

# GSATODAY



Vol. 12, No. 12

A Publication of the Geological Society of America

December 2002

## Slow Crawl Across the Salinity Divide: Delayed Colonization of Freshwater Ecosystems by Invertebrates

### Inside:

Slow Crawl Across the Salinity Divide:  
Delayed Colonization of Freshwater  
Ecosystems by Invertebrates, by Molly  
Fritz Miller and Conrad C. Labandeira, p. 4

Section Meetings:  
Northeastern and  
AGS Joint Meeting, p. 16  
Cordilleran, p. 20

# W hat's to think about!

If you don't have  
Rigaku XRF,  
you don't have the edge!



## ZSX

**Small sample** are no longer a problem with Microanalysis - "target" the area of analysis down to 0.50 mm using the CCD camera

Homogeneity tests and inclusion determinations can be completed in record time with **Mapping**

**30-micron tube** window giving superior light element sensitivity

World class **Fundamental Parameters** package standard with software

The right system for the right application - **tube above or tube below**

All this *plus* a production model 4 kW WDXRF workhorse

Rigaku ZSX  
Call us for a test drive!

**Rigaku**  
MSC

www.RigakuMSC.com  
phone: 281-363-1033  
fax: 281-364-3628  
e-mail: info@RigakuMSC.com

# GSATODAY

*GSA TODAY* publishes news and information for more than 17,000 GSA members and subscribing libraries. *GSA Today* lead science articles should present the results of exciting new research or summarize and synthesize important problems or issues, and they must be understandable to all in the earth science community. Submit manuscripts to science editor Karl Karlstrom, kek1@unm.edu.

*GSA TODAY* (ISSN 1052-5173) is published monthly 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, U.S.A. Periodicals postage paid at Boulder, Colorado, and at additional mailing offices. Postmaster: Send address changes to *GSA Today*, Member Services, P.O. Box 9140, Boulder, CO 80301-9140.

Copyright © 2002, The Geological Society of America, Inc. (GSA). All rights reserved. Copyright not claimed on content prepared wholly by U.S. government employees within scope of their employment. Individual scientists are hereby granted permission, without fees or further requests to GSA, to use a single figure, a single table, and/or a brief paragraph of text in other subsequent works and to make unlimited photocopies of items in this journal for noncommercial use in classrooms to further education and science. For any other use, contact Copyright Permissions, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA, fax 303-357-1073, editing@geosociety.org; reference *GSA Today*, ISSN 1052-5173. Permission is granted to authors to post the abstracts only of their articles on their own or their organization's Web site providing the posting includes this reference: "The full paper was published in the Geological Society of America's journal *GSA Today*, [include year, month, and page numbers if known, where the article will appear]." GSA provides this and other forums for the presentation of diverse opinions and positions by scientists worldwide, regardless of their race, citizenship, gender, religion, or political viewpoint. Opinions presented in this publication do not reflect official positions of the Society.

**SUBSCRIPTIONS** for 2002 calendar year: Society Members: *GSA Today* is provided as part of membership dues. Contact Member Services at 1-888-443-4472, (303) 447-2020, or member@geosociety.org for membership information. Nonmembers & Institutions: Free with paid subscription to both *GSA Bulletin* and *Geology*, otherwise \$65 for U.S., Canada, and Mexico; \$75 elsewhere. Contact Subscription Services at (800) 627-0629 or gsa@allenpress.com. Also available on an annual CD-ROM (together with *GSA Bulletin*, *Geology*, GSA Data Repository, and an Electronic Retrospective Index to journal articles from 1972): \$94 to GSA Members, others call GSA Subscription Services for prices and details. Claims: For nonreceipt or for damaged copies, members contact Member Services; all others contact Subscription Services. Claims are honored for one year; please allow sufficient delivery time for overseas copies, up to six months.

## STAFF

**Executive Director:** John W. Hess  
**Science Editor:** Karl E. Karlstrom, Department of Earth and Planetary Science, University of New Mexico, Albuquerque, NM 87131-1116, kek1@unm.edu  
**Director of Publications:** Jon Olsen  
**Managing Editor:** Jeanette Hammann, jhammann@geosociety.org  
**Editorial Assistant:** Matt Hanauer  
**Production Manager:** Diane C. Lorenz  
**Production Coordinator:** Margo Y. Good  
**Graphics Production:** Margo Y. Good

## ADVERTISING

Classifieds and display: Contact Ann Crawford, 1-800-472-1988, ext. 1053, (303) 357-1053, fax 303-357-1073; acrawford@geosociety.org.  
GSA ONLINE: www.geosociety.org  
Printed in U.S.A. using pure soy inks.

THE GEOLOGICAL SOCIETY  
OF AMERICA



50% Total  
Recovered Fiber  
10% Postconsumer



Confluence of Green and Colorado Rivers.  
Photo by Martin Miller.

# CONTENTS

Vol. 12, No. 12

December 2002

<b>Slow Crawl Across the Salinity Divide: Delayed Colonization of Freshwater Ecosystems by Invertebrates</b> Molly Fritz Miller and Conrad C. Labandeira	4
<b>Dialogue</b>	11
<b>GSA Members Invited to Tasmania in 2004</b>	11
<b>Upcoming Deadlines</b>	12
<b>Call for Geological papers: 2003 GSA Section Meetings</b>	13
<b>Geoscience Horizons: Seattle 2003—Call for Proposals for Keynote Symposia and Topical Sessions</b>	14
<b>Final Announcement: Joint Meeting, Northeastern Section and AGS</b>	16
<b>Final Announcement: Cordilleran Section Meeting</b>	20
<b>Shlemon Programs for 2003—Don't Miss Them!</b>	24
<b>Coal Division Offers Medlin Award</b>	24
<b>GSA Foundation Update</b>	26
<b>Apply Now! GeoCorps America: 2003 Summer Positions</b>	27
<b>Seattle 2003: Call for Proposals for K-16 Education Workshops</b>	28
<b>Classified Advertising</b>	29
<b>Journal Highlights</b>	33
<b>GeoVentures: Kenya and Northern Tanzania GeoTrip</b>	34



**On the cover:** Sandstone recording braided stream deposition during the Triassic (Fremouw Formation) exposed along the Wahl Glacier in the Beardmore Glacier area of the Transantarctic Mountains, Antarctica.

# Slow Crawl Across the Salinity Divide: Delayed Colonization of Freshwater Ecosystems by Invertebrates

Molly Fritz Miller, Geology Department, Box 117 Station B, Vanderbilt University, Nashville, Tennessee 37235, USA, molly.f.miller@vanderbilt.edu

Conrad C. Labandeira, Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560-0121, USA, labandeira.conrad@nmnh.si.edu

## ABSTRACT

Ecologically complex communities occupied marine habitats <100 m.y. after the first appearance of multicellular animals during the Ediacaran Period of the late Neoproterozoic. By contrast, freshwater habitats, particularly habitats within the substrate, remained mostly uninhabited for another 200 m.y. This delayed colonization of freshwater substrate ecospace is reflected by the small amount of bioturbation in Upper Carboniferous to Triassic freshwater deposits and in the records of body and trace fossils. Terrestrial insects invaded some freshwater habitats left open by the paucity of immigrants from the ocean during the late Paleozoic, but insects did not inhabit the substrate extensively until later in the Mesozoic. Marine invertebrates were slow to acquire the osmoregulatory capabilities and reproductive and dispersal mechanisms characteristic of successful freshwater animals.

Compared to modern marine benthic communities and animal-substrate relations, those in fresh water are poorly known. Pristine conditions have been modified by human activities, and human-aided transport has facilitated rapid invasion of some marine animals into fresh water, where they have adapted quickly. Study of the genetic and physiologic changes in animals that have invaded fresh water in historical time may elucidate the macroevolutionary processes that controlled the colonization of fresh water through the Phanerozoic.

## INTRODUCTION

How does the colonization history of freshwater habitats, particularly that of sand or mud substrates, compare to that of soft bottom habitats in the marine realm?

In <100 m.y. from the late Neoproterozoic (600 m.y. ago) into the Cambrian, marine animal life appeared and burgeoned from a few animals with a limited range of body plans and life styles of the Ediacaran fauna (e.g., Narbonne, 1998) to ecologically diverse faunas with representatives from all major phyla, including chordates, of the Chengjiang and Burgess Shale biotas (Briggs et al., 1994; Bowring and Erwin, 1998; Babcock et al., 2001). During this time, algal mats on the sediment surface were consumed by increasingly abundant and diverse grazers and burrowers. As a result, the firm algal-bound substrates of the Neoproterozoic were replaced by the easily resuspended surfaces of sediment present today and throughout the Phanerozoic (Bottjer et al., 2000).

Ichnofabric, the texture imparted to sedimentary rocks by biologic activity

prior to lithification, provides a proxy for animal activity in or on the sediment surface and thus records the use by animals of substrate ecospace, although it is affected by rate of sedimentation and, less commonly, by chemical conditions. Analysis of ichnofabric shows that shallow-water marine bioturbators of the Neoproterozoic confined their activity to surficial layers, but Early Cambrian marine animals burrowed decimeters deep into nearshore sands (Droser and Bottjer, 1990; Droser et al., 1999; McIlroy and Logan, 1999; Droser and Li, 2001). By the

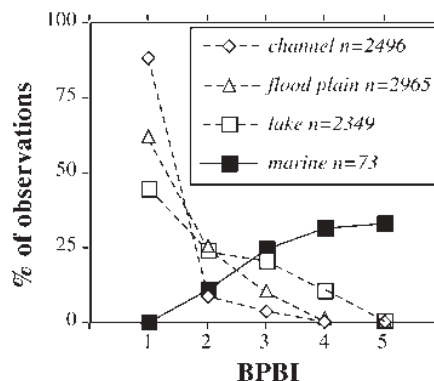


Figure 1. Percent of observations in category of bioturbation, recorded as Bedding Plane Bioturbation Indices (BPBI; Miller and Smail, 1997) on bedding planes from fluvial channel, subaqueous floodplain, lake and marine facies recorded. BPBI categories are: 1—no bioturbation; 2—0%–10% bioturbation; 3—10%–40%; 4—40%–60%; 5—60%–100%. N—number of observations.

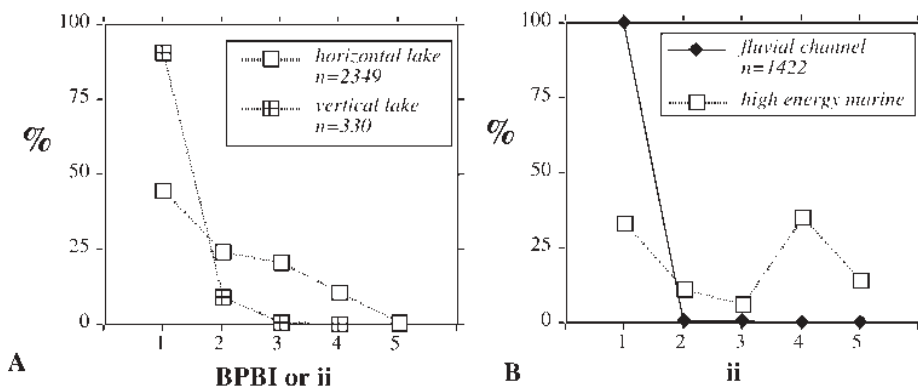


Figure 2. Percent of observations in each category of bioturbation on either bedding planes (BPBI) or vertical surfaces (Ichnofabric Indices, ii, Droser and Bottjer, 1986). Categories of ii are the same as for BPBI (Fig. 1). **A:** Vertical (ii) vs. horizontal bioturbation (BPBI) in lake deposits. **B:** Bioturbation in high-energy fluvial and marine sandstones. Data for fluvial channels are from Miller et al. (2002). Data for marine deposits are from Droser and Bottjer (1990) and are averages of ichnofabric values for 10 m of vertical sections of Cambrian, Ordovician, and Silurian high-energy nearshore sandstones. Paucity of bioturbation in Permian-Jurassic fluvial channels contrasts with the relative abundance of high levels of bioturbation in lower Paleozoic marine sandstones.

Early Ordovician or earlier, sediments in diverse marine environments were highly bioturbated to depths of 10 cm or more (Miller and Byers, 1984; Droser et al., 1994).

Lakes and streams are aquatic habitats that are connected to oceans. If all major phyla appeared and marine habitats were colonized within <100 m.y. after the first appearance of multicellular animals 600 m.y. ago, one would predict that lakes and streams would similarly have been invaded relatively quickly by invertebrates. Accordingly, this paper synthesizes available data from the ichnofabric and body fossil records about the colonization history of freshwater habitats and demonstrates that substrate ecospace in streams and lakes was barely used for ~200 m.y. after the rapid colonization of marine habitats. We suggest factors that might have inhibited colonization of fresh water, and we raise questions about the extent to which modern freshwater substrate ecospace is used. Additionally, we point out limitations in current understanding of modern freshwater benthic communities and of the potential for study of modern freshwater invaders to clarify the macroevolutionary processes involved in the early colonization of freshwater habitats.

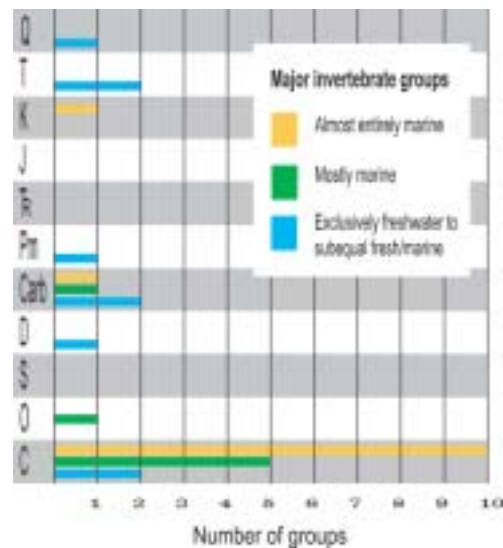
## RECORD OF FRESHWATER INVERTEBRATES

### Trace Fossil and Bioturbation Record

The 4 km thick sequence of diverse freshwater facies of Permian to Jurassic age that are extensively exposed in the Transantarctic Mountains provides a perfect laboratory for evaluating substrate ecospace use by aquatic animals. Using pattern recognition methods, we assessed semiquantitatively the amount of bioturbation on bedding plane and vertical surfaces of subaqueous floodplain, fluvial channel, and lacustrine facies (Miller et al., 2002). We found that (1) the amount of bioturbation is very low, although it varies with facies, and (2) bioturbation is more intense on horizontal than vertical exposures, indicating that animal activity was confined to the surface rather than penetrative. Overall, 67% of observations of bedding planes showed no bioturbation; lake siltstones were the most disrupted and fluvial channel sandstones the least (Fig. 1). Within each facies, horizontal rather than vertical bioturbation is more intense



**Figure 3.** Lacustrine siltstone showing different amounts of bioturbation on closely spaced bedding planes, indicating that the animals were not penetrating the sediment (Permian Mackellar Formation, Transantarctic Mountains, Miller et al., 2002).



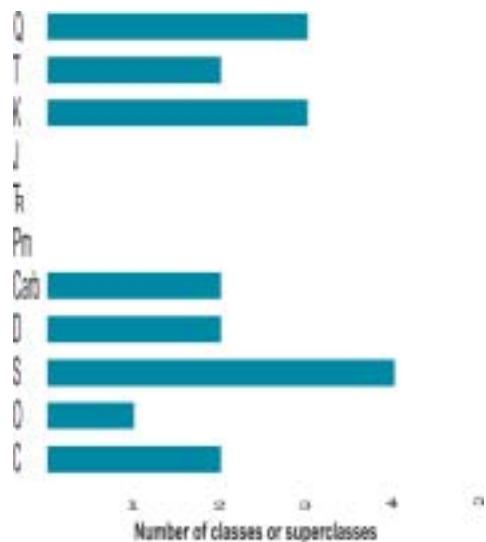
**Figure 4.** First appearances of almost entirely marine, mostly marine, and freshwater (to subsequently freshwater and marine) groups from Pennak (1989) and Conway-Morris (1993.)

(Fig. 2A). Dissection of laminae from lacustrine siltstones demonstrates that the amount of horizontal bioturbation varies between laminae separated by only a few millimeters, indicating that animals clearly did not use the entire substrate ecospace (Fig. 3). In contrast, available data from marine facies indicate much higher levels of bioturbation than in freshwater facies even in much older rocks (Figs. 1, 2B).

The trace fossil record is consistent with these bioturbation data in demonstrating that freshwater animals lived on or near the top of the sediment during the middle to late Paleozoic. Predominantly surficial trails and trackways in Devonian fluvial and shallow lake deposits probably were produced by arthropods (Miller, 1984a). Surface traces characterize Pennsylvanian and Permian lacustrine beds (Maples and Archer, 1989; Pickerill, 1992; Buatois and Mángano, 1995), although deeper burrows occur in fluvial facies (Fitzgerald and Barrett, 1986). Most of these arthropod traces are considered to have been insect-produced and are attributed, with varying degrees of certitude, to adult bristletails, the naiads (aquatic nymphs) of mayflies (Ephemeroptera), dragonflies (Odonatoptera), stoneflies (Plecoptera), and occasional protorthopterans (Braddy, 1998; Braddy and Briggs, 2002). The diversity of subaqueously produced trace fossils increases during the Triassic through Jurassic, as does depth of burrow penetration (Bromley and Asgaard, 1979; Gierlowski-Kordesch, 1991; Metz, 1996; Buatois et al., 1998).

### Body Fossil Record

**All Invertebrates.** Currently there are more higher groups of marine invertebrates than freshwater invertebrates (Fig. 4). Freshwater groups appeared in the fossil record after marine groups. In part, this reflects poor preservation potential of freshwater animals that typically lack a hard skeleton and live in habitats dominated by long-term erosion rather than deposition. However, the fact that four of the 15 marine groups present by the end of the Cambrian are soft-bodied implies controlling factors beyond preservation potential alone. A plot of the first



**Figure 5.** First appearances of superclasses or classes of freshwater animals (from Gray, 1988).

occurrences in fresh water of superclasses and classes of invertebrates as compiled by Gray (1988) yields a similar pattern. Rather than proliferation of many groups before or during the Cambrian, the first appearances of higher taxa in freshwater deposits are spread throughout the Phanerozoic (Fig. 5), albeit with a lack of occurrences during the Permian to Jurassic.

**Freshwater burrowers.** The most common burrowers in modern freshwater substrates are insects, mostly as immature stages and less frequently as adults, and subordinately oligochaetes (earthworms). The oldest putative oligochaete occurs in Carboniferous rocks, but its identity is disputed (Conway-Morris et al., 1982); a later first appearance, particularly of burrowing taxa, is consistent with a recent phylogenetic analysis of annelids (Brinkhurst and Gelder, 2001). Crayfish date back to the Triassic; although they burrow through subaerial floodplain deposits in order to reach the water table, they generally do not burrow in lakes and streams.

Modern taxonomic orders of insects with one or more aquatic stage appeared between the Permian, perhaps Late Carboniferous (Kukalová-Peck, 1983), and the Jurassic (Fig. 6; Wootton, 1988; Sinichenkova and Zherikhin, 1996; Ponomarenko, 1996; Fraser et al., 1996). An aquatic lifestyle for several lineages of Permian insects is demonstrated by presence of abdominal gills, and their dorso-ventral flattening indicates that they were epibenthic, living on top of the sediment (Tillyard, 1935; Tschernova, 1965; Kukalová, 1968; Sinichenkova, 1987; Wootton, 1988). Most early aquatic insects probably were predators living on the bottom based on mouthpart structure and inclusion in taxa with known modern diets (Tschernova, 1965; Kukalová, 1968; Wootton, 1988). These taxa constitute a major dietary guild that continued throughout the Mesozoic (Ponomarenko, 1996; Sinichenkova and Zherikhin, 1996) and to the present. By contrast, benthic filter feeding and deposit feeding within the sediment—the preferred feeding habits of burrowers—were not established until the Late Triassic and Early Jurassic, respectively (Wootton, 1988).

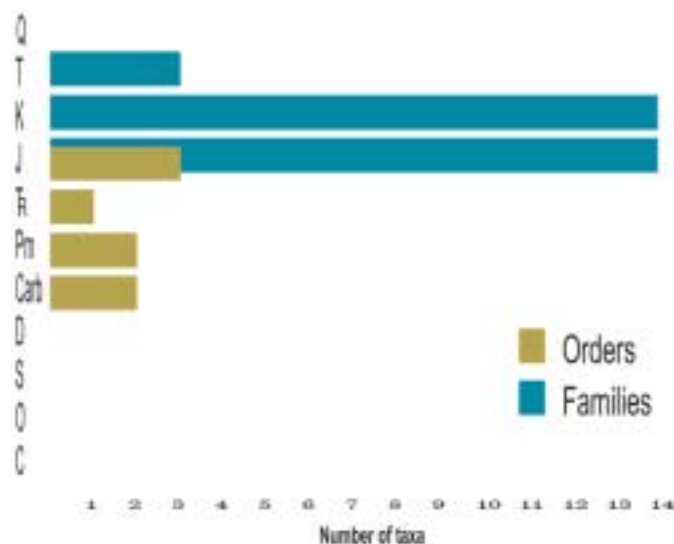
Delayed colonization of habitable space within freshwater substrates until the mid Mesozoic also is indicated by the first

occurrences of modern insect families with representatives that burrow in freshwater sediments (Fig. 6). Families with burrowers were identified in tables summarizing the ecology of modern aquatic insects (Merritt and Cummins, 1996) and their first occurrences are recorded by an update of Labandeira's compendium (1994) that documents the geochronological occurrences of fossil insects. Modern families with insect burrowers evolved after the origin of their respective orders, supporting Wootton's (1988) inference that infaunal life styles were the last to arise in aquatic insects. Thus the body-fossil record of modern burrowers, particularly of insects, supports the important conclusion from ichnofabric and trace fossils that freshwater epibenthic habitats at best were modestly occupied during the Permian, but ecospace below the substrate surface was not extensively inhabited until significantly after the late Paleozoic.

### ROUTES TO FRESH WATER

Animals living in freshwater habitats were evolutionarily derived from (1) marine groups that adapted to reduced salinity as they moved upstream through estuaries into fresh water, and (2) air-breathing terrestrial groups such as insects that secondarily invaded aquatic habitats by transformation of structures into gills or by various behavioral and physiological adaptations (Edney, 1977; Pennak, 1989; Labandeira and Beall, 1990; Little, 1990).

A common pattern is invasion of fresh water by one to several groups within a major taxon, each of which independently adapted to freshwater conditions and each of which includes a limited number of genera and/or species (Hutchinson, 1967). For example, the Phylum Cnidaria consists of animals that vary widely in morphology and life style and that are grouped into three classes: Anthozoa (corals, sea anemones), Scyphozoa (true jellyfish), and Hydrozoa (hydroids, stinging corals, Portuguese-man-of-war). Freshwater cnidarians are almost exclusively confined to a few genera in one small family of one order in the Class Hydrozoa, but the genera, particularly *Hydra*, are geographically widespread and abundant (Hutchinson, 1967;



**Figure 6.** First appearances of modern aquatic insect orders (from Wootton, 1988) and of modern families with burrowers in aquatic sediments (from Merritt and Cummins, 1996, and Labandeira, 1994).

Slobodkin and Bossert, 2001). It is not known what physiological adaptation facilitated colonization and proliferation of the Hydridae in fresh water, nor is it known why only one other order in the Class Hydrozoa and no orders in the Classes Anthozoa or Scyphozoa became adapted to life in fresh water.

The pattern of multiple invasions of fresh water by small groups is also seen in clams and snails. The estimated number of independent invasions of fresh water by marine bivalves is 12, but five of these added only a single genus to the freshwater fauna (Hutchinson, 1967). Similarly, freshwater gastropod species belong to 15 families, 11 of which have five or fewer genera (Brown, 2001).

The earliest known Devonian insects were clearly terrestrial and lacked wings (Labandeira et al., 1988). Although it has been suggested that winged insects were derived from aquatic ancestors (Kukalová-Peck, 1983; Toms, 1984; Thomas et al., 2000), the consensus now is that all insects, including those with wings, evolved on land and were equipped with tracheae for respiration in air and that water-dwelling insects are secondarily aquatic (Ward, 1992; Pritchard et al., 1993; D'Haese, 2002). Thus insects, so dominant in the faunas of lakes and streams, invaded fresh water from land rather than from the sea.

## **BARRIERS TO COLONIZATION OF FRESHWATER HABITATS**

### **What's to Eat?**

If vascular land plants did not appear and diversify until the Late Silurian to Devonian (Edwards and Wellman, 2001; Kotyk et al., 2002), the lack of food resources would have delayed freshwater colonization, particularly of substrate ecospace (Maples and Archer, 1989). However, there is increasing evidence that establishment of vascular plant communities was the third and final stage in the colonization of terrestrial habitats by plants (Gray, 1993; Strother, 2000). It was preceded by a microbial phase in the Precambrian to Cambrian and a moss-liverwort phase in the Cambrian to Silurian characterized by simple ecosystems and some plant cover (Strother, 2000; Retallack, 2000). In addition to land-derived plant material, at least in terrestrial environments bordering coastlines, nearby lakes and streams probably had microbial and

algal food sources (Gray, 1993), and stromatolites occur in Precambrian freshwater deposits (Hoffman, 1976; Awramik, 1984). In modern ecosystems the importance of land-derived

detritus versus water-derived detritus for microbial food sources varies along the length of river systems and in different parts of lakes (Wotton, 1994; Thorp and Covich, 2001) and the same probably was true in the mid to late Paleozoic.

Although live plant tissues and detritus from late Paleozoic forests provided a food bonanza for arthropod herbivores and detritivores (Labandeira et al., 1997; Labandeira, 1998; Roßler, 2000; Raymond et al., 2000), land-plant organic matter also presented a nutritional and biochemical challenge to aquatic animals. The structural rigidity needed to maintain a tree in an upright position originates from materials such as lignin and cellulose that are refractory and difficult to break down, in contrast to microbial and aquatic plant material. Animals dependent on such refractory organic matter commonly have extra enzymes, gut microbes, or behavioral modifications to facilitate their conversion to a usable form; acquisition of these features required evolutionary adaptation on land or in water (Lamberti and Moore, 1984; Hunt and Nalepa, 1994; Giller and Malmquist, 1998). Nevertheless, an ecologically extensive array of plant-consuming mites and insects was present on land during the late Pennsylvanian and Early Permian, representing colonization of communities such as woodlands along streams and peat-dominated swamp forests by distinctive feeding groups of herbivores and detritivores that had specialized morphological adaptations for chewing, piercing, boring, galling, and consuming pollen and spores (Beck and Labandeira, 1998; Labandeira, 1998; Raymond et al., 2000).

### **Barriers Along the Marine → Fresh Water Route**

The composition of body fluids of marine animals is similar to that of seawater, but body fluids of freshwater animals are much saltier than the water that surrounds them. Consequently there is a strong osmotic gradient with water flowing into the animal across all permeable surfaces (Little, 1990). In general, freshwater animals maintain constant concentration of body fluids by limiting permeability of

surfaces, and, unlike marine animals, by secreting highly dilute urine; they also are able to absorb salts that are in very low concentration in fresh water (Pennak, 1989). Maintaining this osmoregulatory system is energetically expensive and requires physiological adaptations from the cellular to organal levels. Along the marine to brackish to fresh aquatic continuum, by far the smallest number of species occurs in brackish waters (salinity of 7‰–10‰; Pennak, 1989). Thus estuaries, characterized by both low and fluctuating salinities, effectively serve as ecological and taxonomic filters and barriers to marine species.

Optimal strategies for reproduction and dispersal differ for marine versus freshwater macroinvertebrates, for which an adjustment presents challenges to potential invaders from the sea. Marine animals commonly produce large numbers of planktic larvae which may be widely dispersed in the oceans (Scheltema, 1971). This strategy is rare in fresh water, probably because favorable habitats are spatially fragmented and because small planktic larvae with large surface areas would face potentially insurmountable osmoregulatory problems in fresh water. In general, freshwater animals lack planktic larval stages and produce fewer and much larger eggs that are brooded rather than broadcast (Pennak, 1989). Unionid clams, probably present in fresh water since the late Paleozoic, have responded to dispersal challenges by developing a larval form that is temporarily parasitic on fish. Such innovations imply significant evolutionary change for adaptation to fresh water.

### **Barriers Along the Terrestrial → Fresh Water Route**

Insects and pulmonate snails colonized fresh water from terrestrial habitats. Pulmonate snails have a vascularized mantle cavity that functions as a lung. Some aquatic pulmonates have a secondarily derived gill within the mantle cavity for obtaining oxygen from water. By contrast, terrestrial insects have a tracheal system to efficiently obtain oxygen from air, but are encased in a fairly impermeable exoskeleton that reduces water loss. In fully aquatic insects the tracheal system is modified and used for distribution of gases, the exoskeleton is reduced to facilitate uptake of oxygen, and commonly

there are external respiratory epithelia deployed as gills. These modifications have been accomplished in a variety of styles in different insect groups (Ward, 1992; Wichard et al., 2002). Alteration of the respiratory systems in these two groups required significant evolutionary change. Additionally, in insects, other structural, physiological, and behavioral changes have resulted in the colonization of freshwater ecosystems. For example, eggs are inserted into such unconventional substrates as internal stem tissues of submergent plants in the case of dragonflies (Corbet, 1999).

### **Special Challenges Faced by Burrowers**

The sediment in which animals burrow is more likely than the overlying water to become depleted in oxygen, especially if it contains much organic matter. Burrowers in sand and mud have adaptations for obtaining or using oxygen efficiently. Some burrowing dragonfly naiads have long respiratory siphons (Ward, 1992), but most burrowing insects, such as certain mayfly naiads, have gills rather than respiratory siphons, and bear special hairs on shields that are needed to keep respiratory surfaces from being covered with sediment (Wichard et al., 2002).

Burrowers in shifting sand substrates are prone to exhumation and/or burial by sediment. The premiere marine burrowers are crustacean callianassid shrimp; some populations can overturn a layer 30 cm thick in less than 40 days (Miller, 1984b). They owe their burrowing prowess to highly modified leg appendages which freshwater insects rarely have.

### **WERE THE BARRIERS OVERCOME?**

#### **Yes**

The very presence of freshwater animals derived from marine ancestors demonstrates that the barriers along the marine to freshwater route were surmountable (Edney, 1977; Little, 1990). Representatives of numerically many, but a small percentage, of marine taxa independently developed the osmoregulatory systems and reproductive or dispersal strategies needed for success in fresh water.

