Cost: $56, includes transportation, snacks (not lunch), wine tasting, and field guide.

14. **San Francisco Bay: Floating Classroom on an Urban Estuary.** 1 day, May 1. Matt McMackin, San José State University, mcmackin@geosun.sjsu.edu, (408) 206-9521. This trip includes a 4 hour cruise on San Francisco Bay aboard the R/V *Robert G. Brownlee* of the Marine Science Institute. Learn about the geology and biology of the bay with hands-on activities in a unique learning environment that is utilized by many area schools. Leave the Fairmont Hotel, San José, at 12 p.m., May 1; return to San José at 5:30 p.m. Limit: 40. Cost: $65, includes transportation, snacks, and field guide.
15. **Franciscan Complex and Coast Range Ophiolite, Eastern San Francisco Bay Area: A Record of Processes along a Complex Active Plate Margin.** 1 day, May 2. John Wakabayashi, Geologic Consultant, wako@tdl.com, (510) 887-1796. This trip will examine Franciscan and Coast Range ophiolite outcrops from Newark to the El Cerrito Hills. Stops will include Franciscan chert, basalt, and serpentinite at the Coyote Hills in Newark with a bird's eye view of an amazing quarry exposure; Coast Range ophiolite, gabbro, and volcanics on or near the California State University–Hayward campus; a depositional contact of Great Valley Group shales on Coast Range ophiolite volcanics near Highway 24; a shear zone separating blueschist-facies and prehnite-pumpellyite–facies Franciscan metagraywackes in El Cerrito; and high-grade Franciscan garnet amphibolites and coarse-grained blueschists in El Cerrito. Leave the Fairmont Hotel, San José, at 7:30 a.m., May 2; return to San José at 5:30 p.m. Limit: 50. Cost: $40, includes transportation and guidebook.

TECHNICAL SESSIONS

In addition to general technical sessions, the program will include a variety of symposia and theme sessions. Detailed description of symposia and theme sessions can be found at www.geosociety.org/sectdiv/cord/05cdmtg.htm.

SYMPOSIA

1. **Alaskan Energy Resources: New Assessments and Related Geological, Geophysical, and Geochemical Studies.** Rick Stanley, U.S. Geological Survey, rstanley@usgs.gov, (650) 329-4918; Ken Bird, U.S. Geological Survey, kbird@usgs.gov, (650) 329-4907. ORAL.
2. **Tectonics of the U.S. Cordillera, SWEAT Connection and Beyond: A Session in Honor of Eldridge Moores.** *Sponsored by GSA Cordilleran Section.* Yildirim Dilek, Miami University, dileky@muohio.edu, (513) 529-2212; John Wakabayashi, wako@tdl.com, (510) 887-1796. ORAL.
3. **Crowding the Rim—Dealing with Energy Needs, Food, and Other Living Resources and Natural Calamities around the Pacific.** *Sponsored by the Circum-Pacific Council.* David G. Howell, U.S. Geological Survey, dhowell@usgs.gov, (650) 329-5430; H. Gary Greene, Moss Landing Marine Laboratories, greene@mlml.calstate.edu, (831) 771-4183; Nahum Schneidermann, Chevron Texaco Overseas Petroleum, nahu@chevrontexaco.com, (925) 842-3679. ORAL.
4. **Ophiolites, Batholiths, and Regional Geology: A Session in Honor of Cliff Hopson.** Jim Wright, University of Georgia, jwright@gly.uga.edu (706) 542-4394. ORAL and POSTER.
5. **Plutons and Their Host Rocks in the Sierra Nevada Batholith: A Forum and Discussion on Magma Emplacement, Magmatic Differentiation, and Pluton Solidification.** Drew Coleman, University of North Carolina, dcoleman@unc.edu, (919) 962-0705; William Hirt, College of the Siskiyous, hirt@siskiyous.edu; Aaron Yoshinobu, Texas Tech University, aaron.yoshinobu@ttu.edu. ORAL and POSTER.

THEME SESSIONS

Cordilleran Section, GSA

1. **Provenance of Sediments and Sedimentary Rocks in the Cordillera.** Andrew Barth, Indiana University–Purdue University, ibsz100@iupui.edu, (317) 274-1243; Nancy Riggs, Northern Arizona University, nancy.riggs@nau.edu, (928) 523-4561. ORAL and POSTER.
2. **Late Cenozoic Transition from Subduction to Transform Margin Inboard of the San Andreas Fault: Northern San Francisco Bay Area to Cape Mendocino.** Robert J. McLaughlin, U.S. Geological Survey, rjmcl@usgs.gov, (650) 329-4945; David L. Wagner, California Geological Survey (retired), dwagner@consrv.ca.gov. ORAL and POSTER.
3. **Earthquakes, Past and Future, in the San Francisco Bay Region.** David P. Schwartz, U.S. Geological Survey, dschwartz@usgs.gov, (650) 329-5651; William Lettis, William Lettis & Associates, lettis@lettis.com, (925) 256-6070. ORAL and POSTER.
4. **Transpressional Neotectonics of the Central and Northern California Coast Ranges.** Jeff Unruh, William Lettis & Associates, unruh@lettis.com, (925) 256-6070. ORAL.
5. **Crustal Cross Sections from the Western North America Cordillera and Elsewhere—Implications for Tectonic and Petrologic Processes.** Art Snoke, University of Wyoming, snoke@uwyo.edu, (307) 766-5457; Bob Miller, San José State University, rmiller@geosun.sjsu.edu, (408) 924-5025. ORAL and POSTER.
6. **Hydrogeology of Alluvial Aquifers in the Western United States.** June Oberdorfer, San José State University, june@geosun.sjsu.edu, (408) 924-5026. ORAL.
7. **Recent Advances in the Science of Floodplain and Channel Processes and Restoration.** Douglas Smith, California State University–Monterey Bay, douglas_smith@csumb.edu, (831) 582-4696; Joan Florsheim, University of California–Davis, florsheim@geology.ucdavis.edu. ORAL.
8. **Naturally Occurring Asbestos Hazards: Geology, Regulatory Issues, and Methods of Identification and**

Assessment. Mark Bailey, Asbestos TEM Laboratories, mark@asbestostemlab.com, (510) 528-0108. ORAL.

9. **Ethics in the Geological Community.** John Williams, San José State University, williams@geosun.sjsu.edu, (408) 924-5050. ORAL.
10. **Earth Science for Everyone: Diverse Student Populations—Recruiting Techniques for Attracting Them; Curricular and Extracurricular Strategies for Retaining Them.** Ellen Metzger, San José State University, metzger@geosun.sjsu.edu, (408) 924-5048; Richard Sedlock, San José State University, sedlock@geosun.sjsu.edu, (408) 924-5020. ORAL.
11. **Undergraduate Research Posters.** *Cosponsored by Council on Undergraduate Research.* Karen Grove, San Francisco State University, kgrove@sfsu.edu, (415) 338-2617. POSTER.

Pacific Section, AAPG

12. **Sacramento Valley Gas Exploration and Production.** Rick Blake, Lawrence Livermore National Laboratory, blake2@llnl.gov, (925) 422-9910. ORAL.
13. **Application of New Technologies to Petroleum Reservoirs: (A) Implications for Exploration; (B) Implications for Production.** Tim McHargue, ChevronTexaco, TimMcHargue@chevrontexaco.com, (925) 842-6255; Bryan Bracken, ChevronTexaco, BryanBracken@chevrontexaco.com, (925) 842-2144. ORAL.
14. **CO_2 Sequestration: Science and Opportunity in the West.** S. Julio Friedmann, Lawrence Livermore National Laboratory; friedmann2@llnl.gov, (925) 423-0585. ORAL.
15. **A New Three-Dimensional Look at the Geology, Geophysics, and Hydrology of the Santa Clara Valley, California: A Showcase of Urban Earth Science.** Randall T. Hanson, U.S. Geological Survey, rthanson@usgs.gov, (858) 637-6839; Bob Jachens, U.S. Geological Survey, jachens@usgs.gov, (650) 329-5300. ORAL and POSTER.
16. **Data Visualization, 3-D Mapping, and Property Modeling.** Vic Madrid, Lawrence Livermore National Laboratory, madrid2@llnl.gov, (925) 422-9930. ORAL.
17. **Groundwater and Surface Water Interactions: Hydrogeology and Water Quality in the San Francisco Bay Region.** Alec Naugle, San Francisco Bay Regional Water Quality Control Board, awn@rb2.swrcb.ca.gov, (510) 622-2510. ORAL.

Pacific Section, SEPM

18. **Estimating Recharge.** Karin A. Hoover, California State University–Chico, khoover@csuchico.edu, (530) 898-5618. ORAL.
19. **Sediment Delivery to Streams: Mechanisms, Volumes, and Timing.** Karin A. Hoover, California State University–Chico, khoover@csuchico.edu, (530) 898-5618. ORAL.
20. **The Hydrobiogeochemical Cycle of Mercury.** William M. Murphy, California State University–Chico, wmurphy@csuchico.edu, (530) 898-5163; Ronald K. Churchill, California Geological Survey. rchurch@consrv.ca.gov, (916) 327-0745. ORAL.
21. **Tectonics and Sedimentation: New Models and Recent Advances.** Dave Barbeau, University of South Carolina, dbarbeau@geol.sc.edu, (803) 777-5162; Boyan Vakarelov, University of Texas at Dallas, boyan.vakarelov@student.utdallas.edu, (972) 883-2401. ORAL.
22. **Beds to Basins in Turbidite Systems.** Stephan A. Graham, Stanford University, graham@pangea.stanford.edu, (650) 723-0507; Donald R. Lowe, Stanford University, lowe@pangea.stanford.edu, (650) 725-3040. ORAL.
23. **Volcaniclastic Strata: Process, Paleogeography, and Tectonic Reconstructions.** Cathy Busby, University of California–Santa Barbara, busby@geol.ucsb.edu, (805) 893-3471; Ian Skilling, University of Pittsburgh, skilling@pitt.edu, (412) 624-5873. ORAL.
24. **Fault-Related Diagenesis and Fluid Flow.** Hilario Camacho, Signal Hill Petroleum, camachoh@shpi.net, (562) 595-6440; Jim Sample, Northern Arizona University, James.Sample@nau.edu, (928) 523-0881. ORAL.

WORKSHOPS

Roy J. Shlemon Mentor Program in Applied Geoscience. *Sponsored by GSA Foundation.* Fri., April 29, and Sat., April 30, 11:30 a.m.–1 p.m. Luncheon location information available at GSA's registration desk. Karlon Blythe, kblythe@geosociety.org. This interactive and informative program for undergraduate and graduate students, led by professional geoscientists, will cover real life issues, including professional opportunities and challenges that await students after graduation. Plan to attend both free luncheons to hear different presenters each day. Students will receive FREE LUNCH tickets in the registration packets to attend both Shlemon Programs; however, space is limited: first come, first served.

The John Mann Mentors in Applied Hydrogeology Program. *Sponsored by GSA Foundation.* Fri., April 29, 5–6:30 p.m. Meeting location information available at GSA's registration desk. Karlon Blythe, kblythe@geosociety.org. This early evening event presents mentoring opportunities for undergraduate and graduate students and recent graduates with declared interest in applied hydrogeology as a career to interact and network with practicing hydrogeology professionals. This program is a focused, small-scale event that features FREE FOOD for participants. Participant eligibility is limited to those students who have declared their career interest to be hydrology or hydrogeology on their GSA membership applications and who have registered online for this section meeting. An e-mail invitation will then be sent to those qualified students. Keep in mind that only a quick response to the invitation will secure you a seat, as attendance at this Mann Mentor event is limited!

SHORT COURSES

1. **Groundwater Age-Dating: Application and Interpretation of Tritium and the Noble Gases for Water Resource Investigations.** *Sponsored by the Groundwater Resources Association.* Thurs., April 28, 8:30 a.m.–5:30 p.m. G. Bryant Hudson, Lawrence Livermore National Laboratory, hudson5@llnl.gov, (925) 422-3160; Jean E. Moran, Lawrence Livermore National Laboratory, moran10@llnl.gov, (925) 423-1478; Andrew F. Tompson, Lawrence Livermore National Laboratory, tompson1@llnl.

gov, (925) 422-6348. Professional: $120. Student: $25. An additional fee of $25 applies if you are not registered for the meeting.

Understanding groundwater age, or the time since groundwater entered the saturated zone, can have important implications for managing groundwater resources and determining aquifer vulnerability to contamination. Knowledge of the groundwater age distribution in a basin can be used to delineate groundwater or contaminant flow pathways, identify recharge areas, and provide a measure of hydraulic conductivity. While the presence or absence of tritium in groundwater can mark a component of "modern" groundwater—recharged in the past few decades—the tritium-helium age dating method allows the dating of a water sample with an analytical uncertainty of one year.

Participants will be guided through all stages of the increasingly popular technique of groundwater age dating, from sampling and analysis to data reduction and modeling the results. Students will see a video showing the sampling method for dissolved gases in groundwater, learn about mass spectrometric methods for measuring helium isotopes and other gases, calculate groundwater ages using real data from groundwater samples in California, learn how to apply groundwater ages to water resource investigations, and see how groundwater ages can be used to validate and constrain groundwater flow models. Participants will be exposed to other parameters that are derived from dissolved gas measurements, including residence times from radiogenic ^{4}He, recharge conditions from excess air and recharge temperature determinations, and excess dissolved nitrogen for quantification of denitrification. Emphasis will be on understanding the meaning of a groundwater age from a well water sample, including limitations in its interpretation, and on proven applications. Participants are encouraged to bring their own laptop with Excel.

Who should attend: Students at the B.S. or M.S. level; practicing geologists, hydrologists, and engineers with a senior undergraduate or graduate level background in geology, hydrology, chemistry, and physics; and researchers who would like to upgrade their knowledge of groundwater age dating and isotope hydrology.

2. **Application of Sequence Stratigraphy to Define the Aquifer Architecture of Groundwater Resources.** Wed., April 27, and Thurs., April 28, 9 a.m.–6 p.m. Morgan Sullivan, California State University–Chico, mdsullivan@csuchico.edu, (530) 898-4748; Kenneth Ehman, Skyline Ridge, Inc., kdehman@aol.com, (408) 482-0715; Brian Edwards, U.S. Geological Survey, bedwards@usgs.gov, (650) 329-5488. Cost: Check registration form.

   This two-day workshop will introduce the concepts of sequence stratigraphic analysis. Today, sequence stratigraphy is considered the state-of-the-art method for delineating reservoir geometry and continuity in the petroleum industry and is being applied to groundwater basins to understand aquifer architecture. The workshop will consist of a combination of lectures and exercises that will provide the hands-on experience to learning sequence stratigraphy. The exercises will include classic case studies from which many of the original concepts were derived. A case study from the Los Angeles Basin will be highlighted to illustrate the application of sequence stratigraphy to solve problems with seawater intrusion into freshwater aquifers.

3. **Quantitative *P-T-t* Paths from Integrated Thermodynamic Modeling, Geochronology, and Metamorphic Textures.** Wed., April 27, and Thurs., April 28. Harold Stowell, University of Alabama, hstowell@wgs.geo.ua.edu, (205) 348 5098; Douglas Tinkham, University of Calgary, tinkham@calgary.ca; Carlos Zuluaga, University of Alabama, zulua001@bama.ua.edu. Cost: Check registration form.

   This one and a half day workshop for graduate students and Ph.D. petrology, mineralogy, or tectonics specialists will provide participants with hands-on knowledge about data and methods needed for constructing quantitative *P-T-t* paths using pseudosections (e.g., composition-specific *P-T* phase diagrams), mineral textures, and geochronological data. The course will emphasize the use of THERMOCALC (Powell and Holland, 1988) and ISOPLOT (Ludwig, 2001) for constructing *P-T-t* paths. Participants will learn the details of THERMOCALC data file organization and will construct parts of a *P-T* pseudosection.

4. **Half-Day Bay Area Earth Science Institute (BAESI) Teacher Workshop. Geologic Mapping for Teachers: Field Trip to Santa Teresa Hills County Park.** Sat., April 30, 8:30 a.m.–12:30 p.m. Ellen Metzger, San José State University, metzger@geosun.sjsu.edu, (408) 924-5048; Richard Sedlock, San José State University, sedlock@geosun.sjsu.edu, (408) 924-5020. $10 fee.

   Participants will learn more about California's famous Franciscan Complex and will produce a simple geologic map and cross section. Each participant will receive a rock kit and a wall-sized geologic cross section of California as it was 100 million years ago. Snacks provided.