#### **Gradually**

The dominance of insects in freshwater habitats underscores the slowness of

marine animals in crossing the salinity barrier. Insect invasion from terrestrial environments was permitted because ecospace was still available as marine animals struggled and straggled across the salinity divide through the Paleozoic. The diversity and abundance of aquatic insects, and to a lesser extent pulmonate snails, testify to their success in crossing barriers along the terrestrial to fresh water route.

### **IS SUBSTRATE ECOSPACE FULLY OCCUPIED IN MODERN LAKES AND STREAMS?**

#### **No?**

Sand depleted in organic matter and mud bottoms of streams and lakes have depauperate insect faunas and few individuals (Ward, 1992), although the data are relatively poor. Cobble substrates with plant debris have one order of magnitude more insects. Because the few burrowers in sand and mud are usually very small in size, much of this ecospace is empty.

The very existence of varves in lacustrine deposits also implies absence of infaunal animals disrupting and churning the sediment. The fact that detailed Quaternary climate histories can be reconstructed on the basis of pollen and insect remains preserved in thin laminae in lake-bottom sediments attests to absence of disruption by burrowing animals that in some cases is not due to low oxygenic conditions (Cohen, 1984; Bennike, 2000).

#### **Yes?**

Insects, oligochaetes, clams, and amphipods mix sediment of the Great Lakes to a depth of 5 to 10 cm, which affects both the physical and chemical characteristics of the sediment (e.g., McCall and Tevesz, 1982; Fisher, 1982). Recent laboratory work has documented the rates at which freshwater burrowers transport materials within the sediment, across the sediment-water interface, and the depth to which they rework sediment (see references in Charbonneau and Hare, 1998; Miller et al., 2002). If animals occur commonly in the high densities recorded, and if they are as active in natural settings as they are in laboratory conditions, the substrate ecospace of modern lakes and streams is extensively used.

### **Too little is known about freshwater animal-sediment relations to generalize**

With the exception of the Great Lakes, lake bottoms and their inhabitants are barely explored. The same is true of large rivers, which as of 1989 were the subject of only 4% of papers on fluvial ecology (Thorp and Covich, 2001). It is particularly difficult to generalize about the use of substrate ecospace because bottom dwelling animals are patchily distributed and their substrates are heterogeneous (Brinkhurst, 1974; Beckett et al., 1983).

In contrast, the bottoms of the world's oceans have been cored and box cored extensively, documenting the pervasive use of the substrate ecospace (Howard and Reineck, 1972; Ekdale and Berger, 1978). Unfortunately, equivalent understanding of pristine benthic habitats in fresh water may not be possible due to anthropogenically induced invasions by exotic species and pollution in lakes, and to modification of substrate characteristics caused by channelization of large rivers (Thorp and Covich, 2001).

### **MORE RECENT INVASIONS**

Invasion of freshwater habitats by some marine animals belonging to groups with freshwater representatives has occurred during the last few million years, especially in tropical areas (Pennak, 1989; Diesel et al., 2000; Vermeij and Wesselingh, 2002). In the last 150 yr, freshwater invasion by marine species has increased, particularly in reservoirs and polluted rivers. This is probably a result of human and climate-related reduction in indigenous faunas coupled with human-provided opportunities for dispersal (Lee and Bell, 1999). These authors have identified common characteristics of these invaders that facilitated the transition to fresh water, including high rates of growth and reproduction, but identification of the ultimate causes of successful invasions has remained elusive. It also is not known if these invaders will persist over geologic time.

The frequency and speed of the invasions is striking (Lee, 1999). One-third of the 139 exotic aquatic organisms in the Great Lakes, many of them of marine origin, have been introduced since 1960 (Mills et al., 1993). Morphological adaptations can occur within decades after introduction (Klepaker, 1993). Such rapid adaptation provides a unique opportunity



to identify and explore the genetic and physiological changes that are associated with colonization of fresh water. Given the present state of knowledge, it remains puzzling why invasion of fresh water appears so easy now but so difficult in the past. In addition to elucidating human impact on freshwater ecosystems, more extensive study of human-aided invasions in historical time may lead to better understanding of why freshwater habitats were so slow to be colonized so many tens of millions of years after the rapid establishment of diverse marine communities during the Cambrian.

## CONCLUSIONS

Freshwater habitats were very slowly colonized over hundreds of millions of years during the late Paleozoic, in contrast to marine habitats that were invaded quickly in the Cambrian by many different animals with diverse lifestyles. Terrestrial plant communities were ecologically colonized and partitioned by insect herbivores and detritivores during the late Pennsylvanian to Early Permian, significantly before the occupation of freshwater habitats. Eventually, the freshwater ecospace left open by a paucity of colonizers from the sea was gradually invaded by insects from land during and after the Permian.

Colonization of fresh water by marine animals may have been slowed by the need to develop more complex osmoregulatory systems and different styles of reproduction and dispersal. To use freshwater ecospace, burrowing insects needed new and efficient means of obtaining oxygen, handling sediment, and completing their reproductive cycle. Although animals overcame the barriers to fresh water, it is not well documented that they ever used the substrate ecospace as effectively and completely as marine animals.

During the past 150 years many human-transported marine invaders have adapted to fresh water. Documentation of the genetic and physiological changes occurring now may help understand the processes that were involved in the large-scale colonization of freshwater habitats.

## ACKNOWLEDGMENTS

This work is supported by National Science Foundation grants OPP9417978 and OPP 9614709 to Miller, and the Walcott Fund and Scholarly Studies

Program of the Smithsonian Institution to Labandeira. We thank H. Allen Curran, A.A. (Tony) Ekdale, Karl E. Karlstrom, and L. David Smith for helpful comments on an earlier version of this manuscript.

## REFERENCES CITED

- Awramik, S.M., 1984, Ancient stromatolites and microbial mats, in Cohen, Y., Catenholz, R.W., and Halvorson, H.O., eds., *Microbial mats, stromatolites*: New York, Liss, p. 1–22.
- Babcock, L.E., Zhang, W., Leslie, S.A., 2001, The Chengjiang Biota: Record of the Early Cambrian diversification of life and clues to exceptional preservation of fossils: *GSA Today*, v. 11, no. 2, p. 4–9.
- Beck, A., and Labandeira, C.C., 1998, Early Permian insect folivory on a giantopterid-dominated riparian flora from north-central Texas: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 142, p. 139–173.
- Beckett, D.C., Bingham, C.R., and Sanders, L.G., 1983, Benthic macroinvertebrates of selected habitats of the Lower Mississippi River: *Journal of Freshwater Ecology*, v. 2, p. 247–261.
- Bennike, O., 2000, Paleocological studies of Holocene lake sediment from west Greenland: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 155, p. 285–304.
- Bottjer, D.J., Hagadorn, J.W., and Dornbos, S.Q., 2000, The Cambrian substrate revolution: *GSA Today*, v. 10, no. 9, p. 1–7.
- Bowring, S.A., and Erwin, D.H., 1998, A new look at evolutionary rates in deep time: Uniting paleontology and high-precision geochronology: *GSA Today*, v. 8, no. 7, p. 1–8.
- Braddy, S.J., 1998, An overview of the invertebrate ichnotaxa from the Robledo Mountains ichnofauna (Lower Permian), southern New Mexico: *New Mexico Museum of Natural History and Science Bulletin*, v. 12, p. 93–98.
- Braddy, S.J., and Briggs, D.E.G., 2002, New Lower Permian nonmarine arthropod trace fossils from New Mexico and South Africa: *Journal of Paleontology*, v. 76, p. 546–557.
- Briggs, D.E.G., Erwin, D.H., and Collier, F.J., 1994, *The fossils of the Burgess Shale*: Washington, Smithsonian Institution Press, 238 p.
- Brinkhurst, R.O., 1974, *The benthos of lakes*: New York, St. Martin's Press, 182 p.
- Brinkhurst, R.O., and Gelder, S.R., 2001, Annelida: Oligochaeta, including Branciobdellidae, in Thorp, J.H., and Covich, A.P., eds., *Ecology and classification of North American freshwater invertebrates*, 2nd edition: San Diego, Academic Press, p. 431–463.
- Bromley, R.G., and Asgaard, U., 1979, Triassic freshwater ichnocoenoses from Carlsberg Fjord, East Greenland: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 24, p. 39–80.
- Brown, K.M., 2001, Mollusca: Gastropoda, in Thorp, J.H., and Covich, A.P., eds., *Ecology and classification of North American freshwater invertebrates*, 2nd edition: San Diego, Academic Press, p. 297–329.
- Buatois, L.A., and Mángano, M.G., 1995, The paleoenvironmental and paleoecological significance of the lacustrine *Mermia* ichnofacies: an archetypical subaqueous nonmarine trace fossil assemblage: *Ichnos*, v. 4, p. 151–161.
- Buatois, L.A., Mángano, M.G., Genise, J.F., Taylor, T.N., 1998, The ichnological record of the continental invertebrate invasion: evolutionary trends in environmental expansion, ecospace utilization, and behavioral complexity: *Palaio*, v. 13, p. 217–240.
- Charbonneau, P., and Hare, L., 1998, Burrowing behavior and biogenic structures of mud dwelling insects: *Journal of the North American Benthological Society*, v. 17, p. 239–249.
- Cohen, A.S., 1984, Effect of zoobenthic standing crop on laminae preservation in tropical lake sediment, Lake Turkana, East Africa: *Journal of Paleontology*, v. 58, p. 499–510.
- Conway-Morris, S., 1993, The fossil record and the early evolution of the Metazoa: *Nature*, v. 361, p. 219–225.
- Conway-Morris, S., Pickerill, R.K., and Harland, T.L., 1982, A possible annelid from the Trenton Limestone (Ordovician) of Québec, with a review of fossil oligochaetes and other annu-

late worms: *Canadian Journal of Earth Sciences*, v. 19, p. 2150–2157.

Corbet, P.S., 1999, *Dragonflies—behaviour and ecology of Odonata*: Colchester, U.K., Harley Books, 829 p.

D'Haese, C.A., 2002, Were the first springtails semi-aquatic? A phylogenetic approach by means of 28S rDNA and optimization alignment: *Proceedings of the Royal Society of London (B)*, v. 269, p. 1143–1151.

Diesel, R., Schubart, C.D., and Schuh, M., 2000, A reconstruction of the invasion of land by Jamaican crabs (Grapsidae: Sesaminae): *Journal of the Zoological Society of London*, b. 250, p. 141–160.

Droser, M.L., and Bottjer, D.J., 1986, A semi-quantitative field classification of ichnofabric: *Journal of Sedimentary Petrology*, v. 56, p. 558–559.

Droser, M.L., and Bottjer, D.J., 1990, Ichnofabrics of sandstones deposited in high-energy nearshore environments: Measurements and utilization: *Palaio*, v. 4, p. 598–604.

Droser, M.L., Gehling, J.G., and Jensen, S., 1999, When the worm turned: Concordance of Early Cambrian ichnofabric and trace-fossil record in siliciclastic rocks of South Australia: *Geology*, v. 27, p. 625–628.

Droser, M.L., Hughes, N.C., and Jell, P.A., 1994, Infaunal communities and tiering in early Paleozoic nearshore clastic environments: Trace fossil evidence from the Cambro-Ordovician of New South Wales: *Lethaia*, v. 27, p. 2273–2283.

Droser, M.L., and Li, Xing, 2001, The Cambrian radiation and the diversification of sedimentary fabrics, in Zhuravlev, A.Y., and Riding, R., eds., *The ecology of the Cambrian explosion*: New York, Columbia University Press, p. 137–169.

Edney, E.B., 1977, *Water balance in land arthropods*: Berlin, Springer-Verlag, 282 p.

Edwards, D., and Wellman, C., 2001, Embryophytes on land: the Ordovician to Lochkovian (Lower Devonian) record, in Gensel, P.G., and Edwards, D., eds., *Plants invade the land—evolutionary and environmental perspectives*: New York, Columbia University Press, p. 3–28.

Ekdale, A.A., and Berger, W.H., 1978, Deep-sea ichnofacies: modern organism traces on and in pelagic carbonates of the western equatorial Pacific: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 23, p. 263–278.

Fisher, J.B., 1982, Effects of macrobenthos on the chemical diagenesis of freshwater sediments, in McCall, P.L., and Tevesz, M.J., eds., *Animal-sediment relations: the biogenic alteration of sediment*: New York, Plenum Press, p. 177–218.

Fitzgerald, P.G., and Barrett, P.J., 1986, *Skolithos* in a Permian braided river deposit, southern Victoria Land, Antarctica: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 52, p. 237–247.

Fraser, N.C., Grimaldi, D.A., Olsen, P.E., and Axsmith, B., 1996, A Triassic Lagerstätte from eastern North America: *Nature*, v. 380, p. 615–619.

Gierlowski-Kordesch, E., 1991, Ichnology of an ephemeral lacustrine/alluvial plain system: Jurassic East Berlin Formation, Hartford Basin, USA: *Ichnos*, v. 1, p. 221–232.

Giller, P.S., and Malmquist, B., 1998, *The biology of streams and rivers*: Oxford, Oxford University Press, 296 p.

Gray, J., 1988, Evolution of the freshwater ecosystem: the fossil record: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 62, p. 1–214.

Gray, J., 1993, Major Paleozoic land plant bio-events: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 104, p. 153–169.

Hoffman, P., 1976, Environmental diversity of middle Precambrian stromatolites, in Walter, M.F., ed., *Stromatolites*: Amsterdam, Elsevier, p. 599–611.

Howard, J.D., and Reineck, H.E., 1972, Physical and biogenic sedimentary structures of the nearshore shelf: *Senckenbergiana Maritima*, v. 4, p. 81–123.

Hunt, J.H., and Nalepa, C.A., 1994, Nourishment and evolution in insect societies: New Delhi, Oxford & IBH Publishing Co., 449 p.

Hutchinson, G.E., 1967, *A Treatise on limnology: vol. II, introduction to lake biology and the limnoplankton*: New York, John Wiley & Sons, 1115 p.

- Klepaker, T., 1993, Morphological changes in a marine population of threespined stickleback, *Casterosteus aculeatus*, recently isolated in fresh water: Canadian Journal of Zoology, v. 71, p. 1251–1258.
- Kotyk, M.W., Basinger, J.F., Gensel, P.G., De Freitas, T.A., 2002, Morphologically complex plant macrofossils from the Late Silurian of Arctic Canada: American Journal of Botany, v. 89, p. 1004–1013.
- Kukalová, J., 1968, Permian mayfly nymphs: Psyche, v. 75, p. 310–327.
- Kukalová-Peck, J., 1983, Origin of the insect wing and wing articulation from the arthropodan leg: Canadian Journal of Zoology, v. 61, p. 1618–1669.
- Labandeira, C.C., 1994, A compendium of fossil insect families: Milwaukee Publication Museum Contributions in Biology and Geology, no. 88, 71 p.
- Labandeira, C.C., 1998, Early history of arthropod and vascular plant associations: Annual Review of Earth and Planetary Sciences, v. 26, p. 329–377.
- Labandeira, C.C., and Beall, B.S., 1990, Arthropod terrestriality, in Mikulic, D.G., ed., Arthropod Paleobiology: Short Courses in Paleontology, v. 3, p. 214–256.
- Labandeira, C.C., Beall, B.S., Hueber, F.S., 1988, Early insect diversification: evidence from a Lower Devonian bristletail from Québec: Science, v. 242, p. 913–916.
- Labandeira, C.C., Phillips, T.L., and Norton, R.L., 1997, Oribatid mites and decomposition of plant tissues in Paleozoic coal-swamp forests: Palaios, v. 12, p. 317–351.
- Lamberti, G.A., and Moore, J.W., 1984, Aquatic insects as primary consumers, in Resh, V.H., and Rosenberg, D.M., eds., The ecology of aquatic insects: New York, Praeger, p. 164–195.
- Lee, C.E., 1999, Rapid and repeated invasions of fresh water by the copepod *Eurytemora affinis*: Evolution, v. 53, p. 1423–1434.
- Lee, C.E., and Bell, M.A., 1999, Causes and consequences of recent invasions by saltwater animals: Trends in Ecology and Evolution, v. 14, p. 284–288.
- Little, C., 1990, The terrestrial invasion: Cambridge, U.K., Cambridge University Press, 304 p.
- Maples, C.G., and Archer, A., 1989, The potential of Paleozoic nonmarine trace fossils for paleoecological interpretations: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 73, p. 185–195.
- McCall, P.L., and Tevesz, M.J., 1982, The effects of benthos on physical properties of freshwater sediments, in McCall, P.L., and Tevesz, M.J., eds., Animals-sediment relations: The biogenic alteration of sediment: New York, Plenum Press, p. 105–176.
- McIlroy, D., and Logan, G.A., 1999, The impact of bioturbation on infaunal ecology and evolution during the Proterozoic-Cambrian transition: Palaios, v. 14, p. 58–72.
- Merritt, R.W., and Cummins, K.W., 1996, An introduction to the aquatic insects of North America, 3rd edition: Dubuque, Iowa, Kendall/Hunt Publishing, 862 p.
- Metz, R., 1996, Newark Basin ichnology: The Late Triassic Perkasie Member of the Passaic Formation, Saratoga, Pennsylvania: Northeastern Geology, v. 18, p. 118–129.
- Miller, M.F., 1984a, Distribution of biogenic structures in Paleozoic nonmarine and marine-margin sequences: an actualistic model: Journal of Paleontology, v. 58, p. 550–570.
- Miller, M.F., 1984b, Bioturbation in intertidal quartz-rich sands: a modern example and its sedimentologic and paleoecologic implications: Journal of Geology, v. 92, p. 201–216.
- Miller, M.F., and Byers, C.W., 1984, Abundant and diverse early Paleozoic infauna indicated by the stratigraphic record: Geology, v. 12, p. 40–43.
- Miller, M.F., McDowell, T.A., Smail, S.E., Shyr, Y., and Kemp, N.R., 2002, Hardly used habitats: Death and distribution of burrowing in Paleozoic and Mesozoic stream and lake deposits: Geology, v. 30, p. 527–530.
- Miller, M.F., and Smail, S.E., 1997, A semiquantitative field method for evaluating bioturbation on bedding planes: Palaios, v. 12, p. 391–396.
- Mills, E.L., Leach, J.H., Carlton, J.T., Secar, C.L., 1993, Exotic species in the Great Lakes: a history of biotic crisis and anthropogenic introductions: Journal of Great Lakes Research, v. 19, p. 1–54.
- Narbonne, G.M., 1998, The Ediacara Biota: A terminal Neoproterozoic experiment in the evolution of life: GSA Today, v. 8, no. 2, p. 1–6.
- Pennak, R.W., 1989, Fresh-water invertebrates of the United States: Protozoa to Mollusca, 3rd edition: New York, John Wiley & Sons, 628 p.
- Pickerill, R.K., 1992, Carboniferous nonmarine invertebrate ichnocoenoses from southern New Brunswick, eastern Canada: Ichnos, v. 2, p. 21–35.
- Ponomarenko, A.G., 1996, Evolution of continental aquatic ecosystems: Paleontological Journal, v. 30, p. 705–709.
- Pritchard, G., McKee, M.H., Pike, E.M., Scrimgeour, G.J., and Sloty, J., 1993, Did the first insects live in water or in air?: Biological Journal of the Linnean Society, v. 49, p. 31–44.
- Raymond, A., Cutlip, P., and Sweet, M., 2000, Rates and processes of terrestrial nutrient cycling in the Paleozoic: The world before beetles, termites and flies, in Allmon, W.D., and Bottjer, D.J., eds., Evolutionary paleoecology: The ecological context of macroevolutionary change: New York, Columbia University Press, p. 235–283.
- Retallack, G.J., 2000, Ordovician life on land and early Paleozoic global change, in Gastaldo, R.A., and DiMichele, W.A., eds., Phanerozoic terrestrial ecosystems: Paleontological Society Papers, v. 6, p. 21–45.
- Roßler, R., 2000, The late Palaeozoic tree fern *Psaronius*—an ecosystem unto itself: Review of Palaeobotany and Palynology, v. 108, p. 55–74.
- Scheltema, R.S., 1971, Larval dispersal as a means of genetic exchange between geographically separated populations of shallow-water benthic marine gastropods: Biological Bulletin, v. 140, p. 284–322.
- Sinichenkova, N.D., 1987, The historical development of the Plecoptera: Transactions of the Paleontological Institute, v. 221, p. 1–142 (in Russian).
- Sinichenkova, N.D., and Zherikhin, V.V., 1996, Mesozoic lacustrine biota: extinction and persistence of communities: Paleontological Journal, v. 30, p. 710–715.
- Slobodkin, L.B., and Bossert, P.E., 2001, Cnidaria, in Thorp, J.H., and Covich, A.P., eds., Ecology and classification of North American freshwater invertebrates, 2nd edition: San Diego, Academic Press, p. 135–154.
- Strother, P.K., 2000, Cryptospores: The origin and early evolution of the terrestrial flora, Gastaldo, R.A., and DiMichele, W.A., eds., Phanerozoic terrestrial ecosystems, in Paleontological Society Papers, v. 6, p. 3–20.
- Thomas, M.A., Walsh, K.A., Wolf, M.R., McPherson, B.A., and Marden, J.H., 2000, Molecular phylogenetic analysis of evolutionary trends in stonefly wing structure and locomotor behavior: Proceedings of the National Academy of Sciences, USA, v. 97, p. 13,178–13,183.
- Thorp, J.H., and Covich, A.P., 2001, An overview of freshwater habitats, in Thorp, J.H., and Covich, A.P., eds., Ecology and classification of North American freshwater invertebrates, 2nd edition: San Diego, Academic Press, p. 19–41.
- Tillyard, R.J., 1935, Upper Permian insects of New South Wales. V. The order Perlaria or stone-flies: Proceedings of the Linnean Society of New South Wales, v. 60, p. 385–391.
- Toms, R.B., 1984, Were the first insects terrestrial or aquatic?: South African Journal of Science, v. 80, p. 319–323.
- Tschernova, O.A., 1965, Some fossil mayflies (Ephemeroptera, Mishhodotidae) from Permian beds of the Ural: Entomological Review, v. 44, no. 2, p. 202–207.
- Vermeij, G.J., and Wesselingh, F.P., 2002, Neogastropod molluscs from the Miocene of western Amazonia, with comments on marine to freshwater transitions in molluscs: Journal of Paleontology, v. 76, p. 265–270.
- Ward, J.V., 1992, Aquatic insect ecology 1. Biology and habitat: New York, John Wiley & Sons, 438 p.
- Wichard, W., Arens, W., and Eisenbeis, G., 2002, Biological atlas of aquatic insects: Stenstrup, Denmark, Apollo Books, 339 p.
- Wootton, R.J., 1988, Historical ecology of aquatic insects: an overview: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 52, p. 477–482.
- Wotton, R.S., 1994, The biology of particles in aquatic systems, 2nd ed.: Boca Raton, Lewis Publishers, 325 p.

*Manuscript received September 3, 2002; accepted October 8, 2002. \**

## ERRATUM

In our paper challenging the Noah's Flood Hypothesis for catastrophic flooding of the Black Sea (Aksu et al., 2002), proper acknowledgement was mistakenly not given to similar criticisms of this hypothesis in the literature. In particular, Çağatay et al. (2000), Görür et al. (2001), and Algan et al. (2001) have all criticized the proposal of a catastrophic flood. The Aksu et al. (2002) "Outflow Hypothesis" differs in several ways from the scenarios presented by Çağatay et al. (2000) and Görür et al. (2001) and was based entirely on our own data and ideas. The similarities to Algan et al. (2001) are more embarrassing for us, but we had not read this paper when we submitted our manuscript to *GSA Today*. Nevertheless, we apologize to the authors of Çağatay et al. (2000), Görür et al. (2001), and Algan et al. (2001) for unjustifiably ignoring

several of their important contributions to the evolution of the Black Sea–Marmara Sea–Aegean Sea oceanographic gateway.

*Ali E. Aksu and Richard N. Hiscott,  
Memorial University, Canada*

## REFERENCES CITED

- Aksu, A.E., Hiscott, R.N., Mudie, P.J., Rochon, A., Kaminski, M.A., Abrajano, T., and Yaşar, D., 2002, Persistent Holocene outflow from the Black Sea to the eastern Mediterranean contradicts Noah's Flood Hypothesis: *GSA Today*, v. 12, no. 5, p. 4–10.
- Algan, O., Çağatay, N., Tchepalyga, A., Ongan, D., Eastoe, C., and Gökaşan, E., 2001, Stratigraphy of the sediment infill in Bosphorus Strait: Water exchange between the Black and Mediterranean Seas during the last glacial Holocene: *Geo-Marine Letters*, v. 20, p. 209–218.
- Çağatay, M.N., Görür, N., Algan, O., Eastoe, C., Tchepalyga, A., Ongan, D., Kuhn, T., and Kuşçu, I., 2000, Late Glacial–Holocene palaeoceanography of the Sea of Marmara: Timing of connections with the Mediterranean and the Black Seas: *Marine Geology*, v. 167, p. 191–206.
- Görür, N., Çağatay, M.N., Emre, Ö., Alpar, B., Sakıncı, M., İslamoğlu, Y., Algan, O., Erkal, T., Keçer, M., Akkök, R., and Karlık, G., 2001, Is the abrupt drowning of the Black Sea shelf at 7150 yrBP a myth?: *Marine Geology*, v. 176, p. 65–73.

# DIALOGUE



## A Year Later

*Jack Hess, GSA Executive Director*

It is an honor for me to report on the great achievements of GSA over the past year. Last year at this time, I attended the Boston Annual Meeting wondering what I had jumped into and what the next year would bring. I am pleased to say that despite many challenges, in many aspects GSA stands stronger today than at any other time in its history. Financially, we are still not out of the woods, but I do see a path forward. We have taken and are continuing to take many steps to help bring our financial situation under control.

GSA has seen positive membership growth for the seventh year in a row, more members have participated in Society and Division elections than in the past few years, the annual meeting was a great success, and our publications thrive. Additionally, our Education and Outreach programs experienced great success, and we continue to strengthen our relationships with a number of our sister societies.

To add some statistics to the above observations, total membership stood at 17,469 on October 1, an increase of 421 over last year.

We had 3,364 abstracts submitted for the Denver Annual Meeting, only one fewer than the record-setting 2000 meeting in Reno, and 6,269 total attendees.

GSA Publications saw much activity this past year. Submissions to *Geology* are up 30% over last year. The books division was reorganized, resulting in cost savings and reduction in production time from acceptance to publication. Fourteen volumes are scheduled for 2002, up from seven in 2001. Looking to the future, GSA continues to work with six other societies to develop an electronic journal aggregate.

Education and Outreach programs saw an increase in both the number of participants and sponsorships. GSA named Chris McLelland this year's Subaru Distinguished Earth Science Teacher, and Raphael Sagarin, a scientist with a degree in earth systems and interest in climate change was appointed as the 16th GSA-USGS Congressional Science Fellow. I am also pleased to announce that Gary Lewis from Geoscience Australia has agreed to join GSA as its Education and Outreach director beginning in January.

Building strong, meaningful partnerships is important to GSA's future. To that end, I have established a staff focal point for building effective, meaningful partnerships with others in our earth science community. The number of Associated Societies has grown to 24 with the addition of the International Association of Hydrogeologists—U.S. National Chapter, and the number of Allied Societies stands at five. We continue to develop and renew memoranda of understanding with other societies to strengthen our relationships.

Under the leadership of GSA President Tony Naldrett, two important ad hoc committees were formed, with participation from both staff and members to look at future revenue opportunities and efficiencies in headquarters operation and governance.

GSA has much to be proud of and can look forward with optimism to a bright future as a broad, unifying scientific society that is advancing the geosciences, enhancing the growth of its members, and promoting the geosciences in the service of humankind.

I want to end by thanking you, the GSA members, the Council and Executive Committee, and the GSA Headquarters staff for a most challenging and enjoyable year as your executive director. We could not have accomplished as much without your support and understanding.

---

## GSA Members Invited to Tasmania in 2004

As part of GSA's strategic plan to work with sister geological societies around the world, GSA is a scientific co-host for the 17th Australian Geological Convention in beautiful Hobart, Tasmania, February 8–13, 2004. U.S. geoscientists are warmly encouraged to submit ideas for symposia under the theme of "Dynamic Earth: Past, Present and Future." The theme was chosen as a tribute to S. Warren Carey, Foundation Professor of Geology at the University of Tasmania, who died in March 2002. Carey is best known for his influence in having continental drift accepted as reality. Carey was named an Honorary Fellow by GSA in 1979 and received the Career Contribution Award from the GSA Structural Geology and Tectonics Division in 2000.

Organizing Committee Chair Pat Quilty is seeking symposia proposals that demonstrate the relevance of geology to the dynamic nature of our planet—the way Earth has evolved, its current state, and how it might be in the future. Each symposium will last a full day and may feature a keynote address, invited and volunteered scientific presentations, and a wrap-up dialogue about future research needs and opportunities for collaboration. Topics of interest currently include: Late Precambrian continental margins; Precambrian banded iron formations and atmospheric evolution; law of the sea; Macquarie Island, Ridge and Alpine fault; deep ocean gateways around the southern hemisphere; mineral and petroleum exploration; groundwater and hydrogeology; en-

vironmental issues, including the geology of estuaries; and tectonics.

Suggestions for symposium themes should be sent to Pat Quilty at P.Quilty@utas.edu.au. Please see current information about the convention at [www.17thagc.gsa.org.au](http://www.17thagc.gsa.org.au). **Proposal deadline: January 15, 2003.** Proposals should include: purpose, focus and scope of the symposium; relevance of the topic; suggested keynote speakers; and your contact information.

**Collaboration between Australian and North American geoscientists is encouraged. Call your friends and propose a symposium together!**

# UPCOMING DEADLINES

---

## Committee Service

### Nominations Due January 15, 2003

Candidates are needed for service on the following GSA committees: Annual Program; Arthur L. Day Medal Award; Education; Geology and Public Policy; Honorary Fellows; Joint Technical Program; Membership; Minorities and Women in the Geosciences; Nominations; Penrose Conferences and Field Forums; Penrose Medal Award; Professional Development; Research Grants; and Young Scientist Award. Candidates are also needed for a GSA representative to the North American Commission on Stratigraphic Nomenclature (NACSN). Service begins July 2003 for all positions except NACSN, which begins November 1, 2003, and Joint Technical Program, which begins January 1, 2004.

For complete information on committee service, current vacancies, and required qualifications, see the October 2002 issue of *GSA Today*. Nomination form and instructions are available at [www.geosociety.org/aboutus/commtees/](http://www.geosociety.org/aboutus/commtees/).

## Officers and Councilors

### Nominations Due January 15, 2003

The GSA Committee on Nominations requests nominations for officers (vice president and treasurer) and councilors to serve on the GSA Council beginning in 2004. Each nomination should be accompanied by basic data and a description of the qualifications of the individual for the position recommended.

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](mailto:rharrison@geosociety.org).

## Congressional Science Fellowship

### Applications Due January 24, 2003

For application information for the 2003-2004 GSA-U.S. Geological Survey Congressional Science Fellowship, visit [www.geosociety.org/science/csf/](http://www.geosociety.org/science/csf/), or contact Karlon Blythe, Program Officer, GSA Headquarters, (303) 357-1036, [kblythe@geosociety.org](mailto:kblythe@geosociety.org).

## Medals and Awards

### Nominations Due February 1, 2003

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 2002 issue of *GSA Today*, go to [www.geosociety.org](http://www.geosociety.org), or call (303) 357-1037. Materials and supporting information for any of the nominations may be sent to GSA, Grants, Awards, and Medals, P.O. Box 9140, Boulder, CO 80301-9140.

## Student Research Grants

### Applications Must Be Postmarked by February 1, 2003

For information on 2003 Research Grant Program for Students, see the October issue of *GSA Today* or visit [www.geosociety.org](http://www.geosociety.org). Application forms are available online, at the geology departments of colleges and universities offering graduate degrees in earth sciences, or from Grants, Awards, and Medals, GSA, P.O. Box 9140, Boulder, CO 80301, [lcarter@geosociety.org](mailto:lcarter@geosociety.org).

## 2003 Doris M. Curtis Memorial Fund for Women in Science Award

(Sponsored in part by Subaru of America, Inc.)

### Nominations Due February 1, 2003

This award is given to a woman or group of women who have impacted the field of the geosciences in a major way based on their Ph.D. research. For nomination, eligibility, and award details, see the October issue of *GSA Today*, or visit [www.geosociety.org](http://www.geosociety.org). Send nominations and supporting material to Grants, Awards, and Medals, P.O. Box 9140, Boulder, CO 80301-9140.

## GSA Fellows

### Nominations Due February 15, 2003

The Committee on Membership requests nominations of members to be elevated to GSA Fellow status. Any GSA Fellow may nominate a member 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 more information, a list of the criteria, and a nomination form, please see [www.geosociety.org/members/fellow.htm](http://www.geosociety.org/members/fellow.htm) or contact Nancy Williams, (303) 357-1017, [nwilliams@geosociety.org](mailto:nwilliams@geosociety.org).

## John C. Frye Environmental Geology Award

### Nominations Due March 31, 2003

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. For details, see the October issue of *GSA Today* or visit [www.geosociety.org](http://www.geosociety.org). Nominations must be sent to Program Officer, Grants, Awards, and Medals, GSA, P.O. Box 9140, Boulder, CO 80301-9140.

## National Awards

### Nominations Due April 30, 2003

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 issue of *GSA Today*. Nominations should be sent to GSA, Grants, Awards, and Medals, P.O. Box 9140, Boulder, CO 80301-9140.

# Crystal Clear.

## The Meiji EM Series of Modular Stereo Microscopes.

If you are looking for precision, durability, quality and value in a Stereo Microscope, we invite you to take a closer look at Meiji's EM Series of Stereo Microscopes.

The modular design (A wide variety of bodies, single magnification or zoom - rotatable 360°, auxiliary lenses, eyepieces, stands, holders, etc.) gives you the freedom to create the ideal instrument for your specific need or application, and Meiji stands behind every instrument with its "Limited Lifetime Warranty."

For more information on these economically priced Stereo Microscopes, please call, FAX, write us or log on to our website today.

### MEIJI TECHNO AMERICA

2186 Bering Drive, San Jose, CA 95131,  
Tel: 408.428.9654, FAX: 408.428.0472

**Toll Free Telephone: 800.832.0060 or visit our website at [www.meijitechno.com](http://www.meijitechno.com)**



## Call for Geological Papers: 2003 GSA Section Meetings

South-Central–Southeastern  
Sections Joint Meeting  
March 12–14, 2003

University of Memphis, Memphis, Tennessee

**Abstract deadline: December 10, 2002**

**Information:** Dan Larsen, Dept. of Earth Sciences,  
University of Memphis, 421 J.M. Smith Bldg., Memphis,  
TN 38152, (901) 678-4358, [dlarsen@memphis.edu](mailto:dlarsen@memphis.edu).

Northeastern Section  
March 27–29, 2003

Westin Hotel, Halifax, Nova Scotia

**Abstract deadline: December 18, 2002**

**Information:** Jane Barrett, Dept. of Earth Sciences,  
Dalhousie University, Halifax, NS B3H 3J5, Canada,  
(902) 494-1473, [jmbarret@is.dal.ca](mailto:jmbarret@is.dal.ca).

Cordilleran Section  
April 1–3, 2003

Hotel NH Krystal, Puerto Vallarta, Mexico

**Abstract deadline: December 16, 2002**

**Information:** Elena Centeno-García, Instituto de  
Geología, Universidad Nacional Autónoma de México,  
(National Autonomous University of Mexico), Ciudad  
Universitaria, México, D.F. 04510, México,  
[centeno@servidor.unam.mx](mailto:centeno@servidor.unam.mx).

North-Central Section  
March 24–25, 2003

Kansas City Airport Hilton, Kansas City, Missouri

**Abstract deadline: December 10, 2002**

**Information:** Raymond M. Coveney Jr., Dept. of  
Geosciences, 420 Flarshem Hall, University of Missouri,  
5110 Rockhill Rd., Kansas City, MO 64110-2499,  
(816) 235-2980, [coveneyr@umkc.edu](mailto:coveneyr@umkc.edu).



Rocky Mountain Section  
May 7–9, 2003

Fort Lewis College, Durango, Colorado

**Abstract deadline: January 30, 2003**

**Information:** James Collier, Dept. of Geosciences,  
Fort Lewis College, 1000 Rim Dr., Durango, CO 81301-  
3999, (970) 247-7129, [collier\\_j@fortlewis.edu](mailto:collier_j@fortlewis.edu).

1. Cordilleran Section  
2. Rocky Mountain Section

3. North-Central Section  
4. South-Central Section

5. Northeastern Section  
6. Southeastern Section

# Geoscience Horizons: Seattle 2003

## Call for Proposals for Keynote Symposia and Topical Sessions

Proposal deadline: January 16, 2003

Submit proposals at [www.geosociety.org](http://www.geosociety.org)

The 2003 GSA Annual Meeting returns to Seattle, hub of the Pacific Northwest. Seattle's geological landscape reminds us of the value of our annual meeting—the interplay of a tremendous range of geologic processes and their influence on both natural and human environments. This setting provides a fitting backdrop for the great variety of ongoing national and international geoscience investigations for which GSA provides the broadest forum.

At GSA's annual meeting, the topics presented are the topics you propose. If you have a special interest you would like to see scheduled, propose a topical session or Pardee Keynote Symposium.

### Program Opportunities

We welcome proposals for Pardee Keynote Symposia and topical sessions. Submit proposals electronically on or before **January 16, 2003**, via the link at [www.geosociety.org](http://www.geosociety.org).

The annual meeting program structure offers opportunities for effective and dynamic program building, allowing a mixture of invited and volunteered papers and different session formats. Joint Technical Program Committee (JTPC) representatives from GSA Divisions play a large role in decisions. Please read the various program options and guidelines at [www.geosociety.org](http://www.geosociety.org) carefully before submitting a proposal of one of two types:

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

**Topical sessions** promote the exchange of timely or state-of-the-art information with respect to a focused topic and allow scheduling

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

### Oral and Poster General Sessions

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

### Hot Topics

The focus of these popular lunchtime forums held Sunday through Wednesday, is on discussion, with plenty of audience participation. Depending on the subject, a debate format is recommended, and panels are discouraged. Each session must have a moderator. Titles should be catchy and provocative. If you are interested in organizing a Hot Topic session, contact Hot Topics Chair Fred Schwab, [schwab.f@wlu.edu](mailto:schwab.f@wlu.edu).

### Make Yours the Session Everyone Talks About

Topical session organizers have the ability to ensure a successful, excellent program through topical sessions, with their combination of invited speakers and volunteered papers and Pardee Keynote Symposia, which expand the opportunity

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

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

### Technical Program Chair

David Bush, (770) 836-4597,  
[dbush@westga.edu](mailto:dbush@westga.edu)

### 2003 Local Committee Chair

Derek Booth, (206) 543-7923,  
[dbooth@u.washington.edu](mailto:dbooth@u.washington.edu)

### Seattle 2003 Dates and Deadlines

- Jan. 16 Proposals due by midnight, MST. Electronic submission required.
- April 1 Electronic abstract form posted at [www.geosociety.org](http://www.geosociety.org).
- April 1st announcement in April *GSA Today*.
- June 2nd announcement in June *GSA Today*.
- July 15 Abstracts due by midnight, MST.
- Aug. 4 Technical program schedule finalized.

Accepted abstracts with links to speakers and titles will be posted at [www.geosociety.org](http://www.geosociety.org) after Sept. 1.

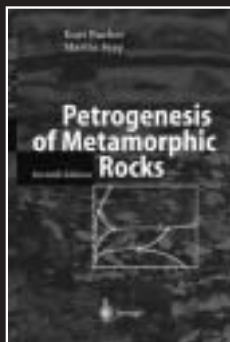
### Propose a Session: Who Knows Where It Could Lead?

When you organize a session, you can help ensure that your area of expertise gets exposure through meeting attendees and the widely cited *Abstracts with Programs* volume. You'll also make valuable contacts, and you'll see your name in lights! (Well, on poster board.)

"I think it's a rewarding experience for session organizers to see their sessions unfold," says Nancy Carlson, GSA technical program officer. "As the abstracts come in, organizers are able to see what is being submitted for their sessions." And organizers aren't the only ones watching. GSA's marketing and communications staff keeps tabs on the sessions with an eye out for items the media may want to pick up, and GSA's publications staff is always looking for that next best-selling Special Paper.

# Springer for Geoscience

To thank everyone who visited us at the GSA 2002 Annual Meeting in Denver, we're extending our offer of **20% off** these new and best-selling titles through December 31, 2002. Just use code **S1225** to order or visit [www.springer-ny.com/geo](http://www.springer-ny.com/geo) for more information.



## Petrogenesis of Metamorphic Rocks

SEVENTH EDITION

**K. BUCHER**, *University of Freiburg, Germany*; and **M. FREY**, *formerly, University of Basel, Switzerland*

The outstanding feature of this seventh edition is the large number of phase diagrams showing the stability relations among minerals and groups of minerals found in metamorphic rocks. The diagrams help to determine the pressure and temperature conditions under which a given collected set of metamorphic rocks may have formed. More than half of the chapters have been completely rewritten or revised. All figures have been edited and improved and recent advances in the field, such as multiequilibria thermobarometry and pseudosections, have been incorporated. The bibliography has been revised and extended, with new research publications included.

Brief reviews of relevant software and web addresses for downloads have also been integrated.

2002/341 PP., 124 ILLUS./HARDCOVER/ISBN 3-540-43130-6  
LIST PRICE: \$59.95  
YOUR PRICE: \$47.96

## Geodynamics of the Lithosphere *An Introduction*

**K. STÜWE**, *University of Graz, Austria*

2002/449 PP., 210 ILLUS./HARDCOVER  
ISBN 3-540-41726-5  
LIST PRICE: \$69.95  
YOUR PRICE: \$55.96

## Principles of Sedimentary Basin Analysis

THIRD EDITION

**A.D. MIALL**, *University of Toronto, Canada*

1999/672 PP., 468 ILLUS./HARDCOVER  
ISBN 3-540-65790-8  
LIST PRICE: \$79.95  
YOUR PRICE: \$63.96

## Microtectonics *CD-ROM*

**C.W. PASSCHIER**, *Johannes Gutenberg University, Mainz, Germany*; and

**R.A.J. TROUW**, *Federal University of Rio de Janeiro, Brazil*

2000/WINDOWS CD-ROM WITH BOOKLET  
ISBN 3-540-14679-2  
LIST PRICE: \$89.95  
YOUR PRICE: \$71.96

## Stable Isotope Geochemistry

FOURTH EDITION

**J. HOEFS**, *University of Göttingen, Germany*

1996/212 PP., 73 ILLUS./HARDCOVER  
ISBN 3-540-61126-6  
LIST PRICE: \$69.95  
YOUR PRICE: \$55.96

## 3D Structural Geology

*A Practical Guide to Surface and Subsurface Map Interpretation*

**R.H. GROSHONG, JR.**, *University of Alabama, Tuscaloosa, AL*

1999/340 PP., 366 ILLUS./HARDCOVER  
ISBN 3-540-65422-4  
LIST PRICE: \$94.00  
YOUR PRICE: \$69.95

## Self-Organized Criticality in Earth Systems

**S. HERGARTEN**, *University of Bonn, Germany*

2002/272 PP., 100 ILLUS./HARDCOVER  
ISBN 3-540-43452-6  
LIST PRICE: \$69.95  
YOUR PRICE: \$55.96

## *More than 40% off list price—* Microbial Sediments

**R. RIDING**, *University of Cardiff, UK*; and  
**S.M. AWRAMIK**, *University of California, Santa Barbara, CA*

2000/352 PP., 152 ILLUS./HARDCOVER  
ISBN 3-540-61828-7  
LIST PRICE: \$227.00  
YOUR PRICE: \$130.00

## Redox

*Fundamentals, Processes, and Applications*

**J. SCHURING**, *University of Bremen, Germany, et al.*

2000/272 PP., 110 ILLUS./HARDCOVER  
ISBN 3-540-66528-5  
LIST PRICE: \$109.00  
YOUR PRICE: \$87.20

## Archaeomineralogy

**G.R. RAPP**, *University of Minnesota, Duluth, MN*

2002/338 PP., 71 ILLUS./HARDCOVER  
ISBN 3-540-42579-9  
LIST PRICE: \$89.95  
YOUR PRICE: \$71.96

## Dynamics of Rockslides and Rockfalls

**T.H. ERISMANN** and **G. ABELE**

2001/316 PP., 120 ILLUS./HARDCOVER  
ISBN 3-540-67198-6  
LIST PRICE: \$99.00  
YOUR PRICE: \$79.20

## Temporal GIS

*Advanced Functions for Field-Based Applications*

**G. CHRISTAKOS**, *Center for Advanced Study of the Environment, Chapel Hill, NC*; **P. BOGAERT**, *Catholic University of Louvain, Belgium*; and **M. SERRE**, *Center for Advanced Study of the Environment, Chapel Hill, NC*

2002/229 PP., 73 ILLUS./HARDCOVER  
ISBN 3-540-41476-2  
LIST PRICE: \$59.95  
YOUR PRICE: \$47.96

## Quantitative Geophysics and Geology

**L. LLIBOUTRY**, *Joseph Fourier University, Grenoble, France*

2000/495 PP./SOFTCOVER/ISBN 1-85233-115-1  
LIST PRICE: \$64.95  
YOUR PRICE: \$51.96

*An essential 1,000-page reference for only \$26.50—*

## Handbook of Mathematics and Computational Science

**J.W. HARRIS**, *Yale University, New Haven, CT*; and **H. STOCKER**, *University of Frankfurt/Main, Germany*

1998/1,056 PP., 545 ILLUS./HARDCOVER  
ISBN 0-387-94746-9  
LIST PRICE: \$34.95  
YOUR PRICE: \$26.50

For more information on any of these titles, visit [www.springer-ny.com/geo](http://www.springer-ny.com/geo)

## Easy Ways To Order

CALL Toll-Free 1-800-SPRINGER

WEB [www.springer-ny.com](http://www.springer-ny.com)

E-MAIL [orders@springer-ny.com](mailto:orders@springer-ny.com)

WRITE to Springer-Verlag New York, Inc., Dept. S1225, PO Box 2485, Secaucus, NJ 07096-2485

VISIT your local scientific bookstore or urge your librarian to order for your department. Prices subject to change without notice.

12/02

Promotion #S1225



Springer

[www.springer-ny.com](http://www.springer-ny.com)



## Final Announcement

# 1<sup>st</sup> Joint Meeting, Northeastern Section, GSA, and Atlantic Geoscience Society



**38th Annual Meeting, Northeastern Section, GSA • 29th Annual Meeting, Atlantic Geoscience Society  
Westin Nova Scotian Hotel, Halifax, Nova Scotia, Canada • March 27–29, 2003**

The hosts of the 2003 meeting of the GSA Northeastern Section and the Atlantic Geoscience Society are geoscientists from Dalhousie University, Acadia University, St. Francis Xavier University, St. Mary's University, Memorial University of Newfoundland, University of New Brunswick, Geological Survey of Canada (Atlantic), Nova Scotia Department of Natural Resources and Energy, Nova Scotia Museum of Natural History, New Brunswick Department of Natural Resources and Energy, New Brunswick Department of Environment and Local Government, Eastern Section of American Association of Petroleum Geologists (AAPG), Society of Economic Geologists (SEG), International Geological Correlation Programme (IGCP) Project #453, and the Council on Undergraduate Research (CUR)—Geoscience Division.

## REGISTRATION

**Preregistration deadline: February 14, 2003**

**Cancellation deadline: February 21, 2003**

GSA headquarters will handle preregistration. Please preregister online at [www.geosociety.org/sectdiv/northe/03nemt.htm](http://www.geosociety.org/sectdiv/northe/03nemt.htm), or download the PDF preregistration form at the site. If you are unable to preregister this way, contact GSA Member Services at 1-888-443-4472, [member@geosociety.org](mailto:member@geosociety.org).

## REGISTRATION

(All prices in U.S. dollars; Canadian dollar exchange is approximately US\$1 = CDN\$1.6)

	Full Meeting	One-Day
Professional Member	\$95	\$55
Professional Member (70+ yrs)	\$35	\$30
Professional Nonmember	\$115	\$65
Student Member	\$30	\$25
Student Nonmember	\$40	\$30
K–12 Professional	\$45	\$30
Guests or spouses	\$10	\$5
Field Trip or Short Course Only	\$5	NA

Members pay less. Registration discounts are given to members of GSA, AGS, and the associated societies listed on the registration form. Students and K–12 teachers must send or show

a current ID in order to obtain these rates. You can join now or at the meeting. Contact GSA Member Services, 1-888-443-4472, [member@geosociety.org](mailto:member@geosociety.org), for further information.

Register only one professional or student per form and retain a copy for your records. If you preregister, your badge will be mailed to you approximately two weeks prior to the meeting.

## CANCELLATIONS, CHANGES, AND REFUNDS

All requests for additions, changes, and cancellations must be made in writing and received by February 21, 2003. There will be NO refunds for on-site registration, *Abstracts with Programs*, or ticket sales.

## ON-SITE REGISTRATION SCHEDULE

Westin Nova Scotian Hotel, Commonwealth Foyer, Second Floor

Wed., March 26	4–8 p.m.
Thurs.–Fri., March 27–28	7 a.m.–4:30 p.m.
Sat., March 29	7–10 a.m.

## ACCESSIBILITY FOR REGISTRANTS WITH SPECIAL NEEDS

The GSA Northeastern Section is committed to making every event at its 2003 meeting accessible to all people interested in attending. If you have special requirements, please indicate this on the meeting registration form, or contact Jane Barrett, Dept. of Earth Sciences, Dalhousie University, (902) 494-2358, fax 902-494-6889, [Jane.Barrett@Dal.Ca](mailto:Jane.Barrett@Dal.Ca). Please let us know your needs by February 22, 2003.

**Childcare.** Childcare services can be arranged at the Westin Hotel if required. Contact Jane Barrett (see above).

## LOCATION AND DIRECTIONS

Meeting registration, technical sessions, poster sessions, and exhibits will be in the Westin Nova Scotian Hotel, 1181 Hollis Street, Halifax, NS, Canada, B3H 2P6, (902) 496-8585. Halifax, a significant port city founded in 1749, has been

recognized for its strategic importance and its protected ice-free harbour. The Westin Nova Scotian Hotel is located adjacent to the Via Rail and Acadian Lines Bus Station, near the waterfront, the commercial center, many attractive parks, museums, restaurants and pubs, theaters, and a casino ([www.halifaxinfo.com](http://www.halifaxinfo.com)). Temperatures in late March range unpredictably from the 20s to the 50s (°F). By air, Halifax is located closer to New York and Boston than any other Canadian city. The area is served by the Halifax International Airport, located approximately 22 miles (35 km) from the Westin Nova Scotian Hotel; Airbus, an hourly airport bus shuttle, charges approximately \$20 return. Highways from all points of the United States and Canada join the Trans Canada Highway from New Brunswick into Nova Scotia. Greyhound from New York and Voyageur from Montreal connect with SMT Bus Lines in New Brunswick, which in turn connect with Acadian Lines in Nova Scotia ([www.smtbus.com](http://www.smtbus.com)). Via Rail Canada provides transcontinental train service with daily arrivals to the building adjacent to the Westin Hotel ([www.viarail.ca](http://www.viarail.ca)).

Maps and tourist information for Halifax Regional Municipality can be obtained from [www.halifaxinfo.com/general-information.php](http://www.halifaxinfo.com/general-information.php) and [www.halifaxinfo.com](http://www.halifaxinfo.com).

## ACCOMMODATIONS

The Westin Nova Scotian Hotel, the conference venue, has reserved a block of rooms for this conference, at a rate of approximately CDN\$99 (approximately US\$75 single/double; US\$95 four per room, tax included). Taxes are 16.5%. To receive the discount rate, identify yourself as attending the Northeastern Section, Geological Society of America Meeting when making reservations. For reservations, call the hotel at (902) 496-8585, or toll-free 1-877-993-7846; fax 902-425-2717.

## CALL FOR PAPERS

Papers are invited from students and professionals for presentation in oral and poster general sessions and for presentations that may fit into the symposia and theme sessions listed below. Additional general discipline sessions will be scheduled on the basis of submitted abstracts. Oral technical sessions and symposia provide 15



minutes for presentation and five minutes for questions and discussion. One PowerPoint data projector and two slide projectors will be provided in each of the technical sessions. **All PowerPoint presentations must be provided on CD 15 minutes before the beginning of their session segment; presenters will not be able to use their own laptops.** All slides must fit a standard 35 mm (standard circular) carousel tray. Speakers are encouraged to bring their own loaded trays to the meeting. Poster sessions will allow at least three hours of display time. Posters must fit on a single 8'x4' glossy display board. Pins or Velcro fasteners may be used. For questions about posters or visual aids, contact Charles Walls, Dalhousie University, charles.walls@dal.ca.

Following the tradition in annual meetings of the Atlantic Geoscience Society, there will be prizes for student posters and student presentations. For information on these, please contact Graham Williams, Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, NS B2Y 4A2, Canada, (902) 426-5657, gwilliam@agc.bio.ns.ca.

## ABSTRACTS

**Abstract deadline: December 18, 2002**

Abstracts for all sessions must be submitted online at [www.geosociety.org](http://www.geosociety.org). If you have questions, contact technical program committee chairs, Sandra M. Barr, Dept. of Geology, Acadia University, Wolfville, NS B4P 2R6, Canada, (905) 585-1340, sandra.barr@acadiau.ca, and David J.W. Piper, Geological Survey of Canada (Atlantic) Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, N.S. B2Y 4A2, Canada, (902) 426-6580, piper@agc.bio.ns.ca. An individual may present only one volunteered paper; however, a person may be a co-author on other papers. Also, those invited for symposia may present additional papers.

## SYMPOSIA

Symposia will include invited papers and selected submitted papers. Prospective authors are encouraged to contact individual conveners directly. Address requests for general information regarding symposia to Sandra M. Barr, Dept. of Geology, Acadia University, Wolfville, NS B4P 2R6, Canada, (905) 585-1340, sandra.barr@acadiau.ca, and David J.W. Piper, Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, N.S. B2Y 4A2, Canada (902) 426 6580, piper@agc.bio.ns.ca.

1. **Regional Hydrogeological Studies in Northeastern America.** Yves Michaud, Ressources Naturelles Canada, Commission Géologique du Canada—Division Québec 880, Chemin Ste-Foy, Bureau 840, Québec G1S 2L2, Canada (418) 654-2673, ymichaud@nrcan.gc.ca; Roger Morin, U.S. Geological Survey, MS 403, Denver Federal

Center, Denver, CO 80225, USA, (303) 236-5915, rhmorin@usgs.gov.

2. **Eastern North America Mesozoic-Cenozoic Margins and Their Hydrocarbon Potential.** *Cosponsored by Eastern Section, AAPG.* Paul E. Olsen, Lamont-Doherty Earth Observatory of Columbia University, 61 Rt. 9W, Palisades, New York 10964-1000, USA, (845) 365-8491, polsen@ldeo.columbia.edu; John Hogg, VP Atlantic Canada, EnCana Corporation, 150 9th Ave. SW, Calgary, Alberta T2P 2S5, Canada, (403) 645-2533, john.hogg@encana.com.
3. **Evolution of the East Laurentia Continental Margin, Eastern USA—Canada: From Late Proterozoic Rifting to Devonian Collisions.** Denis Lavoie, Geological Survey of Canada—Quebec, 880 Chemin Ste-Foy, Room 840, Quebec City, Quebec G1S 2L2, Canada, (418) 654-2571, delavoie@nrcan.gc.ca; Ed Landing, New York State Geological Survey, 3140 Cultural Education Center, Albany, NY 12230, USA, (518) 442-4572, elanding@mail.nysed.gov; Alain Tremblay, Université du Québec à Montréal, C.P. 8888, succ. Centre-Ville, Montréal, Quebec H3C 3P8, Canada, (514) 987-3000 (7974), tremblay.a@uqam.ca; Sébastien Castonguay, Geological Survey of Canada—Quebec Division, 880, chemin Ste-Foy, Québec, Quebec, G1S 2L2, (418) 654-2566, scastong@nrcan.gc.ca.
4. **New Developments in Understanding of the Avalon Terrane from Southern New England to Newfoundland.** *Cosponsored by IGCP 453—Modern and Ancient Orogens.* Margaret Thompson, Dept. of Geology, Wellesley College, Wellesley, MA 02481, USA, (781) 283-3029, mthompson@wellesley.edu; J. Brendan Murphy, Dept. of Geology, St. Francis Xavier University, P.O. Box 5000, Antigonish, NS B2G 2W5, Canada, (902) 867 2481, bmurphy@stfx.ca.
5. **Metals in the Environment.** Don Fox, Dept. of Environment and Local Government, P.O. Box 6000, Fredericton, NB E3B 5H1, Canada, (506) 457-7257, don.fox@gnb.ca; Terry A. Goodwin, Nova Scotia Dept. of Natural Resources, 1701 Hollis Street, P. O. Box 698, Halifax, NS B3J 2T9, Canada, (902) 424-2438, goodwita@gov.ns.ca.

## THEME SESSIONS

Theme sessions will include only volunteered papers. Prospective authors are encouraged to contact individual conveners directly. Address requests for general information regarding symposia to Sandra M. Barr, Dept. of Geology, Acadia University, Wolfville, NS B4P 2R6, Canada, (905) 585-1340, sandra.barr@acadiau.ca, and David J.W. Piper, Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, P.O.

Box 1006, Dartmouth, N.S. B2Y 4A2, Canada, (902) 426-6580, piper@agc.bio.ns.ca.

1. **Communicating the Critical Relevance of Earth Science.** Jennifer Bates, Publishing and Communications, Geological Survey of Canada (Atlantic) Bedford Institute of Oceanography, 1 Challenger Drive, P.O. Box 1006, Dartmouth, NS B2Y 4A2, Canada, (902) 426-4386, bates@agc.bio.ns.ca.
2. **History of Geology: Links Between Northeastern United States and Atlantic Canada.** John Calder, Nova Scotia Dept. of Natural Resources, 1701 Hollis Street, P.O. Box 698, Halifax, NS B3J 2T9, Canada, (902) 424-2778, jhcalder@gov.ns.ca.
3. **Metallogeny of the Northern Appalachian Orogen.** *Cosponsored by SEG.* Dave Lentz, Dept. of Geology, University of New Brunswick, P.O. Box 4400, Fredericton, NB E3B 5A3, Canada, (506) 447-3190, fax 506-453-5055, dlentz@unb.ca; Dan J. Kontak, Nova Scotia Dept. of Natural Resources, 1701 Hollis Street, P.O. Box 698, Halifax, NS B3J 2T9, Canada, (902) 424-2516, kontakdj@gov.ns.ca.
4. **Paleozoic Arcs in the Northern Appalachian Orogen and Their Accretionary History.** (Second Annual NETectonics session.) Leslie R. Fyffe, New Brunswick Department of Natural Resources and Energy, P.O. Box 6000, Fredericton, NB E3B 5H1, Canada, (506) 453-2206, les.fyffe@gnb.ca; Cees R. van Staal, Geological Survey of Canada, 601 Booth Street, Ottawa, ON K1A 0E8, Canada, (613) 995-4333, cvanstaa@NRCan.gc.ca.
5. **Mesozoic Basalts, Sills, and Feeder Dikes.** J. Gregory McHone, Dept. of Earth and Environmental Sciences, Wesleyan University, Middletown, CT 06459, USA, (860) 685-3139, gregmchone@snet.net; John H. Puffer, Department of Geological Sciences, Rutgers University, 195 University Ave., Newark, NJ 07102, USA, (973) 353-5238, jpuffer@andromeda.rutgers.edu.
6. **Processes in Felsic Magma Chambers—From Crystallization and Evolution to Emplacement.** David Gibson, Dept. of Natural Sciences—Geology, University of Maine at Farmington, Preble Hall, 173 High Street, Farmington, Maine 04938, USA, (207) 778 7402, dgibson@maine.edu; Dan Lux, Dept. of Geological Sciences, University of Maine, Bryand Global Sciences Center, Orono, Maine 04469-5790, USA, (207) 581-4494, dlux@maine.maine.edu.
7. **Acadian Metamorphism in the Northern Appalachian Orogen—Styles, Timing, and Tectonic Significance.** Rebecca A. Jamieson, Dept. of Earth Sciences, Dalhousie University, Halifax, NS B3H 3J5, Canada, (902) 494-3771, beckyj@is.dal.ca;

Robert J. Tracy, Dept. of Geological Sciences, Virginia Polytechnic Institute and State University, 4044 Derring Hall, Blacksburg, VA 24061, USA, (540) 231-5980, rtracy@vt.edu.