SPECIAL EVENTS

- **Icebreaker.** Thurs., April 28, 5–9 p.m., Exhibit Hall, Fairmont Hotel.
- **Keynote Address.** *1906 Earthquake Centennial: A Century of Progress in Understanding Earthquake Science,* Mary Lou Zoback, U.S. Geological Survey, zoback@usgs.gov, Sat., April 30, 5 p.m., Fairmont Hotel.
- **An Evening of Exploration—Geology and Wine.** Hosted by David Howell, U.S. Geological Survey, dhowell@usgs.gov, and Jonathan Swinchatt, authors of *The Winemaker's Dance, Exploring Terroir in the Napa Valley*. Sat., April 30, 6:30 p.m. Cost: Check registration form.
- **Annual Business Meeting and Social Hour, Cordilleran Section, GSA.** Fri., April 29, 5–7 p.m. The annual business meeting is open to all members of the Cordilleran Section GSA. The vitality of the Cordilleran Section depends on the strength and sustained input of

its membership. This is your chance to have a say in section business and to help plan for the future. Come to the business meeting to meet the Management Board, learn how the section operates, and meet other members who share a commitment to the future of the Cordilleran Section of GSA. Student members are encouraged to attend. The formal meeting will begin at 5 p.m. but will then adjourn for informal discussion with FREE food and a cash bar.

- **Annual Banquet, Pacific Section, AAPG.** Fri., April 29, 11:30 a.m.–1:30 p.m. Cost: $50.
- **Business Meeting, Pacific Section, AAPG.** Sun., May 1, 5 p.m.
- **Association of Women Geoscientists (AWG) Breakfast.** Sat., April 30, 7:30–9 a.m. Professional: $22; Student: $10.
- **Dibblee Foundation Luncheon.** Sun., May 1, 11:30 a.m.–1:30 p.m.

SPOUSE AND GUEST ACTIVITIES

Day Trip to Monterey Bay Aquarium. Fri., Apr. 29. Visit the award-winning aquarium and enjoy the beautiful scenery of the Monterey Peninsula. Trip includes a round-trip bus ride from San José to Monterey and the entry fee to the aquarium with a docent present. Depart San José at 9 a.m.; return at 4:30 p.m. Begin the aquarium visit with a tour provided by aquarium staff and finish on your own. Many restaurants are available at nearby Cannery Row or within the aquarium. Enjoy a leisurely stroll along the walkway, shop at specialty stores, or return to the aquarium to see more. Cost: adult, $45; seniors (62 or older), $42; child (5–11), $39; 4 and under, free.

Saturday in San Francisco and Alcatraz. Sat., Apr. 30. Visit "The Rock," Union Square, and one of the colorful neighborhoods of San Francisco. Enjoy a leisurely ride to Fisherman's Wharf, where the ferry to Alcatraz departs at 10:15 a.m. The 2.5 hour tour includes the round trip ferry ride on San Francisco Bay, a short film of the island's history, a quarter-mile walk to the cell house, and an audio tour of the cell house. Board the bus upon returning from the tour for a trip to Union Square, the shopping center of San Francisco. North Beach and Chinatown are easy walking or a short cable car ride away. Tea at the Westin St. Francis on Union Square is not to be missed. This trip includes the round

2005 GSA Section Meetings

NORTHEASTERN SECTION
March 14–16, 2005
Prime Hotel and Conference Center, Saratoga Springs, New York
Information: Kurt Hollocher, Union College, Department of Geology, Olin Building, Nott Street, Schenectady, NY 12308-3107, (518) 388-6518, hollochk@union.edu

SOUTHEASTERN SECTION
March 17–18, 2005
Grand Casino Biloxi, Biloxi, Mississippi
Information: Gail Russell, University of Southern Mississippi, Department of Geology, Box 5044, Hattiesburg, MS 39406-2000, (601) 266-4077, Gail.Russell@usm.edu

SOUTH-CENTRAL SECTION
April 1–2, 2005
Trinity University, San Antonio, Texas
Information: Diane Smith, Trinity University, Department of Geosciences, #45, One Trinity Place, San Antonio, TX 78212-4674, (210) 999-7656, dsmith@trinity.edu

CORDILLERAN SECTION
(*Joint meeting with American Association of Petroleum Geologists*)
April 29–May 1, 2005
Fairmont Hotel, San José, California
Abstract Deadline: February 1, 2005
Information: Jonathan Miller, San José State University, Department of Geology, 1 Washington Square, San José, CA 95192-0102, (408) 924-5015, jsmiller@email.sjsu.edu

NORTH-CENTRAL SECTION
May 19–20, 2005
University of Minnesota, Minneapolis, Minnesota
Abstract Deadline: February 22, 2005
Information: Carrie Jennings Patterson, University of Minnesota, Minnesota Geological Survey, 2642 University Ave. W., St. Paul, MN 55114-1032, (612) 627-4780, ext. 220, carrie@umn.edu, or Barbara Lusardi, University of Minnesota, Minnesota Geological Survey, 2642 University Ave. W., St. Paul, MN 55114-1032, (612) 627-4780, ext. 212, lusar001@umn.edu

ROCKY MOUNTAIN SECTION
May 23–25, 2005
Mesa State College, Grand Junction, Colorado
Abstract Deadline: February 22, 2005
Information: Rex Cole, Mesa State College, Department of Physical & Environmental Science, 1100 North Ave., Grand Junction, CO 81501-3122, (970) 248-1599, rcole@mesastate.edu

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trip bus ride from San José to San Francisco, the tour of Alcatraz, and a ride to Union Square. Depart San José at 8:45 a.m.; return at 5:15 p.m. Cost: adult, $44; seniors (62 or older), $42; junior (13–17), $40; child (3–12), $33; 2 and under, free.

In addition to the planned activities mentioned above, San José offers a variety of activities, including a science center and IMAX theatre, a haunted house, one of the few combined public/university libraries, symphony and opera in the historic and newly renovated California Theater, shopping, hiking, fine dining, comedy and dance clubs, and many more activities. For information on these and other activities, contact Paula Jefferis, San José State University, jefferis@geosun.sjsu.edu.

STUDENT TRAVEL AND FIELD TRIP ASSISTANCE

The Cordilleran Section of GSA and the GSA Foundation have made travel grants available for students who are presenting oral or poster papers. The Cordilleran Section of GSA is also providing assistance for students wanting to attend field trips. Students must be currently enrolled and must be members of the Cordilleran Section to apply for support. For more information, contact the Cordilleran GSA secretary, Joan Fryxell, (909) 880-5311, jfryxell@csusb.edu.

STUDENT AWARDS

The GSA Cordilleran Section will present cash awards for the best and honorable mention undergraduate and graduate papers, both oral and poster; papers will be considered from any theme or discipline session. To qualify for an award, the student must be first author and presenter and a student member of the Cordilleran Section.

EXHIBITS

Exhibit booths will be available at $1000 for commercial organizations and $500 for nonprofit organizations. For more information or to reserve a booth, contact Larry Knauer, (661) 392-2471, larryknauer@chevrontexaco.com.

ACCOMMODATIONS

250 rooms have been reserved at the Fairmont Hotel, San José, meeting headquarters. Special meeting rates are available if reservations are made by April 4, 2005. Reservations with the Fairmont can be made through the Cordilleran Section GSA Web site, www.geosociety.org/sectdiv/cord/05cdmtg.htm, or by calling the Fairmont's global reservation line at 1-800-346-5550. Callers must identify themselves as with the Geological Society of America.

ADDITIONAL INFORMATION

To obtain the most complete and up-to-date information, visit www.geosociety.org/sectdiv/cord/05cdmtg.htm. If you have additional questions or need further clarification, contact either of the convention co-chairs: Jonathan Miller, Cordilleran Section GSA, jsmiller@email.sjsu.edu, (408) 924-5015; Mel Erskine, Pacific Section AAPG, mcerskine@comcast.net, (510) 234-6214.

STUDENTS—Mark Your Calendars!

Students: Plan now to attend a Shlemon Mentor Program and/or a Mann Mentor Program in Applied Hydrogeology at your 2005 Section Meeting to chat one-on-one with practicing geoscientists. These volunteers will answer your questions and share insights on how to get a job after graduation. When programs are scheduled for multiple days, each day's program will offer a different set of mentors.

FREE LUNCHES will be served (students only) at the Shlemon Mentor Programs. Students will receive a **FREE LUNCH** ticket, along with their registration badge, to attend each Shlemon Program. However, space is limited. First come, first served.

And, it gets better: **FREE light suppers** will be served (students only) at the Mann Mentor Programs. The **Mann Programs** are specific to careers in hydrogeology; if you're interested in receiving an invitation to attend the Mann Program for a **FREE light supper** after the tech sessions end, contact Karlon Blythe, kblythe@geosociety.org. Be sure to indicate which Section Meeting you plan to attend.

Mentor Programs for 2005 Section Meetings

FOR LOCATIONS OF PROGRAMS, ASK AT THE GSA REGISTRATION DESK.

NORTHEASTERN SECTION MEETING

Saratoga Springs, New York
SHLEMON MENTOR LUNCHEON PROGRAMS:
Mon. and Tues., March 14–15, 11:30 a.m.–1 p.m.

MANN MENTORS IN APPLIED HYDROGEOLOGY PROGRAM:
(by invitation; contact kblythe@geosociety.org)
Mon., March 14, 5–6:30 p.m.

SOUTHEASTERN SECTION MEETING

Biloxi, Mississippi
SHLEMON MENTOR LUNCHEON PROGRAMS:
Thurs. and Fri., March 17–18, 11:30 a.m.–1 p.m.

MANN MENTORS IN APPLIED HYDROGEOLOGY PROGRAM:
(by invitation; contact kblythe@geosociety.org)
Thurs., March 17, 5–6:30 p.m.

SOUTH-CENTRAL SECTION MEETING

San Antonio, Texas
SHLEMON MENTOR LUNCHEON PROGRAM:
Fri., April 1, 11:30 a.m.–1 p.m.

MANN MENTORS IN APPLIED HYDROGEOLOGY PROGRAM:
(by invitation; contact kblythe@geosociety.org)
Fri., April 1, 5–6:30 p.m.

CORDILLERAN SECTION MEETING

San José, California
SHLEMON MENTOR LUNCHEON PROGRAMS:
Fri. and Sat., April 29–30, 11:30 a.m.–1 p.m.

MANN MENTORS IN APPLIED HYDROGEOLOGY PROGRAM:
(by invitation; contact kblythe@geosociety.org)
Fri., April 29, 5–6:30 p.m.

NORTH-CENTRAL SECTION MEETING

Minneapolis, Minnesota
SHLEMON MENTOR LUNCHEON PROGRAMS:
Thurs. and Fri., May 19–20, 11:30 a.m.–1 p.m.

MANN MENTORS IN APPLIED HYDROGEOLOGY PROGRAM:
(by invitation; contact kblythe@geosociety.org)
Thurs., May 19, 5–6:30 p.m.

ROCKY MOUNTAIN SECTION MEETING

Grand Junction, Colorado
SHLEMON MENTOR LUNCHEON PROGRAMS:
Mon. and Tues., May 23–24, 11:30 a.m.–1 p.m.

MANN MENTORS IN APPLIED HYDROGEOLOGY PROGRAM:
(by invitation; contact kblythe@geosociety.org)
Mon., May 23, 5–6:30 p.m.

For more information contact kblythe@geosociety.org

Making Congress Work for You

Michèle Koppes, *2003–2004 GSA–U.S. Geological Survey Congressional Science Fellow*

My year on Capitol Hill has mostly consisted of meetings, lots of meetings. I've met with constituents eager to get members of Congress to cosponsor legislation or address new issues at the national level, with fellow staffers trying to move bills or plan for hearings, with agency personnel sent to the Hill to laud their programs and request appropriations, and with scientific and policy experts brought to the Hill to brief legislative staff on the state of knowledge of hot issues. Although these meetings bring new meaning to the bumper sticker "Meetings: the practical alternative to work," they provide a proactive approach to bringing issues to the forefront that elevates these issues above the steady stream of information that flows into congressional offices. Constituents need to be reminded of the importance of meeting with their Congress members; i.e., of lobbying.

The "L" Word

The term "lobbyist" was coined in the early 1800s, when members of Congress traveled twice a year from their home states to the nation's Capitol and would often stay at the Hotel Washington, across the street from the White House. With their time on the Hill being so short, tenant farmers and others who wished to discuss their issues would come to the hotel lobby and hang around until they could corner their representatives and discuss their particular issue. Not much has changed, although now the "tenant farmers" do the cornering and talking in the members' offices, and some can now afford to pay others to come and do the talking for them. The importance for citizens to discuss and emphasize issues is just as great as it was then.

The Role of the Lobbyist

In one of the more infamous moments in Michael Moore's film, *Fahrenheit 9/11*, Congressman John Conyers is asked how Congress could vote and pass the USA Patriot Act without reading the bill first, to which he responds "Sit down my son. We [members] don't actually read most of the bills we vote on." Though he was attempting to be facetious, the comment is not so far-fetched in reality. Quite often legislation does not become available for members to read until within 24 hours of a vote. Appropriation bills in particular are affected as the appropriations committees continue the horse-trading of funding levels for federal programs until the very last minute. When the legislation does become available, congressional staff sift through the often lengthy legislation. A heads-up from the citizen lobbyist is critical as their input can often provide the deciding factor toward a Representative's vote.

The Citizen Scientist

Congress needs your expertise. Representatives are rarely elected based on their understanding of the sciences, yet science is often an important factor in policy decisions. While policymakers have been singing the praises of "sound science" in decision-making of late, the electorate is often unfamiliar with both the sciences and the scientific process in general. For example, only two members of Congress hold doctorates in the sciences, both in physics: Rep. Vern Ehlers of Michigan (chair of the House Science Committee, Subcommittee on Environment, Technology and Standards), and Rep. Rush Holt of New Jersey (leader of the congressional Science Coalition and former Congressional Science Fellow). Sadly, the House Science Committee and the Senate Subcommittee on Science, Technology, and Space are not considered high profile committees and many of the members assigned to these committees have little expertise in the broad array of scientific issues that come before them, yet they are being asked to determine the direction and funding of federal science. The same is true of the natural resource committees, which have primary jurisdiction over the federal agencies dealing with earth sciences, and which deal with much of the legislation that utilize the earth sciences in decision-making. Most of the current internal scientific expertise on the Hill comes from the 33 congressional science fellows supported by GSA, AGI, AGU, and others, as well as detailees from the federal scientific agencies and former fellows who chose to remain in Congress following their fellowship year (about 3 to 4 per class). Dispersed through the Senate and House, they need your help in keeping track of the latest issues and breakthroughs in the sciences, in educating the members on issues, and in working on legislation in support of upcoming programs in the earth sciences.

Timing, Timing, Timing

In the legislative process, timing is everything. By keeping abreast of legislative issues coming to the House or Senate floor or to committees in Congress, you can prepare a quickly timed letter, call, or even better, visit your representative while the legislation is being discussed and drafted, which will help to bring scientific expertise to the debate. If you are interested in an issue that is not currently up for debate in the committees or on the floor, a quick check to see if there are bills introduced that you could get your representative to cosponsor (or to schedule for a hearing if you happen to be talking to committee members) will help make your topic relevant. Current legislation, as well as legislation introduced in prior Congresses, can easily be accessed at www.congress.gov. If you are interested in seeing specific federal programs or agencies funded, the time to talk to your representa-

tives should be in January to March, as appropriations requests are delivered by each member to the appropriations committee in April. These requests should be followed up in the late spring to early summer when the appropriations committees are meeting to consider all the requests.

Zen and the Art of the Congressional Office

Understandably, most lobbyists coming to Capitol Hill wish to speak with their elected official directly. Given the demand on a Congress member's schedule, this is not always possible. Talking to the congressional staff is therefore as important as talking to the members themselves, and often more constructive, for the staff act as the information and issue filters for the members and will do the drafting of letters and legislation on behalf of the member. Most citizen lobbyists who request a meeting or write or call their representatives will end up talking to a legislative assistant (LA) or legislative counsel (an LA in possession of a law degree). There are typically four to five LAs in each congressional office, both in the House and Senate. These LAs run the gamut from recent college graduates to seasoned lawyers with 20 years experience on the Hill. Between the four or five LAs in each office, they tackle every issue under the sun that may come up in Congress, and, understandably, may not have much chance to delve into issues of the earth sciences or of science in general. They have become accustomed to a tidal wave of information thrown at them on a daily basis. In order to make your info stick, and hence have your issue addressed, specific communication tactics are required.