8. **Crustal Structure of the Atlantic Margin and Northern Appalachian Orogen.** Sonya Dehler, dehler@agc.bio.ns.ca, and Charlotte Keen, ckeen@agc.bio.ns.ca, Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, PO Box 1006, Dartmouth, NS B2Y 4A2, Canada, (902) 426-4289.
9. **Energy Resources of the Paleozoic.** *Cosponsored by Eastern Section, AAPG.* Tom Martel, Chief Geologist, Corridor Resources Inc., #301 5475 Spring Garden Rd., Halifax, NS B3J 3T2, Canada, (902) 429-4511, tmartel@corridor.ns.ca; G. Warfield Hobbs, Managing Partner, Ammonite Resources, 181 Mariomi Road, New Canaan, CT 06840, USA, (203) 972-1130, skiphobbs@ammoniteresources.com.
10. **Ichology and Biofacies: Innovations and Applications.** Murray K. Gingras, Dept. of Geology, University of New Brunswick, PO Box 4400 Fredericton, NB E3B 5A3, Canada, (506) 453-5196, mgingras@unb.ca; Andrew J. Pulham, Dept. of Earth Sciences, Memorial University of Newfoundland, Alexander Murray Building, St. John's, NF, A1B 3X5, Canada, (709) 737-8395, andy.pulham@mun.ca.
11. **Late Glacial–Early Holocene Climate and High-Resolution Records of Climate Change from Lakes.** Ian S. Spooner, Dept. of Geology, Acadia University, Wolfville, NS, B4P 2R6, Canada, (902) 585-1312, ian.spooner@acadiau.ca; Ray Spear, Biology Dept., State University of New York College of Arts and Science, 1 College Circle, Geneseo, NY 14454, (585) 245-5301, spear@geneseo.edu.
12. **Geological Impacts of Extreme Events on Land and Sea (Storms, Floods, Climate Variability, Tsunamis).** Donald L. Forbes, Geological Survey of Canada, Bedford Institute of Oceanography, PO Box 1006, 1 Challenger Drive, Dartmouth, NS, B2Y 4A2, Canada (902) 426-7737, forbes@agc.bio.ns.ca; Brian G. McAdoo, Dept. of Geology, Vassar College, 124 Raymond Avenue, Mail Drop 735, Poughkeepsie, New York 12604, USA, (845) 437-7703, brmcadoo@vassar.edu.
13. **Undergraduate Research in the Geological Sciences (Poster Session).** *Cosponsored by CUR—Geoscience Division.* Graham Williams, Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, NS B2Y 4A2, Canada, (902) 426-5657, gwilliam@agc.bio.ns.ca; David G. Bailey, Dept. of Geology, Hamilton College, 198

College Hill Rd., Clinton, NY 13323, USA, (315) 859-4142, dbailey@hamilton.edu.

14. **Late Pleistocene Mastodon Environments of the Northeastern United States and Adjacent Canada.** Peter L. Nester, Paleontological Research Institution, Museum of the Earth, Ithaca, NY 14850, USA, (607) 273-6623, ext. 26, nester@museumoftheearth.org; John J. Chiment, Cornell Institute for Biology Teachers, 169 Biotechnology Bldg., Cornell University, Ithaca, NY 14853, USA, (607) 255-1010, jjc1@cornell.edu.

## GENERAL SESSIONS

In addition to symposia (invited papers) and theme sessions (volunteered papers), general sessions for both oral presentations and posters will be organized to accommodate other volunteered papers. These may include oral presentations by students. In order to accommodate the large number of papers expected, the Technical Program Committee may appeal for some papers to be presented as posters instead of orally.

## SHORT COURSES

Complete details are posted at [www.geosociety.org/sectdiv/northe/03nemtg.htm](http://www.geosociety.org/sectdiv/northe/03nemtg.htm). For more information, contact the short course organizer, Djordje Grujic, Dalhousie University, Halifax, NS Canada, djordje.grujic@dal.ca.

1. **Use of Benthic Foraminifera for Environmental Applications.** Sun., March 30, 9 a.m.–2 p.m. Cost: US\$100. Includes textbook (normally US\$100 retail), light lunch and refreshments. David B. Scott, david.scott@dal.ca, and others.
2. **From Lithosphere to Basin: Numerical and Analogue Modelling of Basin Evolution.** Sun., March 30, 9 a.m.–4 p.m. Cost: US\$45. Includes course notes, a light lunch and refreshments. Djordje Grujic, djordje.grujic@dal.ca, Chris Beaumont's Geodynamics Group, Dalhousie University, <http://adder.ocean.dal.ca>; Hans Wielens, Geological Survey of Canada (Atlantic), hwielens@nrcan.gc.ca.

## FIELD TRIPS

Trips planned at this time are listed below and are contingent on the weather. Complete details are posted at [www.geosociety.org/sectdiv/northe/03nemtg.htm](http://www.geosociety.org/sectdiv/northe/03nemtg.htm). For more information, contact the field trip committee chair, Peter Wallace, peter.wallace@dal.ca.

1. **Macrotidal Environments of the Minas Basin and Bay of Fundy: Morphology, Sedimentology, and Natural History.** Wed., March 26, 8:30 a.m.–5 p.m. Ian Spooner, Acadia University, Wolfville, NS, (902) 585-1312, ian.spooner@acadiau.ca. Cost US\$45. Includes: guidebook, lunch, return transportation from Halifax; please bring rubber boots or

suitable wet weather footwear. Min.: 30; max.: 44.

2. **Tour of Geological Survey of Canada, Atlantic, Bedford Institute of Oceanography, Dartmouth, NS.** Wed., March 26, 2–5 p.m. Gordon Fader, Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, GFader@nrcan.gc.ca. Cost: US\$10, includes transportation.
3. **Exploded Xenoliths, Layered Granodiorites, and Chaotic Schlieren Associated with the Eastern Contact of the South Mountain Batholith.** Wed., March 26, 9 a.m.–5 p.m. Barrie Clarke, Dept. of Earth Sciences, Dalhousie University, Halifax, NS (902) 494-3438, clarke@dal.ca. Cost: US\$40. Includes guidebook and an early light supper at Peggy's Cove. Min.: 15. The longest walk is 20 minutes over flat, but possibly squelchy terrain. Bring appropriate clothing and footwear.
4. **Tour of Geology and Paleontology Collections, Nova Scotia Museum of Natural History.** Wed., March 26, 6–8 p.m. (A Friday visit will be organized if interest is high.) Deborah Skilliter, Curator of Geology, Nova Scotia Museum of Natural History, (902) 424-7353, skillidm@gov.ns.ca. Cost: US\$5. Includes bus transportation and museum fee. Max.: 25.
5. **Hidden Cretaceous Basins in Nova Scotia.** 1½ days, Sun. and Mon., March 30–31. Ralph Stea, Nova Scotia Dept. of Natural Resources, (902) 424-2528, rrstea@gov.ns.ca. Cost: US\$130. Includes transportation, guidebook, food and accommodation; overnight in Truro, Nova Scotia. Cold and wet weather can be expected; rubber boots or suitable wet weather footwear advised.

## WORKSHOPS

1. **Drillcore Display.** Wed., March 26, 8:30 a.m.–4:30 p.m. David Brown, Canada Nova Scotia Offshore Petroleum Board, (902) 496-0748, dbrown@cnsopb.ns.ca; Grant Wach, Dalhousie University, grant.wach@dal.ca; Andrew MacRae, Saint Mary's University, andrew.macrae@stmarys.ca. Cost: US\$25 for members, US\$12 for students. Includes transportation and light lunch. Max.: 60.
2. **Roy J. Shlemon Mentor Program in Applied Geology.** *Sponsored by GSA Foundation.* Thurs. and Fri., March 27–28, 11:30 a.m.–1 p.m. Location TBA. Cost: free (includes lunch). Karlon Blythe, GSA, (303) 357-1036, kblythe@geosociety.org. These programs for undergraduate and graduate students will be led by practicing geoscientists. Plan to attend both free luncheons to hear different presenters each day. These interactive and informal events will cover real-life issues such as the professional

opportunities and challenges that await students after graduation. Students will receive in their registration packet FREE LUNCH tickets to attend both Shlemon Programs. However, space is limited. First come, first served.

## SPECIAL EVENTS AND GUEST ACTIVITIES

Some local sightseeing tours will be offered; information will be available at the Registration Desk. Participants are encouraged to explore the many food and entertainment possibilities in downtown Halifax (check out [www.halifaxinfo.com](http://www.halifaxinfo.com)). For matters relating to special events, contact Brian J. Todd, Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2, (902) 426-3407, [brian.todd@NRCCan.gc.ca](mailto:brian.todd@NRCCan.gc.ca). More information is posted at [www.geosociety.org/sectdiv/northe/03nemt.htm](http://www.geosociety.org/sectdiv/northe/03nemt.htm).

- 1. Welcoming Reception.** Wed., March 26, 6–10 p.m., Westin Nova Scotian Commonwealth A room. Entertainment will be a jazz trio.
- 2. Dinosaur Talk.** Wed., March 26, 7:30 p.m. "Mass Extinctions, Asteroid Impacts, and Giant Volcanic Eruptions—The Beginning and End of the Dinosaurs," by Paul E. Olsen at the Nova Scotia Museum of Natural History, 1747 Summer Street, Halifax. Although not an official part of the meeting, may be of interest to participants. Admission free, food bank donation requested. For details: Deborah Skilliter, (902) 424-7353, [skillidm@gov.ns.ca](mailto:skillidm@gov.ns.ca).
- 3. Tour: The Annapolis Valley of Nova Scotia: The Land of (Longfellow's) Evangeline.** Fri., March 28, 9 a.m.–4 p.m. Ian Spooner, Dept. of Geology, Acadia University, Wolfville, NS (902) 585-1312 [ian.spooner@acadiau.ca](mailto:ian.spooner@acadiau.ca). Accompanying Guests/Special Interest. Cost: US\$40. Includes lunch and return transportation from Halifax. Min.: 30; max.: 44.
- 4. Annual AGS and Northeastern GSA Banquet and Awards Evening.** Sat., March 29. Pre-dinner reception on the Westin Hotel Mezzanine starts at 5:30 p.m.; banquet begins at 7:30 p.m. in the Commonwealth A room, Westin Nova Scotian Hotel. As is traditional with AGS Banquets, members and guests are encouraged to bring along their musical instruments. Cost: US\$35.

## STUDENT TRAVEL AND RESEARCH GRANTS

The Northeastern Section and the GSA Foundation are giving travel grants to students who are presenting papers at the Halifax meeting. The awards are open to both graduate and undergraduate students. To apply, please contact Stephen Pollock, Secretary-Treasurer, GSA Northeastern Section, [pollock@usm.maine.edu](mailto:pollock@usm.maine.edu). The Northeastern Section also announces the availability of undergraduate research grants. Students in the Northeastern Section who are juniors in the 2002–2003 academic year are eligible to apply for a research grant. For an application, e-mail Stephen Pollock, [pollock@usm.maine.edu](mailto:pollock@usm.maine.edu). The deadline for completed applications is January 25, 2003.

## EXHIBITS

Exhibits will be located in the Westin Nova Scotian Hotel, Halifax, Nova Scotia. Snacks and refreshments will be available for exhibitor visitors. For information on exhibit rates and space reservations, contact Patrick Ryall, Treasurer NEGSA–AGS 2003, (902) 494-3465; fax 902-494-6889, [patrick.ryall@dal.ca](mailto:patrick.ryall@dal.ca). Cost: US\$200 for an approximately 8'x10' booth for commercial exhibitors and US\$100 for not-for-profit organizations. Space is limited.

## SPONSORSHIP

The committee is actively seeking sponsorship for this conference from industry and government agencies. If you are interested in sponsoring an event, audiovisual equipment rentals, coffee breaks, or donations to the general sponsorship of the conference, please contact John Hogg, EnCana

## HOW WILL YOU SPEND YOUR SAVINGS?

*Geological Society of America members can save on auto insurance with Group Savings Plus.™*



If you're not a member of our Group Savings Plus program, then you're not taking advantage of the group buying power of the Geological Society of America. So you could be paying too much for auto insurance. Just think what you could do with that extra money.

Call now and see just how much you can save. Then start spending your money on something a bit more exciting than auto insurance!

For a free coverage evaluation and no-obligation rate quote, please call **1.800.524.9400** or visit [www.libertymutual.com/lm/geologicalsoc](http://www.libertymutual.com/lm/geologicalsoc).

GROUP SAVINGS PLUS™

Discounts and credits are available where state laws and regulations allow, and may vary by state. Certain discounts apply to specific coverages only. To the extent permitted by law, applicants are individually underwritten, and all applicants may qualify. Coverage provided and administered by Liberty Mutual Insurance Company and its affiliates, 171 Parkside Square, Suite 100, Bedford, MA. License Department of Insurance License number: 12060117. © 2002 Liberty Mutual Insurance Company. All Rights Reserved.

## THE POKESCOPE™ FOLDING 3D VIEWER

for viewing stereo images of all sizes

**COMPACT**—HOLDS 10 2" 90. **EASY TO USE**  
FOR: DIGITAL STEREO IMAGES • UNMOUNTED STEREO PRINTS  
USGS AERIAL PHOTOGRAPHS • FIELD USE

\$49.95 plus shipping  
INCLUDES  
PokeScope™  
Image Manager  
SOFTWARE



Graphic Media  
Research  
211 Ridgecrest Dr.  
Cannon Falls, MN  
55009 USA  
507-263-4611

[www.pokescope.com](http://www.pokescope.com)

Corporation, 150 9th Ave. SW, Calgary, Alberta T2P 2S5, Canada, (403) 645-2533, fax 403-645-2926, [john.hogg@encana.com](mailto:john.hogg@encana.com). Appropriate receipts will be provided.

Checks can be made payable to "Treasurer, NEGSA–AGS 2003," c/o Patrick Ryall, Dept. of Earth Sciences, Dalhousie University, Halifax, NS, B3H 3J5, Canada, (902) 494-3465, [Patrick.ryall@dal.ca](mailto:Patrick.ryall@dal.ca).

## DETAILED INFORMATION

For further information, see [www.geosociety.org/sectdiv/northe/03nemt.htm](http://www.geosociety.org/sectdiv/northe/03nemt.htm), contact the General Co-Chairs Marcos Zentilli, [marcos.zentilli@dal.ca](mailto:marcos.zentilli@dal.ca), and David B. Scott, [david.scott@dal.ca](mailto:david.scott@dal.ca), or Administrative Assistant Jane Barrett, [jane.barrett@dal.ca](mailto:jane.barrett@dal.ca), all at the Dept. of Earth Sciences, Dalhousie University, Halifax, Nova Scotia, Canada, B3H 3J5, (902) 494-2358, fax 902-494-6889.



Final Announcement

# 99<sup>th</sup> Annual Meeting of the Cordilleran Section, GSA



THE  
GEOLOGICAL  
SOCIETY  
OF AMERICA

**Puerto Vallarta, Jalisco, Mexico • April 1–3, 2003**

## The Cordillera Beyond Borders

[www.geosociety.org/sectdiv/cord/03cdmtg.htm](http://www.geosociety.org/sectdiv/cord/03cdmtg.htm)  
and <http://geoinf.igeolcu.unam.mx/cordilleran2003>

The Institute of Geology UNAM (Universidad Nacional Autónoma de México), the Center of Geosciences UNAM, and the Institute of Geophysics UNAM along with the Department of Geology CICESE, the National Disaster Prevention Center (CENAPRED), the Mexican Geological Society (SGM), the Mexican Geophysical Union (UGM), and the Institute of Geochemistry (INAGEO) invite you to participate in the 99th Cordilleran Section Annual Meeting of GSA. The meeting will be held at the Hotel NH Krystal, in Puerto Vallarta, Jalisco, Mexico.

## LOCATION AND ACCESS

Puerto Vallarta is located in the Mexican state of Jalisco on the Pacific coast. Settled on Bahía de Banderas, the largest natural bay in Mexico (42 km), ringed by mountains, it is unique among the Mexican beach resorts because, in spite of its international touch, it keeps a strong typical Mexican flavor, with cobblestone streets and white wall–red tile roofed houses. It is also located in the middle of the main earth science research centers of Mexico and near the western end of the Mexican volcanic belt. Puerto Vallarta's population is about 160,000; the climate is tropical-humid, with average annual temperatures of 27 °C (81°F). The Puerto Vallarta airport has

good connections to all countries and several direct flights from U.S. cities such as Dallas, Houston, Phoenix, Los Angeles, and San Francisco. It is between 24 to 32 hours driving distance from the southwest U.S.–Mexican border (Nogales, Tijuana, or Mexicali).

## ENTERING THE COUNTRY (VISAS)

U.S. and Canadian citizens do not require a visa to travel to destinations in Mexico. Only a valid passport will be requested at the port of entry. You will be asked to fill out a tourist form at the immigration desk or during your flight. Those of other nationalities (even if you live in the U.S. or Canada) must check at your local Mexican Embassy or Consulate for requisites to obtain a visa. We recommend you contact the Mexican Embassy or Consulate for visa requirements at least three months in advance.

## ACCOMMODATIONS

A block of 100 rooms has been reserved at the Hotel NH Krystal. A special rate of US\$93 single/double rooms (plus 17% tax) is guaranteed for GSA participants. The hotel is full service and includes three pools, exercise room, beautiful gardens, excellent restaurants and lounge, computer room, a small supermarket and a private beach. For reservations, call toll free 1-800-903-3300 in the U.S., +52 322 224-0202 in Mexico,

[nhkrystalvallarta@nh-hoteles.com.mx](mailto:nhkrystalvallarta@nh-hoteles.com.mx). To get this rate, you must indicate, at the time of booking, that you are with the Geological Society of America group. Taxi booths are located inside the airport for shuttle and taxis to the hotel. There will be assistance at the airport to help with ground transportation to the hotel on Mon., March 31, and the morning of Tues., April 1.

Since Puerto Vallarta is a popular tourist destination, there are several hotels of different qualities and a wide range of rates. A list of the options can be found on the Web and in tourist guidebooks. However, the organizing committee will not be responsible for any inconvenience or problem with hotels other than NH Krystal. The Hotel NH Krystal is about 4 miles north of downtown, and taxis and public transportation run every 3 minutes from downtown to the hotel.

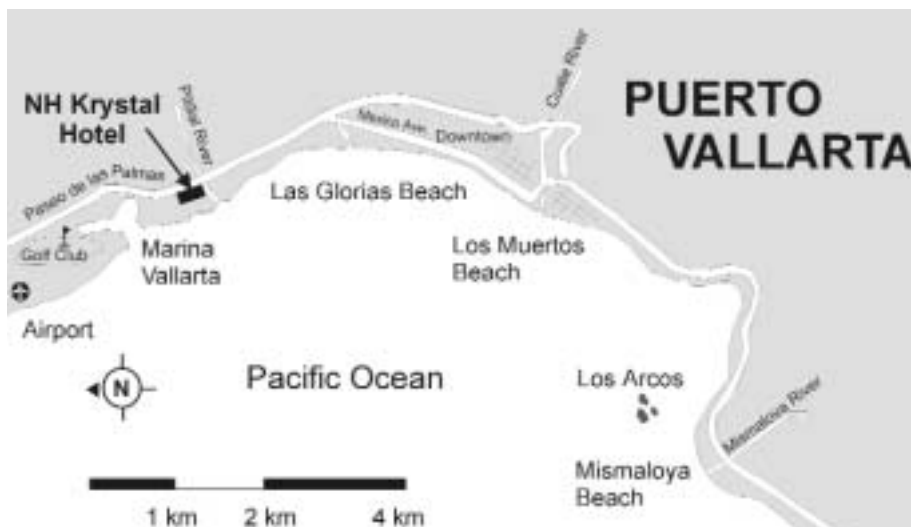
## REGISTRATION

**Preregistration deadline: February 21, 2003**

GSA headquarters will handle registration. Preregister to qualify for lower registration fees. To obtain lower registration fees and to assist planning by the local committee, please preregister online at [www.geosociety.org/sectdiv/cord/03cdmtg.htm](http://www.geosociety.org/sectdiv/cord/03cdmtg.htm), or download the PDF preregistration form at the site. If you are unable to preregister this way, contact GSA Member Services at 1-888-443-4472, [member@geosociety.org](mailto:member@geosociety.org).

**Short course and workshop participants must preregister for the meeting.** Guest registration is required for those attending meetings and guest activities. Guests must be accompanied by a professional or student registrant. Students and K–12 professionals must show a current ID on-site in order to obtain reduced rates.

Full payment must accompany the registration form. Credit cards and personal checks are accepted as indicated on the preregistration form, one form per professional or student. Errors in credit card numbers will delay your registration. Preregistration forms must be received by February 21. All registrations received after February 21 will be held for on-site processing and charged the on-site rates.



**On-site registration, main lobby, NH  
Krystal Hotel:**

Mon., March 31	4:30 p.m.–7 p.m.
Tues.–Wed., April 1–2	7:30 a.m.–4:30 p.m.
Thurs., April 3	7:30 a.m.–noon

**Cancellations, Changes, and Refunds**

All requests for registration changes must be made in writing and received by **February 28, 2003**. GSA will refund or credit preregistration fees for cancellations received in writing by that date. Refunds will be processed after the meeting. No refunds for on-site registration or ticket sales.

**ACCESSIBILITY FOR  
REGISTRANTS WITH SPECIAL  
NEEDS**

The Cordilleran Section is committed to making every event at the 2003 meeting accessible to all persons interested in attending. The NH Krystal Hotel has wheelchair accessibility. Please indicate special requirements on the meeting registration form, or contact the conference general chairs (see Detailed Information).

**TECHNICAL PROGRAM**

**Abstracts deadline: December 16, 2002**

Abstracts for all sessions must be submitted online at [www.geosociety.org/sectdiv/cord/03cdmtg.htm](http://www.geosociety.org/sectdiv/cord/03cdmtg.htm). If you are unable to submit your abstract electronically, please contact the GSA technical program officer, Nancy Carlson, (303) 357-1061, [ncarlson@geosociety.org](mailto:ncarlson@geosociety.org).

General information regarding the technical program should be addressed to Luca Ferrari, [luca@geociencias.unam.mx](mailto:luca@geociencias.unam.mx), +52 55 5623-4104, ext. 118.

The following symposia and theme sessions are planned for the Puerto Vallarta meeting. **In addition, volunteered abstracts will be considered for any general discipline listed on the GSA abstract form.**

**Symposia**

1. **Tectonics, Structure, and Geophysics of the Gulf of California–Salton Trough Region.** *Sponsored by MARGINS initiative.* Arturo Martin Barajas, [amartin@cicese.mx](mailto:amartin@cicese.mx), +52 646 174-5050, CICESE, Ensenada, Baja California, Mexico; Gary Axen, [gaxen@ess.ucla.edu](mailto:gaxen@ess.ucla.edu), (310) 825-6928, University of California at Los Angeles.
2. **Stratigraphy, Sedimentation, and Volcanism in the Gulf of California–Salton Trough Region.** *Sponsored by MARGINS initiative.* Ana Luisa Carreño, [anacar@servidor.unam.mx](mailto:anacar@servidor.unam.mx), +52 55 5622-4312, Instituto de Geología UNAM, Mexico City; Rebecca Dorsey, [\[uoregon.edu\]\(mailto:uoregon.edu\), \(541\) 346-4431, University of Oregon at Eugene.](mailto:rdorsey@darkwing.</a></li></ol></div><div data-bbox=)

3. **Modern and Ancient Orogens.** *Sponsored by IGCP project 453.* Duncan Keppie, [duncan@servidor.unam.mx](mailto:duncan@servidor.unam.mx), +52 55 5622-4299 ext.109, Instituto de Geología UNAM, Mexico City; Brendan Murphy, (902) 867-2481, [bmurphy@stfx.ca](mailto:bmurphy@stfx.ca), St. Francis Xavier University, Antigonish, Canada.
4. **Mexican Terranes, 20 years after: A Symposium in Honor of Peter Coney.** Fernando Ortega-Gutiérrez, [fortega@servidor.unam.mx](mailto:fortega@servidor.unam.mx), +52 55 5622-4300, Instituto de Geología UNAM, Mexico City.
5. **Geological Hazards.** Hugo Delgado, [hugo@tonatiuh.igeofcu.unam.mx](mailto:hugo@tonatiuh.igeofcu.unam.mx), Instituto de Geofísica UNAM, Mexico City; Carlos Gutiérrez-Martínez, [cgm@cenapred.unam.mx](mailto:cgm@cenapred.unam.mx), CENAPRED, Mexico City.

**Theme Sessions**

1. **Cretaceous and Cenozoic Tectonic Evolution of Baja California.** Harald Böhnell, [hboehnel@geociencias.unam.mx](mailto:hboehnel@geociencias.unam.mx), +52 55 5623-4105, ext. 109, Centro de Geociencias UNAM, Queretaro, Mexico; Luis Delgado, [ldelgado@cicese.mx](mailto:ldelgado@cicese.mx), +52 64 6174-5050, CICESE, Ensenada, Baja California, Mexico; Dave Kimbrough, [david.kimbrough@geology.sdsu.edu](mailto:david.kimbrough@geology.sdsu.edu), San Diego State University.
2. **Mesozoic Invertebrate Paleontology.** Ricardo Barragán Manzo, [ricardor@geologia.unam.mx](mailto:ricardor@geologia.unam.mx), and Ana Bertha Villaseñor, [anab@servidor.unam.mx](mailto:anab@servidor.unam.mx), +52 55 5622-4280, Instituto de Geología, UNAM, Mexico City.
3. **Groundwater Resources Management in the Cordillera: Quality and Conservation.** Adrián Ortega, [maog@servidor.unam.mx](mailto:maog@servidor.unam.mx), +52 55 5623-4106, ext. 113, Centro de Geociencias UNAM, Queretaro, Mexico.
4. **Subduction of Young Plates, Arc Magmatism, and Tectonics: The TransMexican Volcanic Belt and the Cascades.** Luca Ferrari, [luca@geociencias.unam.mx](mailto:luca@geociencias.unam.mx), and Arturo Gomez Tuena, [tuena@geociencias.unam.mx](mailto:tuena@geociencias.unam.mx), +52 55 5623-4104, ext. 118, Centro de Geociencias UNAM, Queretaro, Mexico.
5. **Cordilleran Tectonics: Contribution from Low Temperature Thermochronology.** Thierry Calmus, [tcalmus@servidor.unam.mx](mailto:tcalmus@servidor.unam.mx), +52 662 217-5019, Instituto de Geología UNAM, ERNO Hermosillo, Sonora, Mexico.
6. **The Caribbean and Central American Realms of the Southernmost Cordillera.** Robert Rogers, [rogers@ig.utexas.edu](mailto:rogers@ig.utexas.edu), University of Texas at Austin.
7. **Basin Analysis for Determining Timing of Collisional Events.** Sarah Roeske, [roeske@geology.ucdavis.edu](mailto:roeske@geology.ucdavis.edu), (530) 752-4933, University of California at Davis.

8. **Sedimentation in Ancient and Recent Volcanic Arcs.** Elena Centeno-García, [centeno@servidor.unam.mx](mailto:centeno@servidor.unam.mx), +52 55 5622- 4314, Instituto de Geología, UNAM, Mexico City.
9. **New Insights from Paleontology, Stratigraphy, and Sedimentology on Accreted Terranes of Western North America.** Robert B. Blodgett, [blodgetr@science.oregonstate.edu](mailto:blodgetr@science.oregonstate.edu), Oregon State University at Corvallis; George D. Stanley, [fossil@selway.umt.edu](mailto:fossil@selway.umt.edu), (406) 243-5693, University of Montana.
10. **Multidisciplinary Studies of Land Subsidence and Regional Fracturing in Fluvio-lacustrine Basins.** Dora Carreón Freyre, [freyre@geociencias.unam.mx](mailto:freyre@geociencias.unam.mx), +52 55 5623-4104, ext. 112, Centro de Geociencias UNAM, Queretaro, Mexico.
11. **The Present as a Key to the Past: Modern Marine Biotas as Analogues for Fossil Assemblages.** Ralph Hitz, [rhitz@tcc.ctc.edu](mailto:rhitz@tcc.ctc.edu), (253) 566-5299, Tacoma Community College, Washington.
12. **Sediment Provenance: Constraints on Terrane Paleogeography.** Brian Mahoney, [mahonej@uwec.edu](mailto:mahonej@uwec.edu), (715) 836-4952, University of Wisconsin—Eau Claire.
13. **Geophysics of Batholiths and Volcanic Sequences.** Jaime Urrutia Fucugauchi, [juf@tonatiuh.igeofcu.unam.mx](mailto:juf@tonatiuh.igeofcu.unam.mx), +52 55 5622- 4120, Instituto de Geofísica, UNAM, Mexico City.
14. **Origin and Displacements of Cordilleran Terranes: New Debates and Constraints.** Sandra Wyld, [swyld@gly.uga.edu](mailto:swyld@gly.uga.edu), (706) 542-9908, James E. Wright, [jwright@gly.uga.edu](mailto:jwright@gly.uga.edu), (706) 542-4394, University of Georgia at Athens.
15. **Teaching Geology Online: How Students of the Future Will Learn Better.** Ralph Dawes, [rdawes@wvc.edu](mailto:rdawes@wvc.edu), (509) 662-1651, ext. 2848, Wenatchee Valley College, Washington.
16. **Eocene-Oligocene Magmatism and Deformation in Mexico.** Dante J. Moran Zenteno, [dantez@servidor.unam.mx](mailto:dantez@servidor.unam.mx), +52 55 5622-4328, Instituto de Geología, UNAM, Mexico City.
17. **Undergraduate Research.** (Poster Session.) *Sponsored by Council on Undergraduate Research.* Karen Grove, [kgrove@sfsu.edu](mailto:kgrove@sfsu.edu), (415) 338-2617, San Francisco State University.
18. **Cretaceous and Paleogene Magmatism in the Western Cordillera.** Jonathan S. Miller and Robert B. Miller, [jsmiller@email.sjsu.edu](mailto:jsmiller@email.sjsu.edu), (408) 924-5015, San Jose State University.

## FIELD TRIPS

### Field trip preregistration deadline:

February 15, 2003

### Cancellation deadline: February 28, 2003

Unless otherwise noted, all field trips will begin and end at the Hotel NH Krystal in Puerto Vallarta. Trip costs include transportation during the trip, a copy of the field trip guidebook that you will participate in, and other services as noted by the following letter codes: B-breakfast, L-lunch, R-refreshments, D-dinner, N-overnight lodging. The complete guidebook, including all the field trips will be for sale at the meeting. For additional details about particular field trips, contact the leaders listed below or the field trip chairs: General Coordinator Dante Morán Zenteno, +52 55 5622-4238, Barbara Martiny, +52 55 5622-4285, ext. 131, Hugo Delgado (for southern Mexico) +52 55 5622-4145, fax +52 55 5550-2486, and Arturo Martin Barajas (for northern Mexico) +52 646 174-5050, +52 646 174-4504, ext. 26030.

Preregistration for all field trips is strongly encouraged because of participant limitations. Participants are accepted on a first-come, first-served basis through GSA headquarters. Meeting registration is recommended but not required for participation in field trips. Registration after the preregistration deadline is possible if field trip logistics and space permit. Please contact the leaders or the General Coordinator Dante J. Morán Zenteno, dantez@servidor.unam.mx.

If a field trip must be cancelled due to logistics of registration requirements, a full refund for the field trip will be issued after the meeting. Be aware of cancellation deadlines and possible penalties imposed by the airlines. We suggest that the participants not make plane reservations until field trip participation is confirmed. There will be no refunds if participants fail to show up on time for reasons other than serious illness or other medical emergencies. Sponsoring agencies assume no liability whatsoever for failure to show up for a trip, for missed connections, or injury, loss, or damage during or resulting from transportation on the field trips. We recommend that participants contact their insurance company to check about coverage for medical expenses in Mexico. Please note that there have been some changes with respect to the preliminary announcement, such as the place the field trips begin or end, postmeeting to premeeting period, etc. Up-to-date field trip descriptions are posted at [geoinf.igeolcu.unam.mx/cordilleran2003/](http://geoinf.igeolcu.unam.mx/cordilleran2003/).

## PREMEETING

1. **Cenozoic Volcanism and Tectonics in Northwestern Mexico.** 5 days, Tues.–Sun., March 25–30. Begins and ends in Mazatlan. José Jorge Aranda Gómez, Centro de Geociencias, UNAM, Campus Juriquilla, Querétaro, Qro., +52 (55) 5623-4123 or +52 (55) 5623-4116, ext. 145, fax 52 (55) 5623-

4101, [jjag@geociencias.unam.mx](mailto:jjag@geociencias.unam.mx), [jjag@servidor.unam.mx](mailto:jjag@servidor.unam.mx); Chris Henry; Fred McDowell, Jim Luhr. Min. 20, max. 30. Cost: US\$760 (6B, 6L, 6R, 2D, 6N). After the field trip, ground transportation will be arranged to travel to Puerto Vallarta on March 31.

2. **Recent Basaltic Volcanism and Submarine Hydrothermal Activity in the Punta Mita Area, Near Puerto Vallarta.** 2 days, Sun.–Mon., March 30–31. Rosa María Prol Ledesma, Instituto de Geofísica, UNAM, Mexico City, +52 (55) 5622-4131, +52 (55) 5622-4133 or +52 (55) 5622-4135, [prol@servidor.unam.mx](mailto:prol@servidor.unam.mx); Gustavo Tolson. Min. 7; max. 12. Cost: US\$350 (Transportation, boat trip, diving gear, 2L).
3. **The Puerto Vallarta Batholith: High Diversity Parenthood of Continental Arc Magmas.** 1 day, Mon., March 31. Peter Schaaf, Instituto de Geofísica, UNAM, Mexico City, +52 (55) 5622-4221, [pschaaf@tonatiuh.igeofcu.unam.mx](mailto:pschaaf@tonatiuh.igeofcu.unam.mx). Max. 17. Cost US\$70 (1B, 1L).
4. **Ridge-trench Interactions and the Ongoing Capture of the Baja California Microplate: Insights from the Southern Gulf Extensional Province.** 3 days, Sat.–Mon., March 29–31. Begins and ends in La Paz; John Fletcher, Departamento de Geología, CICESE, Ensenada, Baja California, México C.P. 22860, +52 (646) 174-4501, ext. 26031, fax 646-175-0557, [jfletche@cicese.mx](mailto:jfletche@cicese.mx); José Jorge Aranda-Gómez; José Antonio Pérez-Venzor. Min. 12, max. 24. Cost: US\$395 (2B, 3L, 2D, 2N). In order to keep the cost of the trip low, participants are asked to arrange their own travel between La Paz and Puerto Vallarta and, if necessary, hotels in La Paz before and after the trip.
5. **Pliocene Sedimentary Units and Tectonic Evolution at the Santa Rosalia-Loreto Region, Gulf of California.** 3 days, Fri.–Sun., March 28–30. Begins and ends in Loreto. Jorge Ledesma-Vazquez, Facultad de Ciencias Marinas, Universidad Autónoma de Baja California, Ensenada, Baja California, Mexico, C.P. 22860, +52 (646) 174-4570, ext. 146., [ledesma@uabc.mx](mailto:ledesma@uabc.mx); Markes Johnson, Geosciences Dept. Williams College, Williamstown, MA 01267, (413) 597-2329. Min. 7, max. 14. Cost: US\$550 (3B, 3L, 3R, 2D, 2N). Possibility of ground transportation after the field trip to La Paz.
6. **Volcanic Hazards in the Greater Mexico City Metropolitan Area: Late Pleistocene-Holocene Plinian Deposits from Popocatepetl and Nevado de Toluca Stratovolcanoes and Monogenetic Scoria Cones in the Chichinautzin Volcanic Field.** 4½ days, 3 p.m. Wed. to 8 p.m. Sun., March 26–30. Begins and ends at the Mexico City International airport. Claus Siebe, Instituto de Geofísica, UNAM, Mexico City, +52 (55) 562-24146, [csiebe@tonatiuh.igeofcu.unam.mx](mailto:csiebe@tonatiuh.igeofcu.unam.mx); José Luis Macías, [macias@tonatiuh.igeofcu.unam.mx](mailto:macias@tonatiuh.igeofcu.unam.mx), and José Luis Arce. Max. 20. Cost: US\$470 (4B, 4L, 4N).
7. **Eruption Rates and Proportions of Magma Types Erupted at the Tequila and Ceboruco Volcanic Fields.** 4 days, 7 a.m. Fri. to Mon., March 28–31. Begins at the Guadalajara airport and ends at the Hotel NH Krystal, Puerto Vallarta. Hugo Delgado Granados, Instituto de Geofísica, UNAM, México City, +52 (55) 5622-4145, [hugo@tonatiuh.igeofcu.unam.mx](mailto:hugo@tonatiuh.igeofcu.unam.mx); Rebecca Lange, [becky@umich.edu](mailto:becky@umich.edu), Kate Lewis-Kenedi, [katek@umich.edu](mailto:katek@umich.edu), and Hollie Frey, [hfrey@umich.edu](mailto:hfrey@umich.edu), University of Michigan, Department of Geological Sciences, 2534 C.C. Little Building, Ann Arbor, MI 48109-1063, (734) 764-7421, fax 734-763-4690. Min. 7, max. 14. Cost: US\$400 (3B, 4L, 4R, 3D, 3N). Transportation in vans from Guadalajara airport to Hotel Krystal in Puerto Vallarta.

## POSTMEETING

8. **Geology and Tectonic Evolution of the Western Guerrero Terrane: A Transect from Puerto Vallarta to Zihuatanejo.** 3 days, Fri.–Sun., April 4–6. Begins in Puerto Vallarta, Jalisco and ends in Zihuatanejo, Guerrero. Elena Centeno-García, Instituto de Geología, UNAM, Mexico City, +52 (55) 5622-4283 or 5622-4285, ext. 128, [centeno@servidor.unam.mx](mailto:centeno@servidor.unam.mx); Pedro Corona, Oscar Talavera, Alex Iriondo. Min. 7, max. 28. Cost: US\$380 (2B, 3L, 3R, 3D, 3N, vans).
9. **Tertiary Arc Magmatism and Deformation in Southern Mexico: Cuernavaca to Acapulco Transect.** 3 days, Fri.–Sun., April 4–6. Begins and ends in Mexico City. Dante J. Morán Zenteno, Instituto de Geología, UNAM, Mexico City, +52 (55) 5622-4328, [dantez@servidor.unam.mx](mailto:dantez@servidor.unam.mx); Leticia Alba, Barbara Martiny, Susana Alaniz. Min. 8, max. 15. Cost: US\$350 (2B, 3L, 3R, 3D, 3N).
10. **Geology of the Northern Sierra Madre Occidental, Eastern Sonora and Western Chihuahua, Mexico.** 3 days, Sat.–Mon., April 5–7. Begins and ends in Hermosillo, Sonora. Jaime Roldán Quintana, Instituto de Geología, UNAM, Hermosillo, Sonora, +52 (55) 5622-6150 or 5622-8587, [jaimer@servidor.unam.mx](mailto:jaimer@servidor.unam.mx); F. McDowell, T. Calmus, R. Amaya-M. Min. 8, max. 18. Cost US\$225 (2B, 3L, 3R, 2D, 2N, vans).
11. **Three Superimposed Volcanic Arcs in the Southern Cordillera: A Record of Tectono-magmatic Activity from the Early Cretaceous to Middle Miocene in Central**

**Mexico.** 4 days, Sat.–Tues. (1 p.m.), April 5–8. Begins in Puerto Vallarta and ends at the Bajío International Airport in Guanajuato, Mexico. Gerardo de Jesús Aguirre Díaz, Centro de Geociencias, UNAM, Campus Juriquilla, Querétaro, Qro., +52 (55) 5623-4105 or 5623-4116, ext. 107, ger@geociencias.unam.mx; José Jorge Aranda-Gómez, Martha M. Godchaux, Bill Bonnichse. Min. 20, max. 30. Cost: US\$535 (4B, 4L, 3N). Ground transportation the day before the field trip (April 4) will be arranged from Puerto Vallarta to Guanajuato and is included in the cost of the trip.

12. **Geological Features and Biostratigraphy of the Cretaceous Sequences in Southwestern Mexico (Guerrero Terrane).** 4 days, Fri.–Mon., April 4–7. Begins and ends in Mexico City. Jerjes Pantaja Alor, Instituto de Geología, UNAM, Mexico City, +52 (55) 5622-4262, ext. 119, jerjes@servidor.unam.mx; Blanca Buitrón, Arturo Gómez Caballero. Min. 8, max. 15. Cost US\$375 (3B, 3L, 4D, 3N).
13. **IGCP 453 Fieldtrip: The Grenvillian Oaxacan Complex and the Eastern Part of the Acatlan Complex.** 6 days, Fri. evening–Thurs. morning, April 4–10. Begins in Mexico City and ends in Oaxaca City. J.D. Keppie, Instituto de Geología, UNAM, Mexico City, +52 (55) 5622 4299, ext.109, duncan@servidor.unam.mx; F. Ortega-Gutiérrez, L. Solari, UNAM, R.D. Nance, Ohio University. Cost US\$600 (6B, 5L, 5D, 6N).
14. **Continental Edge Tectonics of Isla Tiburón.** 4 days, Sat.–Tues., April 5–8. Begins and ends in Hermosillo. Mike Oskin, Institute for Crustal Studies, U.C. Santa Barbara, (805) 893-7993 (office), fax 805-893-8649, (818) 324-2077 (cell), oskin@crustal.csb.edu, www.crustal.ucsb.edu/~oskin. Cost: US\$400 (3B, 3D, 2L, 2R, 3N [1 night hotel, 2 nights camping]).

## POSTER SESSIONS

Poster sessions will allow four hours of display time. Each poster booth will contain two 4' x 4' boards suitable for thumb tacks or push pins.

## PROJECTION EQUIPMENT

Two viewing screens will be provided in each meeting room. One standard 35 mm carousel projector for 2" x 2" slides, one overhead projector, one LCD projector, and one computer with Windows 2000 and Office 2000 (PowerPoint XP and Mac presentations must be saved in a PC format) will be available for each room as well. A speaker-ready room equipped with projectors will be available for review of slides and overheads and for speaker preparation. Speakers are encouraged to bring their slides already loaded into carousel trays.

## SHORT COURSES

Short course and workshop coordinator is Victor Dávila, Instituto de Geología UNAM, +52 55 5622-4264, davilal@servidor.unam.mx.

1. **Construction of Balanced Cross Sections by Computer Simulation.** Mon., March 31, 9 a.m.–5 p.m., US\$240, lunch included. Juan Contreras, Department of Earth Sciences, Centro de Investigacion Cientifica y de Educacion Superior de Ensenada, Ensenada, Baja California, Mexico, +52 (646) 174-4504, juanc@cicese.mx.
2. **New Satellite Data for the Field Geologist.** Mon., March 31, 9 a.m.–5 p.m., US\$40, lunch included. Tom G. Farr, Jet Propulsion Lab, Pasadena, CA, (818) 354-9057, tom.farr@jpl.nasa.gov.
3. **Digital Mapping.** Fri., April 4, 9 a.m.–5 p.m., US\$40, lunch included. Joan E. Fryxell and Mark P. Kumler, Department of Geological Sciences, California State University—San Bernardino, (909) 880-5311, jfryxell@csusb.edu.

## WORKSHOPS

**Roy J. Shlemon Mentor Program.** April 1–2, 11:30 a.m.–1 p.m. Karlon Blythe, GSA, (303) 357-1036, kblythe@geosociety.org. These workshops for undergraduate and graduate students will be led by practicing geoscientists. Plan to attend both free luncheons to hear different presenters each day. These interactive and informal workshops will cover real life issues such as the professional opportunities and challenges that await students after graduation. Students will receive in their registration packets FREE LUNCH tickets to attend both Shlemon Programs. However, space is limited. First come, first served.

## STUDENT AWARDS AND SUPPORT

The GSA Cordilleran Section and the GSA Foundation have funds available for partial support for Student Members or Associates who are presenting papers or posters. The Section will present cash awards for best and honorable-mention undergraduate and graduate papers, both oral and poster, papers will be considered from any theme or discipline session. For both awards and travel subsidies, students should submit their abstracts on the standard form. The student must be first author and presenter, and a student member or associate of the Cordilleran Section. For travel support, apply to Joan Fryxell, (909) 880-5311, jfryxell@csusb.edu by January 31, 2003.

## EXHIBITS

Exhibit space will be available in the Hotel NH Krystal. Deadline for reserving space is March 1. Information about temporary imports to Mexico, cost, and space dimensions will be available at

the meeting Web sites. Interested exhibitors should contact Alex Iriondo, U.S. Geological Survey, Denver, CO, (303) 236-5562, iriondo@usgs.gov, in the U.S., and Gerardo Zenteno, Instituto de Geologia UNAM, +52 (55) 5622-4301, ext. 124, gzenteno@geol-sun.igeolcu.unam.mx, in Mexico.

## WELCOMING PARTY

An informal icebreaker reception will be held Mon., March 31, 7–9 p.m. in the area of the seven columns (area de las siete columnas) at the restaurant/pool area by the beach at the NH Krystal Hotel. Enjoy the sunset, meet old and new friends, and learn more about special events and activities. Two free drinks, attendees must register before the gathering.

## SPECIAL EVENTS

**GSA Cordilleran Section Management Board Luncheon.** Tues., April 1, noon–2 p.m. (by invitation only), Hotel NH Krystal, room to be confirmed.

**Thursday Night Mexican Party.** Thurs., April 3, Sheraton Hotel, starts 7 p.m., cost: US\$52. Includes dinner and show with live music and Mexican dances. Details are on meeting Web sites.

**GSA Cordilleran Section Business Meeting Luncheon.** Thurs., April 3, noon–2 p.m., cost: US\$18, Hotel NH Krystal, room TBA.

## GUEST TOURS

City & Tropical Tour, Cruise to Las Animas Beach, and Cruise to Quimixto's Waterfall. These three tours will be offered upon attendance, they will run from 8 a.m. to 2 or 5 p.m., and costs will vary from US\$25 to US\$70 depending on the duration of the tour and if it includes lunch. For more information, please contact special events chair Lourdes Godínez, lgodínez@servidor.unam.mx, or see the meeting Web sites.

## DETAILED INFORMATION

For additional information or suggestions, contact the general chairs: Elena Centeno-García, +52 (55) 5622-4283, ext. 128, centeno@servidor.unam.mx, and Dante Morán-Zenteno, +52 (55) 622-4328, dantez@servidor.unam.mx, Instituto de Geologia UNAM, Ciudad Universitaria, Delegacion Coyoacan, Mexico City, C.P. 04510, Mexico. Updated detailed information, changes and links to interesting sites related to the meeting can be found at [www.geosociety.org/sectdiv/cord/03cdmtg.htm](http://www.geosociety.org/sectdiv/cord/03cdmtg.htm) or <http://geoinf.igeolcu.unam.mx/cordilleran2003>.



## Don't Miss Them!

### Shlemon Programs for 2003

**Karlton Blythe**, Program Officer

One or more Shlemon Mentor Programs in Applied Geoscience will be offered at each 2003 Section Meeting. These programs for undergrads and graduate students, which include a FREE lunch, are informal and held from 11:30 a.m.–1 p.m. so that they don't interfere with attendance at poster or technical sessions. These glimpses into employment beyond graduation are conducted in a relaxed setting, which promotes interactive questions and answers between Mentors from various backgrounds who are engaged in applied geoscience and undergrads and graduate students. When programs are scheduled for two days, each day's program will offer a different set of mentors or a brief field trip. These programs are made possible by the Roy J. Shlemon Fund, administered by the GSA Foundation.

Students will receive in their registration packet a **FREE LUNCH** ticket to attend each Shlemon Program. However, space is limited. First come, first served.

**Places and Dates for The Spring 2003  
Shlemon Mentor Programs:**

#### **South-Central—Southeastern Sections Joint Meeting**

Thurs. and Fri., March 13–14, 11:30 a.m.–1 p.m.

University of Memphis, Memphis, Tennessee

#### **North-Central Section**

Mon., March 24, 11:30 a.m.–1 p.m.

Kansas City Airport Hilton, Kansas City, Missouri

#### **Northeastern Section**

Thurs. and Fri., March 27–28, 11:30 a.m.–1 p.m.

Westin Hotel, Halifax, Nova Scotia

#### **Cordilleran Section**

Tues. and Wed., April 1–2, 11:30 a.m.–1 p.m.

Hotel NH Krystal, Puerto Vallarta, Mexico

#### **Rocky Mountain Section**

Thurs., May 8, 11:30 a.m.–1 p.m.

Fort Lewis College, Durango, Colorado

# Coal Division Offers Medlin Award

**GSA's Coal Geology Division announces** the availability of the Antoinette Lierman Medlin Scholarship in Coal Geology for the 2003–2004 academic year. The scholarships provide full-time students who are involved in research in coal geology (origin, occurrence, geologic characteristics, or economic implications of coal and associated rocks) with financial support for their project for one year.

Scholarship funding can be used for field or laboratory expenses, sample analyses, instrumentation, supplies, or other expenses essential to the successful completion of the research project. Approximately \$2,000 will be available for the 2003–2004 scholarship award. In addition, the recipient of the scholarship may be provided with a stipend of up to \$1,000 to present results of the research at the 2004 GSA Annual Meeting. For the academic year 2003–2004, the Coal Geology Division is also offering a field study award of \$1,500. The recipient of this award will also be eligible to receive up to \$1,000 in travel funds to present results of this study at the 2004 GSA Annual Meeting.

A panel of coal geoscientists will evaluate proposals for the scholarship and the field study award. Applicants may apply for the scholarship award, the field study award, or both; however, only one award will be made to a successful applicant.

Interested students should submit five copies of the following: (1) a cover letter indicating which award(s) is(are) sought; (2) a concise statement of objectives and methods and a statement of how the scholarship funds will be used to enhance the project (the proposal should be no more than five double-spaced pages in length, including references); and (3) a letter of recommendation from the student's immediate advisor which includes a statement of financial need and the amount and nature of other available funding for the research project.

Send the material to: Leslie F. Ruppert, U.S. Geological Survey, 956 National Center, 12201 Sunrise Valley Drive, Reston, VA 20192, (703) 648-6431, fax 703-648-6419, [lruppert@usgs.gov](mailto:lruppert@usgs.gov).

The proposal and letter of recommendation must arrive no later than February 15, 2003. Applicants will be notified of the Scholarship Committee's decision by April 1, 2003.

The scholarship was established as a memorial to Antoinette "Toni" Medlin who, for many years, dedicated her efforts toward the advancement of coal geoscience and to the encouragement of students in coal geology. Monies for the scholarships are derived from the annual interest income from the scholarship fund. The GSA Foundation manages the Antoinette Lierman Medlin Scholarship fund.



# PARTNERS in a new ENVIRONMENT

**2003** CSPG / CSEG Convention  
Round Up Centre, Stampede Park June 2 - 6, 2003

call for  
abstracts

For more information visit:  
[www.cspg.org](http://www.cspg.org) or [www.cseg.ca](http://www.cseg.ca)





## A Year-End Gift to the Foundation

As the end of 2002 rapidly approaches, it's a good time to make plans for the future. It's also a good time to share with others through a cash contribution to the Foundation or through a charitable gift.

Planning carefully about what to give, and when to give it, can increase the overall impact of the gift and lead the way to added benefits for everyone. All gifts completed by December 31, 2002, qualify for tax deductibility—gifts of cash or checks are the most popular ways of giving for immediate needs. It is possible to eliminate income tax on applicable income, and larger gifts may result in a tax savings for this current year as well as future tax years. The higher your tax bracket, the more you save.

Gifts for the future may be a gift through your will or living trust—a gift of life insurance, a charitable remainder trust, or a gift annuity.

### Gift Annuity Plan

The Foundation is establishing a gift annuity plan for those members 60 to 80 years of age.

Benefits to you, the donor:

- You will be supporting and investing in the mission of the Foundation: *to fund education, research, publications, student support, public outreach, and other geoscientific programs of GSA that the Society considers necessary to accomplish its purposes of advancing the geosciences, enhancing the professional growth of GSA members, and promoting the geosciences in the service of humankind.*
- You will receive quarterly payments from your annuity.
- You will be entitled to a charitable income tax deduction.
- Capital gains taxes may be deferred.
- After your lifetime, the remainder comes to the GSA Foundation.

This is a wonderful way to make a lasting gift!

Please contact the Foundation office for further information about a donation at (303) 357-1054 or drussell@geosociety.org. We can prepare a confidential simple annuity proposal for your consideration.

**Don't forget: Your gift to the Foundation must be postmarked December 31, 2002, to qualify for a 2002 tax deduction, so get your contributions in early.**



*Most memorable early geologic experience*

Receipt of a GSA Research Grant to support dissertation research in Jamaica.

—Rena Mae Bonem

### Donate Online

**It's easy! It's quick! It's secure!**  
Go to [www.geosociety.org/gsaf/](http://www.geosociety.org/gsaf/)  
and follow the directions.



### GSA Foundation

3300 Penrose Place, P.O. Box 9140  
Boulder, CO 80301-9140 • (303) 357-1054  
drussell@geosociety.org

Enclosed is my contribution in the amount of \$\_\_\_\_\_.

Please credit my contribution for the:

- Greatest need  Other: \_\_\_\_\_ Fund
- I would like more information on the Foundation's gift annuity plan.
- I have named GSA Foundation in my will.

PLEASE PRINT

Name \_\_\_\_\_

Address \_\_\_\_\_

City/State/ZIP \_\_\_\_\_

Phone \_\_\_\_\_

## GSA Members: Considering Buying or Leasing a New Car? Read This First!

Both you and GSA can benefit from this Subaru of America program.

If you're a current GSA member and have been for at least six months, you may purchase or lease a new Subaru at dealer invoice cost. Before visiting a Subaru dealer in the U.S., contact the VIP Partners Program Administrator at GSA and request a Dealer Visit Authorization form and letter of introduction. Present the letter to the participating dealer sales manager upon entry to your preferred Subaru dealership, and before pricing negotiations are initiated. It's that simple! The savings vary by vehicle, but may range from approximately \$1,300 to more than \$3,000.

For every car sale or lease reported, Subaru of America will donate \$150 to the GSA Foundation to further support the Subaru Distinguished Earth Science Educator program and the Doris Curtis Women in Science Fund.

Subaru of America and GSA are very pleased to extend their partnership by providing this benefit to GSA members. For more information or to request a letter of introduction, contact the VIP Partners Program Administrator, Nancy Williams, [nwilliams@geosociety.org](mailto:nwilliams@geosociety.org), 1-800-472-1988, ext. 1017.

# OUTBACK

L.L.Bean  
EDITION



*"We bought a Subaru Outback in Fort Collins, and the experience was an extremely pleasant one. No hassle. No hassle. And buying a car at dealer invoice was especially nice. The entire process was remarkably smooth. I can only conclude that the Subaru-GSA cooperative effort is a win-win-win situation for everyone involved—Subaru makes a new sale, GSA receives a donation, and the GSA member buys a car at a decent price without the usual head-to-head 'negotiations.'"*

Darwin  
 Estes Park, Colorado

**SUBARU** 

Official vehicle of The Geological Society of America.

## APPLY NOW!

### GEOCORPS AMERICA: 2003 SUMMER POSITIONS

Summer 2003 positions are posted on the GeoCorps Web site, <http://rock.geosociety.org/geocorps/allJobDescriptions.asp>.

**Application materials must be postmarked by Friday, February 7, 2003.**

#### About GeoCorps

Through the GeoCorps America Program, GSA places all levels of geoscientists—college students, professionals, and retirees—in temporary summer geoscience positions with the Forest Service and National Park Service. Participants receive a stipend of \$2,500 and housing (or a housing allowance). Check upcoming issues of *GSA Today* for a report on GeoCorps America.

#### A GeoCorps Participant's Alaskan Experience

As a member of Denali National Park's five-person glaciology-geology team, Austin Baldwin's primary duty was to monitor glacier movement in the park. He used differential GPS to collect glacier surface flow velocities and elevations, radar and electromagnetics to measure glacier depth, and snow pits to calculate yearly snow-water equivalents. Many of the glaciers in the park have been surveyed regularly for 50 years, and the continuation of these surveys is crucial for the study of global warming.

"I learned a lot about scientific methods, logistics of field work, and how to work under extreme conditions," Baldwin said. "I saw amazing places and worked with fun people. I also made valuable contacts in the National Park Service, which may prove very useful someday. Apply! I had an amazing summer."



Austin Baldwin, Summer 2002 GeoCorps participant, Denali National Park, Alaska.



### American Geological Institute Congressional Science Fellowship

The American Geological Institute is offering a Congressional Science Fellowship for the geosciences. The successful candidate will spend 12-16 months (starting September 2003) in Washington working as a staff member for a member of Congress or congressional committee. The fellowship is a unique opportunity to gain first-hand experience with the legislative process and contribute to the effective and timely use of geoscientific knowledge on environmental, resource, natural hazards, and science policy issues.

Minimum requirements are a master's degree with at least three years of post-degree work experience or a Ph.D. at the time of appointment. The fellowship carries a stipend of up to \$49,000. Funding for the fellowship is provided by the AGI Foundation. All application materials must be postmarked by Feb. 3, 2003.

For details on the fellowship and application procedures, visit the AGI website  
[www.agiweb.org/gapac/csf.html](http://www.agiweb.org/gapac/csf.html)

*AGI is an equal-opportunity employer.*

## Geoscience Horizons: Seattle 2003

**Call for Proposals for K-16 Education Workshops**  
Proposals must be postmarked by February 14, 2003.

GSA invites K-12 teachers, teacher trainers, pre-service educators, college faculty, and informal educators to submit proposals for K-16 education workshops at the 2003 GSA Annual Meeting in Seattle.

For more information and a proposal packet, contact Julie Sexton, (303) 357-1005, [js Sexton@geosociety.org](mailto:js Sexton@geosociety.org).

# GSA Member Services

One-Stop Shopping For All Your GSA Needs!

## Renew Your Membership

Your 2002 membership expires on December 31. Renew now while you can take advantage of the "EARLY-RENEWAL" rates; dues go up to full price on January 1, 2003. By renewing now, you can expect your *GSA Today* to arrive on time in January.

**Also:**

- ▶ Buy a publication
- ▶ Update your mailing address
- ▶ Get the information you need

Online membership applications & renewals for 2003 are at [www.geosociety.org](http://www.geosociety.org).  
(303) 447-2020, option 3, FAX: 303-357-1071,  
TOLL-FREE: 1-888-443-4472, E-MAIL: [member@geosociety.org](mailto:member@geosociety.org)

Ads (or cancellations) must reach the GSA Advertising office one month prior. Contact Advertising Department, (303) 357-1053, 1-800-472-1988, ext. 1053, fax 303-357-1073, [acrawford@geosociety.org](mailto:acrawford@geosociety.org). Please include address, phone number, and e-mail address with all correspondence.

Classification	Per Line for 1st month	Per line each add'l month (same ad)
Situations Wanted . . . . .	\$2.25	\$1.90
Positions Open . . . . .	\$7.00	\$6.00
Consultants . . . . .	\$7.00	\$6.00
Services & Supplies . . . . .	\$7.00	\$6.00
Opportunities for Students		
first 25 lines . . . . .	\$0.00	\$2.85
additional lines . . . . .	\$1.85	\$2.85
Web Only Ads . . . . .	\$7.00	\$6.00
live link: add \$25		

Agencies and organizations may submit purchase order or payment with copy. Individuals must send prepayment with copy. 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.

## Situations Wanted

**PhD in geology/paleontology** w/ 5+ years exper in science research, oil industry, grad & undergrad teaching. Field experience in W. America, Europe, Greenland. Bilingual, published. Want to again be a geologist in USA. Willing to relocate. Contact @ (352) 278-3481.

## Positions Open

**HYDROGEOLOGY, UNIVERSITY OF SOUTH FLORIDA**  
The University of South Florida (USF) Department of Geology ([www.cas.usf.edu/geology](http://www.cas.usf.edu/geology)) is accepting applications for a tenure-earning Assistant Professor position to begin in August of 2003, pending available funding. We are looking for a dynamic scientist with a commitment to educational and research excellence, who will develop an active research program and mentor graduate students in hydrogeology. Collaborative opportunities are available with well-established faculty research programs including hydrogeology, coastal processes, aqueous geochemistry and environmental geophysics. The expected teaching load is three courses/yr, including undergraduate and graduate-level courses. The USF Geology Department offers an innovative undergraduate curriculum, and grants B.S., M.S. and Ph.D. degrees in Geology. A Ph.D. is required at the time of employment. Salary is negotiable.

USF has a long-standing tradition of promoting a holistic and global view of water research and education. Recent hires in Geography, Environmental Science & Policy and several Engineering departments were water-related. The USF Water Institute ([water.grad.usf.edu/water.html](http://water.grad.usf.edu/water.html)) serves as an umbrella for the multidisciplinary approach to a wide-range of water-related issues.

To apply, send a letter of interest, current curriculum vitae, a statement of research goals, statement of teaching goals and arrange for at least three letters of reference to be sent to: Dr. Thomas Pichler, Chair, Hydrogeology Search Committee, Department of Geology, University of South Florida, 4202. E. Fowler Ave., SCA 528, Tampa, FL 33620-5201.