Contacting Congress

The first step is to contact the relevant LA. The legislative staff and the specific issues each staff member covers are often listed on a member's Web site, or on committee Web sites, available at www.house.gov. If you are unable to reach the LA or if the information is not available, contact the member's scheduler (a.k.a. executive assistant). When contacting the office, give a background for the meeting in two or three sentences and set up a meeting in Washington, D.C., or in the district office. Most meetings last 10–15 minutes; if you can convince the LA that your issue is important enough, he or she may extend the meeting to 30 minutes or arrange for a stop-by visit with the Congress member. When meeting with or making a phone call to the member or LA, be succinct. Explain both the issue and what you would like to see the member do, whether it is to write a letter to an agency head, draft legislation, or request an appropriation. The best means to get the ball rolling is to bring one to two pages of talking points as well as any supporting documentation to any meeting (it is rare that the supporting documentation will get read in its entirety, if at all). Subsequent to the meeting, follow up with a draft of the letter or bill you spoke about as a reminder to the staff of your meeting and to help move your issue forward.

Of prime importance in whether your issue will get any face time is if the issue is germane to the members' constituency, district, state, or committee jurisdiction. Many issues are prioritized in terms of how they affect the member's constituency or state, and members have little interest in devoting significant effort to address issues affecting citizens in another state, unless the issue at hand has repercussions for their own state or comes under the purview of their assigned congressional committee. If you are not a constituent of the district of the member to whom you wish to speak (e.g., you are interested in funding for the Earth Resources Observation Systems Data Center, but are not from South Dakota), consider speaking with your professional societies and contacting other society members within the district or state who would be willing to contact the appropriate Congress member with you.

If you would like to see a piece of legislation moved forward, make an effort to contact your representatives in both the House and Senate. The legislative process is not known for its expediency, and the process moves fastest if legislation is introduced in both chambers at the same time. This tactic will also help put pressure on one chamber or committee if the legislation has passed on the floor of the other chamber and is hung up due to tight legislative timelines or due to the personal political agendas of specific committee chairs. This is very important when requesting appropriations, for there is strength in having matching requests in the House and Senate appropriations bills as they go into conference. There is also support in numbers if several members are requesting the funding, particularly if some members of your state delegation happen to sit on the right appropriations committee.

But Why Make the Effort?

Too often I have heard geologists express distaste at the political process, preferring to leave policymaking to the policymakers and to go about their own business of concentrating on the bigger picture of Earth, the longer timeframe of the geologic record. Why meddle in policy? We often forget the role the federal government plays in the support of the sciences, through funding grants, programs, academic institutions, and agencies such as the U.S. Geological Survey and the National Science Foundation. The topics being discussed in the last presidential election cycle, including the influence of politics on scientific panels and on the advancement of scientific endeavors such as stem cell research, highlight the importance of making sure science is understood and used to benefit society at large. Going straight to the policymakers is one small step to ensuring the future of our collective profession.

This manuscript is submitted for publication by Michèle Koppes, 2003–2004 GSA–U.S. Geological Survey Congressional Science Fellow, with the understanding that the U.S. government is authorized to reproduce and distribute reprints for governmental use. The one-year fellowship is supported by GSA and by the U.S. Geological Survey, Department of the Interior, under Assistance Award No. 02HQGR0141. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. government. *Koppes can be reached at michele.koppes@mail.house.gov.*

UPCOMING DEADLINES

Committee Service
Nominations Due January 15, 2005

Candidates are needed for service on the following GSA committees (service begins July 2005 unless otherwise noted): Annual Program; Arthur L. Day Medal Award; Education; Geology and Public Policy; Honorary Fellows; Membership; Minorities and Women in the Geosciences; Nominations; Penrose Conferences and Field Forums; Penrose Medal Award; Professional Development; Publications; Public Service Award; Research Grants; Young Scientist Award; and Joint Technical Program (service begins Jan. 1, 2006). Candidates are also needed for GSA representatives to the North American Commission on Stratigraphic Nomenclature (service begins Nov. 1, 2005); the AAPG Publication Pipeline Committee; the AGI Environmental Geoscience Advisory Committee (service begins Jan. 1, 2006), and the AAAS Consortium of Affiliates for International Programs.

For complete information on committee service, current vacancies, and required qualifications, see the October 2004 issue of *GSA Today*. Nomination form and instructions are available at www.geosociety.org/aboutus/commtees/.

Officers and Councilors
Nominations Due August 1, 2005

The GSA Committee on Nominations requests nominations for officers (vice president and treasurer) and councilors to serve on the GSA Council beginning in 2006. Each nomination should be accompanied by basic data and a description of the qualifications of the individual for the position recommended.

The online nomination form is available at www.geosociety.org/aboutus/commtees/, or you may send materials for committee, officer, and councilor nominations to Ruth Harrison, GSA, P.O. Box 9140, Boulder, CO 80301-9140, (303) 357-1000, ext. 0, 1-800-472-1988, ext. 0, rharrison@geosociety.org.

Medals and Awards
Nominations Due February 1, 2005

Nominations of candidates are requested for the following medals and awards: Penrose Medal, Day Medal, Honorary Fellows, Young Scientist Award (Donath Medal), GSA Public Service Award, and Distinguished Service Award. For details on the awards and nomination procedures, see the October 2004 issue of *GSA Today*, go to www.geosociety.org, or call (303) 357-1028. Materials and supporting information for any of the nominations may be sent to Grants, Awards, and Recognition, GSA, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301-9140.

National Awards
Nominations Due April 30, 2005

Candidate nominations are needed for the following national awards: William T. Pecora Award, National Medal of Science, Vannevar Bush Award, and Alan T. Waterman Award. For details, see the October 2004 issue of *GSA Today*. Nominations should be sent to Grants, Awards, and Recognition, GSA, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301-9140.

GSA Fellows
Nominations Due January 15, 2005

The Committee on Membership requests nominations of members to be elevated to GSA Fellow status. Any GSA Fellow may nominate up to two members per election cycle for this honor. Two other supporting signatures are needed, along with a letter stating the member's qualifications to be evaluated on the basis of eight established criteria. For updated information, a list of the criteria, and a new nomination form, please see www.geosociety.org/members/fellow.htm or contact Diane Lorenz, (303) 357-1028, awards@geosociety.org.

2005 Subaru Outstanding Woman in Science Award
(*Sponsored by Subaru of America, Inc.*)
Nominations Due February 1, 2005

This award is given to a woman who has made a major impact on the field of the geosciences, based on her Ph.D. research. For nomination, eligibility, and award details, see the October 2004 issue of *GSA Today*, visit www.geosociety.org, or call (303) 357-1028. Send nominations and supporting material to Grants, Awards, and Recognition, GSA, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301-9140.

John C. Frye Environmental Geology Award
Nominations Due March 31, 2005

In cooperation with the Association of American State Geologists, GSA makes an annual award for the best paper on environmental geology published either by GSA or by one of the state geological surveys. This fund managed by GSA Foundation. For details, see the October 2004 issue of *GSA Today*, visit www.geosociety.org, or call (303) 357-1028. Nominations must be sent to Grants, Awards, and Recognition, GSA, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301-9140.

Student Research Grants
Online submission must be completed by midnight (MST), February 1, 2005.

The GSA student research grant application process is now available only online. Although the current forms have not changed significantly, the process for submitting applications and appraisal letters is accessible only online through GSA's password-protected Web site. No paper applications or letters will be accepted. For information on the 2005 Research Grant Program for Students, see the October 2004 issue of *GSA Today*, visit www.geosociety.org, call (303) 357-1028, or e-mail awards@geosociety.org.

Congressional Science Fellowship
Applications Due January 21, 2005

For application information for the 2005–2006 GSA–U.S. Geological Survey Congressional Science Fellowship, visit www.geosociety.org/science/csf/, or contact Ginger Williams, GSA Headquarters, (303) 357-1040, gwilliams@geosociety.org.

Call for Nominations: GSA Division Awards

Funds for the following GSA Division awards are administered through the GSA Foundation.

Don J. Easterbrook Distinguished Scientist Award—Quaternary Geology and Geomorphology Division

The Quaternary Geology and Geomorphology Division of GSA seeks nominations for the Don J. Easterbrook Distinguished Scientist Award. This award will be given to an individual who has shown unusual excellence in published research, as demonstrated by a single paper of exceptional merit or a series of papers that have substantially increased knowledge in Quaternary geology or geomorphology. No particular time limitations apply to the recognized research. The recognition is normally extended to an individual, but in the event of particularly significant research, two people may share the award. Monies for the award are derived from annual interest income from the Don J. Easterbrook Fund, administered by the GSA Foundation.

Although recognition of extraordinary prior research excellence is the principle goal of this award, it carries with it an opportunity for funding additional research. The Easterbrook Distinguished Scientist is eligible to draw funds for research from the GSA Easterbrook Fund in an amount to be determined by availability of funds. This opportunity for funding additional research by the winner is a secondary consideration of this award.

Members of the Quaternary Geology and Geomorphology Division Award Panel will evaluate nominations for the Easterbrook Award. Because the award primarily recognizes research excellence, self-nomination is not allowed. Nominees need not be members of the division. Nominations are not automatically carried forward to subsequent years, but the same individuals may be renominated.

Nominations must be accompanied by supporting documentation, including a statement of the significance of the nominee's research, curriculum vitae, letters of support, and any other documents deemed appropriate by the nominating committee. Send nominations by April 1, 2005, to John E. Costa, U.S. Geological Survey, 10615 S.E. Cherry Blossom Dr., Potland, OR 97216-3103, USA, jecosta@usgs.gov.

Farouk El-Baz Award for Desert Research—Quaternary Geology and Geomorphology Division

The GSA Quaternary Geology and Geomorphology Division seeks nominations for the Farouk El-Baz Award for Desert Research. This award rewards excellence in research in desert geomorphology worldwide and is intended to stimulate research in desert environments by recognizing an individual whose research has significantly advanced the understanding of the Quaternary geology and geomorphology of warm deserts. Although the award primarily recognizes achievement in desert research, the funds that accompany it ($10,000 anticipated for 2005) may be used for further research. The award is normally given to one person but may be shared by two people if the recognized research was the result of a coequal partnership. Monies for the award are derived from annual interest income from the Farouk El-Baz Fund, administered by the GSA Foundation.

Any scientist from any country may be nominated for the award. Because the award recognizes research excellence, self-nomination is not permitted. Neither nominators nor nominees need be members of GSA. Nominations must be accompanied by a statement of the significance of the nominee's research, a curriculum vitae, letters of support, and documentation of published research results that have significantly advanced the knowledge of the Quaternary Geology and Geomorphology of warm desert environments.

Send nominations by April 1, 2005, to Alan R. Gillespie, Quaternary Reseach Center, P.O. Box 351310, University of Washington, Seattle, WA 98195-1360, USA, alan@rad.ess.washington.edu.

Laurence L. Sloss Award for Sedimentary Geology

The Sedimentary Geology Division of GSA solicits nominations for the 2005 Laurence L. Sloss Award for Sedimentary Geology. This award is given annually to a sedimentary geologist whose lifetime achievements best exemplify those of Larry Sloss—i.e., achievements that contribute widely to the field of sedimentary geology and service to GSA. Monies for the award are derived from annual interest income from the Laurence L. Sloss Award for Sedimentary Geology fund, administered by the GSA Foundation.

Nominations should include a cover letter describing the nominee's accomplishments in sedimentary geology, contributions to GSA, and curriculum vitae. The management board of the Sedimentary Geology Division will choose the recipient from the two nominees forwarded from the nominations committee, and the award will be presented at the GSA Annual Meeting in Salt Lake City in October 2005.

Send nominations electronically by Feb. 20, 2005, to Paul Link, secretary, Sedimentary Geology Division, linkpaul@isu.edu.

Gilbert H. Cady Award—Coal Geology Division

The Coal Geology Division of GSA seeks nominations for the 2005 Gilbert H. Cady Award, made for outstanding contributions in the field of coal geology. The first award, established by the division in honor of Gilbert H. Cady, was presented in 1973. Monies for the award are derived from annual interest income from the Gilbert H. Cady Memorial Fund, administered by the GSA Foundation. The award will be made for contributions considered to advance the field of coal geology within and outside North America and will be presented at the Coal Geology Division Business Meeting at the GSA Annual Meeting in Salt Lake City in October 2005.

Nominations will be evaluated by the Gilbert H. Cady Award Panel and should include the name, office or title, and affiliation of the nominee; date and place of birth; education, degree(s), and honors and awards; major events in his or her professional career; and a brief bibliography noting outstanding achievements and accomplishments that warrant nomination.

Send three copies of the nomination by February 28, 2005, to R. Marc Bustin, The University of British Columbia, Vancouver, BC V6T1Z4, Canada, mbustin@eos.ubc.ca.

THE GEOLOGICAL SOCIETY OF AMERICA

New Members: GSA Welcomes You!

The following individuals joined GSA during the period of February 2004 through August 2004. They were elected into membership by Council at its November 2004 meeting.

SCIENCE • STEWARDSHIP • SERVICE

GSA Fellow

Julia A. Jackson

GSA Members

Masud Ahmed
Omar Salim Al-Ja'aidi
Isam Amin
John A. Andrew
Brian Andrews
Richard P. Archdeacon
Adam Armour
Eliana Avella
Ebenezer O.A. Babatope
James F. Baichtal
Kristin M. Bailey
Robert V. Bailey
Gry Hoffmann Barfod
Hazel Barton
Matthew E. Basch
Alan R. Batcheller
Persaram O. Batra
Travis Bauer
Olivier Bethoux
Richard J. Bichsel
Eric Bivens
Cory W. Black Eagle
Margaret E. Blanchard
Leslie F. Bleamaster
Geoffrey C. Bohling
Costanza Bonadonna
Revital Bookman
Matthew Boyd
Jon W. Branstrator
Roy Breckenridge
Adam Bren
James Arnold Brey
Henry O. Briceno
John Bridge
Dennis Brinkley
Emily Brodsky
Craig Buchan
Connie B. Burkhart
Ravidya N. Burrowes
Gary Butler
Antonio Z. Camargo
Dante Canil
Mary E. Caress
William Carroll
William Chamberlin
Beverly Chenausky
Augustin F. Chicarro
Susan Childers
Tait Chirenje
Robert W. Christopherson
Charles S. Churcher
Geoffrey Alden Clayton
Gary D. Clow
Robert Cluff
Daniel E. Colling
Wendy Copeland
Alan K. Craig
Matthew Curren
Wendy S. Curtis
Stephen Daly
Scott Darst
Rupali Datta
Brian M. Davis
Robert V. Demicco
Kristin O. Dennen
Ernesto A. Diaz
Paul R. Dinkmeyer
Patrick Diver
John C. Dolson
Rhonda Driscoll
Lance Erickson
Robert C. Ervin
Sage K. Evans
Phillip D. Everhart
Kim McChesney Farrah
Bernhard E. Felber
Richard S. Ferenbach
Julia L. Fields
Doug R. Fils
David Fink
Thomas R. Fisher
Richard Fluegeman
Matthew W. Frailey
Howard Frost
Emmanuel J. Gabet
Glen E. Gardner Jr.
David Genereux
Serge Genest
Tom J. Gignoux
Linda Godfrey
Lisa Goggin
Michael N. Gooseff
Kazuhisa Goto
Kim P. Granzow
Deanna Greco
Douglas S. Greer
Steve G. Gridley
Jason J. Gurdak
John Christopher Haley
Laura Lei Hallberg
Heather D. Hanna
William H. Hanson
Tom Harding
Michael J. Harris
David J. Hart
Michalann Harthill
Leo Hathaway
David E. Hawthorn
Daniel R. Hayes
Adam Seth Heffernan
Jean Hemzacek Laukant
C. Brian Hennessey
F. Vincent Hernly
Jeffrey B. Hill
Frank Hole
Kelly Holladay
Lars E. Holmer
Benjamin P. Horton
Jackie House
John Houston
Douglas B. Howard
Martha S. Hughes
Thomas F. Hughes
Youngsook Huh
Margaret Imhof
Akira Ishikawa
Wayne M. Itano
Jessica Jager
Sandra Jewett
Quintin Johnson
Elizabeth G. Jones
Jamie P. Jones
Grant D. Kaye
John W. Keller
Eloise Kendy
Kirsten C. Kennedy
Jeffrey T. Kiehl
Rodney M. Kilgore
Patrick Kinnicutt
James W. Kirchner
Karin B. Kirk
Kevin Kitchin
Thomas R. Klopf
Kimbell L. Knight
Gary A. Kocurek
Lanna K. Kopachena
Scott F. Korom
Michael Kowalsky
Shannon M. Krasel
Peter Krembs
Eric D. Kruger
Frederick G. Kruger
John R. Larson
Edward J. Layton
Stephanie M. Leicester
Varsha Levi
Chee Kneong Lim
Henry Lin
Richard Lis
Ronald J. Litwin
Joseph L. Lockett
Antonette Logar
Russanne Low
Thomas S. Lowry
Gary A. Lund
Richard Lupia
Jean Lynch-Stieglitz
Ian R. MacDonald
Vera Markgraf
Craig P. Marshall
Rudy V. Matalucci
Murray McClaren
K. Maggie McColl
Karen M. McCurdy
Edward R. McDuffie
Forrest S. McFarland III
Joseph B. McHugh
Glen Evan McIlwain
Robert McIntyre
Charles M. McKenzie
Brendan J. Meade
Richard H. Meadow
Summer R. Miles
Keith E. Millard
Jeffrey L. Mills
James Molholm
Jonathan R. Moll
Gretchen E. Moore
Rory N. Mortimore
Gene L. Murray
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Raoul J. Mutter
Guy M. Narbonne
JoAnne Nelson
Peter Kwok-Hei Ng
Clayton R. Nichols
Matthew Nowell
Keri Ayn Nutter
Richard J. O'Hearn
Celia T. Onishi
Richard M. Ortiz
Colin Osborne
Aaron S. Otteman
James B. Palmer
Elizabeth M. Pangerl
Peter G. Pearson
Vital Pearson
Roy S. Pescador Jr.