Applications will be accepted through January 15, 2003. For additional information contact Thomas Pichler (813-974-0321, [pichler@chuma.cas.usf.edu](mailto:pichler@chuma.cas.usf.edu)).

USF is an equal opportunity/affirmative action/equal access employer. Women and minorities are strongly encouraged to apply. Those persons requiring reasonable accommodation under the Americans with Disabilities Act should contact Thomas Pichler at the mail or email addresses above. According to Florida law, applications and meetings regarding them are open to the public.

### GEOBIOLOGY / VA TECH

The Department of Geological Sciences at Virginia Polytechnic Institute and State University (Virginia Tech) invites applications for a tenure-track Assistant Professor in Geobiology beginning August 2003. See the following website for qualifications and application information: <http://www.geol.vt.edu/>.

**EARTH SYSTEMS SCIENTIST, GETTYSBURG COLLEGE**  
Gettysburg College invites applications for a tenure-track assistant professor position in earth systems science in the interdisciplinary Environmental Studies Department to

begin fall, 2003. A Ph.D. in climatology, geology, hydrology, oceanography, or a related discipline, a strong interest in environmental studies, and a commitment to interdisciplinary teaching in the liberal arts tradition are essential. The College is prepared to assist in establishing a research program involving students, including paid pre-tenure leave. Teaching responsibilities include an introductory non-majors course and upper-level courses in the specialty area. The successful candidate will play a key role in broadening the scope of the growing Environmental Studies Department ([www.gettysburg.edu/academics/env/top.html](http://www.gettysburg.edu/academics/env/top.html)), which benefits from proximity to policy-making agencies and a variety of terrestrial, freshwater, and marine study sites. It is housed in a new Science Center with outstanding facilities, including a GIS laboratory supported by the Arthur Vining Davis Foundations and NSF. Gettysburg College is a highly selective liberal arts college located within 90 minutes of the Washington/Baltimore metropolitan area. Established in 1832, the College has a rich history and is situated on a 220-acre campus with an enrollment of 2400 students. Gettysburg College is committed to creating a more diverse campus environment. As part of that process, the College gives strong consideration to candidates from historically underrepresented groups. Send curriculum vitae and statement of teaching and research goals and have three letters of reference (of which at least one can speak to the candidate's teaching effectiveness) sent to: Dr. John A. Commito, Chair, Environmental Studies Department, Box 2455, Gettysburg College, Gettysburg, PA 17325. Complete applications received by December 16, 2002, will be afforded full consideration.

### FLORIDA INTERNATIONAL UNIVERSITY INSTRUCTOR IN EARTH SCIENCES

The Department of Earth Sciences at Florida International University ([www.fiu.edu/orgs/geology](http://www.fiu.edu/orgs/geology)), is seeking qualified candidates for a non-tenure track position to teach undergraduate Earth Science courses (Introduction to Earth Sciences, Environmental Geology, Oceanography) at its Biscayne Bay Campus. The position will begin with the Fall term 2003. Responsibilities are to teach three 3-credit courses per semester and to supervise the teaching laboratory facilities at the Biscayne Bay Campus. Applicants must have an advanced degree (M.S. or Ph.D.) in Geology or a related geoscience field, and effective teaching experience in this field. Experience in conducting courses over the Internet (WebCT) is especially desired. Applicants should send a complete curriculum vitae, statement of teaching interests, transcripts, and the name of at least three references (with e-mail and mailing address, and phone number) to: Dr. Florentin Maurrasse, Department of Earth Sciences, Florida International University, PC 344 - University Park Campus, Miami, FL 33199. Florida International University is part of the State University System of Florida, and is an equal opportunity/affirmative action/equal access employer. Application deadline is January 10, 2003.

### LEHMAN COLLEGE

#### THE CITY UNIVERSITY OF NEW YORK

#### DEPARTMENT CHAIR, GEOLOGY AND GEOGRAPHY

The Department of Geology and Geography at Lehman College invites applications for a full time Department Chair. The Chairperson is expected to provide the leadership necessary to develop and expand the Department. This includes fostering an environment that promotes faculty teaching, extramurally-funded research, and service. It is expected that the successful candidate will participate fully in the life of the Department, College, and University including teaching, committee work, obtaining grants and publishing research in refereed professional journals. A Ph.D. with a specialization in either Geology or Geography is required. The successful candidate will have an established record of scholarship and teaching that merits appointment as a tenured Associate Professor or Professor. Administrative experience and experience in the development of interdisciplinary research programs particularly those related to environmental issues are preferable. Familiarity with GIS applications in earth and environmental science is desirable. Salary range \$56,684-\$93,507. To apply, please submit a curriculum vitae, names, addresses and phone numbers of three references to: Search Committee of the Chair for Department of Geology and Geography, Office of the Dean of Natural and Social Sciences, Lehman College/CUNY, 250 Bedford Park Boulevard West, Shuster Hall Room 302, Bronx, NY 10468-1589. Review of applications to begin December 13, 2002 and continue until the position is filled. [www.lehman.cuny.edu](http://www.lehman.cuny.edu) Lehman College/CUNY is an EO/AA/ADA/IRCA Employer.

### QUATERNARY GEOLOGIST UNIVERSITY OF NEVADA, LAS VEGAS

The Department of Geoscience at the University of Nevada Las Vegas invites applications for a tenure-track

position in Quaternary Geology. We seek applicants who apply quantitative measures of paleoenvironmental / paleoclimatic change to field-based studies. Preference will be given to applicants with research experience in Quaternary geochronology, stable isotope geochemistry, paleoclimatology, terrestrial paleoecology, cosmogenic dating, quantitative geomorphology, or GIS. The successful applicant will have a strong commitment to teaching at both graduate and undergraduate levels. Development of a rigorous externally funded research program and supervision of graduate students at both the master's and doctoral levels is expected. Additional information may be obtained at <http://unlv.edu> and <http://geoscience.unlv.edu>.

Qualifications include a Ph.D. in an appropriate discipline with at least one degree in geology. Demonstrated teaching experience is desired. The appointment will begin in August, 2003. Position is contingent upon funding.

To apply, please submit a letter indicating teaching and research interests; a detailed CV; unofficial transcripts; and the names and contact information of five references. The review of materials will begin January 10, 2003. Documentation may be mailed to: Quaternary Geologist Search Committee, Department of Geoscience, University of Nevada Las Vegas, 4505 S. Maryland Parkway, Box 454010, Las Vegas, NV 89154-4010.

Specific questions may be addressed to Wanda Taylor at [wtaylor@ccmail.nevada.edu](mailto:wtaylor@ccmail.nevada.edu).

UNLV is an Affirmative Action / Equal Opportunity educator and employer committed to excellence through diversity.

### HYDROGEOLOGIST UNIVERSITY OF NEVADA, LAS VEGAS

The Department of Geoscience at UNLV invites applications for a tenure-track position in Hydrogeology at the Assistant Professor level to begin fall 2003. We seek a candidate with a strong field-based approach to flow through fractured media. Additional expertise in groundwater tracers, fluid-rock interaction, theoretical and/or physical modeling, fracture analysis, or aqueous geochemistry is desirable. The successful candidate will be expected to develop and maintain an active externally funded program of research and to supervise graduate students at both the master's and doctoral levels. Teaching duties will include introductory and core undergraduate geoscience courses including hydrogeology, and graduate courses in the area of specialization. Additional information may be obtained at <http://hr.unlv.edu> and <http://geoscience.unlv.edu>. Candidates should submit a letter of application outlining their teaching philosophy and research interests and goals, a curriculum vitae, unofficial academic transcripts, and contact information for four professional references to: Dr. Michael Wells, Chair, Hydrogeology Search Committee, 4505 S. Maryland Pkwy, Box 454010, Las Vegas NV 89154-4010. Email: [mlwells@unlv.edu](mailto:mlwells@unlv.edu) or call (702) 895-3262. Review of applications will begin January 15, 2003 and continue until appointment is made. Applicants must hold a Ph.D. in hydrogeology or in geoscience with an emphasis in hydrogeology by the start date. Position is contingent upon funding. UNLV is an Affirmative Action / Equal Opportunity educator and employer committed to excellence through diversity.

### GEOPHYSICS/REMOTE SENSING/EARTH SYSTEM SCIENCE

#### UNIVERSITY OF ILLINOIS AT CHICAGO (UIC)

The Department of Earth and Environmental Sciences at UIC seeks a geophysicist for a tenure-track appointment to begin August 2003 at the Assistant Professor level. Specific areas of interest may include atmospheric science, biogeoscience, geodynamics, hydrology, oceanography, structural geology, and seismology. Preference will be given to candidates with expertise in the broad area of remote sensing, who can help bridge existing strengths in geochemistry, geophysics, mineralogy, petrology, and surficial processes. The Department is an expanding, dynamic unit with a growing emphasis on integrative research approaches.

The successful candidate will be expected to establish a significant, externally funded research program and to teach effectively at undergraduate and graduate levels. The Department has extensive laboratories for earth-materials characterization, aqueous, organic, and isotopic geochemistry, experimental petrology, Quaternary geochronology and sedimentology (see <http://www.uic.edu/depts/geos/> for additional details). UIC is a leader in advanced computational resources and electronic visualization capabilities.

Applicants must submit statements of research and teaching interests, CV, and contact information for four professional references to: S. L. Forman (Search Chair), Department of Earth and Environmental Sciences, University of Illinois at Chicago, 845 West Taylor Street,

MC-186, Chicago, IL 60607-7059. Applications should be received by January 15, 2003, although the search will remain open until the position is filled. UIC is a Carnegie category-one research university. UIC is an AA/EEO.

**U.S. GEOLOGICAL SURVEY  
MENDENHALL POSTDOCTORAL  
RESEARCH FELLOWSHIP PROGRAM**

The U.S. Geological Survey (USGS) invites applications for the Mendenhall Postdoctoral Research Fellowship Program for Fiscal Year 2004. The Mendenhall Program provides an opportunity to conduct research in association with selected members of the USGS professional staff. Through this Program the USGS will acquire current expertise in science to assist in implementation of the science strategy of its programs. The Program is also intended to provide research fellows with experiences that enhance their personal scientific skills and accomplishments. Fiscal Year 2004 begins in October 2003.

Opportunities for research are available in a wide range of areas including: microbiological characterization of soils; modeling post-wildfire sediment transport; geologic controls on low-rank coal gas; quantifying coastal hazard vulnerability; debris flows; estimation of environmental change using stable isotope and plant morphology; influence of scales in land surface characterization, process studies and modeling; statistical study of magnetic field variations for mapping of hazardous effects; remotely triggered seismicity at Alaskan volcanoes; water-organic matter interactions; sea level variations; economics of oil and gas production; and interplate and intraplate earthquake processes.

The postdoctoral fellowships are 2-year USGS appointments with full benefits and salaries. The closing date for applications is January 31, 2003. Appointments will start between October 2003 and May 2004, depending on availability of funds. A complete description of the program, research opportunities, and the application process are available at <http://geology.usgs.gov/postdoc>. The U.S. Geological Survey is an equal opportunity employer.

**CHAIR, DEPARTMENT OF EARTH  
AND ENVIRONMENTAL SCIENCES  
VANDERBILT UNIVERSITY**

The Department seeks an established senior-level scholar with research interests relevant to lead a newly reorganized Department of Earth and Environmental Sciences (formerly Geology). The new Chair will be expected to build on existing departmental strengths and lead the Department in its participation in a new interdisciplinary initiative in environmental studies. The Department plans to participate in a joint Ph.D. program in environmental science with the Department of Civil and Environmental Engineering to augment an existing Master's program. The Department and the University emphasize excellence in research and teaching at all levels.

Interested individuals may contact the Search Committee at: [EES.search@vanderbilt.edu](mailto:EES.search@vanderbilt.edu). Send applications to: Search Committee, Earth and Environmental Sciences Chair, 2301 Vanderbilt Place, VU Station B Box 351805, Vanderbilt University, Nashville, TN 37235-1805. Applications should include a C.V. and names and contact information for four references (inform us if you prefer to make initial contact with references). Please also include a statement of your vision for leading the Department and developing a dynamic new program in Earth and Environmental Sciences and a discussion of your experiences relevant to leadership and interdisciplinary endeavors. Vanderbilt is an Equal Opportunity/Affirmative Action employer. Applications from women and minorities are strongly encouraged.

We will begin formal review of applications on February 1, 2003.

**VANDERBILT UNIVERSITY  
ASSISTANT PROFESSOR, DEPARTMENT OF GEOLOGY**

The Department of Geology at Vanderbilt University is accepting applications for a two-year, non-tenure-track position at the rank of Assistant Professor. Duties will include teaching structural geology and possibly one other course, as well as developing and overseeing introductory laboratories. Interested applicants should send curriculum vitae, a teaching statement, course evaluations if available, and names and contact information of three references to: Department of Geology, 2301 Vanderbilt Place, VU Station B Box 351805, Nashville, TN 37235-1805 ([structure@vanderbilt.edu](mailto:structure@vanderbilt.edu)). Review of applications beginning February 15, 2002.

**ASSISTANT PROFESSOR  
IN TECTONICS/STRUCTURAL GEOLOGY  
DEPARTMENT OF GEOLOGY  
UNIVERSITY OF CALIFORNIA, DAVIS**

We seek a process-oriented, quantitative geologist, whose research interests may include, but are not limited

to, tectonics and landscape evolution, brittle and ductile deformational processes, structural and tectonic history at all scales, or structural controls on the segregation and transport of silicate or aqueous fluids. The successful candidate will be expected to develop a vigorous research program that integrates field-based investigations with modern quantitative methods to address fundamental geologic problems. Preference will be given to candidates whose interests complement our existing research programs and who will be effective teachers and mentors in our undergraduate and graduate programs.

For more information about the U.C. Davis Geology Department, visit our Web page at <http://www-geology.ucdavis.edu>.

A Ph.D. or equivalent degree in the geological sciences is required at the time of appointment. Applicants should send a curriculum vitae, a statement of research and teaching interests, and names, addresses, phone numbers and e-mail addresses of at least three people who can be contacted for recommendations to: Chair, Geology Search Committee, Department of Geology, One Shields Avenue, University of California, Davis, CA 95616. Phone: (530) 752-0350, Fax (530) 752-0951, E-mail: [geo\\_search@geology.ucdavis.edu](mailto:geo_search@geology.ucdavis.edu).

The position will be effective starting July 1, 2003. To ensure full consideration, applications should be received by January 15, 2003. The position will remain open until filled.

The University of California is an affirmative action/equal-opportunity employer.

**TENURE-TRACK POSITIONS IN GEOCHEMISTRY  
MCMASTER UNIVERSITY  
SCHOOL OF GEOGRAPHY AND GEOLOGY**

The School of Geography and Geology at McMaster University invites applications for two tenure track positions at the Assistant or Associate Professor level beginning July 1, 2003. The School has been undergoing active faculty renewal with twelve new faculty hired in the last five years. (<http://www.science.mcmaster.ca/geo/geomain.html>).

The successful applicants must hold a Ph.D. degree in Geology, Earth Sciences, Geochemistry, or a closely related field. Candidates will be expected to develop a strong externally funded research program and to have a strong commitment to the teaching of geology and geochemistry courses at both the undergraduate and graduate levels.

**Position #1—Stable Isotope Geochemist.** The School seeks an innovative earth scientist with an outstanding research record in the application of isotopes to understand processes in the environmental context, or the development of new and innovative isotopic techniques for the investigation of the geosphere and particularly coupled geological-biological processes.

**Position #2—Aqueous Geochemist.** The School seeks an outstanding candidate from any field of aqueous geochemistry; however we are particularly interested in process oriented research with direct linkages to surface water and groundwater quality, environmental contaminants, and/or Environment and Health. (<http://www.mcmaster.ca/mieh/index/sitemap.html>).

One appointment with an outstanding research record will be selected to be nominated for a Tier II Canada Research Chair and if successful will be appointed at the Assistant or Associate Professor level. Canada Research Chairs are open to all qualified candidates with "no immigration restrictions" (see [www.chairs.gc.ca](http://www.chairs.gc.ca)) and offers will be made in accordance with Canadian immigration requirements associated with the Canada Research Chairs program.

All qualified applicants are encouraged to apply; however for the non-CRC position, Canadians and Permanent Residents will be considered first. McMaster University is strongly committed to employment equity within its community, and to recruiting a diverse faculty and staff, including women, members of visible minorities, Aboriginal persons, members of sexual minorities, and persons with disabilities.

Applicants should send a curriculum vitae, a statement of research interest, and a statement of teaching philosophy along with contact information for three referees (address, phone number and e-mail). Your cover letter should indicate to which position you are applying. The evaluation of candidates will begin on December 1, 2002 and will continue until the positions are filled.

Dr. Pavlos Kanaroglou, Chair, Search Committee, School of Geography and Geology, McMaster University, Hamilton, ON L8S 4K1, Tel: (905) 525-9140, ext. 23525, Fax: (905) 546-0463, Email: [pavlos@mcmaster.ca](mailto:pavlos@mcmaster.ca).

**GEOLOGY, UNIVERSITY OF ST. THOMAS**

The University of St. Thomas Geology Department, St. Paul, MN, invites applicants for a new limited-term faculty position that is renewable up to five years. Ph.D. in

geology required, with expertise in environmental geology, earth system science, geochemistry, or any field that would complement our existing strengths. We are a young department growing a new majors program built on a foundation of undergraduate research and quality teaching. The successful candidate will be expected to teach introductory and upper-level geoscience courses and develop an undergraduate research program. For department information, visit: [www.stthomas.edu/geology](http://www.stthomas.edu/geology). The University of St. Thomas is a Catholic, private, liberal arts university with student enrollment in excess of 10,000. UST website: [www.stthomas.edu](http://www.stthomas.edu).

Send letter of interest (refer to position #200082), curriculum vitae and a statement of teaching interests and philosophy, (including the feasibility of involving undergrads in your research) to: HR Dept., Mail #AQU217, 2115 Summit Avenue, St. Paul, MN 55105, or electronically to: [www.hr.stthomas.edu/employment](mailto:www.hr.stthomas.edu/employment). AA/EEO.

**ASSISTANT PROFESSOR, QUEENS COLLEGE, CUNY  
ECOLOGY AND PALEOECOLOGY**

The School of Earth and Environmental Sciences invites application for a tenure-track Assistant Professor position to begin in the 2003 fall semester. The Ph.D. is required. Candidates should apply quantitative, laboratory, analytical, and field methods to the studies of ecology and paleoecology as they relate to stratigraphy and environmental sciences. Candidates should have a demonstrated commitment to college teaching and experience in seeking external funding. Duties will include teaching undergraduate through doctoral courses in geoscience and/or environmental science, establishing a research program that includes graduate student support and undergraduate research projects, and interacting with other departmental faculty in geology and environmental sciences. Completed application comprising letter of application addressing the qualifications and teaching and research objectives, curriculum vitae, transcripts of all degrees, and three letters of reference should be sent by December 30, 2002 to Dr. Daniel Habib, Chair of the School of Earth and Environmental Sciences, Queens College, Flushing, NY 11367-1597, telephone 718-997-3300, e-mail to [Daniel.Habib@qc.edu](mailto:Daniel.Habib@qc.edu). For additional information about the department and college, visit the web site at <http://www.qc.edu/EES>. Queens College is an equal opportunity/affirmative action employer.

**GIS/REMOTE SENSING, WEBER STATE UNIVERSITY**

The Department of Geosciences at Weber State University invites applications for a tenure-track Assistant Professor position with emphasis on use of GIS/Remote Sensing methods in the geosciences. The position begins August, 2003, and a PhD in geosciences, geography, or a related discipline is required by time of appointment. We seek a colleague dedicated to excellence in undergraduate education who will complement departmental strengths in hydrology, geomorphology, stratigraphy, and structural geology. The successful candidate will: teach GIS, Remote Sensing, and one or more introductory courses (such as Environmental Geosciences, Physical Geology, or Meteorology); conduct research incorporating GIS/RS; foster interdisciplinary collaboration with related programs; help establish ties with the community including student internships; and help oversee a state-of-the-art GIS/RS lab with ESRI and ERDAS software. The standard teaching load is 12 hours (3 to 4 classes) per semester. The department offers bachelor degrees in Applied Environmental Geosciences, Geology, and Earth Science Teaching, plus a certificate in Geomatics. Weber State is a comprehensive undergraduate university with 18,000 students, located at the base of the Wasatch Mountains near world-class recreational areas and the metropolitan Salt Lake City area. For additional information see <http://weber.edu/Geosciences/>.

Applicants should send a letter of application, vita, and statement of teaching, research, and outreach interests, and arrange to have at least three letters of reference sent to: Geosciences Search Committee, c/o Human Resources Department, Weber State University, 1016 University Circle, Ogden, UT 84408-1016. Screening of applicants will begin January 15, 2003, and continue until the position is filled. Weber State University values diversity and is an EO/AA employer.

**ASSISTANT PROFESSOR  
DEPARTMENT OF GEOGRAPHY, GEOLOGY  
AND THE ENVIRONMENT**

**SLIPPERY ROCK UNIVERSITY, SLIPPERY ROCK, PA**  
Slippery Rock University is seeking applicants for a tenure track position in the Department of Geography, Geology and the Environment at the Assistant Professor rank starting August 2003. The Department offers programs in geography, geology, and environmental science and studies with approximately 120 undergraduate majors.

Teaching responsibilities include introductory courses

in environmental and physical geology, upper level courses in mineralogy and petrology and potential development of advanced courses in area of expertise. The successful candidate is expected to demonstrate excellence in teaching, to maintain an active program of research resulting in peer-reviewed publication, to mentor student research, and to participate in college service and student advising. The Department is strongly committed to student field experiences and active participation is expected as a faculty member. Contribution to the geology and environmental programs is expected.

Ph.D. in geosciences is required. Applicants should have expertise in mineralogy and petrology. Classroom and field teaching experience is desired. Successful performance in an on-campus interview, including teaching and research presentations, is required.

Send letter of interest, curriculum vitae, statement of research and teaching interests, graduate and undergraduate transcripts (official transcripts needed before hiring) and the names, addresses (postal and e-mail) and phone numbers of three references to: Dr. Patricia A. Campbell, Geoscience Search Chair, C/o Dept. of Geography, Geology and the Environment, Slippery Rock University, Slippery Rock, PA 16057, Ph. 724-738-4405, E-mail: patricia.campbell@sru.edu.

Review of applications will begin Jan. 15, 2003 and continue until position is filled. TTY#724-738-4881 Visit our web site at [www.sru.edu](http://www.sru.edu). AA/EOE.

**TENURE TRACK POSITION  
SURFACE PROCESSES/HYDROLOGY  
BOSTON COLLEGE**

The Department of Geology and Geophysics at Boston College seeks an Environmental Geoscientist in the broad area of surficial processes/hydrology. The applicant's specialty may also include geomorphology, environmental geophysics, soils and/or sediment transport. The applicant is expected to develop an externally funded research program integrated with excellence in teaching at both undergraduate and graduate levels. The appointment is expected to be made at the Assistant Professor level, but outstanding individuals qualified for appointment at higher rank will be considered. Information on the Department, its faculty and research strengths can be viewed on the Department's web page at [www.bc.edu/geology](http://www.bc.edu/geology). Applicants should send a curriculum vita, a statement of teaching and research interests and the names and contact information of at least three references to Professor Alan Kafka, Chair, Department of Geology and Geophysics, Devlin Hall 213, Boston College, Chestnut Hill, MA 02467-3809. Review of applications will begin in early January 2003, and applications will continue to be accepted until the end of January 2003. Boston College is an academic community whose doors are open to all students and employees without regard to race, religion, age, sex, marital or parental status, national origin, veteran status, or handicap.

**TENURE TRACK POSITION IN ENVIRONMENTAL  
GEOPHYSICS  
UNIVERSITY OF SOUTHERN MAINE**

The Geosciences Department at the University of Southern Maine seeks to fill a tenure track appointment (rank is open) in near-surface geophysics beginning September 1, 2003.

We seek an individual that will focus on environmental, groundwater, and archeological applications. Teaching responsibilities will include introductory-level physical geology and/or oceanography courses plus upper-level courses in geophysics and environmental geophysics. The successful applicant will develop an active research program that will involve undergraduates in the research. The department owns the following research and teaching equipment: GSM 19 Overhauser magnetometer, Phoenix VR5 receiver, Phoenix T3 EM transmitter, Geonics EM-31, Geonics Protem digital receiver plus supporting EM, equipment, and access to GPS, and Total Station precision survey equipment, and a GIS lab.

Qualifications: A Ph.D. in Geophysics, Geology or closely related field, with all requirements including dissertation defense completed prior to September 1, 2003. Relevant teaching experience preferred. Salary: competitive, based on experience.

Please submit a cover letter, current curriculum vitae, transcripts (to be provided at time of interview), and the names, postal, telephone, and e-mail addresses of three references to: Search Chair, Geosciences Dept, RE: 103, University of Southern Maine, 37 College Avenue, Gorham, Maine 04038, Pollock@usm.maine.edu, (207) 780-5350. Review of applications will begin on Jan. 1, 2003 and continue until the position is filled.

**EARTH-SURFACE (GEOMORPHIC) PROCESSES  
PALEOCLIMATOLOGY/PALEOCEANOGRAPHY  
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL**  
The Department of Geological Sciences at the University

of North Carolina at Chapel Hill invites applications for a tenure-track faculty position at the Assistant Professor level in one of the two fields below. The appointment will begin July 1, 2003.

**EARTH-SURFACE (GEOMORPHIC) PROCESSES.** Candidates should conduct field-oriented and preferably also quantitative, model-based research that includes the investigation of topography, landscape, and stratigraphy in relation to a broad range of earth surface processes, such as rates of erosion and weathering, responses of fluvial systems to climatic and tectonic change, variations in sea level and base level, and rates of river and glacial incision. Study of the development of geomorphic systems based on scale-independent processes is especially welcome.

**PALEOCLIMATOLOGY/PALEOCEANOGRAPHY.** We seek a researcher who applies biostratigraphic and biogeochemical methods to the study of paleoclimatology and paleoceanography across a broad range of spatial and temporal scales, incorporating data from continental and deep sea deposits and/or ice cores. The study of past climatic and oceanographic change should also be applied to understanding present and predicting future climate change. This position will complement existing strengths at UNC Chapel Hill in Geological Sciences and Marine Sciences in continental margin geology, quantitative paleoclimatology, low temperature geochemistry, physical oceanography, and marine biology and ecology.

The Department houses a variety of analytical facilities, including thermal ionization mass spectrometry, SEM, DCP spectrometry, and alpha spectrometry. We routinely access additional facilities in the Department of Marine Sciences (GC-isotope ratio mass spectrometry, gamma spectrometry) and at Duke University (ICP-MS, electron microprobe). A gas-source mass spectrometer and research reactor are available at NC State University. UNC and Duke jointly operate *R/V Cape Hatteras*, part of the UNOLS oceanographic fleet. UNC faculty have access to centralized statistical computing facilities on StatApps, a Sun ES10000 server with 32 processors and 16GB of memory, an SGI Origin 3800 with 64 Processors and 64 GB memory, and the North Carolina Supercomputing Center (<http://www.ncsc.org>).

The successful candidate must hold the Ph.D. by the start of the appointment, show exceptional promise for developing a vigorous, externally funded research program, and be committed to undergraduate and graduate teaching.

Applicants must submit a letter of application, statements of research and teaching interests, vita, and contact information (names, addresses, email, and phone numbers) for four references to Chair, Search Committee, Department of Geological Sciences, CB#3315, University of North Carolina, Chapel Hill, NC 27599. Review of applications will begin December 15, 2002 and will continue until the position is filled. Members of the Department will be present at the AGU Meeting in San Francisco. Please contact Patsy Webb (pwebb@email.unc.edu) to arrange an interview at AGU.

The University of North Carolina is an Equal Opportunity/Affirmative Action employer. Women and minorities are encouraged to apply.

**ASSISTANT PROFESSOR HYDROGEOLOGY  
INDIANA UNIVERSITY**


The Department of Geological Sciences at Indiana University in Bloomington invites applications for a tenure-track position in hydrogeology. We are especially interested in candidates whose research impacts one or more of the following areas: isotope hydrology, chemical hydrogeology, modeling of water-rock geochemical interactions, and the fate and transport of microbes in subsurface environments. The position will be at the assistant professor level. Successful applicants would be expected to develop a strong program of research supplemented by external funding sources and demonstrate excellence and enthusiasm in teaching and mentoring.

Applications should be sent to: Mark Person, Hydrogeology Search Committee Chair, Department of Geological Sciences, Indiana University, 1001 East Tenth Street, Bloomington, IN 47405, phone (812) 855-4404, e-mail [maperson@indiana.edu](mailto:maperson@indiana.edu).

The application material should include a letter outlining the candidate's research and teaching interests, a curriculum vitae and three letters of recommendation which are due at the time of application. Review of applications will begin on January 15, 2003, and will continue until the position is filled. Indiana University is an equal opportunity/affirmative action employer and encourages the candidacies of women and minorities.

**TURNER POSTDOCTORAL FELLOWS  
UNIVERSITY OF MICHIGAN**

The Department of Geological Sciences is pleased to invite applications for Turner Postdoctoral Fellows, which



NICHOLAS SCHOOL OF THE  
ENVIRONMENT AND EARTH SCIENCES  
DUKE UNIVERSITY



**Graduate Assistantships in  
Earth & Ocean Sciences**

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

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

are open to any area of Geological Sciences. We seek to fill positions of two-year duration with a competitive salary plus benefits and a research/travel fund. A third year of support may be offered. Applicants are encouraged to collaborate with an existing research group at the University of Michigan, but may also work independently. Consult our department web pages for more information on faculty and research (<http://www.geo.lsa.umich.edu/>). Teaching opportunities may also be available for those who are interested. Please submit a CV, brief (less than 5 pages) research proposal, and the names of at least three references by January 15, 2003 to: Prof. Rob Van der Voo, Turner Postdoc Committee, Dept. of Geological Sciences, University of Michigan, Ann Arbor, MI, 48109-1063. The University of Michigan is an affirmative action/equal opportunity employer.

**DIRECTOR**

**TAHOE ENVIRONMENTAL RESEARCH CENTER**  
[http://johnmuir.ucdavis.edu/terc\\_dir.html](http://johnmuir.ucdavis.edu/terc_dir.html)

The University of California, Davis, invites nominations and applications for an 11-month position as Director (50%), Tahoe Environmental Research Center (TERC) and Professor (50%). The director will provide academic and administrative leadership for the TERC and conduct research and teach at both undergraduate and graduate levels in an appropriate academic department at UC Davis. The TERC will be located on the north shore of Lake Tahoe in California, a 2.5-hour drive from the Davis campus. Research at the Center will focus on the physical, chemical, and biological effects of human development on the ecology of freshwater lakes, streams and watersheds, including various aspects of water quality, air quality, forest health, biodiversity, and socioeconomics. The web site has additional information and instructions on how to apply. Nominations and applications should be received by January 10, 2003. The University of California, Davis is an equal opportunity /affirmative action employer.


**GEOBIOLOGY**

**UNIVERSITY OF SOUTHERN CALIFORNIA**

The University of Southern California is seeking applicants for two tenure-track assistant/associate professor positions in Geobiology to join an active Geobiology research

**Lafayette College**  
**Mineralogy/Petrology/**  
**Geochemistry**

The Department of Geology and Environmental Geosciences at Lafayette College invites applications for an anticipated full-time one-year appointment in mineralogy, petrology or geochemistry, beginning fall 2003. We seek an individual to teach upper-level courses in mineralogy, igneous and metamorphic petrology, and geochemistry and an intro-level course in geology. In support of our teaching efforts, we have well equipped petrographic, computational and x-ray facilities as well as an extensive mineral and rock collection. Preference will be given to candidates with the Ph.D. and teaching experience; however we will consider well-qualified ABD applicants. The review process will begin February 15, 2003. Candidates should submit a letter of application, statement of teaching interests, vita, college and graduate school transcripts and three letters of reference to Lawrence Malinconico, Department of Geology and Environmental Geosciences, Lafayette College, Easton, PA 18042. The College is an equal opportunity employer and encourages applications from women and minorities.



**LAFAYETTE COLLEGE**

and teaching group within the University of Southern California. Each candidate is expected to establish an active and funded research program in Geobiology with an emphasis on his/her particular area of interest. A Ph.D. in earth sciences, biology, chemistry, or physics, is required, along with a desire to promote and participate in interdisciplinary research and teaching. The University of Southern California has active research programs in earth sciences, molecular biology, marine sciences, chemistry, and physics, all of which are expected to have strong interactions with the Geobiology program.

The successful candidates will be housed in the department that best fits their own background, but will be expected to have some of their laboratory space located jointly with other members of the Geobiology research group. Candidates will be expected to teach courses in their home department and to take part in interdisciplinary teaching in the Geobiology program as it develops.

Review of applications will begin in early November and continue until the positions are filled. It is expected that the appointments could be made as early as January 2003, but otherwise will be June 1, 2003. Applications should include a complete resume, statement of research interests, teaching abilities and desires, and names and addresses of at least three referees.

Applicants should apply to: Dr. Kenneth H. Nealson, Geobiology Search Committee Chair, Department of Earth Sciences, Science Hall 223, University of Southern California, Los Angeles, CA, 90089-0740.

USC is an affirmative action/equal opportunity employer.

**LECTURER IN GEOLOGY**  
**UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN**  
 The Department of Geology at the University of Illinois invites applications for a full-time position as Lecturer beginning Fall semester, 2003. The appointment will be a non-tenure track, continuing academic professional position, renewable annually. In a given year, either a 9- or 12-month appointment is possible. The successful candidate will teach undergraduate geoscience courses, mostly at the introductory level. Responsibilities include developing and teaching a special introductory geology course for non-science students that introduces basic mathematical methods by using geological examples—this course is

designed to fulfill a University requirement in "quantitative reasoning." Teaching responsibilities will include both small classes and large lectures, and participation in teaching field camp may be possible.

The successful applicant must have a broad knowledge of geoscience, must be able to utilize algebra, trigonometry, statistics, and basic calculus in geoscience, and must have completed a Ph.D. The successful applicant must also be able to demonstrate excellence in teaching, outstanding interpersonal skills, and strong motivation to pursue excellence in areas related to geoscience education. Experience with field-based and computer-based instruction is particularly desirable. We will consider applications from candidates in any geoscience discipline, but particularly encourage candidates with backgrounds in aspects of "soft-rock" geology, broadly defined. Maintaining research interests is strongly encouraged. Salary is commensurate with qualifications and experience.

Applicants should submit a vita, transcripts, names of at least three referees, and a letter describing geologic background, research interests, teaching accomplishments, and teaching interests to: Lecturer Search Committee, Department of Geology, 1301 West Green Street, University of Illinois, Urbana, IL 61801.

Questions can be directed to Prof. Stephen Altaner (217-244-1244; altaner@uiuc.edu). For full consideration, applications must be received by January 15, 2003. Further information about the Department is available at: <http://www.geology.uiuc.edu/>. Women, minorities, and other designated classes are encouraged to apply. The University of Illinois is an Affirmative Action, Equal Opportunity Employer.

**FACULTY POSITION**  
**IN PALEOENVIRONMENTAL ANALYSIS**  
**NORTHWESTERN UNIVERSITY**

The Department of Geological Sciences at Northwestern University invites applications for a tenure-line assistant professorship to begin fall 2003. Fields of interest include numerical modeling of climate-ocean-solid Earth interactions, biogeochemical cycles, and quantitative geomorphology. Candidates are expected to complement existing research efforts in paleoenvironmental analysis, including the study of modern environmental analogues. Deadline for applications is January 15, 2003. Applicants should submit a letter of application, curriculum vitae, description of teaching and research objectives and accomplishments, reprints and preprints, and the names and addresses of three or more referees. Please send material to: Paleoenvironmental Search Committee, Department of Geological Sciences, 1850 Campus Drive, Northwestern University, Evanston, Illinois 60208-2150. AA/EOE. Applications from women and members of minority groups are especially welcome.

**TENURE-TRACK FACULTY POSITION (NEW POSITION) IN EARTH SCIENCE EDUCATION AT THE UNIVERSITY OF WISCONSIN—EAU CLAIRE**  
**BEGINNING AUGUST 2003.**

Instructional responsibilities include a lab and field intensive introductory Earth Science course for education majors, one upper-division geology course per year, and introductory geology courses as needed. Position requires participation in an established K-12 education program with other scientists, science educators in geology and the School of Education, and mentor teachers in the area. Applicants will be expected to conduct high-quality scholarly research with undergraduate students. A PhD in geology or a closely related discipline is required at the time of appointment. The department has modern facilities in hydrogeology, geophysics, geochemistry, and sedimentology.

To apply, please send a letter of application, curriculum vita, copies of college transcripts, and arrange to have three letters of recommendation sent to Dr. Robert Hooper, Chair, Dept. of Geology, University of Wisconsin, Eau Claire, WI, 54702-4004. To be considered for priority screening, all application materials must be received by February 1, 2003; however, screening may continue until position is filled.

For a complete position description, call 715/836-3732 or visit <http://www.uwec.edu/acadaff/jobs/>. UW-Eau Claire is an AA/EEO employer and encourages applications from women and minorities.

**LABORATORY MANAGER**  
**UNIVERSITY OF ARKANSAS**  
**STABLE ISOTOPE RATIO FACILITY**

A laboratory manager is needed for the stable isotope ratio facility in the Department of Biological Sciences at the University of Arkansas. The facility, with two Finnigan Delta+’s and all necessary supporting equipment, began operation during summer of 1999. Capabilities include elemental analysis, trace gas analysis, and compound-specific isotope analysis. The facility provides in-house

and commercial services for isotope ratio analysis of C, N, O, and H from biological and geological samples. It is a component of the statewide mass spectrometry facility and serves researchers of all disciplines. The successful applicant will assume day-to-day management of the facility. Responsibilities include daily operation and maintenance of the instruments, training of students and post-doctoral associates, and managing sample throughput. The salary is negotiable and will be commensurate with experience. Fayetteville is an affordable University community nestled in the Ozarks (<http://biology.uark.edu/devans/fay.html>). To apply for the position, send a cover letter detailing previous experience, a curriculum vitae, and three letters of reference to: Dr. Steve Beupre, Biological Sciences, University of Arkansas, Fayetteville, AR, 72701. Applications will be reviewed until the position is filled. Questions about the position can be directed to Dr. S. Beupre at [sbeupre@uark.edu](mailto:sbeupre@uark.edu).

The University of Arkansas is an Equal Opportunity/Affirmative Action Employer.

**SOUTHWEST MISSOURI STATE**  
**ASSISTANT PROFESSOR, STRUCTURAL GEOLOGY**  
**AND/OR EARTH SCIENCE EDUCATION**

MISSOURI, SPRINGFIELD 65804. Southwest Missouri State University. The Department of Geography, Geology and Planning invites applications for a tenure track Assistant Professor in Geology with an emphasis area of Structural Geology and/or Earth Science Education beginning August 2003. Ph.D. in Geology required at time of appointment. ABD Considered. A commitment to teaching, research, and service is essential. Evidence of teaching effectiveness would be advantageous together with evidence of a productive research agenda. The Department grants undergraduate degrees in Geology, Geography, Cartographic Sciences, and Planning and an M.S. in Resource Planning. The Department also provides much of the course work for the Earth Science emphasis in the B.S. and M.S. programs in Secondary Education. It is essential that the successful candidate be able to teach Structural Geology to our undergraduate Geology majors and introductory General Education courses in Physical and/or Environmental Geology. Candidates with interests and expertise to contribute to the Earth Science Education programs and/or the M.S. in Resource Planning will be advantaged in their application.

Applicants should submit letter of interest, current curriculum vitae, arrange for three reference letters to be submitted and copies of all academic transcripts to Dr. James Skinner, Head, Department of Geography, Geology and Planning, Southwest Missouri State University, 901 South National, Springfield, MO 65804. Consideration of applications begins Fall 2002 and continues until position is filled. Further information can be obtained at (417) 836-5800 or fax to (417) 836-6006, or visit our web site at. Women and minority candidates are encouraged to apply. EO/AA employer.

**EARTH SCIENCE**  
**RESEARCH OPPORTUNITIES IN GEON**

Post-doctoral, technical and graduate student positions in Geoinformatics based Geoscience Network (GEON) are available immediately. GEON is a new National Science Foundation-funded Information Technology research program to conduct fundamental research towards developing a cyberinfrastructure for the earth sciences. Please contact the Principal Investigators for additional details.

**Igneous petrology and geochronology:** Ph.D. with demonstrated ability in numerical modeling, isotope geochemistry and experience in database management under GIS protocol. Contact A. Krishna Sinha, Virginia Tech, [pitlab@vt.edu](mailto:pitlab@vt.edu), 540-231-5580.

**Metamorphic petrology and tectonics:** Ph.D. with an interest in tectonics and ability in computer modeling, database management and GIS. An interest in combining the research with mentored teaching in a liberal arts environment is a plus. Contact M.L. Crawford, Bryn Mawr College, [mcrawfor@brynmawr.edu](mailto:mcrawfor@brynmawr.edu), 610-526-5111.

**Paleobiology:** Ph.D. to create database of Phanerozoic paleoenvironmental information, work with other GEON database efforts, and integrate the database with the ongoing Paleobiology Database Project. Requires experience with paleontological database management; GIS skills a plus. Applications closed. (Karl Flessa, University of Arizona, [kflessa@geo.arizona.edu](mailto:kflessa@geo.arizona.edu), 520 621-7336) Chronostratigraphy and time scale calibration: position filled for first year. Contact Paul Sikora for future opportunities, [psikora@egi.utah.edu](mailto:psikora@egi.utah.edu).

**Structure:** Ph.D. for developing a comprehensive database and model of the crustal structure and active tectonics of the Rocky Mountain Region. Contact John Oldow, University of Idaho, [oldow@uidaho.edu](mailto:oldow@uidaho.edu), 208-885-7327.

continued on p. 36





# Stop !

Don't buy a different software product for every modeling problem.

With FlexPDE you can solve whole families of 2D and 3D field problems!

Like electromagnetics, heatflow, deformation, and lots more. Steady-state, time-dependent, time-harmonic or eigenvalues.



Open Tube Convection Reactor



3D Multi-material Thermal Conductivity



T-Deplete Waveguide

With a redesigned user interface, FlexPDE 3.0 is more than ever the indispensable tool for scientists and engineers • FlexPDE 3.0 is a scripted finite element model builder for partial differential equations systems • Linear or Nonlinear • 2D or 3D plus time or eigenvalues • Unlimited number of variables • Windows, Unix, Linux or Mac OSX • Download a demo from our website

## PDE Solutions Inc

P.O. Box 4217 • Antioch, CA • 94531  
925-776-2407 • FAX 925-776-2408  
www.pdesolutions.com

# DISCOVER an actual 60 MILLION YEAR OLD FISH

## ULRICH'S FOSSIL GALLERY

Student Fossil Preparation Kits

Quality Grade "A" Kits

\$21.50

(5 or more, \$15.50 each plus shipping and handling)



Fossil Station #308  
Kemmerer, WY 83101  
PH (307) 877-6466  
FAX (307) 877-3289

For the Earth Science-Minded Student

# Journal HIGHLIGHTS



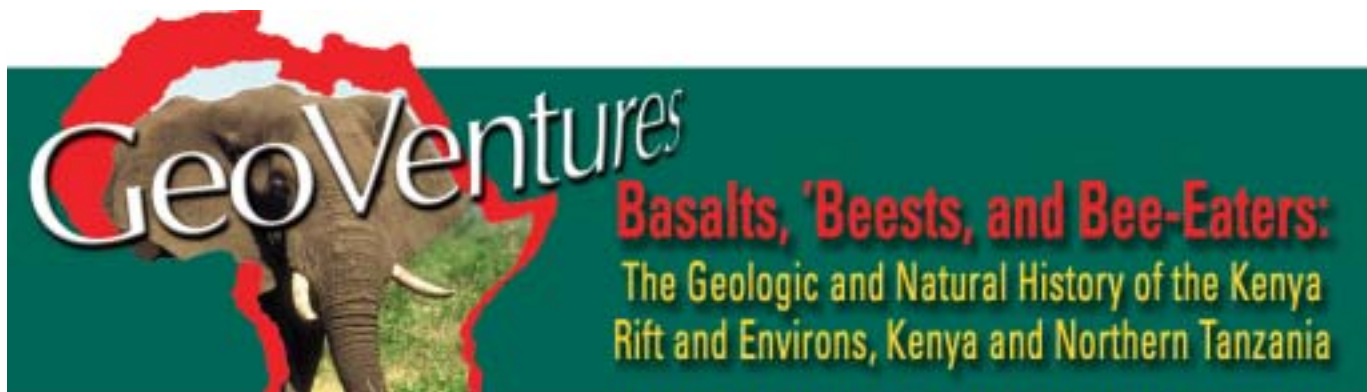
THE GEOLOGICAL SOCIETY OF AMERICA

To subscribe, contact [member@geosociety.org](mailto:member@geosociety.org)  
1-888-443-4472, or (303) 447-2020  
Visit our online journals at [www.gsa-journals.org](http://www.gsa-journals.org)

December GSA Bulletin



December Geology  
Stasis to stability  
Healthy rosickyites  
Bison wear the genes  
Aquicludes from Mars



## GeoTrip

July 30–August 14, 2003

**Co-Leaders:** Timothy F. Lawton, New Mexico State University, Las Cruces, and Brenda J. Buck, University of Nevada, Las Vegas

Kenya and Tanzania host the Kenya rift, the eastern prong of the East African rift system, which separates the Somalian and Nubian plates. The East African rift overlies a mantle superplume, which has generated abundant bimodal and alkalic volcanism, high elevation, the formation of two large rift valley systems, and spectacular scenery and natural history. The Kenya rift transects western Kenya and northern Tanzania to create one of the most spectacular geologic provinces on Earth. The focus of this GeoTrip to the Kenya rift is to explore the geologic and natural history of this unique tectonic province and its associated spectacular environments, supporting a variety of bird and wildlife habitats. Participants will have the opportunity to hike and view ice-sculpted landscapes on glaciated Mount Kenya, Kenya's highest peak, situated squarely on the equator; visit saline internally drained lakes in the rift itself; boat immense Lake Victoria, the second largest freshwater lake in the world in the topographic sag between the rift valleys; traverse the Precambrian shield on the north edge of the Serengeti Plains; explore the spectacular Ngorongoro Crater, an intra-rift caldera; visit Olduvai Gorge, the cradle of humankind; and ponder the great Kilimanjaro, Africa's highest peak.

Because the elevation is high, the climate ranges from warm to cool and generally lacks the sweltering heat we expect in the tropics. The trip is scheduled to coincide with the second of two annual dry seasons and the peak of the big-animal migration on the Serengeti. This will be an unforgettable adventure in exotic geology and wildlife: even the starlings, ten different iridescent species, are startling.

**Itinerary** (Information on accommodations is posted at [www.geosociety.org/meetings/gv](http://www.geosociety.org/meetings/gv).)

**July 30:** Depart U.S. in the evening.

**July 31:** Amsterdam/Nairobi, Kenya! Arrive Jomo Kenyatta International Airport. The capital of Kenya is a modern city located 87 miles south of the equator at an altitude of 4452 ft. above sea level. Established in 1899, Nairobi today has a population of over one million people.

**Aug. 1:** Traverse the highlands of the eastern rift shoulder, crossing many streams and rivers, some with waterfalls, which flow east away from the rift toward the Indian Ocean. Our destination, **Mount Kenya**, is the highest point in Kenya at 17,055 ft. and lies east of the rift. The mountain is a spectacular example of a rift-related nepheline-syenite volcano whose eruptive history spanned 3.1–2.6 Ma.

**Aug. 2:** Hike on the lower flanks of **Mount Kenya**, emphasizing volcanic landforms, glacial history of Africa, and views of the upper reaches of the mountain. We'll depart early for the road head on the Naromoru Track at 10,000 ft. At 10,000 ft., the forest gives way to a heath with scattered arboreal shrubs, and at 11,000 ft., the heath in turn gives way to a moor with tussock grass and giant lobelia and groundsel.

**Aug. 3:** Rift structure, geomorphology, and changing climate in East Africa. The route crosses the rift shoulder and the Nyandarua Valley, a rift sub-basin, before descending into the hydrologically closed basin occupied by **Lake Nakuru**, famous for its million or so flamingoes, both Lesser Flamingoes that feed on blue-green algae and diatoms that thrive in the warm, soda-rich water and Greater Flamingoes, which prefer crustaceans and insect larvae. In addition to the flamingo spectacle, Lake Nakuru National Park boasts some 400 species of birds.

**Aug. 4:** Lake Nakuru–Lake Naivasha: rift stratigraphy, evidence for a changing rift stress field, and reactivation of Proterozoic lithospheric fabric during the Neogene evolution of the rift system.

**Aug. 5:** Lake Naivasha and vicinity: Pliocene-Quaternary volcanic stratigraphy, which contains evidence for young bimodal magmatism in the rift, rift structure, geomorphology, energy development, and catastrophic flooding in the central Kenya rift.

**Aug. 6:** Final views of the Rift Valley, then introduces participants to the Neoproterozoic and lower Paleozoic rocks of the Mozambique Belt. The route heads south, then west, skirting south of the intra-rift Mau Escarpment and north of the rift-flanking Nguruman Escarpment. Our destination, the Maasai Mara reserve, is located in the Precambrian province west of the Kenya rift. This province extends south into Tanzania and underlies the enormous Serengeti Plain.

**Aug. 7:** Exploration of the **Maasai Mara**, a 320 km<sup>2</sup> game reserve that constitutes the northern extension of the Serengeti Plain. We will discuss paleontologic and isotopic evidence for the Miocene rise and expansion of the tall grasslands. No trip to East Africa is complete without its big game safari, and we'll make morning and afternoon game-viewing drives. The Mara is the land of African legend: Lion are abundant throughout the park. Finally, several species of Bee-Eater, the flying rainbow that heads the list of the Mara's birds, occur in the reserve.

**Aug. 8:** Full day in the reserve to pick up any animal spectacles missed yesterday. (*Additional option: balloon ride or flight to Lake Victoria.*)

**Aug. 9:** Return to **Nairobi** with the afternoon free (museums; local giraffe park; shopping, including chance to pick up geologic maps and literature).

**Aug. 10:** From Nairobi to a lodge on the flank of **Mount Meru**, a stratovolcano 20 km southwest of Mount Kilimanjaro. Like Mount Kenya, this volcano lies east of the Kenya rift. Technical emphasis will be volcanic style and structural controls of plume-related magmatism and

volcanic edifices. Mount Meru, with a summit at 14,979 ft., is still active; its last eruption was in 1910. (*Additional option: flight over Mount Kilimanjaro.*)

**Aug. 11:** Westward across the eastern Tanzanian rift shoulder and past Lake Manyara, a soda lake with a surface elevation of 3150 ft. that occupies an enclosed basin in the Kenya rift. We then climb 5570 ft. to the rim of the awesome **Ngorongoro Crater**, a caldera 25 km (15 mi) across and 1670 ft. deep. Noted for its five separate ecozones and famous tree-climbing lions, **Lake Manyara National Park** is also home to great herds of Cape Buffalo and African Elephant.

**Aug. 12:** Visit to the **Olduvai Gorge**, located 40 km (75 road km) northwest of Ngorongoro Crater. Technical emphasis will be on hominid paleontology, paleoecology, and stratigraphy of this key geologic locality as well as the influence of the volcanic landscape on human development. For example, fluvial cobbles derived from various volcanos of the Ngorongoro volcanic highland were used in tool making by hominids in Olduvai Gorge at 1.75 Ma. Museum visit.

**Aug. 13:** Morning flight from Lake Manyara airstrip for our flight back to **Arusha**. The flight will offer a spectacular overview of the Aug. 11 driving route. A day room at the Mount Meru Game Lodge will permit



Mount Kilimanjaro. Photo by Toni Rottenberg.

participants to prepare for the long trip home. Evening departure to the Kilimanjaro airport for our flight to Amsterdam.

**Aug. 14:** Amsterdam–U.S.

**Fees and Payment:** \$5,650 for GSA members; \$5,750 for nonmembers. A \$500 deposit is due with your reservation and is refundable (less \$300 cancellation fee) through June 1. Balance is due June 1. Fee is based on double occupancy. The single supplement, based on availability, is an additional \$895. Minimum number of participants (*firm*): 15; maximum: 40.

**Included:** Accommodations in twin-bedded rooms, all meals on tour beginning August 1, flights within East Africa, guidebook, all tips and gratuities to drivers/guides, hotel and camp staff, temporary membership in the Flying Doctors Service, government taxes and levies.

**Not included:** Airfare to Nairobi and return from Tanzania, optional tours (flight over Mount Kilimanjaro, \$385, hot air ballooning, \$435, Lake Victoria excursion \$435, lunch in Nairobi on August 9, entry visa fees to Kenya and Tanzania (approx. \$100), alcoholic beverages, and other expenses not specifically included.

GSA recommends that you purchase your airline ticket through TR Consultants, 1-800-923-7422. Their quoted rates will be held until 60 days prior to departure with a \$100 deposit. 60 days prior to departure full payment will be required and the rates shown below will be honored:

<b>Economy airfare from Boston (BOS)</b>	<b>\$1,695.00 + tax</b>
<b>Economy airfare from Detroit (DTW)</b>	<b>\$1,863.00 + tax</b>
<b>Economy airfare from Los Angeles (LAX)</b>	<b>\$1,905.00 + tax</b>
<b>Economy airfare from New York (JFK)</b>	<b>\$1,695.00 + tax</b>

For more information, visit [www.geosociety.org](http://www.geosociety.org). Go to "Meetings and Excursion" then to "GeoVentures." Or, call GSA's Meetings Department at (303) 357-1034, or e-mail [ecollis@geosociety.org](mailto:ecollis@geosociety.org).

**Registrants with Special Needs:** GSA is committed to making GeoTrips accessible to all. If you require special arrangements or have special dietary concerns, please contact Edna Collis, [ecollis@geosociety.org](mailto:ecollis@geosociety.org).

## REGISTER TODAY!

Send a deposit to hold your reservation; please pay by check or credit card. You will receive further information soon.

Name \_\_\_\_\_

Institution/Employer \_\_\_\_\_

Mailing Address \_\_\_\_\_

City/State/Country/ZIP \_\_\_\_\_

Phone (business/home) \_\_\_\_\_

E-mail \_\_\_\_\_

Guest Name \_\_\_\_\_

GSA Member # \_\_\_\_\_

	DEPOSIT PER PERSON	NO. OF PERSONS	TOTAL PAID DEPOSIT
--	-----------------------	-------------------	-----------------------

<b>AFRICA</b>	\$500	_____	\$ _____
---------------	-------	-------	----------

<b>TOTAL DEPOSIT</b>			\$ _____
----------------------	--	--	----------

VISA    MasterCard    American Express    Discover

Credit Card # \_\_\_\_\_ Exp. Date \_\_\_\_\_

Signature \_\_\_\_\_

### MAIL OR FAX REGISTRATION FORM AND CHECK OR CREDIT CARD INFORMATION TO:

2003 GSA GeoVentures, Member Services  
P.O. Box 9140, Boulder, CO 80301  
Fax 303-357-1071

**MAKE CHECKS PAYABLE TO:** GSA 2003 GeoVentures

**Lafayette College  
Environmental Geology  
and Geomorphology**



The Department of Geology and Environmental Geosciences at Lafayette College invites applications for a full-time sabbatical leave replacement for the spring semester 2003 in geomorphology and environmental geology. We seek an individual with an expertise in fluvial geomorphology to teach an upper-level course in Earth Surface Processes and an intro-level course in environmental geology. In support of our teaching efforts, we have well-equipped geomorphology facilities including a 9 meter recirculating flume for simulating river processes. Preference will be given to candidates with the Ph.D. and teaching experience; however we will consider well-qualified ABD applicants. The review process will begin immediately and continue until an individual is selected. Candidates should submit a letter of application, statement of teaching interests, vita, college and graduate school transcripts and three letters of reference to Lawrence Malinicono, Department of Geology and Environmental Geosciences, Lafayette College, Easton, PA 18042. The College is an equal opportunity employer and encourages applications from women and minorities.



**LAFAYETTE COLLEGE**

continued from p. 32

**Fault systems, landscape development, and tectonics:** graduate student research assistantship or post-doctoral scholar. Contact Ramon Arrowsmith, Arizona State University, ramon.arrowsmith@asu.edu, 480-965-3541.

**Active Tectonics and education:** graduate student research assistantship with interests in geological sciences, geography, and GIS and relational database management. Contact Charles Meertens, UNAVCO/UCAR, chuckm@unavco.ucar.edu, 303-497-8011. Graduate student research assistantship with emphasis on library science, geoscience education, and resource evaluation. Contact Mary Marilino, Digital Library for Earth System Education, DLESE/UCAR, marilino@ucar.edu, 303-497-8350.

**Crustal geophysics:** M.S. or Ph.D. with interests in integrated analysis and ability in database management, GIS, remote sensing, and website development. Contact G. Randy Keller, University of Texas, El Paso, keller@utep.edu, 915-747-5850.

**Lithospheric Structure and Information Systems:** Ph.D. in geophysics with information technology background. Working knowledge of GIS, Database systems, web-based applications is required. Educational interest is a plus. Contact Dogan Seber, Cornell University, ds51@cornell.edu, 607-255-4383.

**Geodynamic modeling:** Postdoc or Ph.D. student to work on geodynamic modeling of large-scale crustal deformation. Solid background in numerical analysis and finite element modeling is needed, and knowledge of GIS is a plus. Contact Mian Liu, University of Missouri-Columbia, lium@missouri.edu, 573-882-3784.

**CARBONATE SEDIMENTOLOGIST  
THE UNIVERSITY OF TEXAS AT DALLAS**

The Department of Geosciences invites applications for a tenure-track faculty appointment in Carbonate Sedimentology at the Assistant Professor level to begin Fall 2003. We seek applicants who will strengthen our 3-D Reservoir Characterization and/or Environmental Geosciences initiatives. Applicants are expected to hold a Ph.D. at the time of appointment and to have a strong commitment to building an externally funded research program as well as excellence in teaching of undergraduate, M.S. and Ph.D.

students. This is one of several positions we anticipate filling over the next few years due to impending retirements. The successful candidate will play an important role in shaping the department during this transition. Applications, including statement of research and teaching objectives, curriculum vitae, and contact information for three references should be sent to: Academic Search # 2056, UT Dallas, PO Box 830688, Richardson, Texas 75083-0688. Informal inquiries can also be made directly to janokb@utdallas.edu. Applications must be received before January 15, 2003, to receive fullest consideration. For more information see: <http://www.utdallas.edu/dept/geoscience/>. UTD is an Affirmative Action/Equal Opportunity employer that is committed to fostering diversity in its student body, faculty, and staff.

**UNIVERSITY OF MINNESOTA, TWIN CITIES  
CAMPUS TWO POSITIONS: PROFESSORSHIP  
IN HYDROGEOLOGY AND  
GEOFLUIDS LIMNOGEOLOGIST**

The Newton Horace Winchell School of Earth Sciences at the University of Minnesota, Twin Cities Campus, is soliciting applications for the two following tenure-track faculty positions:

**GEORGE AND ORPHA GIBSON PROFESSORSHIP IN HYDROGEOLOGY AND GEOFLUIDS.** The University of Minnesota Department of Geology and Geophysics invites applications for a faculty position in hydrogeology-geofluids studies. We are looking to make the appointment at the Assistant Professor level. For exceptionally qualified candidates, appointment at the Associate Professor level may be considered. Salary will be commensurate with rank and experience. This tenure-track position will carry the title "George and Orpha Gibson Professor." The Professorship will be accompanied by resources from the Gibson Endowment for a 6-year term.

The candidate's interest in the broad aspects of hydrogeology and geofluids should serve as background for more specialized research and scholarly activities. Examples of areas of interest include quantitative and computational hydrogeology, scale-dependent heterogeneous flow, continental and oceanic geofluids, basin-scale fluid flow, interactions between crustal fluids and tectonics, hydrothermal systems, surface hydrology, subsurface fluid mechanics, isotope hydrology and hydrogeochemistry, atmosphere-surface water-groundwater interactions, interaction between hydrogeology and geobiology, and the impact of climate change on geofluids systems.

The appointee is expected to develop a vigorous research program, attract external funding, and contribute to the instructional and research efforts of the Newton Horace Winchell School of Earth Sciences. The School includes the Department of Geology and Geophysics, the Limnological Research Center (LRC), the NSF funded National Center for Earth-surface Dynamics (NCED), the Institute for Rock Magnetism, and the Minnesota Geological Survey. The potential of this position is enhanced by access to the facilities of the Minnesota Supercomputer Institute (MSI) and the Digital Technology Center (DTC), the interdisciplinary program in environmental and geophysical fluid dynamics at the St. Anthony Falls Laboratory, and the interdisciplinary Water Resources graduate program.