Jonathan P. Peterson
Stephen P. Phipps
Elisabetta Pierazzo
Anne Rebecca Poole
Wayne Powell
Susan G. Price
Robert E. Puckett
William L. Rader
Dharma Rao
Keith B. Rapp
Donald S. Reimer
William A. Reiners
Audrey D. Reznik-Jose
James W. Rice
Gigi Richard
Hugh J. Rieck
Michael F. Robbins
Vincent P. Robino
Eryn Robinson
Gilpin R. Robinson Jr.
Cesare Roda
Larry Rollins
Peter D. Roopnarine
Lawrence Q. Ross
Stephanie D. Ross
Stacy Marie Saari
Manas R. Sahoo
Daniel H. Sandweiss
Isabelle Yasmina Sarikhan
Frederick S. Saville
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Tom Fouch Joins the Foundation's Board of Trustees

Thomas D. Fouch

I am pleased to announce that Thomas D. Fouch has joined GSA Foundation's Board of Trustees. He will serve a five year term, which began at the November 2004 meeting of the Board. Fouch also served as president of the Foundation from January 2002–2004, where he was successful in raising funds for several GSA projects.

Fouch worked for the U.S. Geological Survey for 27 years until his retirement in December 2001. Previously, he spent one year with J.M. Huber and five years with Shell Oil. He received his B.S. degree in earth science in 1966 from Portland State University in Oregon and his M.S. degree in geology in 1968 from the University of Oregon.

Fouch has extensive experience as a leader, a manager, a strategic planner, and an implementer, and he brings to GSA Foundation's Board a broad background in program development, program evaluation, and resource planning. He is also skilled at representing his organization to outside groups or agencies. He has a reputation as a trusted, credible, and respected team player with a warm personality and remarkable people skills. His work ethic, long history of performance, and intellectual capacity are all exceptional and will be helpful in the Foundation's quest to be successful in its efforts to seek funds in support of GSA programs and activities.

Welcome aboard Tom!

GeoTales, volume 1

A 100 page booklet with amazing stories of adventures and discoveries from GSA members is available. A copy of *GSA GeoTales*, volume 1, will be sent to you once you complete the coupon below, and include **a minimum $50 contribution** to the GSA Foundation. Please send your check and completed coupon to the Foundation office, and the booklet will be mailed to you immediately.

If you have a tale or two you would like to share for volume 2, please send it via e-mail to drussell@geosociety.org. We are hoping to finalize volume 2 by February 2005.

Most memorable early geologic experience:

To illustrate the differences between rational (cause and effect) and empirical deductions in his classes, J. Hoover Mackin used to point out that if you put one foot into a bed of red-hot coals and other foot on a block of ice, the *average* temperature should be comfortable.

—Donald J. Easterbrook

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HISTORY OF GEOLOGY DIVISION INITIATES STUDENT AWARD

GSA's History of Geology Division is soliciting proposals for a student award for the amount of $500 for a paper to be given at the national GSA meeting. It may be:

- A history of geology paper —or—
- A literature review of ideas for technical work

Are you interested in where the ideas that you work with came from? How do you know your research is original? What ideas were prominent in the literature review you did for your thesis or dissertation? Were there ideas that didn't work out? Why? Is your portion of our science "refining the numbers" and extending observations, or are you working on a novel theory? Is there an area of geology whose origins you would like to investigate?

The History of Geology Division would like to hear from you! Mentors are available to help you with this process, or you may work with your own faculty. Contact William Brice, wbrice@pitt.edu, Professor of Geology and Planetary Science, University of Pittsburgh at Johnstown, Schoolhouse Rd., Johnstown, PA 15904, for proposal guidelines and application forms.

Proposals and application are due **May 1, 2005,** so that content and the official GSA abstract can be refined. The History of Geology Division award committee will make the selection.

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 2005 award is for $7,600.

The **W. Storrs Cole Memorial Research Award** supports research in invertebrate micropaleontology. This award carries a stipend of $7,000 in 2005 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 2005 application forms, visit www.geosociety.org/grants/postdoc.htm. For more information, contact Diane Lorenz, Grants, Awards, and Recognition, GSA, P.O. Box 9140, Boulder, CO 80301-9140, awards@geosociety.org.

Applications must be mailed and must be postmarked on or before February 1, 2005. Applications sent by facsimile or e-mail will not be accepted. The Committee on Research Grants will report its actions to each applicant in April 2005.

THE GLADYS W. AND W. STORRS COLE AWARD FUNDS ARE MANAGED BY THE GSA FOUNDATION.

GEOLOGICAL SOCIETY OF AMERICA
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SPECIAL PAPERS

Orogenic Curvature: Integrating Paleomagnetic and Stuctural Analyses
edited by Aviva J. Sussman and Arlo B. Weil, 2004
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$80.00, member price $64.00

Cenozoic Climatic and Environmental Changes in Russia
edited by A.A. Velichko and V.P. Nechaev (editors of the English-language edition are H.E. Wright Jr., A.A. Velichko, T.A. Blyakharchuk, and Olga Borisova), 2004
SPE382, ISBN 0-8137-2382-5
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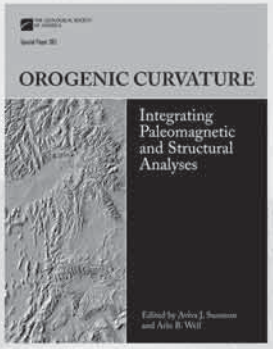
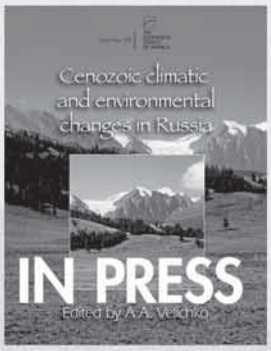
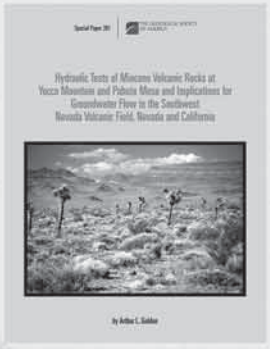
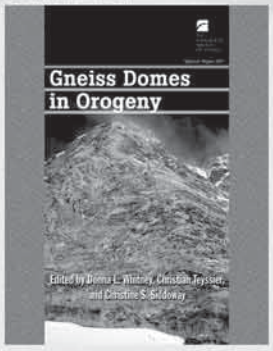
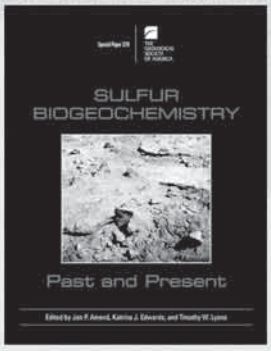
edited by Terry W. Swanson, 2003
FLD004, 284 p., ISBN 0813700043
$45.00, (sorry, no additional discounts)

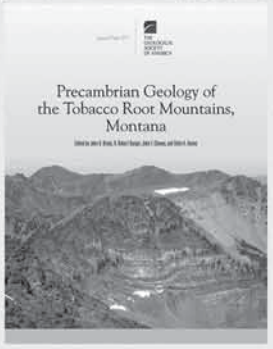


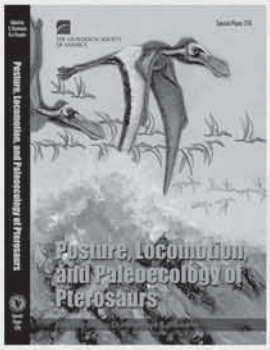


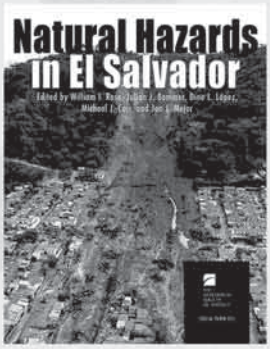


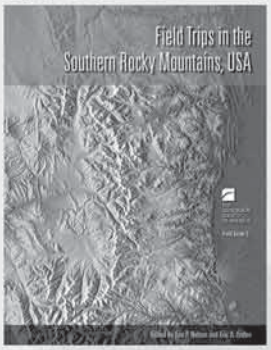












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ANNOUNCEMENTS

MEETINGS CALENDAR

2005	
March 29–April 1	Partnering for the Global Hydrogen Future: Annual Hydrogen Conference & Exposition, Washington, D.C. **Information:** National Hydrogen Association, (202) 223-5547, info@hydrogenassociation.org, www.hydrogenconference.org.
June 20–24	Uranium 2005: International Symposium on Uranium Production and Raw Materials for the Nuclear Fuel Cycle—Uranium Supply and Demand, Uranium Geology, Uranium Production, Uranium Mining and Milling, Waste Management, and Environment and Safety; Vienna, Austria. **Information:** Karen Wenrich, Scientific Secretary, International Atomic Energy Agency, NEFW, +43-1-26000, fax +43-1-26007, K.J.Wenrich@iaea.org, Uranium2005@iaea.org.
2006	
February 8–9	Oil & Gas Habitats of Russia and Surrounding Regions, London. **Information:** www.geolsoc.org.uk, Lucy Kimber, lucy.kimber@geolsoc.org.uk.
April 18–23	100th Anniversary Earthquake Conference, San Francisco, California. Seismological Society of America, Earthquake Engineering Research Institute, and the California Governor's Office of Emergency Services. **Information:** www.1906eqconf.org/; field trip information: cprentice@usgs.gov. Field trip proposals deadline: March 1, 2005.

Visit www.geosociety.org/calendar/ for a complete list of upcoming geoscience meetings.

Call for Nominations: 2005 Laurence L. Sloss Award

Each year the Sedimentary Geology Division of GSA offers the L.L. Sloss award for lifetime contributions to the field of sedimentary geology and service to GSA. This award is a significant honor for the top sedimentary geologists of our time. Previous awardees include Bill Dickinson, Bob Dott, George Kline, Pete Palmer, Bob Weimer, and James Lee Wilson. To make a nomination, please include a cover letter describing the nominee's accomplishments in sedimentary geology and contributions to GSA and a curriculum vitae for the nominee. The award will be presented at the 2005 GSA Annual Meeting in Salt Lake City. Nominations remain active for three years. Please send your nominations electronically by Feb. 20, 2005, to Paul Link, secretary, Sedimentary Geology Division, linkpaul@isu.edu.

iScienceProject Launches K–12 Energy Contest

Sponsored by iScienceProject, the HOBO Energy Challenge promotes energy awareness within schools with a fun, hands-on science learning tool, HOBO® data loggers (portable electronic recording devices that monitor light usage, room temperature, and relative humidity to find examples of energy waste). Participating classrooms will receive a free HOBO Loaner Package that includes a data logger, software, and energy-saving contest activities. Information: www.iscienceproject.com/energy_challenge/energy_challenge.html. Deadline for contest entries: April 30, 2005.

Call for Scholarship Applications

Each year, the Dan David Prize awards 10 scholarships of US$15,000 each to outstanding doctoral students and post-doctoral researchers from universities all over the world. In addition, 10 scholarships of US$15,000 each are awarded to outstanding doctoral students from Tel Aviv University. For information on applying and on the fields selected for 2005, visit www.dandavidprize.org. Application deadline: March 30, 2005.

AWG Announces New Officers

The Association for Women Geoscientists has named the following people to its 2004–2005 Executive Committee: president—GSA member **Allyson Anderson**, ExxonMobil Exploration Company; president elect—GSA member **Laurie E. Scheuing**, Quantitative Environmental Analysis LLC; past president—GSA Fellow **Helen Delano**, Pennsylvania Geological Survey; secretary—GSA member **Tamie J. Jovanelly**, Ph.D. candidate at Kent State University; treasurer—GSA member **Kata McCarville**, Institute of Atmospheric Sciences, South Dakota School of Mines and Technology; editor—**Marguerite Toscano**, Smithsonian Department of Paleobiology; assistant editor—**Lorraine Manz**, North Dakota Geological Survey; GAEA advertising editor—GSA member **Jane H. Gill**, environmental geologist, North Carolina; publicist—GSA member **Pranoti M. Asher**, Georgia Southern University; and business manager—**Carol Dicks**.

AGI Announces New President and Officers

The American Geological Institute has named its new president, GSA Member **Stephen M. Testa**, and new AGI officers: president-elect—GSA Fellow **Ernest Mancini**; secretary—GSA Fellow **Robert H. Fakundiny**; and member-at-large—**G.W. "Skip" Hobbs**.

About People

GSA Senior Fellow **Russell G. Slayback** has received the American Geophysical Institute's William B. Heroy Jr. Award for exceptional and beneficial long-term service to AGI. Slayback, president and chairman of the board of directors of Leggette, Brashears & Graham Inc., earned his degree in geology from Rensselaer Polytechnic Institute in Troy, New York.

GSA Fellow **Warren D. Allmon** has been recognized for his work leading to the greater understanding and public appreciation of the role the geosciences play in society with AGI's Outstanding Contribution to the Public Understanding of Geoscience Award. Allmon is the director of the Paleontological Research Institution and the Museum of the Earth in Ithaca, New York. He earned his A.B. degree at Dartmouth College in 1982 and his Ph.D. from Harvard University in 1988.

In Memoriam

Allan P. Bennison
Grass Valley, California
May 1, 2004

D.L. Blackstone
Laramie, Wyoming
May 24, 2004

John W. Blagbrough
Albuquerque, New Mexico
July 11, 2004

Reuben G. Bullard
Independence, Kentucky
July 3, 2004

Arthur E. Burford
Hudson, Ohio
August 1, 2004

George H. Davis
Gaithersburg, Maryland
May 24, 2004

William J. Domoracki
Columbia, South Carolina
July 25, 2004

Leo A. Herrmann
Ruston, Louisiana
July 16, 2004

Alan D. Hoagland
Murfreesboro, Tennessee
August 1, 2004

John H. Hoke
Sardinia, Italy
September 18, 2004

W.G.Q. Johnston
Saskatchewan, Canada
May 14, 2004

Helen Tappan Loeblich
Yorba Linda, California
August 18, 2004

Frederic B. Loomis
Peoria, Arizona
April 23, 2004

John A. Mann
Yorba Linda, California
September 19, 2004

Barney C. McCasland Jr.
Midland, Texas
June 12, 2004

David A. Morris
Oklahoma City, Oklahoma
April 14, 2004

Elmer D. Patterson
Roswell, New Mexico
July 24, 2004

John B. Reid Jr.
Amherst, Massachusetts
Notified August 3, 2004

Donald H. Richter
Anchorage, Alaska
October 8, 2004

Robert P. Sharp
Pasadena, California
May 24, 2004

Harold K. Stager
Bodega Bay, California
October 9, 2004

Sherwood D. Tuttle
Fort Thomas, Kentucky
June 27, 2004

Karen M. Weber
Blacksburg, Virginia
May 26, 2004

Peter V. Wiese
Fairhope, Alabama
October 13, 2004

Keith P. Young
Austin, Texas
August 20, 2004

Please contact the GSA Foundation at (303) 357-1057 or drussell@geosociety.org for information on contributing to the Memorial Fund.

Neil Kelley, GeoCorps 2004, Fossil Butte National Monument

2005 Summer Positions Posted

Spend your summer working on a priority geoscience project in a National Park or National Forest.

GeoCorps™ America Program

Through the GeoCorps America Program, GSA offers geoscientists of all levels—university students, professionals, and retirees—a 10 week summer experience working in a National Park or National Forest on a priority land management project to protect America's public lands.

All 2005 summer positions are posted on the Web site listed below. To find out more about the GeoCorps program, positions and locations on National Parks and National Forests, or how to apply, refer to:

http://www.geosociety.org/geocorps

Deadline to apply is Friday, February 11, 2005

Apply today to be involved in an exciting on-the-ground project on America's public lands this summer!

GEOLOGIC PAST

100 Years Ago

GLACIERS A HOT TOPIC
H.L. Fairchild's paper, "Ice Erosion Theory a Fallacy," printed in *GSA Bulletin*

"Probably there is no subject in geology on which the divergence of opinion is so great while at the same time the observational material is so ample as that of glacial erosion" (H.L. Fairchild, p. 14). In his February 1905 *GSA Bulletin* article, H.L. Fairchild addressed the "extreme differences of opinion and the sudden and radical shifting of views" (p. 15) regarding ice erosion in order to argue against the view that "glaciers possess great erosive power."

In this refutation of ice erosion theory, Fairchild included a brief definition of erosion, presented an extensive discussion on the nature and activity of glaciers around the world, and then focused on ice-sheet erosion in the state of New York, USA. Fairchild was also known as an avid and skilled photographer, and the *Bulletin* article includes several photographs taken of quarries and building sites throughout New York state.

Herman Leroy Fairchild (1850–1943) was a GSA founding member in 1888 and served as GSA secretary from 1891 to 1906 and GSA president in 1912. Fairchild first presented this controversial paper in two parts at the GSA Philadelphia and St. Louis meetings in January and December 1904, respectively.

50 Years Ago

FRACTURES, CLAY, MAKE GEOLOGY LESS DULL
Ernst Cloos' address to GSA on "Experimental Analysis of Fracture Patterns" printed in *GSA Bulletin*

In his address as retiring president of GSA, published in *GSA Bulletin* in March 1955, Ernst Cloos stated, "The importance of fractures can hardly be exaggerated. Most likely man could not live if rocks were not fractured" (p. 242). As a prelude to encouraging his colleagues to use experimentation to imitate fracture patterns, Cloos noted, "Geology without fractures would be rather dull, and what would the geologist do if he were without faults when his imagination exceeds his geology?" (p. 242).

In this introduction to fracture pattern experimentation, Cloos drew on work by his brother, Hans Cloos, and outlined four scale models for those scientists who wished to engage in the "good deal of fun" (p. 242) to be had in attempting to imitate and measure fault fracture patterns using wet clay, a trowel, a table, boards, wire cloth, and "a lively imagination" (p. 243).

Ernst Cloos (1898–1974) served as president of GSA in 1954, and first presented this paper at the 1954 GSA Annual Meeting in Los Angeles, California.

The Geological Society of America

GSA Mission, Vision, and Goals Updated for 2005

Mission

The mission of GSA is to be a leader in advancing the geosciences, enhancing the professional growth of its members, and promoting the geosciences in the service of humankind.

Vision

- GSA will be a broad, unifying scientific society
- Fostering the human quest for understanding Earth, planets, and life;
- Catalyzing new scientific ways of thinking about natural systems; and
- Supporting the application of geoscience knowledge and insight to human needs, aspirations, and stewardship of the Earth.

THE GEOLOGICAL SOCIETY OF AMERICA

Goals

1. To increase the quality and vitality of meetings and conferences.
2. To increase the quality and vitality of publications.
3. To promote geoscience in the service of society.
4. To attract and sustain a dynamic, dedicated, diverse, and viable membership and to be responsive to this membership.
5. To maintain GSA and the GSAF as financially viable entities.
6. To optimize GSA's governance and organizational structure in fulfillment of GSA's mission.

GSA Beginnings

The first meeting and the official formation of the Geological Society of America took place in Ithaca, New York, on December 27, 1888. The founders of the GSA were a distinguished group.

James Hall (1811–1898), considered the "elder statesman" of the geological profession at that time, was the first president of GSA. **James Dwight Dana** (1813–1895), one of the great exploration geologists, was the initial first vice president of the society, while the man believed to have worked the hardest toward the foundation of the GSA, **Alexander Winchell** (1824–1891), served as initial second vice president. **John James Stevenson** (1841–1924) was GSA's first secretary, **Henry Shaler Williams** (1847–1918) was the society's first treasurer, and those elected to serve as members at large were **Charles Henry Hitchcock** (1836–1919), stratigrapher and paleontologist **John Strong Newberry** (1822–1892), and Rocky Mountain region geologist **John Wesley Powell** (1834–1902). The other members of the founding group, many of whom went on to serve as society officers, were **Herman LeRoy Fairchild** (1850–1943), **James Furman Kemp** (1859–1926), **William John McGee** (1853–1912), **Henry Bradford Nason** (1831–1895), **Israel Charles White** (1848–1927), **John Francis Williams** (1862–1891), **Samuel Gardner Williams** (1827–1900), and **Newton Horace Winchell** (1839–1914). In 1889, **Mary Emilee Holmes** (1850–1906) became the first woman GSA Fellow.

This information is taken from GSA Memoir 155, The Geological Society of America—Life History of a Learned Society, by Edwin B. Eckel (1982), and a booklet titled "The Founding of The Geological Society of America," by Arthur Mirskey of GSA's History of Geology Division (1988).

EARTHCACHING

An Adventure Game with an Earthy Twist

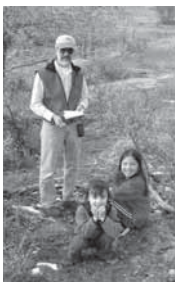
***Gary Lewis**, GSA Education and Outreach*

Geocaching is an outdoors phenomenon that is growing rapidly worldwide. Geocaching is an adventure game for Global Positioning System (GPS) users. It involves the creation and placement by players of caches containing a logbook and often other items and the subsequent searching for and locating of these caches by other players. Currently, there are 98,909 caches hidden within the United States and about 500,000 players. Caches are also hidden in over 200 other countries.

The details of each geocache, or the "cache notes," are recorded on a database-driven Web site, www.geocaching.com. This Web site is operated by Groundspeak Inc.

Hunting for a geocache can be an individual pursuit or, more commonly, a group or family affair. Some players use the game as a way to travel to unusual places in the country or to see features that are not marked on tourist maps. Some sites require access by four-wheel drive vehicles and many by hiking.

GSA is involved in setting up some earth science education geocaches, called *Earthcaches*, in association with the U.S. National Park Service, Forest Service, and other agencies and organizations and in partnership with Groundspeak Inc. and Subaru of America.



GSA Exec Jack Hess and friends on an Earthcaching expedition in Colorado.

As the name implies, Earthcaches are meant for learning about Earth. This includes geological phenomena (fossils, minerals, faults, folds, resources) and geographical features (glacial features, waterfalls, etc.). Already, there are some great GSA Earthcaches in Australia, the United States, and Canada, and some are under development in Germany and Norway.

Earthcaches are a type of "virtual" geocache—that is, they do not involve the creation of physical containers hidden at sites, but rather, Earthcache visitors learn about Earth through the cache notes when they visit the site. Unlike "traditional" caches, the visitors do not leave or remove items from a cache. Some Earthcaches may be established at places where geocachers can log their visits in a book at a visitors' center. All visitors to Earthcaches will be encouraged to log their visits on the Web site.

Earthcaches provide not only location but also a lesson about what the geocacher is seeing. For example, the first Earthcache developed takes the visitor to six places on a headland where they can see evidence of what it was like during the Permian ice age. The cache notes provide the geocacher with an introduction as well as information on each site they visit.

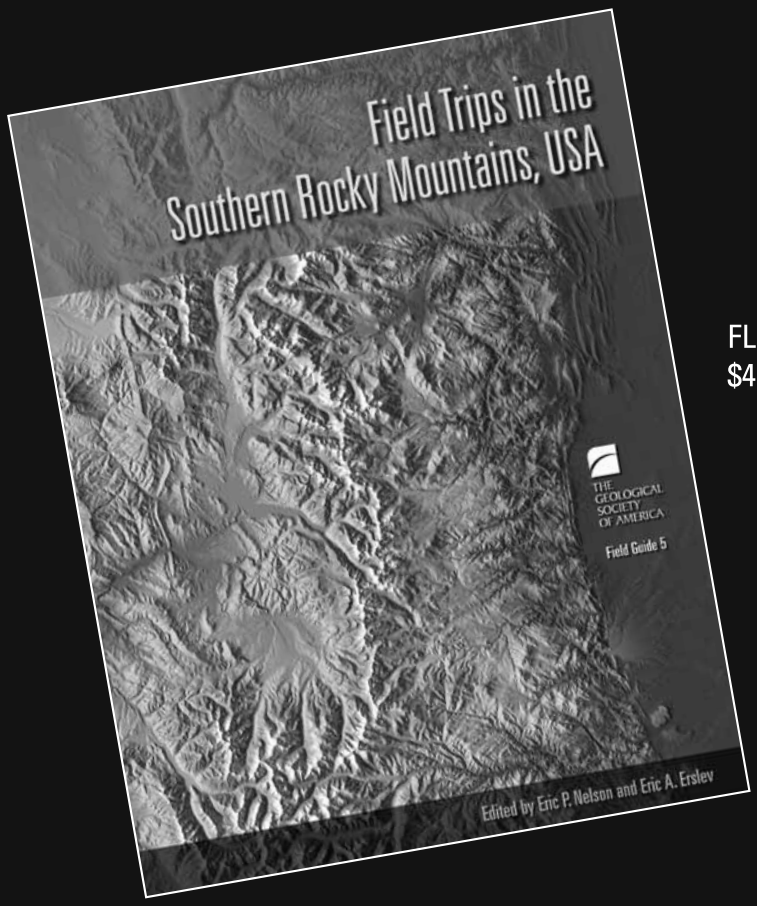
Another Earthcache, in Colorado, takes visitors to a site where Earth's internal forces have injected pegmatite veins of minerals, some as big as a matchbox, into the surrounding country rock. The explanations for how and why this happened are right there in the cache notes in a language understandable for the layperson.

Because Earthcaches are virtual caches, they are a perfect way for many places, both rural and urban, to become cache sites. For example, an Earthcache is currently under development that will take people on a guide of the amazing variety of building stones used in Denver. It will provide the story of each stone type as well as other information. This will be a perfect way for teachers to take inner city kids on a geology field trip using GPS technology.

Earthcaches, because of their educational nature, go through a special approval process in which the language and appropriateness of the cache are tested by the GSA Earthcache team. The team uses a set of guidelines (which you can read at www.earthcache.org) as well as their own earth science experience to ensure that the quality of Earthcaches is maintained. The Earthcache team is also expanding to make sure that caches in languages other than English are not excluded from the project.

So, how do you develop an Earthcache? First, read the guidelines at www.earthcache.org. The most important guideline is that the cache must really teach the visitor something wonderful about our planet. Just a "view" will not make it as an Earthcache. We would suggest that you check out some of the excellent Earthcaches, like "The Rocks that Grew" Earthcache or the WoolShed Creek Earthcache to see how others have written the accompanying notes. Then complete the online submittal form. The Earthcache team will make a decision on the value of the cache, and if it meets the standards, it is submitted to Geocaching.com to undergo the normal geocache approval process. At this stage, around 60% of submitted Earthcaches have been approved and listed.

If you would like to work on setting up Earthcaches in your area and would like to discuss these with the Earthcache Team, please contact Gary Lewis, glewis@geosociety.org, or Wesley Massey, wmassey@geosociety.org.



FLD005, 234 p., ISBN 0-8137-0005-1
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Field Trips in the Southern Rocky Mountains, USA

Edited by Eric P. Nelson and Eric A. Erslev, 2004

The theme of the 2004 GSA Annual Meeting and Exposition, "Geoscience in a Changing World," covers both new and traditional areas of the earth sciences. The Front Range of the Rocky Mountains and the High Plains preserve an outstanding record of geological processes from Precambrian through Quaternary times, and thus serve as excellent educational exhibits for the meeting. With energy and mineral resources, geological hazards, water issues, geoarchaeological sites, and famous dinosaur fossil sites, the Front Range and adjacent High Plains region provide ample opportunities for field trips focusing on our changing world. The chapters in this field guide all contain technical content as well as a field trip log describing field trip routes and stops. Of the 25 field trips offered at the meeting, 14 are described in the guidebook, covering a wide variety of geoscience disciplines, with chapters on tectonics (Precambrian and Laramide), stratigraphy and paleoenvironments (e.g., early Paleozoic environments, Jurassic eolian environments, the K-T boundary, the famous Oligocene Florissant fossil beds), economic deposits (coal and molybdenum), geological hazards, and geoarchaeology.

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Field Guide

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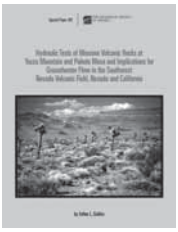
FLD005, 234 p., ISBN 0-8137-0005-1
$45.00, member price $36.00

Special Papers

Gneiss Domes in Orogeny, edited by Donna L. Whitney, Christian Teyssier, and Christine S. Siddoway

Domal structures cored by high-grade metamorphic rocks and granite occur in every exhumed mountain belt worldwide, representing orogenic events from the Archean to the present. Field relationships, thermal histories, and results of modeling of these structures show that dome emplacement and orogenesis are intimately related. Flow of crust in domes focuses lithospheric deformation and strain and is dynamically linked to surface processes. This book illustrates that domes are archives of information about first-order tectonic processes common to contractional, extensional, and transcurrent regimes. Investigations in structural geology, metamorphic and igneous petrology, geochronology, thermochronology, geophysics, and geomorphology presented in this volume explore the origin and dynamics of gneiss domes in diverse tectonic settings.

SPE380, 378 p., plus index, CD-ROM ISBN 0-8137-2380-9
$85.00, member price $68.00



Hydraulic tests of Miocene volcanic rocks at Yucca Mountain and Pahute Mesa and implications for groundwater flow in the Southwest Nevada Volcanic Field, Nevada and California, by Arthur L. Geldon

Pahute Mesa was the principal site for underground nuclear tests in the United States, and Yucca Mountain is the proposed site for this nation's first permanent high-level nuclear-waste repository. This paper interprets results of hydraulic tests from 41 sites in the Yucca Mountain–Pahute Mesa area, emphasizing 46 new or revised test analyses. Methods used to analyze data account for the dual fracture and matrix permeability of the tuffaceous rocks and lava flows. Because these rocks are unlike many commonly studied aquifer systems, some conventional analytical methods used for pumping tests in porous media could not be used or had to be used with caution. Hydraulic conductivity obtained from drawdown in a pumped well was observed to be comparable to hydraulic conductivity obtained from slug-injection and swabbing-recovery tests but much smaller than hydraulic conductivity obtained from observation-well data. The length of a pumping test also was found to influence the shape of the drawdown curve and, hence, the determination of hydraulic properties. Many pumping test analyses illustrate conclusions about flow-system dynamics and hydraulic properties presented in the paper.

SPE381, 93 pages, ISBN 0-8137-2381-7
$50.00, member price $40.00

Orogenic curvature: Integrating paleomagnetic and structural analyses, edited by Aviva J. Sussman and Arlo B. Weil

Most active and ancient orogenic systems display salients and recesses with varying degrees of curvature in map view. Within these arcuate orogens, many observations (e.g., out-of-plane strains, oblique slip, earthquake swarms, vertical-axis rotations) indicate that material is transported (or flows) in three dimensions, such that no single cross section can fully describe the motion. Although our conceptualization of the architecture of curved mountain belts has become increasingly sophisticated, many questions as to the kinematics and mechanics of forming arcuate orogenic systems still need to be answered. To this end, GSA Special Paper 383 brings together several investigations which integrate structural and paleomagnetic techniques. Examples of the multidisciplinary research presented in the volume include: the impact that vertical-axis rotations have on shortening estimates; magnetic anisotropy and strain distribution as a function of basement/cover decoupling; remagnetization and structural growth; mantle-lithosphere delamination caused by plate bending; and the relationship between shear zones and vertical-axis rotations.

SPE383, 258 p. plus index, ISBN 0-8137-2383-3
$80.00, member price $64.00

In Press

Cenozoic climatic and environmental changes in Russia
edited by A.A. Velichko and V.P. Nechaev (editors of the English-language edition are H.E. Wright Jr., A.A. Velichko, T.A. Blyakharchuk, and Olga Borisova)
SPE382, ISBN 0-8137-2382-5 (in prep.)

Large meteorite impacts III
edited by Thomas Kenkmann, Friedrich Hörz, and Alex Deutsch
SPE 384, ISBN 0-8137-2384-1 (in prep.)