The ideal candidate for this position would have two to three years of experience beyond the Ph.D. degree. **The review of completed applications will begin on December 16, 2002.** Application requirements are: 1) curriculum vitae, 2) complete list of publications, 3) statement of research interests, 4) statement of teaching interests, and 5) names of at least 4 referees. Send application to Olaf Pfannkuch, Gibson Search Committee Chair, Department of Geology and Geophysics, University of Minnesota, 310 Pillsbury Drive S.E., Minneapolis, MN 55455 USA. For further information, phone (612) 624-1333 or FAX (612) 625-3819. email: h2olafpr@umn.edu; Web Site: <http://www.geo.umn.edu/>.

**LIMNOGEOLOGIST.** The Department of Geology and Geophysics at the Newton Horace Winchell School of Earth Sciences, University of Minnesota-Twin Cities, invites applications for a tenure-track Assistant Professor with expertise in biogeochemistry, climatology, geobiology, geochemistry, geophysics, hydrology, paleolimnology, and/or sedimentology of lake systems. The successful candidate will develop a vigorous research program, attract external funding, and contribute to the instructional and research efforts of the School of Earth Sciences. Excellent opportunities for cooperative research are provided by existing faculty in the Department of Geology and Geophysics and its Limnological Research Center, which has a long tradition of excellence in limnology. Potential collaborations also exist with the National Center for Earth-surface Dynamics (NCED) at the St. Anthony Falls Laboratory, the Institute for Rock Magnetism, and the Minnesota Geological Survey. Further collaborative

opportunities exist with the Department of Ecology, Evolution, and Behavior; the physical geography program in the Geography Department; archeology program in the Department of Anthropology, and the Large Lakes Observatory (Duluth Campus). Research efforts in paleolimnological and paleoenvironmental studies are further linked through a University-wide graduate program in Quaternary Paleocology. The Limnological Research Center also collaborates actively with the St. Croix Watershed Research Station of the Science Museum of Minnesota.

Applicants are expected to have a Ph.D. at the time of appointment. To apply, send curriculum vitae, statements of teaching and research interests, and **three letters of recommendation** to Emi Ito, Chair, Limnology Search Committee, Department of Geology and Geophysics, University of Minnesota, 310 Pillsbury Dr. SE, Minneapolis, MN 55455. The application deadline is **December 16, 2002.** The start date is expected to be Fall 2003. Questions may be addressed by emailing Professor Emi Ito, Director of Limnological Research Center, at [eito@umn.edu](mailto:eito@umn.edu) or by visiting (<http://www.geo.umn.edu/>).

The University of Minnesota is an equal opportunity educator and employer.

**FLORIDA ATLANTIC UNIVERSITY  
(BOCA RATON, FLORIDA)  
CHARLES E. SCHMIDT COLLEGE OF SCIENCE  
CLIMATOLOGY/BIOGEOGRAPHY AND  
GEOGRAPHIC INFORMATION SCIENCE**

The Department of Geography and Geology invites applications for two academic year positions beginning in August 2003. Both positions are tenure-track and require a Ph.D. in geography, geology, or related discipline for appointment at the Assistant Professor level.

**Position 1—tenure-track Assistant Professor** within the fields of **climatology/biogeography.** Preference will be given to candidates with additional expertise in digital image analysis, physical climatology, natural hazards, or hydrology. The successful candidate will share responsibility for a large enrollment lower division weather and climate general education course, along with courses at the upper division and graduate level. The successful candidate will have the opportunity to participate in a growing interdisciplinary research environment at FAU, and with the Center for Geo-Information Science and the Center for Hydrological Research and Modeling each housed in the Department of Geography and Geology. Documented interest in quality teaching, published research, and external funding will be expected.

**Position 2—tenure-track Assistant Professor in Geographic Information Science.** Responsibility for teaching in the undergraduate and graduate curriculum in GIS and within one or more sub-fields within Geography and the Earth Sciences. Preference will be given to candidates with demonstrated programming skills and expertise in data base management. This position will be expected to develop and offer an upper-division course in "Programming in GIS". The successful candidate will have the opportunity to participate in a growing interdisciplinary research environment at FAU, and with the Center for Geo-Information Science and the Center for Hydrological Research and Modeling each housed in the Department of Geography and Geology. Documented interest in quality teaching, published research, and external funding will be expected.

The Department consists of 13 full-time faculty, 2 computer and research support professional staff, along with secretarial and budget personnel, a variable number of adjunct instructors, and over a dozen graduate teaching assistantships. The Department offers BA and BS degrees in geography and in geology as well as MA and MS degrees. Department faculty support an Environmental Science master's degree and the undergraduate Environmental Studies Certificate administratively housed in the Biological Sciences Department. Authorized salary for each 9-month position is \$45,000-\$48,000. Review of applications will begin January 15, 2003 and continue until the position is filled.

Applications should include a letter of qualifications and interests, academic transcript, curriculum vitae, and the names of three references with email addresses. Please visit our web site at: [www.geoggeol.fau.edu](http://www.geoggeol.fau.edu) for further information on our programs and faculty interests. Apply: Chair Search Committee Position 1 or Position 2, Department of Geography and Geology, Florida Atlantic University, Boca Raton, FL 33431. Phone 561-297-3250, Fax -2745, email [SchultzR@fau.edu](mailto:SchultzR@fau.edu). FAU is an Equal Opportunity/Equal Access/Affirmative Action Institution.

**HYDROGEOLOGY-STRUCTURAL GEOLOGY  
ASSISTANT PROFESSOR  
TUFTS UNIVERSITY**

Tufts University has a full-time, tenure-track position as an Assistant Professor of Geology in the area of Hydrogeology and Structural Geology, beginning September 1,

# The Petroleum Institute in Abu Dhabi



## Program Head, Petroleum Geosciences Engineering

The Petroleum Institute in Abu Dhabi is seeking applications for the position of Program Head for the Petroleum Geosciences Engineering Department. This position reports directly to the Chief Academic Officer of the Institute and has overall responsibility for leadership of the Petroleum Geosciences Engineering program. Applicants should possess an earned PhD degree in Geology, Geological Engineering, Geophysics, Geophysical Engineering or a closely related field, and must have a demonstrated history of progressively increasing responsibility and achievement in academic or industrial management and leadership.

The Program Head for Petroleum Geosciences Engineering is responsible for all academic and administrative functions relating to the operation of the department, including the following activities:

- Faculty recruitment
- Faculty development
- Faculty evaluation
- Program assessment
- Curriculum and laboratory development
- Departmental staff management, recruiting, and evaluation
- Departmental strategic planning
- Departmental budget

The Petroleum Geosciences Engineering Program Head will work closely with the Chief Academic Officer and the Executive Director to develop departmental and institutional budgets and appropriate departmental and institutional staffing plans.

The Petroleum Institute opened in September of 2001 in newly-constructed “start-up” facilities, which provide interim space required for instruction while a new grass-roots permanent campus is built. Architectural design for the permanent campus is complete, with a view to occupancy in 2005. The Program Head will have the opportunity to interact with the facilities design process, and will be involved in decisions on the specification of departmental infrastructure as well as acquisition of equipment and hiring of faculty and program administrative staff. The Program will have an operating budget that is being sized for excellence in the area of faculty development and the provision of program resources.

The total compensation package includes a 12-month base salary, an expatriation allowance, and a benefits allowance that covers housing, utilities, initial furnishings, transportation (automobile purchase loan), health insurance and annual leave travel.

An appointment is desired in early summer, 2003, and should continue for at least three years. The Petroleum Institute is affiliated with the Colorado School of Mines, and additional information can be found at the PI provisional website: [www.mines.edu/pi](http://www.mines.edu/pi).

Interested candidates should submit a letter of application and a detailed resume to:

Ms. Dixie Termin  
Center for the Development of the Petroleum Institute  
1700 Illinois St., Colorado School of Mines  
Golden, Colorado 80401 USA

Applications should be submitted no later than January 31, 2003; transmission of materials by email is encouraged. Please send all electronic submissions to [piapp@mines.edu](mailto:piapp@mines.edu).

Department of Geosciences  
PRINCETON UNIVERSITY



## HARRY HESS FELLOWS PROGRAM

The Department of Geosciences at Princeton University announces competition for the Harry Hess Fellowships for the 2003-2004 academic year. This honorific postdoctoral fellowship program has been established to provide opportunities for outstanding young geoscientists to work in the field of their choice. Research may be carried out independently or in collaboration with members of the Geosciences Department. One or more Hess fellows are usually appointed each year. Applicants must have obtained a Ph.D. at the time of the start of the fellowship, but not more than five years before. Current areas of research include:

- Geochemistry
- Biogeochemical Cycles
- Paleontology
- Mineral Physics
- Tectonics
- Petrology
- Structural Geology
- Geophysics
- Seismology
- Geomicrobiology

Candidates should send a letter of application and the supporting materials listed below to the HESS FELLOWS COMMITTEE, c/o Professor F. A. Dahlen, Department of Geosciences, Guyot Hall, Princeton University, Princeton, NJ 08544. Applications will continue to be accepted until the available positions are filled, but no later than December 31, 2002.

- Curriculum vitae
- List of publications and preprints
- Brief statement of research interests and goals
- Name, address and email address of three referees familiar with the candidate's work

Hess fellowships provide a competitive annual salary, depending upon experience, along with an allowance for travel to meetings and research support. Initial awards are for one year, with a starting date that must be before January 1, 2004. Extensions for an additional year are generally granted depending upon satisfactory performance. Applications will continue to be accepted until the available positions are filled, but no later than December 31, 2002. Hess fellowship applicants will also be considered for other available postdoctoral positions in the Geosciences Department.

Princeton University is an Affirmative Action/Equal Opportunity employer and particularly welcomes applications from women and members of minority groups.

Information about the research activities of the Department of Geosciences may be viewed at <http://geoweb.princeton.edu>.

2003. Qualifications of applicants should include the Ph.D. or equivalent degree, although candidates about to complete the Ph.D. will be considered. We will also consider candidates at the Associate Professor level, based on experience and qualifications. Preference will be given to those with teaching experience at the college level and demonstrated research potential, especially in areas that blend hydrogeology and structural geology. The applicant should be able to fit into a small, well-equipped, undergraduate teaching department where research is expected and encouraged. The person hired will be expected to teach Hydrogeology, Structural Geology, and one or more related courses, and to assist in teaching the elementary courses. He or she will develop his/her own research program and seek outside funding for that research. We also encourage collaborative work with fac-

ulty in the Engineering and Environmental programs at Tufts. Applications, including references from three qualified persons, transcripts, and resume, should be sent to Anne F. Gardulski, Chair, Department of Geology, Tufts University, Medford, MA 02155. Review of applications will begin December 15, 2002 and will continue until the position is filled. Tufts University is an Affirmative Action/Equal Opportunity employer. We are committed to increasing the diversity of our faculty. Members of under-represented groups are strongly encouraged to apply.

### TENURE-TRACK FACULTY POSITION STRUCTURE/HYDROLOGY GUILFORD COLLEGE

Guilford College Geology Department seeks applicants for a tenure-track assistant professor position, beginning

August 2003. Background in hydrology, structural geology, and geophysics; strengths in environmental studies; broad interests and versatility in the earth sciences; strong commitment to undergraduate teaching in a liberal arts institution required. Courses taught include Structural Geology, Hydrology, Exploration Geophysics, and introductory courses for non-majors and majors. Areas of expertise may also include soil science, water resources, shallow-level geophysics, GIS, and other applications of information technology. Position also includes teaching courses in the interdisciplinary Environmental Studies major, advising of majors and first-year students, teaching First-Year Seminars and senior interdisciplinary courses, and mentoring undergraduate research. Candidates should send a cover letter, statement of teaching and research interests, curriculum vitae, and names and contact information of three references to Dr. Marlene McCauley, Geology Department Chair, Guilford College, 5800 W. Friendly Ave, Greensboro NC 27410. Additional information available at: [www.guilford.edu/original/academic/geology/GeoPosF02.htm](http://www.guilford.edu/original/academic/geology/GeoPosF02.htm). We begin reviewing applications Dec. 15. Guilford College seeks applications representative of diversity based on age, race, gender, sexual orientation, disabilities, ethnicity, religion, national origin, life experiences, socio-economic background, geographic roots, as well as members of the Society of Friends. EOE/AA <http://www.guilford.edu>.

### COLLEGE OF NATURAL SCIENCES AND MATHEMATICS DEPARTMENT OF GEOLOGICAL SCIENCES EARTH SCIENCE EDUCATION CALIFORNIA STATE UNIVERSITY, FULLERTON

The Department of Geological Sciences, in conjunction with the Science Education Program, seeks applicants for a full-time tenure-track position in Earth Science Education at the Assistant or Associate Professor level beginning fall 2003. Teaching responsibilities include introductory and/or specialized courses in the Geological Sciences Department and courses for K-12 pre-service teachers and graduate courses for in-service teachers in the Science Education Program. Supervision of MAT-S (Master of Arts in Teaching-Science) students is also required. More information regarding qualifications and application procedures is available from <http://geology.fullerton.edu> (go to Job Opportunities). The successful candidate is expected to pursue extramural funding to support research interests in Earth Science Education. Applicants should send: 1) a detailed curriculum vita, 2) a letter that explains how you meet the qualifications, 3) a statement that explains courses you would feel competent to teach, 4) a statement of your teaching philosophy, 5) a statement that identifies your research specialty within Earth Science Education, your accomplishments and future research plans and 6) at least three signed letters (emails are acceptable if followed by signed originals) of recommendation from references familiar with your teaching and research potential to: Galen Carlson-Chair of Search Committee ([GCarlson@Fullerton.edu](mailto:GCarlson@Fullerton.edu)), Department of Geological Sciences, California State University, Fullerton, P.O. Box 6850, Fullerton, CA 92834-6850. Review of applicants will begin December 31, 2002. CSUF is an Affirmative Action/Equal Opportunity/Title IX/Americans With Disabilities.

### ENVIRONMENTAL GEOCHEMISTRY/GEOPHYSICS MONTCLAIR STATE UNIVERSITY

The Department of Earth and Environmental Studies at Montclair State University invites applications for two full-time (10-month), tenure-track faculty positions at the assistant (geochemistry) and/or associate (geophysics) rank starting September 1, 2003. The geochemistry position requires expertise in environmental analytical chemistry or geochemistry. A field-oriented research program, especially air, soil, and water field sampling as well as experience with environmental analytical laboratory techniques is preferred. The geophysics position requires expertise in environmental geophysics preferably with applications in coastal and/or aquatic systems. Experience should include environmental applications of one or more of the following geophysical techniques: resistivity profiling, shallow seismic exploration, ground-penetrating radar, gravity and/or magnetics. Additional information about the positions and the department is available at <http://www.csam.montclair.edu/earth/eesweb>.

Applicants should send cover letter, curriculum vitae, three letters of recommendation, and a statement of professional goals, research interests and teaching philosophy to: Dr. Matthew Goring, Search Committee Chair (VF39 Geochemistry or VF40 Geophysics), Dept. of Earth and Environmental Studies, Montclair State University, Upper Montclair, NJ 07043.

### STABLE ISOTOPE GEOCHEMISTRY UNIVERSITY OF IOWA

The Department of Geoscience at the University of Iowa invites applications for a full-time tenure-track Assistant or Associate Professorship in stable isotope geochemistry. We seek an outstanding researcher and teacher, who has developed or will develop an internationally recognized research program involving stable isotopes, and who will serve as Director of the Department's Paul H. Nelson Stable Isotope Laboratory (Finnigan MAT 252 IRMS with a Kiel III device, a Gasbench II H Device, and a Costech CHNS Analyzer). Desirable qualifications include expertise in areas offering collaborative opportunities with faculty within the department and university and the ability to attract external funding. The successful applicant typically will be responsible for teaching three courses per academic year including participation in the Environmental Science general education course rotation. Applicants should have their Ph.D. by the time the appointment begins in August 2003. Women and minorities are especially encouraged to apply. Applicants should send a complete resume (including a bibliography and a statement of teaching and research interests) and have at least three letters of recommendation sent to: Ann F. Budd, Search Committee Chair, Department of Geoscience, University of Iowa, Iowa City, IA 52242-1379 (phone 319-335-1818; Fax 319-335-1821; email: geology@uiowa.edu). Screening of applications will begin on January 20, 2003 and continue until the position is filled. The University of Iowa is an affirmative action-equal opportunity employer.

### HIGH-TEMPERATURE GEOCHEMISTRY OR GEOCHRONOLOGY UNIVERSITY OF IOWA

The Department of Geoscience at the University of Iowa invites applications for a full-time tenure-track Assistant Professor position under the broad umbrella of high-temperature geochemistry or geochronology. We seek an outstanding researcher and teacher, who will develop an internationally recognized research program involving the elemental or isotopic chemistry of rocks and minerals that precipitate at high temperatures. Desirable qualifications include expertise in areas offering collaborative opportunities with faculty within the department and university, the ability to attract external funding, and complementary teaching expertise. The successful applicant will typically be responsible for teaching three courses per academic year including participation in the core curriculum of the Geoscience B.S./B.A. degree. Applicants must have their Ph.D. by the time the appointment begins in August 2003. Women and minorities are especially encouraged to apply. Applicants should send a complete resume (including a bibliography and a statement of teaching and research interests) and have at least three letters of recommendation sent to: Dr. Mark K. Reagan, Search Committee Chair, Department of Geoscience, University of Iowa, Iowa City, IA 52242-1379 (phone 319-335-1818; Fax 319-335-1821; email: geology@uiowa.edu). Screening of applications will begin on January 20, 2003 and continue until the position is filled. The University of Iowa is an affirmative action-equal opportunity employer.

### THE UNIVERSITY OF TEXAS AT AUSTIN, FACULTY POSITION IN HYDROGEOLOGY

The Department of Geological Sciences at The University of Texas at Austin seeks to fill a faculty position in hydrogeology. The specific area of research is open, but we would be particularly interested in a scientist with a research background in: (1) modeling of flow, contaminant transport, and reactions on a variety of scales; (2) groundwater/surface water interactions; or (3) integrating geophysical methodologies with groundwater analyses. The rank for this position is open, and candidates at all levels will be considered. Successful candidate will join the newly formed Jackson School of Geosciences, which includes the Department of Geological Sciences, the Bureau of Economic Geology, and the Institute for Geophysics. The School has a large and diverse community of geoscientists, excellent research facilities and support and, through the Environmental Science Institute, opportunity to interact with faculty from many disciplines. The selected candidate will demonstrate the potential to conduct a vigorous externally funded research program and should be an enthusiastic teacher who is well qualified to direct the research of MS and PhD students. The anticipated starting date for this position is August 2003; a PhD is required at the time of appointment. Please refer to <http://www.geo.utexas.edu> for additional information. To apply: please send a curriculum vitae, statement of research and teaching interests, and the names and contact information for four references to: Hydrogeology Search, Department of Geological Sciences, The University of Texas at Austin, 1 University Station C1100, Austin, Texas 78712-0254. Review of applications will begin

December 1, 2002, and will continue until the position is filled. The University of Texas is an Equal Opportunity/Affirmative Action employer.

### CARLETON COLLEGE DEPARTMENT OF GEOLOGY POST-DOCTORAL TEACHING FELLOWSHIP IN GEOMORPHOLOGY

The Geology Department at Carleton College invites applications for a one-year (2/3 time) leave replacement position. We seek an individual with broad strengths in earth surface processes to teach geomorphology, one course in the applicant's specialty (such as hydrology or GIS/Remote Sensing) and possibly introductory geology. The appointment consists of a 2/3 time teaching load with access to departmental funds to support research while in residence at Carleton. We envision this position as a post-doctoral teaching fellowship, but qualified applicants who are ABD are also invited to apply. The ideal applicant will have demonstrated strong interests in teaching with an emphasis on field- and laboratory-oriented, hands-on learning.

Carleton's geology department averages between 16 and 30 majors in each graduating class; it is a vibrant place that emphasizes cooperation, discussion, field work, inquiry-based learning, creativity, and intellectual depth in a supportive atmosphere. Carleton's geology department has a strong, successful tradition of teaching geology as one of the liberal arts and we are looking for someone to help carry out that tradition.

The position begins in late August 2003. Interested individuals should submit a letter discussing their qualifications, statements of teaching and research interests plus a curriculum vitae with the names and addresses of at least three references (we will solicit letters for applicants passing the initial selection) to David M. Bice, Chair, Department of Geology, Carleton College, One North College Street, Northfield, MN 55057. Applications will be considered until an appointment has been made, but to ensure full consideration, applications should be received by Dec. 10, 2002. Carleton College is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply.

### GLOBAL ATMOSPHERIC CHANGE UNIVERSITY OF MICHIGAN

The Department of Geological Sciences intends to fill several tenure-track positions in Atmospheric Sciences during the next few years at the Assistant Professor level (or higher in exceptional cases). We are currently searching for a scientist engaged in the measurement and/or modeling of Global Atmospheric Change on geological or human timescales. The position is part of an effort to broaden the existing research base of the department in Earth Systems Science. We expect the successful applicant to develop a vigorous, externally funded research program and to show a commitment to teaching at both the graduate and undergraduate levels, including involvement in degree programs and interdisciplinary initiatives. A Ph.D. is required. Interested persons should send a curriculum vitae, brief statements of their research and teaching interests, evidence of teaching excellence, and the names, addresses and e-mail addresses of five persons from whom the Department may request letters of recommendation to: Atmospheric Search Committee Chair, Department of Geological Sciences, University of Michigan, Ann Arbor, MI 48109-1063 (e-mail: atmsearch@umich.edu). To ensure a careful evaluation, applications should be received by January 7, 2003. Women and minorities are encouraged to apply. The University is responsive to the needs of dual career couples.

## Opportunities for Students

**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 \$2,400 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, 2003. 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](mailto:pbi@geo.umass.edu). Tel (413) 545-3223. An Equal

**Ph.D. Student Assistantships.** Oregon State and Portland State Universities are offering fifteen Ph.D. research assistantships to explore all aspects of the Earth's sub-surface 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](mailto: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 2/1/02. Oregon State and Portland State Universities are committed to equality in education.

**Jonathan O. Davis Scholarship,** administered by the Division of Earth and Ecosystem Sciences, Desert Research Institute. The family and friends of Jonathan O. Davis, a prominent geologist and geoarchaeologist, have established an endowment which provides an annual scholarship of \$3750.00. Jonathan was tragically killed in an automobile accident in December 1990. It is the wish of his family and friends to support graduate students working on the Quaternary geology of the Great Basin and surrounding areas.

The scholarship is open to graduate students enrolled in an M.S. or Ph.D. program at any university in the United States. "Quaternary geology" encompasses a wide range of topics normally considered as part of the Quaternary sciences. The research, however, must have a substantial geologic component or demonstrate a strong reliance on geological techniques and must be focused on the Great Basin and immediately adjacent areas.

Applications should include: (1) a cover letter explaining how the individual qualifies for the award (please include your social security number); (2) a current resume or vitae; (3) a two-page, single-spaced description of the thesis/dissertation research, which emphasizes the student's ability and potential as a Quaternary scientist. Applications must be post-marked by February 2, 2003.

Applications should be addressed to: Executive Director, Division of Earth and Ecosystem Sciences, Desert Research Research Institute, 2215 Raggio Pkwy, Reno NV 89512. Contact: Barbara Jackson, (775) 673-7454 or email [bj@adri.edu](mailto:bj@adri.edu).

**Research/Teaching Assistantships. Graduate Program of Hydrologic Sciences.** University of Nevada, Reno. Applications are encouraged for graduate teaching/research assistantships beginning July 1, 2003. Positions carry an annual stipend of approximately \$14,000 including tuition and fees. Students interested in the area of ground water, surface water and aqueous geochemistry are encouraged to apply. Additionally, funded research assistantships are available in paleohydrology, contaminant transport, watershed hydrology and numerical simulation, as well as scholarships and doctoral fellowships offered through UNR and the Desert Research Institute. Completed application packages are due January 10, 2003 and should be mailed to: 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](http://www.hydro.unr.edu) or by calling 775-784-6250.

## Services and Supplies

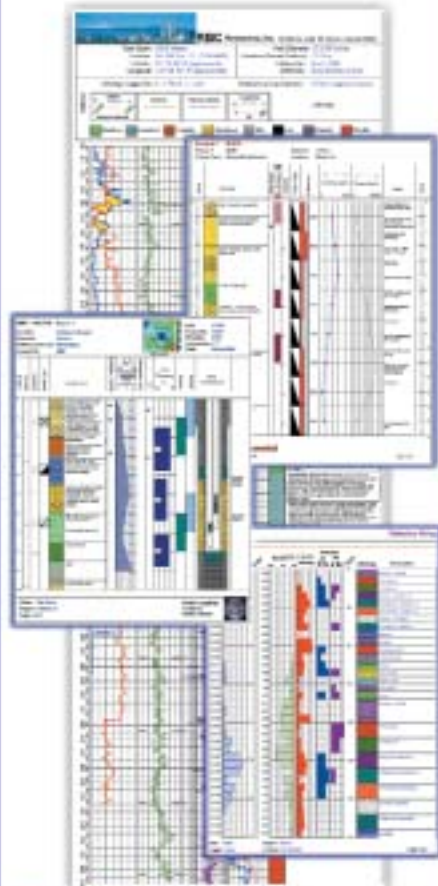
**BEAUTIFUL HOUSE ON THE BIG ISLAND OF HAWAII NEAR VOLCANO NATIONAL PARK.** Special long term rates. Visit [www.haleohou.com](http://www.haleohou.com). or call 1-888-823-5717.

**TRAVEL MAPS**—The world's largest online map catalog. Featuring city maps, topographic maps and digital maps worldwide. Call (336) 227-8300 or visit: [www.omnimap.com](http://www.omnimap.com).

**RECENT, RARE, AND OUT-OF-PRINT BOOKS.** We purchase single books and complete collections. Find our catalog at <http://home.earthlink.net/~msbooks> for books on Geology, Paleontology, Mining History (U.S. & International), Ore Deposits, USGS, Petroleum, Coal; e-mail: [msbooks@earthlink.net](mailto:msbooks@earthlink.net); MS Book and Mineral Company, P.O. Box 6774, Lake Charles, LA 70606-6774

# Logplot™

New Version!  
v. 2003



Mining Petroleum Environmental  
\$599.00 Standard  
\$199.00 Academic

## RockWare® Visual Seismic 2.0

2D, 3D & 4D Reservoir Analysis,  
Visualization & Interpretation



RockWare Visual Seismic is a PC-based 3D seismic visualization and interpretation system written by a career geophysicist.

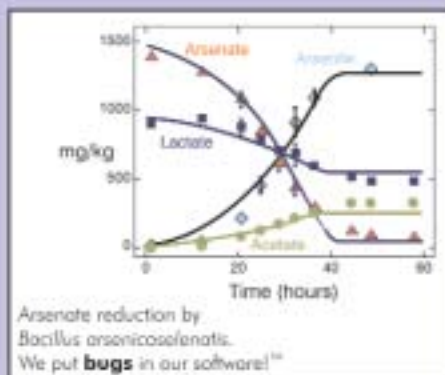
\$1,299 Introductory Price \$499 Academic

## The Geochemist's Workbench®

NEW VERSION! NEW USER INTERFACE! NEW DATA SOURCES! NEW MODELS! NEW TOOLS! NEW REPORTS! NEW HELP!

### New Version 4.0!

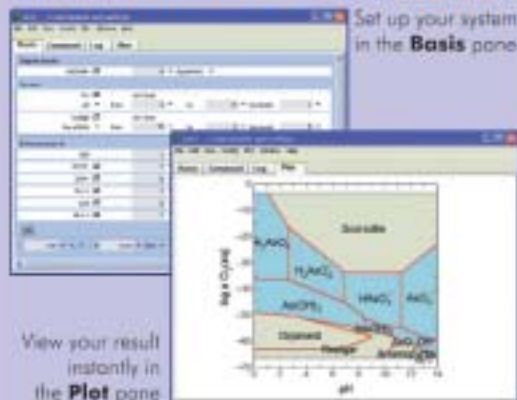
Windows 98/ME and NT/2000/XP



### GWB is your personal toolkit for

- Microbial metabolism and growth
- Reaction simulation
- Kinetics and custom rate laws
- Surface chemistry
- Isotope fractionation
- "Pitzer equations"
- Speciation
- Bioavailability
- Redox disequilibrium
- Calculating species distribution, speciation diagrams
- Eh-pH, pe-pH and activity-activity diagrams—in seconds!
- Catalysis, enzymes, biotransformations and more

### The new user interface— intuitive, efficient, friendly, powerful!



View your result instantly in the **Plot** pane

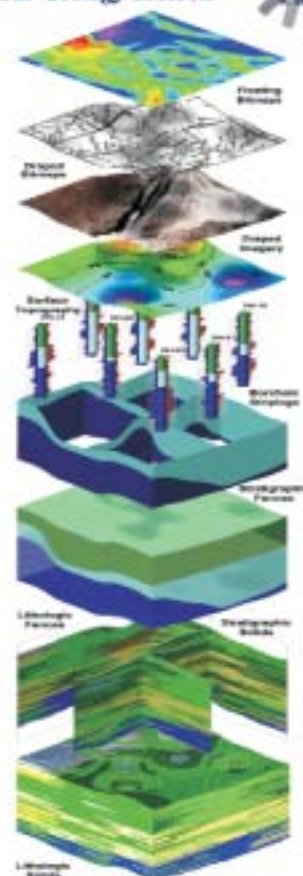
**Plus**  
All results presented graphically  
Powerful, fast & intuitive  
Easy-to-use interface designed by geochemists for geochemists

\$2,999.99 (\$1,599.00 Academic)

The Geochemist's Workbench® is a registered trademark of the University of Illinois.

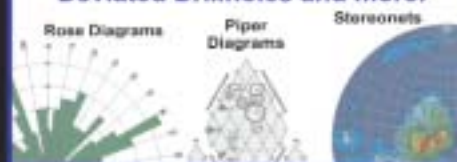
## RockWorks™

Your Geology Toolbox



\$999 Standard  
\$399 Academic

### Deviated Drillholes and more!



## Didger® 3

Didger precisely transforms points, lines, or areas from your paper maps, graphs, aerial photos, scanned raster images, imported vector files, or GeoTIFF images that you can use with your other software.



Digitize your maps with didger.

Price: \$319.00

**RockWare®**  
Earth Science & GIS Software

Over 200 Software Solutions at <http://www.rockware.com>

2221 East St. • Suite 101, Golden • Colorado 80401

1-800-775-6745 or 303-278-3534 • Fax 303-278-4099

RockWare Europe: vicolo del Saroll 1 • 6944 Cureglia • Switzerland

Tel: ++41 91 967 52 53 • Fax: ++41 91 967 55 50 Email: [europe@rockware.com](mailto:europe@rockware.com)