Active tectonics and seismic hazards of Puerto Rico, the Virgin Islands, and offshore areas
edited by Paul Mann
SPE 385, ISBN 0-8137-2385-X (in prep.)

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additional lines	$2.35	$3.35
Web Only Ads	$7.50	$6.50
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To estimate cost, count 54 characters per line, including all punctuation and blank spaces. Actual cost may differ if you use capitals, centered copy, or special characters.

Positions Open

VISITING ASSISTANT PROFESSOR
EARTH MATERIALS
TRINITY UNIVERSITY

The Department of Geosciences at Trinity University invites applications for a one-year term appointment at the rank of visiting assistant professor beginning in August 2005. The appointment is renewable. Primary teaching responsibilities include upper division courses in earth materials and tectonics and introductory geoscience courses in the University's Common Curriculum. Applicants should have a specialization that includes laboratory and field work in mineralogy, petrology or geochemistry, and that broadens the scope of existing faculty specializations which include volcanology, sedimentology, structural geology, invertebrate paleontology, geophysics, and geomorphology/Quaternary geology. Our department, a member of the Keck Geology Consortium, emphasizes excellence in undergraduate teaching and opportunities for undergraduate research.

Applications must include a letter of application, curriculum vitae, undergraduate and graduate transcripts, a detailed description of teaching philosophy and research interests, and contact information for three references; sent to Geosciences Search, Department of Geosciences, Trinity University, One Trinity Place, San Antonio, Texas 78212-7200 (email: geosearch@trinity.edu). Further information about the department and search can be found at http://www.trinity.edu/departments/geosciences/. Specific questions can be directed to Dr. Glenn Kroeger (email: gkroeger@trinity.edu). Review of completed applications will begin January 15, 2005. Women and minority candidates are strongly encouraged to apply. Trinity University is an Equal Opportunity Employer.

GEOGRAPHY, GEOLOGY, AND THE ENVIRONMENT
PENNSYLVANIA, SLIPPERY ROCK 16057

Slippery Rock University is seeking applicants for a tenure-track Assistant Professor with expertise in remote sensing and geomorphology in the Department of Geography, Geology, and the Environment beginning September 2005. The department consists of 13 faculty and approximately 110 undergraduate majors and offers programs in environmental science and studies, geography, and geology.

Qualifications: ABD in Geography or Geology required (PhD must be completed by August 2005). Broad training, with expertise in remote sensing and geomorphology, including applications to environmental concerns are required. The candidate must demonstrate a commitment to the education of diverse populations. Successful performance in an on-campus interview, including teaching demonstration is also required.

Responsibilities: Teach remote sensing, geomorphology, introductory courses, and potential development of advanced courses in area of expertise. Demonstrate excellent teaching and maintain an active program of research, including peer-reviewed publication, mentor undergraduate student research and participate in university service and student advising.

Send letter of interest, curriculum vitae, statement of research and teaching interests, graduate and undergraduate transcripts (official transcripts required before hiring) and the names, addresses (postal and email) and phone numbers of three references to: Carol Prorok, Search Chair, Department of Geography, Geology, and the Environment, Slippery Rock University, Slippery Rock, PA 16057, Phone: 724-738-2384, Fax: 724-738-4762, Email: carolyn.prorok@sru.edu.

Review of applications will begin March 1, 2005, and continue until position is filled. Slippery Rock University of PA is a member of the State System of Higher Education and is an affirmative action/equal opportunity employer. Visit our Web page at www.sru.edu.

UNIVERSITY OF WISCONSIN COLLEGE
RICHLAND CENTER, TENURE TRACK POSITION
DEPARTMENT OF GEOGRAPHY AND GEOLOGY

Tenure track position beginning August 2005. Doctorate degree in geology is preferred, ABD considered. Teach introductory and sophomore geology and introductory physical geography; resource conservation desirable. Online teaching a possibility. Teaching excellence, professional growth, and service to the department, campus, and community are expected for tenure. Application deadline is February 15, 2005. Send letter of interest, current vita, unofficial transcripts, a one-page statement of teaching philosophy and professional goals, and names of three current references to rlngeog@uwc.edu. Materials that cannot be submitted electronically should be mailed to Keith Montgomery, Chair, UW Colleges - Marathon County, Department of Geography/Geology, 518 South 7th. Avenue, Wausau WI 54401. Applications must be accompanied by a statement of whether the applicant wishes to have the application held in confidence or made available to the public upon request. The UW Colleges is an affirmative action/equal opportunity employer. More information about the position can be found at: www.uwc.edu/employment/jobs.htm.

POST-DOCTORAL SCIENTIST
STROUD WATER RESEARCH CENTER
ORGANIC GEOCHEMISTRY OR
ENVIRONMENTAL CHEMISTRY

Post-Doctoral Scientist in organic geochemistry or environmental chemistry needed to participate in an extensive stream-monitoring project to assess the sources of pollution to streams feeding municipal drinking supplies—using polycyclic aromatic hydrocarbon (PAH), fragrance, and fecal steroid compounds as molecular tracers—and to evaluate these proxies relative to other biological, chemical and geographical indicators. For details, go to http://www.stroudcenter.org/jobs/ft.htm. Send cover letter, resume, transcripts, and contact information for three references to Anthony Aufdenkampe (aufdenkampe@stroudcenter.org).

GEOLOGY INSTRUCTOR
RIVERSIDE COMMUNITY COLLEGE DISTRICT
RIVERSIDE CITY CAMPUS

Deadline to apply: January 28, 2005

A completed District application form, a cover letter, a current resume or vita, three current professional reference letters, legible copies of transcripts verifying college work and degrees, must be submitted to Human Resources by the deadline listed above.

Additional information and a required District application form can be downloaded from our Website: http://www.rcc.edu or obtained by contacting RCCD Human Resources, 3845 Market Street, Riverside, CA 92501, Phone: (951) 222-8588.

CHAIR, DEPARTMENT OF EARTH AND
ATMOSPHERIC SCIENCES
SAINT LOUIS UNIVERSITY

Saint Louis University, a Catholic Jesuit Institution dedicated to education, research and healthcare, is seeking applicants for the position of Chair of the Department of Earth and Atmospheric Sciences.

We seek an applicant with demonstrated administrative abilities to head a dynamic and diverse Department of talented and energetic faculty whose interests are in Meteorology, Geology and Geophysics. The new Chair will be expected to take a leadership role in increasing undergraduate and graduate enrollment, developing cooperative programs with other departments and national laboratories, balancing the needs and goals of the solid earth and atmospheric divisions of the Department, and maintaining its strong research programs.

The Candidate should have a Ph.D. in the atmospheric or solid earth sciences and a strong record of scholarly activity suitable for appointment at the rank of Professor. Exceptional individuals at the advanced level of Associate Professor may also be considered. Salary and rank will be commensurate with experience and qualifications.

The Carnegie Foundations classifies Saint Louis University as an Extensive Doctoral / Research Institution. The Department offers undergraduate degrees in Meteorology, Geology, Environmental Science, and Geophysics. An M.S. degree is offered in

Geology, and Ph.D. degrees are offered in Meteorology, and Geophysics. The Department website is: http://www.eas.slu.edu.

To apply, send a letter of application addressing research, teaching, and administrative philosophies, curriculum vitae, publication list, and arrange to have three letters of reference sent to: Steven W. Buckner, Search Committee Chair, Monsanto Hall room 125, Saint Louis University, 3501 Laclede Ave., St. Louis, MO 63103. Electronic materials are acceptable and may be sent to buckners@slu.edu. Review of applications will begin on February 1, 2005.

Saint Louis University is an Affirmative Action, Equal Opportunity Employer, and encourages nominations and applications of women and minorities.

DEPARTMENT OF EARTH & OCEAN SCIENCES
UNIVERSITY OF BRITISH COLUMBIA
ASSISTANT PROFESSOR
APPLIED SEDIMENTOLOGY AND/OR STRATIGRAPHY

The Department of Earth and Ocean Sciences at the University of British Columbia invites applications for a tenure-track faculty position in the area of sedimentology and/or stratigraphy. We seek a scientist whose research enhances and extends our existing strengths, particularly in areas that are process oriented and/or applied, including but not limited to, exploration and exploitation of fossil fuels, environmental studies and economic geology. This appointment is at the Assistant Professor level although applications from exceptionally well-qualified, more senior scientists will be considered, particularly if they address under-representation of designated equity groups such as women, visible minorities, disabled persons or aboriginal people. Candidates from all relevant fields of Science and Engineering are encouraged to apply. The position will be available as early as July 1, 2005. A Ph.D. is required by the commencement date. Teaching at the undergraduate and graduate levels is expected.

The University of British Columbia hires on the basis of merit and is committed to employment equity. All qualified persons are encouraged to apply; however, Canadians and Permanent Residents of Canada will be given priority. This position is subject to final budgetary approval. For more information about the Department and this position, visit our Web site at http://www.eos.ubc.ca.

Applicants should send their curriculum vitae and a statement of research and teaching interests, and arrange for three letters of recommendation to be sent to Dr. Paul L. Smith, Head, Department of Earth and Ocean Sciences, the University of British Columbia, 6339 Stores Road, Vancouver, British Columbia V6T 1Z4. E-mail: AppliedSed@eos.ubc.ca; Fax: 604-822-9014. The deadline for receipt of complete applications is February 14, 2005.

REFLECTION SEISMOLOGY
THE UNIVERSITY OF TULSA

The Department of Geosciences invites applications for a tenure-track faculty position at the Assistant Professor level to begin August 2005. A Ph.D. degree in geophysics or related field with demonstrated experience in quantitative reflection seismology is required. We seek an individual who shows the potential for outstanding achievement in both research and teaching. The successful candidate will be expected to develop and teach courses at the undergraduate and graduate levels, supervise and foster research at both the undergraduate and graduate level, and establish an externally funded research program. Interdisciplinary research with existing petroleum and environmental programs is strongly encouraged. The University of Tulsa is a private, comprehensive university committed to excellence in teaching, research, creative scholarship, and service to the University and community. Minorities and women are encouraged to apply. Send a letter of application stating research and teaching interests, curriculum vita, and name and contact information for three references to Dr. Bryan Tapp, Chair, Department of Geosciences, The University of Tulsa, 600 South College Ave. Tulsa, OK 74104-3189. Electronic applications will be accepted. Application review will begin February 1, 2005, and continue until position is filled. The University of Tulsa does not discriminate on the basis of personal status or group characteristics including but not limited to the classes protected under federal and state law. The University of Tulsa is an EEO/AA employer.

GEOLOGY INSTRUCTOR
SANTA MONICA COMMUNITY COLLEGE

Santa Monica Community College is accepting applications for a full-time, tenure-track **Geology Instructor** to start Fall 2005. Will teach introductory lecture and laboratory courses in physical, historical geology and oceanography; further develop the geology curriculum; conduct field work with students separate from or as a part of assigned class load; teach evening classes and/or Saturday classes as needed; serve as a proponent for geology education on campus and in the community. The minimum qualifications for this position are a Master's in geology, geophysics, earth sciences, meteorology, oceanography or paleontology **or** Bachelor's in geology and Master's in geography, physics or geochemistry, or the equivalent. Advanced graduate work in physical geology and/or historical geology and/or oceanography; fieldwork experience, demonstrated experience and interest in teaching college level physical geology, historical geology, and oceanography lecture and laboratory lecture and lab; have geospatial technology ability in GIS, GPS and remote sensing is preferred. Ability to use technology as a teaching tool. Salary: $41,898–$99,044. **Deadline to apply: February 28, 2005.** Please call (310) 434-4336 for a district application and detailed job description, or write to Santa Monica College, Human Resources, 1900 Pico Blvd., Santa Monica, CA 90405, or visit the website at www.smc.edu. EOE.

CHAIR, DEPARTMENT OF GEOLOGY
STEPHEN F. AUSTIN STATE UNIVERSITY

Applications are invited for chair of the Department of Geology at Stephen F. Austin State University to begin August 2005. We seek an outstanding individual with strong management, communication and interpersonal skills to provide innovative and energetic leadership for our department. Duties include recruiting, advising, developing a strong base of alumni and industry support, teaching, and research. Applicants should have credentials for appointment at associate or full professor level.

Candidates with expertise in petroleum geology and geophysics, or sedimentary petrology are preferred and will teach undergraduate and graduate courses, plus occasional weekend field trips. The department offers a master's degree and is committed to quality teaching, field geology and laboratory studies.

Applicants should send a letter of application, CV, statement of teaching and research interests, statement of leadership skills and administrative philosophy, reprints, copies of official transcripts and three letters of reference to: Search Committee, Department of Geology, P. O. Box 13011, Stephen F. Austin State University, Nacogdoches, TX 75962. Review of applications will begin immediately. EOE; security-sensitive position; criminal history checked. For additional information go to: www.geology.sfasu.edu.

CENOZOIC STRATIGRAPHER
UNIVERSITY OF NEBRASKA–LINCOLN

The Conservation and Survey Division (CSD) of the School of Natural Resources (SNR) at the University of Nebraska-Lincoln, invites applications for a tenure-track, 12-month assistant professor faculty position in Cenozoic stratigraphy (50% research/50% scholarly service).

The incumbent shall develop and conduct a program of field-based research and scholarly service in areas including, but not limited to, stratigraphy, sedimentology, and hydrogeology as applied to natural resource evaluation and management. Candidates will be expected to continue CSD participation in cooperative geologic mapping, focus research on the Cenozoic strata of the increasingly urbanized State of Nebraska, and have a working knowledge of the broader regional geology. The successful candidate will provide expertise and scholarly service to the public sectors on the geology of Nebraska, develop linkages with scientists within SNR, other University of Nebraska units, and other institutions; prepare a research project outline that is approved by the Agricultural Research Division and the U.S. Department of Agriculture, obtain external grant funding, present results of research at professional meetings, and publish research in refereed journals and other appropriate outlets. The candidate will also be expected to participate in classroom teaching, mentor and advise graduate students and research staff, and provide workshop instruction. Requires a Ph.D., earned by date of appointment, in geology or closely related field, with expertise in field research, and experience with interdisciplinary and collaborative research. Preference will be given to candidates with ancillary backgrounds in GIS, biostratigraphy, or other closely related disciplines. Applicant should have an appreciation for environmental concerns and appropriate use of natural resources. More information at SNR Website: http://snr.unl.edu. Interested candidates should send a signed letter of application, curriculum vitae, statement of research interests, and three letters of reference to: Chair, Cenozoic Stratigrapher Search Committee, School of Natural Resources, University of Nebraska-Lincoln, 309 Biochemistry Hall, Lincoln, NE 68583-0758.

Review of applications begins February 15, 2005, and continues until the position is filled or the search is closed.

The University of Nebraska is committed to a pluralistic campus community through affirmative action and equal opportunity and is responsive to the needs of dual career couples. We assure reasonable accommodation under the Americans with Disabilities Act. Contact Sharon Kelly at (402) 472-9873 or for assistance.

MERCYHURST COLLEGE
SURFICIAL GEOLOGY/GEOMORPHOLOGY

The Department of Geology at Mercyhurst College and the Mercyhurst Archeological Institute in Erie, Pennsylvania invites applications for a tenure track position to begin September 2005. A PhD is required. We seek a surficial geologist / geomorphologist with expertise in the mineralogy and petrology of sedimentary rocks and with the ability to conduct ongoing field and laboratory research of Holocene fluvial and coastal processes and deposits. The successful applicant will be expected to continue the Geology Department's contribution to interdisciplinary studies with the Mercyhurst Archaeological Institute and the Mercyhurst Applied Forensic Science Department. Teaching duties will include courses in basic geology for non-majors and several advanced courses which may include sedimentation/stratigraphy, soils, mineralogy, petrology, geomorphology, geoarchaeology, hydrogeology and structural geology. Mercyhurst is currently developing graduate programs in both forensic science and in geoarchaeology, and the successful applicant will have to opportunity to help develop these programs.

As a primarily undergraduate liberal arts institution, we seek an individual with excellent teaching ability and the desire to involve undergraduates in scientific research. We feel strongly that a field component should be incorporated in each of the geology courses taught as appropriate. We've found Mercyhurst's location on the shore of Lake Erie has provided exceptional opportunities for the development of geological research projects in modern coastal processes. Also available for field studies is the underlying glaciated terrain and nearby non-glaciated terrain of the Appalachian Plateau and the folded Appalachian Mountains. Metamorphic and igneous terrain of nearby Canada and the more distant Adirondack Mtns of NY State are also accessible for study. Ongoing geoarchaeological projects include work at the famous Meadowcroft Rockshelter and other nearby aboriginal sites; historic and prehistoric sites at Fort Hood Texas; Paleolithic sites in the Czech Republic and the Ukraine; and coastal and sourcing studies of King Herod's port city of Casearea, Israel.

The Geology Department is well equipped for field and laboratory teaching and research. Our fieldwork is supported by a Nikon Total Station laser theodolite and GPS with full integration to our complete GIS lab (esri ArcGIS-9). A 13-foot Boston Whaler with a recording fathometer is available for near shore studies. Laboratories are equipped for modern Leica petrographic microscopy and image analysis. A Buehler thin-section machine is available, and sediment size-frequency analysis can be performed by Ro-tap and by Beckman Coulter laser particle characterization.

Applicants should submit a letter of teaching and research interests; a current CV and arrange for three reference letters to be submitted to: Mercyhurst College; Department of Geology c/o Dr. J.M. Adovasio; 501 E. 38th Street; Erie, PA 16546.

SEDIMENTOLOGY/STRATIGRAPHY
COLORADO STATE UNIVERSITY

The Department of Geosciences at Colorado State University seeks to fill a position in Sedimentology/Stratigraphy at the assistant professor level. The position is a 9-month tenure-track appointment. Requirements are a Ph.D., a strong research record in the areas of sedimentology and stratigraphy with an emphasis in siliciclastic sedimentary systems, and evidence of teaching ability. Preference will be given to applicants with strong field skills, experience with petroleum systems, and a strong record of external research funding. The applicant's research and teaching interests should complement and enhance one or more of the Department's existing strengths. The successful applicant is expected to teach at all levels and develop a vigorous externally funded research program supporting graduate students. Teaching assignments will include an undergraduate course in sedimentology/stratigraphy, graduate courses in the hire's specialty, team-teaching undergraduate field course(s), and, on a rotational basis, a large enrollment introductory geology course. The preferred start date is August 2005.

To apply, send as email attachments a curriculum vitae, statements of research and teaching interests, and

names and addresses of three referees to barbh@cnr.colostate.edu. Include "Sedimentology Application" in the subject line. Ancillary materials, such as copies of recent publications, may be mailed to: Sedimentology Search Chair, Department of Geosciences, Colorado State University, Fort Collins, CO, 80523-1482. Applications may be accepted until the position is filled, but for full consideration please submit by February 1, 2005. For a full job description and additional information, candidates can visit: http://www.cnr.colostate.edu/geo or contact Dr. Dennis L. Harry at dharry@cnr.colostate.edu or 970-491-2714. CSU is an EEO/AA employer.

GEODYNAMICS FACULTY POSITION
UNIVERSITY OF ALABAMA
DEPARTMENT OF GEOLOGICAL SCIENCES

The Department of Geological Sciences invites applications for a tenure-track faculty position in geodynamics, beginning August 2005. The position will be filled at the Assistant Professor level. Candidates must have a strong record of research and a Ph.D. in geology, geophysics or a related field. The candidate will be expected to teach introductory geology and undergraduate and graduate courses in geodynamics and geophysics, to attract and supervise undergraduate, masters, and doctoral students, and to obtain external research funding. Experience with laboratory and/or computer modeling of tectonic processes is required. Possible areas of research emphasis include the evolution and mechanics of convergent margins and extensional systems, planetary geophysics, mantle flow, melt supply to subduction or mid-ocean ridge systems, erosion, plutonism, tectonics and its effect on climate, and neotectonics. This position compliments existing programs in tectonics, petrology, applied geophysics, basin analysis, hydrogeology, coastal geology, and petroleum systems. Department geophysical equipment includes a multichannel seismic data acquisition system, ground penetrating radar, high-resolution marine seismic systems, a Geoprobe, and a state-of-the-art computing facility supporting seismic data processing, interpretation, and subsurface mapping. Applicants should send a vita, statements of research and teaching interests, and contact information for four referees to Dr. Ernest Mancini, Geodynamics Search Committee Chair, The University of Alabama, Department of Geological Sciences, Box 870338, Tuscaloosa, AL 35487-0338. Further information is available on our Web site at http://www.geo.ua.edu. Review of applications will begin on January 1, 2005, and continue until the position is filled. This position is dependent upon available funding.

The University of Alabama is an Equal-Opportunity, Affirmative-Action Employer. Applications are solicited from women and minority candidates.

TENURE TRACK APPOINTMENT
BOISE STATE UNIVERSITY

The **Department of Geosciences** at **Boise State University**, as part of a planned expansion of its Ph.D. programs, invites applications for the first of two new tenure-track (Assistant Professor) faculty positions to be hired from the following disciplines: **Earth History/Global Change Science**, with an emphasis in applying stable isotopic and other chemostratigraphic proxies to understanding paleoclimatic, paleoceanographic, and/or paleobiological change in both the deep time and recent rock record; **Hydrologic Science**, with an emphasis in applying stable isotopic and other quantitative techniques to modern global climate change, the hydrologic cycle, hydrogeology, surface processes, and/or geobiological investigations; **Neotectonics/Tectonic Geomorphology**, with an emphasis in applying quantitative geophysical and/or geochronological techniques to elucidating geodynamic linkages to landscape evolution.

New colleagues in these fields will complement our existing strengths in biostratigraphy and geochronology, orogenic systems science, hydrological sciences and surficial processes, and shallow subsurface geophysics. The successful applicant will develop a nationally-recognized research program supported by extramural funding and participate in the continued growth of the Department. We seek a colleague eager to establish collaborative research efforts, participate in developing analytical facilities, provide research opportunities for undergraduate and graduate students, and deliver courses for undergraduate and graduate programs. A Ph.D. in an Earth Science discipline is required at the time of appointment; previous teaching and/or postgraduate research experience will be considered strong assets.

Boise State University is a growing institution (>18,000 students) serving Idaho's metropolitan center. As the State's capital and business, financial and cultural center, Boise is recognized as one of America's best places to live. A favorable cost of living, coupled with moderate climate and a wide variety of cultural and recreational opportunities, contribute to an outstanding quality of life for our faculty. A vibrant intellectual community draws from scientists at the University, regional high-tech industries, and numerous state and federal agencies; the Department of Geosciences benefits from collaborative activities with partners across this spectrum. Additional information about the Department of Geosciences and the University can be found through our Web site: http://earth.boisestate.edu/.

Boise State University is an EOE/AA institution and is strongly committed to achieving excellence through cultural diversity. The University actively encourages applications from women, persons of color, and members of other underrepresented groups. Veteran's preference may be applicable. Applicants should send a Curriculum Vita, Statement of Research and Teaching Interests, and contact information for at least three referees to: Search Committee, Department of Geosciences, Boise State University, 1910 University Drive, Boise, ID 83725. Review of applicants will begin December 15, 2004, and continue until a qualified applicant pool is established. Email correspondence (questions or submission of application materials) can be sent to markschmitz@boisestate.edu.

ENDOWED CHAIR AND DEPARTMENT HEAD
BOONE PICKENS SCHOOL OF GEOLOGY
OKLAHOMA STATE UNIVERSITY

The Boone Pickens School of Geology at Oklahoma State University (OSU) is seeking applications from qualified candidates for the combined position of Endowed Chair and Department Head. The term of initial appointment will begin July 1, 2005.

The Boone Pickens School of Geology is a growing department that is strongly committed to the goal of excellence in research, teaching, and extension. It offers a full range of undergraduate and graduate courses that lead to B.S. and M.S. degrees in Geology. The School of Geology currently has more than 60 undergraduate students and more than 30 graduate students. The department is developing plans to enhance the graduate program.

Applicants must have a Ph.D. degree in the geological sciences; must qualify for the rank of Professor in the School of Geology; and have a strong commitment to excellence in research, teaching and extension. A record that clearly demonstrates strong leadership, innovation, and a reputation as an outstanding scientist at an international level is requisite for this Endowed Chair.

Stillwater is a small, attractive university city of about 38,000, located on the prairie in north-central Oklahoma. Stillwater is 65 miles north of Oklahoma City and 60 miles west of Tulsa. Numerous cultural activities can be found within a two-hour drive of Stillwater. The Oklahoma State University campus is one of considerable beauty, with modified Georgian architecture.

Oklahoma State University encourages applications from qualified women, minorities, and persons with disabilities. Please send curriculum vita and names, addresses, e-mail addresses, and phone numbers of three references to Professor Dale Lightfoot, Chair of the School of Geology Search Committee, 225 Scott Hall, Oklahoma State University, Stillwater, OK 74078-4073. Telephone: 405-744-6250; FAX: 405-744-5620; E-mail: drlight@okstate.edu.

Informal inquires to Dean Peter M.A. Sherwood of the College of Arts and Sciences are welcome (e-mail: peter.sherwood@okstate.edu; Telephone: 405-744-5663).

For full consideration, all applications must be received by February 1, 2005. Applications will be accepted until the position has been filled.

Oklahoma State University is an Affirmative Action/Equal Opportunity Employer. This position is subject to availability of funding.

More information on OSU and the Boone Pickens School of Geology can be found on the Web www.pio.okstate.edu and www.okstate.edu/geology.

DAVID B. HARRIS POSTDOCTORAL FELLOWSHIP
TEXAS A&M UNIVERSITY

The Department of Geology and Geophysics at Texas A&M University, College Station, Texas, is pleased to announce the availability of a postdoctoral fellowship funded through a gift from David B. Harris. The postdoctoral fellowship appointment is two years with a possibility of a third year and carries a stipend of $35,000 per year. Additional funds will be available for research/travel expenses. Outstanding young scientists who have finished their Ph.D. degree or who will finish by March, 2005 are eligible to apply. Research may be in any area of the earth sciences. Information about the Department can be found at http://geoweb.tamu.edu.

Review of applications will begin February 1, 2005. Applications should include a curriculum vitae, statement of proposed research, and names and addresses of three referees. Electronic submissions are encouraged (d.wiltschko@tamu.edu, pdf or Word format) or

they can be mailed to: Dr. David V. Wiltschko, Chair of Selection Committee, David B. Harris Postdoctoral Fellowship, Department of Geology and Geophysics, Texas A&M University, Mail Stop 3115, College Station, TX 77843-3115, USA.

Texas A&M University is an affirmative action/equal opportunity employer committed to diversity.

TENURE TRACK FACULTY: GEOPHYSICS
WESTERN WASHINGTON UNIVERSITY

The Geology Department, Western Washington University, seeks applicants for a tenure-track faculty position at the rank of Assistant Professor, in the field of Geophysics, effective September 16, 2005.

Qualifications: Applicants must have a completed Ph.D. in the Geological Sciences on or before the position start date and the ability to teach introduction to geology and upper division courses including Geophysics.

Preferred qualifications include; teaching ability and research emphasizes field-based applications of geophysical methods to geological problems and processes; ability to direct both under graduate and graduate students in research; demonstrated teaching ability; demonstrated ability to do scholarly research; ability to teach upper division courses; potential for externally funded research; the candidate's research should complement (but not duplicate) existing departmental strengths. Responsibilities: We expect the successful candidate to make a significant contribution to our graduate program, and to participate in our undergraduate degree programs by teaching upper division courses in geophysics, and introductory-level geology for nonmajors. The ability to teach existing or new courses in marine geology/geophysics, meteorology, or statistical methods is welcomed.

How to Apply: Submit a letter of application outlining teaching and research experience accomplishments, philosophy and goals, detailing aspects related to the above criteria.

The application should also include a curriculum vitae, graduate school transcripts, evidence of effective teaching and research, as well as letters of reference from four persons familiar with the candidate's teaching and research, at least one of whom is from outside the applicant's current institution. Priority Review Date: 1/14/05. Submit application to: Geophysics Search Committee Chair, (04GEO-01), Geology Department, Western Washington University, 516 High St, Bellingham, WA, 98225-9080 Phone: 360-650-3581. Our department has 13 faculty and offers B.A., B.S. and M.S. degrees with emphases in geology, geophysics, and environmental geology. Additional information about our department and programs can be found at http://geology.wwu.edu/. View the full position announcement, at www.acadweb.wwu.edu/hr/Jobs/faculty.asp. AA/EOE.

TWO-YEAR POST-DOC IN SEDIMENTARY GEOLOGY
CENTRAL MICHIGAN UNIVERSITY

The Department of Geology at Central Michigan University invites applications for a two-year post-doctoral research associate position in sedimentary geology. Research responsibilities will include two weeks of field work in Australia (studying acid and neutral saline lakes), evaporite and siliciclastic petrography, water analyses, and fluid inclusion studies. Experience and a Ph.D. in Sedimentary Geology are required. Documented experience in evaporite sedimentology and geochemistry is preferred, but not required.

Salary is $36,000/year with a full benefits package. Send vita, a short description of research interests and experience, and contact information for two referees by 1/31/05 to Kathy Benison, Dept. of Geology, 314 Brooks Hall, Mt. Pleasant, MI 48859.

Serving 28,000+ students, CMU is an innovative doctoral/research-intensive institution with strong undergraduate education and focused graduate programs and research. CMU, an AA/EO institution, strongly and actively strives to increase diversity within its community (see http://www.cmich.edu/aaeo/).

GEOLOGY ASSISTANT PROFESSOR
UNIVERSITY OF TENNESSEE AT MARTIN

Geology. Assistant Professor tenure-track position beginning August 2005. Ph.D. in Geology is required, however individuals who are ABD will be considered. Potential candidates must demonstrate an ability to teach structural geology, igneous/metamorphic petrology, and mineralogy. Evidence of an ability to teach effectively in English is required. The primary responsibilities include the teaching of introductory-level geology courses, advanced undergraduate courses depending upon the applicant's field of specialty, and associated laboratory sections. The successful applicant will also be expected to develop a research program involving undergraduates and to participate in geoscience education outreach. Additional responsibilities include advising of students, as well as committee and public service. Excellence in undergraduate instruction and scholarly activity is expected. Send hard copies of a letter of interest, curriculum vita, statement of teaching philosophy, copies of transcripts, and three letters of recommendation to: Chair of Geology Search Committee; Department of Geology, Geography, and Physics; 215 Johnson EPS Building; University of Tennessee at Martin; Martin, Tennessee 38238-5039. For further information tel: 731.881.7430. For more information about the department, see its Web site at: http://www.utm.edu/departments/ggp/home.htm. Review of applications will begin on March 07, 2005, and continue until position is filled.

UT Martin is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA employer. The University seeks to diversify its work force. Therefore, all qualified applicants, regardless of race, color, national origin, religion, gender, age, disability or Vietnam veteran status, are strongly encouraged to apply.

GIS-REMOTE SENSING—3xD VISUALIZATION
SAM HOUSTON STATE UNIVERSITY

The Department of Geography and Geology invites applications for an **Assistant Professor**, tenure-track, beginning August 2005. The department seeks a broadly trained geographer or earth scientist with a commitment to both teaching and research in one or more of the following areas: **GIS; Remote Sensing; 3xD Visualization of subsurface phenomena; Computer Cartography.** Starting salary will be within the range of $55k–$65k. Appointees will be expected to have a clearly articulated plan for externally funded research and for regular publication of refereed scholarship, and as a successful faculty member will need to demonstrate an evolving mastery of both teaching and scholarly productivity. Teaching GIS and Remote Sensing courses along with other courses closely linked to their research focus will constitute a core activity but candidates also will be expected to teach in our broad introductory program in Geography. The Department is composed of two distinct academic programs but it is envisaged that GIS as well as other aspects of computer-based and geo-spatial technologies will form a linking foundation between the disciplines. Thus, the department seeks an individual with broad technological interests who can address the interests of students in both constituencies. In the last two years the Department acquired a dedicated GIS teaching and research facility and it benefits from the presence on campus of the Texas Research Institute for Environmental Studies (TRIES) that includes GIS, Remote Sensing and multi-discipline Viz-Lab facilities. To apply submit a letter of application that includes the following: an outline of teaching experience and a summary of teaching philosophies, a summary of present research experience and an outline plan of the next four years of research and scholarly activity; CV, transcripts; and the names and e-mail addresses of at least three referees via snail mail to Dr. Chris Baldwin (Chair, Search Committee), Sam Houston State University, Department of Geography and Geology, Box 2148, Huntsville, TX 773421-2148 *or* electronically to baldwin@shsu.edu. For more information visit http://www.shsu.edu/~gel_geo/. SHSU is an equal opportunity/affirmative action employer that welcomes applications from all underrepresented groups.

LOW-TEMPERATURE GEOCHEMIST
UNIVERSITY OF COLORADO AT BOULDER

The Department of Geological Sciences, University of Colorado at Boulder, invites applications for a tenure-track position in low-temperature geochemistry. We anticipate hiring at the assistant professor level, but applications at other levels will be considered from those who would strengthen the Department's diversity. We seek applicants with a demonstrated potential for innovative research that is likely to lead to a strong, externally funded research program; postdoctoral experience is beneficial. Any applicant specializing in the study of low temperature geochemical processes operating at and near the Earth's surface will be considered, but candidates working in geomicrobiology; aqueous geochemistry; climate change; sediment-, soil- or rock-water interactions; or the contamination of soil and water are preferred. The successful candidate will be expected to teach an undergraduate course in geochemistry, offer graduate level courses in their specialty, and contribute to the Department's non-major course offerings. Information regarding the Department can be found at http://www.colorado.edu/GeolSci/.

Applicants should send a current CV, statements of teaching and research interests, and the names of at least three potential references to: Chair, Geochemist Search, Department of Geological Sciences, University of Colorado, 399 UCB, Boulder, CO 80309-0399.

Inquiries for additional information should be directed to Dr. David A. Budd (budd@colorado.edu). Review of applications will begin on January 3, 2005. Applications will be accepted until the position is filled. The University of Colorado at Boulder is committed to diversity and equality in education and employment.

FACULTY POSITION
ENVIRONMENTAL GEOPHYSICS
CLEMSON UNIVERSITY

The Department of Geological Sciences in the School of the Environment at Clemson University (http://www.ces.clemson.edu/ees/schofenviron.html) invites applications for an assistant professor tenure-track position in environmental geophysics or closely related area. The anticipated starting date is August 15, 2005.

The successful candidate must have a PhD in geophysics or a related discipline. He or she will be expected to teach a course in applied geophysics with environmental field applications, as well as other courses at the undergraduate and graduate levels, and to participate in an innovative department-wide undergraduate research program. The applicant should demonstrate the ability to develop a high-quality, sponsored research program that includes advising graduate students. Preference will be given to candidates who integrate field measurements and theory in their research. Excellent opportunities exist for collaboration with hydrogeologists, geologists, geochemists, and environmental and civil engineers in the School of the Environment and in other programs at Clemson University.

Interested candidates should send a letter of application, detailed resume, statements of teaching interest and teaching philosophy, and the names, phone numbers, e-mail addresses and mail addresses of three persons who may be contacted as professional references to: Chair, Search Committee, Clemson University, Department of Geological Sciences, Room 340 Brackett Hall, Clemson, SC 29634-0919. Review of applications will begin immediately and continue until the position is filled. Applications received by March 1, 2005, will be assured full consideration. Clemson University is an equal opportunity, affirmative action employer. Women and minority candidates are encouraged to apply.

ENVIRONMENTAL FLUID MECHANICS/
HYDROLOGY
UNIVERSITY OF NOTRE DAME

The Department of Civil Engineering and Geological Sciences at the University of Notre Dame has an opening for an outstanding candidate in the area of the physics and/or modeling of fluid flow in the environment (in the area of modeling in environmental fluid mechanics/environmental hydrology). The appointee will be expected to establish a strong, externally-funded research program in some aspect of quantitative surface and/or groundwater hydrology / hydraulics. In the area of teaching, the appointee will be expected to develop innovative contributions to the teaching mission of the Department and University at both the undergraduate and graduate levels. An undergraduate engineering degree is preferred (but not required). The appointee will join a Department that provides unique opportunities for research and educational initiatives involving theory and applications at the intersection of engineering and the environmental geosciences. The position is intended to be filled at the level of assistant professor, but exceptional applicants will be considered at higher levels (but exceptional applicants may be considered for a higher level appointment).

For best consideration, applications should be submitted by January 15, 2005. Applications are particularly encouraged from women, minorities, individuals with disabilities, and veterans. Applications consisting of a letter of interest, current CV, statements on teaching and research, and a list of at least 5 people willing to provide a letter of reference should be submitted to: Dr. Stephen E. Silliman, Chair, Search Committee on Hydraulics, 156 Fitzpatrick Hall, Department of Civil Engineering and Geological Sciences, University of Notre Dame, Notre Dame, IN 46556 (at silliman.1@nd.edu). Information regarding the Department may be viewed at the Department's Web site www.nd.edu/~cegeos.

HARD ROCK & INTRODUCTORY GEOLOGY
TENURE TRACK, EARLHAM COLLEGE

The Geosciences Department at Earlham College invites applications for a tenure track assistant professor position in the general area hard-rock geology. Responsibilities include instruction or co-instruction of introductory geology courses and some combination of alternate-year upper-class courses in structural geology and tectonics, igneous and metamorphic petrology, and two additional topics such as mineralogy, Earth history, an off-campus May term field course, or another subject appropriate to a modern comprehensive undergraduate geoscience major program. Geoscience faculty

members also participate in the geology senior seminar and supervise independent research projects. Faculty research that involves students is strongly encouraged at Earlham, and faculty members have opportunities to lead domestic and foreign off-campus study programs. The strongest candidates will have a completed PhD, college teaching experience, and strong commitment to undergraduate teaching in a liberal arts atmosphere. Duties for this position begin August 2005.

Interested candidates should submit curriculum vitae, a letter discussing their qualifications and names and addresses of at least three references to: Dr. Jon Branstrator, Search Convener, Geosciences Department, Earlham College, Richmond, IN 47374. Applications will be review as received. Visit the college and department web sites at http://www.earlham.edu. Earlham eagerly solicits applications from African Americans and other ethnic minorities, women, and Quakers.

Opportunities for Students

Hydrologic Science Opportunities for Ph.D. and M.S. New Mexico Tech is offering Ph.D. and M.S. Research Assistantships to graduate students interested in ground water hydrology, vadose zone hydrology, surface water hydrology, karst hydrology, contaminant hydrology, and related research areas. The Hydrology Program at New Mexico Tech is one of the nation's largest and strongest programs in hydrology research and education. Eight full-time faculty and six adjunct faculty allow us to offer more than 20 different courses in hydrology. Students with backgrounds in hydrology, hydrogeology, ecohydrology, geology, geochemistry, geophysics, civil and environmental engineering, biology, geomicrobiology, forestry, chemistry, physics, or mathematics are encouraged to apply. For more information contact: Dr. Brian McPherson at brian@nmt.edu or 505-835-5259. Additional information and application procedures may be accessed at www.ees.nmt.edu/Hydro.

NASA Planetary Biology Internships. The Marine Biological Laboratory, Woods Hole, Massachusetts, invites applications from graduate students and seniors accepted to graduate programs for rewards of $2800 plus travel to participate in research in NASA centers and collaborating institutions for approximately 8 weeks. Typical intern programs include: global ecology, remote sensing, microbial ecology, biomineralization, and origin and early evolution of life. Application deadline: March 1, 2005. For information/applications, contact: Michael Dolan, Planetary Biology Internship, Department of Geosciences, Box 3-5820, University of Massachusetts, Amherst, MA 01003-5820. E-mail: pbi@geo.umass.edu. Tel (413) 545-3223. An equal opportunity/affirmative action employer.

Opportunities for Graduate Study in Geology at Kent State University. The Department of Geology at Kent State University, composed of sixteen full-time faculty, seeks motivated students for graduate study in Geology in the general areas of: Earth Evolution, Earth Surface Processes, Engineering Geology, or Tectonics. Interdisciplinary research opportunities are also available through the Kent State University Water Resources Research Institute (http://dept.kent.edu/wrri/). Graduate stipends are awarded on a competitive basis with rolling admission. While applications are evaluated continuously, to receive full consideration for financial support, they must be received by February 15 for August admission. Applications may be submitted to Kent State University online at: http://dept.kent.edu/geology/graduate/gradapp.html.

For complete information regarding faculty research interests and the graduate program, please see our website (http://dept.kent.edu/geology/) or contact the graduate coordinator, Dr. Rodney Feldmann. The Department of Geology offers a comprehensive course of study leading to the M.S. or Ph.D. degree. Emphasis is placed on research designed not only to advance the understanding of the geological sciences, but also to solve societal problems.

Ph.D. Student Assistantships. Oregon State and Portland State Universities are offering ten Ph.D. research assistantships to explore all aspects of the Earth's subsurface microbial biosphere. Tuition and stipend are provided by the NSF IGERT program and the two universities. Students will work in interdisciplinary teams of engineers, oceanographers, microbiologists, microbial ecologists, geologists, soil scientists, and chemists to solve environmental problems, to understand global chemical cycles, and to determine the impact of subsurface microorganisms on surface ecosystems. More information can be found at: http://oregonstate.edu/dept/igert, or Martin R. Fisk, College of Oceanic and Atmospheric Sciences, Oregon State University, mfisk@coas.oregonstate.edu Students from all scientific backgrounds are encouraged to apply to departments represented by IGERT faculty at either institution. U.S. citizens or permanent residents can be supported by IGERT funds however students of all nations can participate in the program. Review of applications starts 1/15/05. Oregon State and Portland State Universities are committed to equality in education.

Ph.D. and M.S. Opportunities in Earth and Environmental Sciences—University of Illinois at Chicago. The Department of Earth and Environmental Sciences, University of Illinois at Chicago, invites applications for graduate admission starting in the Fall 2005 Semester. Financial support through assistantships, including tuition waivers, is available to successful applicants. We offer opportunities to do research in the areas of Hydrology, Lacustrine Processes, Extreme Environments, Paleoclimatology, Geochronology, Quaternary Geology, Clastic Sedimentology, Mineralogy, Organic Geochemistry, Stable Isotope Geochemistry, Hydrogeochemistry, Synchrotron Radiation Studies, Petrology, Geodynamics, Paleontology, Paleoecology, Landscape Statistics, Plate Tectonics and Marine Geophysics. Students have access to state-of-the-art analytical equipment. We are located in a vibrant urban neighborhood, close to mass transit and all that the great city of Chicago has to offer. Application deadline is February 1. For more information (including application procedures), visit our website at http://www.uic.edu/depts/geos/ or contact Dr. Peter Doran at pdoran@uic.edu.

Research/Teaching Assistantships, Graduate Program of Hydrologic Sciences, University of Nevada, Reno. Applications are encouraged for graduate teaching/research assistantships beginning July 1, 2005. Positions carry an annual stipend of approximately $17,000–$18,000 as well as health insurance and a tuition waiver. Students interested in the area of ground water, surface water and aqueous geochemistry are encouraged to apply. Additionally, funded assistantships are available in contaminant transport and watershed hydrology, as well as scholarships and doctoral fellowships offered through UNR and the Desert Research Institute. Completed application packages are due January 10, 2005, and should be mailed to: University of Nevada, Reno, Graduate Program of Hydrologic Sciences, Mail Stop 175, LMR 267, Reno, NV 89557-0180. Information on assistantships and fellowships in the Hydrologic Sciences Graduate Program can be found at www.hydro.unr.edu or by calling 775-784-6250.

Graduate Assistantships and Fellowships University of Kentucky. The Department of Geological Sciences at the University of Kentucky has assistantships and fellowships available for the 2005–2006 academic year for M.S. and Ph.D. students. All awards include tuition and health insurance. The department has 11 regular faculty and 15 adjunct or cross-appointed faculty, including staff at the Kentucky Geological Survey and the Center for Applied Energy Research. Research specializations include tectonics, sedimentary and coal geology, geophysics, geochemistry, hydrogeology, and igneous and metamorphic petrology. Facilities include UK's Environmental Research and Teaching Laboratory, the Kentucky Seismic and Strong-Motion Network, electron microprobe and X-ray diffraction laboratories, and extensive library holdings. UK is located in Lexington, a vibrant community of 260,000. The surrounding area offers a wealth of outdoor and cultural opportunities. For more information, visit www.uky.edu/AS/Geology or contact Dr. Alan Fryar, Director of Graduate Studies (859-257-4392 or afryar1@uky.edu).

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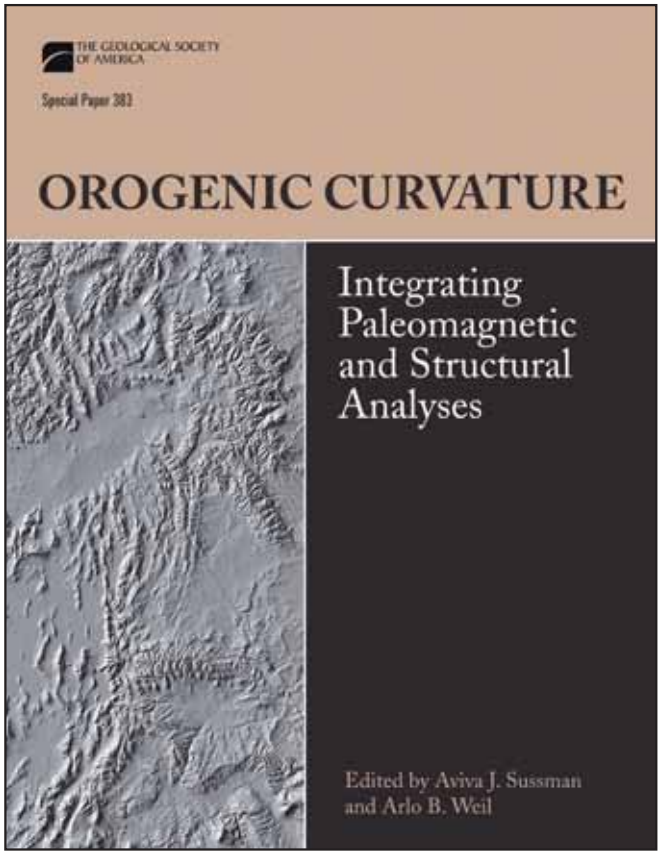

SPE383, 258 p.
ISBN 0-8137-2383-3
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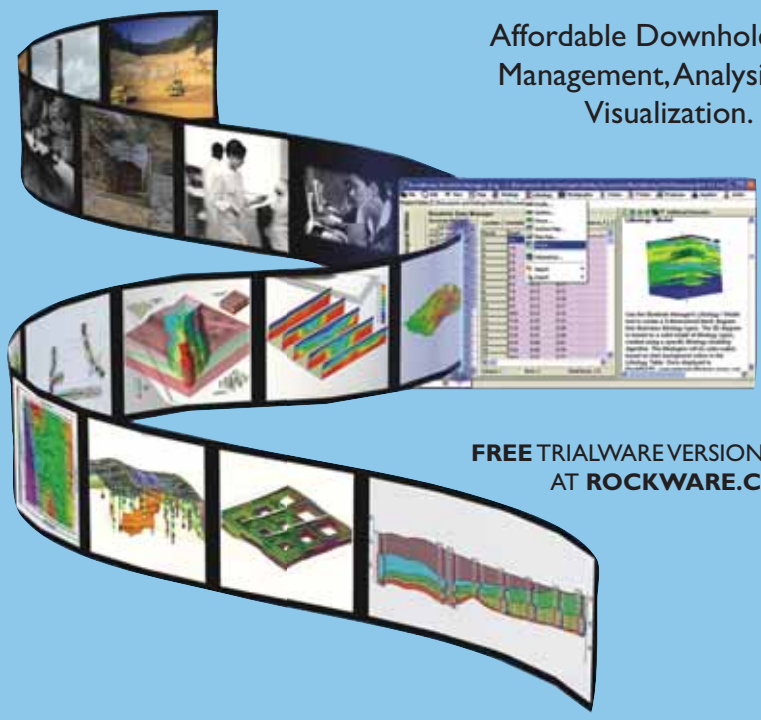

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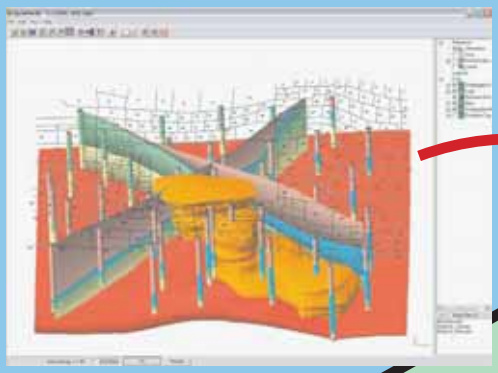

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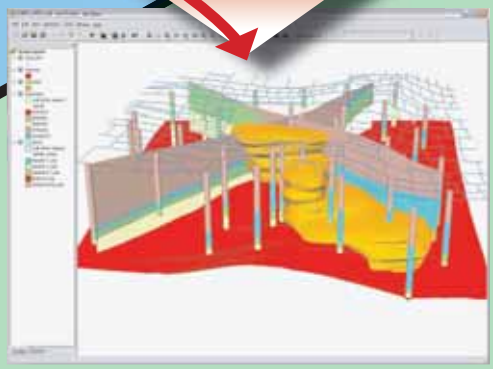

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