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INSIDE

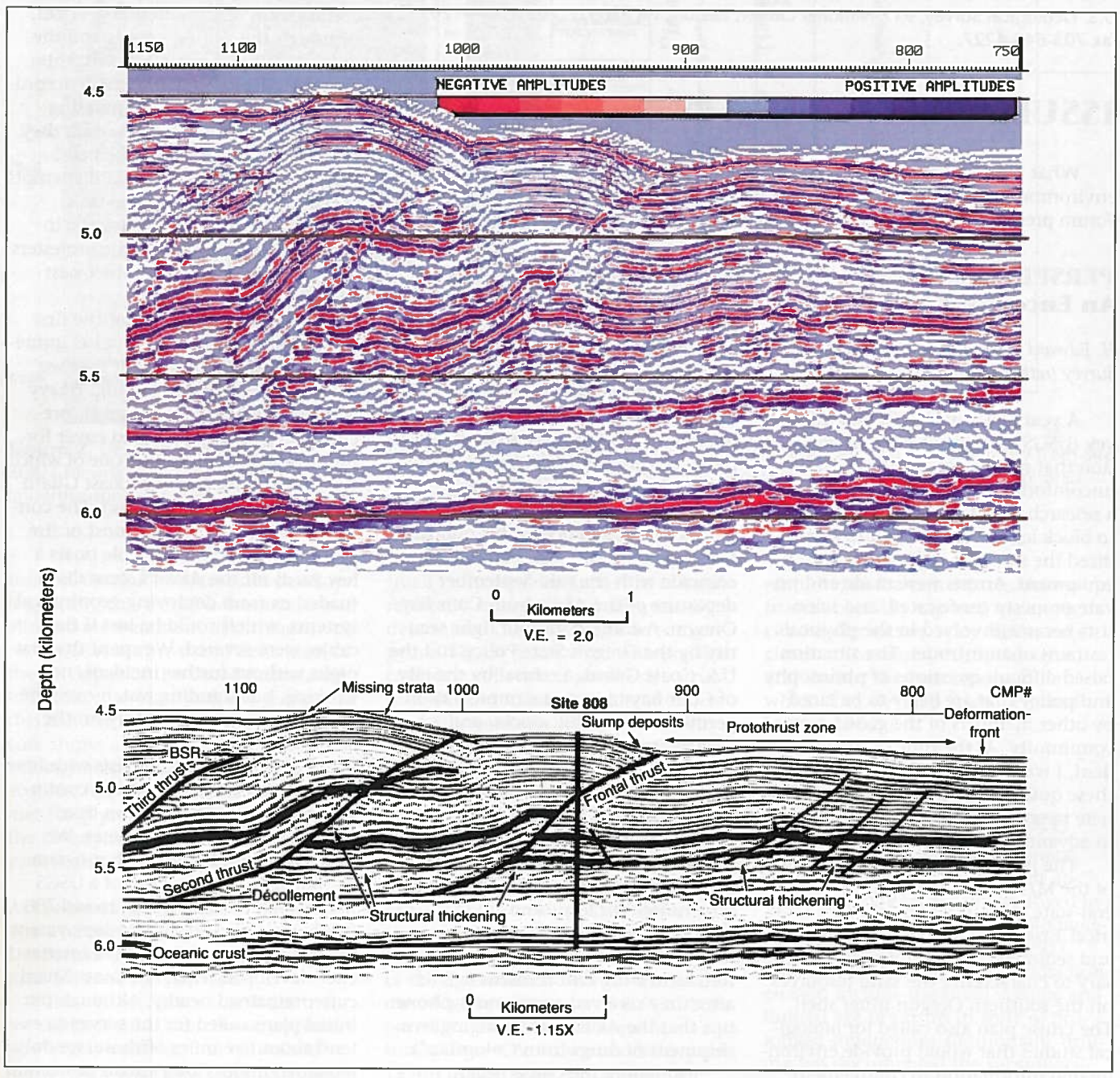

Figure 1. Seismic line along transect of recent Nankai Trough drilling. Upper section is a migrated, uninterpreted depth section with color scale to show seismic polarity. Lower profile shows structural interpretation (after Moore et al., 1991). BSR reflector probably represents a gas hydrate phase boundary.

Ocean Drilling and Accretionary Processes

J. Casey Moore
Earth Sciences, University of California, Santa Cruz, CA 95064

Asahiko Taira
Ocean Research Institute, University of Tokyo, 1-15-1 Minamidai, Nakano-ku, Tokyo 164, Japan

Greg Moore
SOEST, University of Hawaii, Manoa, Honolulu, HI 96822

ABSTRACT

Recent ocean drilling of accretionary prisms has penetrated completely through the incoming sedimentary section, crossing the plate boundary. Intriguing features observed on high-quality seismic reflection profiles have been confirmed and elucidated by drilling. Many structural fabrics that characterize shallowly buried on-land accretionary prisms have been sampled in drill cores, providing constraints on their conditions of formation; the validity of inferring plate-tectonic vectors from the orientation of structural fabrics has been confirmed by observations from the Nankai prism. Drilling into serpentine diapirs of the Mariana forearc reveals a mechanism for transport of blueschists and chemically exotic volcanic rocks from 10 to 20 km depth to the surface. Drilling has documented the ongoing emplacement of a tectonostratigraphic terrane in the Vanuatu fore arc. Subduction erosion of several drilled fore arcs is indicated by a small accretionary prism and substantial subsidence. Anomalies in pore-water geochemistry of drill cores demonstrate that fluids flow both laterally and vertically over tens of kilometres, primarily along faults. In the accretionary prism environment, fluids control structural evolution, cause a significant redistribution of heat, solutes, and solids, and feed surficial biological communities.

Drilling in the immediate future will focus on the processes of ridge-trench interaction off southern Chile, the role of fluid flow in gas hydrate genesis off Vancouver Island, and the dynamics of the faults that feed fluid to surface vents off Oregon. An ultimate goal of ocean drilling in fore arcs includes complete documentation of in situ conditions to understand the processes responsible for the geologic features of the cores. Additionally, the community hopes to drill deeply in accretionary prisms with long-term monitoring designed to record phenomena associated with the earthquake cycle. A broad range of earth scientists, including geologists, geophysicists, geochemists, hydrogeologists, petroleum geologists, and metamorphic petrologists, are needed to achieve these goals and build on the scientific synergism of this program.

INTRODUCTION

Fore arcs are the most dynamic tectonic environment on Earth, being characterized by the largest earthquakes and the highest strain rates. Accordingly, this plate-boundary regime has long been the target of ocean drilling investigations, with studies principally focused on tectonics. The Deep Sea Drilling Project (DSDP) documented the plate-tectonic concept of subduction accretion and discovered subduction erosion. The successor to DSDP, the Ocean Drilling Program (ODP), has focused on more specific process-oriented issues of structural evolution in accretionary prisms, including the calibration of the ever-improving seismic reflection images, and of material transfer during both accretion and subduction erosion. Recently the major scientific driving force for ocean drilling in fore arcs has been the interaction of fluids and rocks in this saturated, structurally complex regime.

ACCRETION

DSDP investigations demonstrated that deposits of the oceanic plate were being progressively accreted at the deformation front of accretionary prisms, verifying simple plate-tectonic models of accretion (Moore, Watkins, et al., 1979). Drilling results also showed that underthrust sediments were underplated at depth (Watkins et al., 1981), that frontally accreted material can constitute only a rind a few kilometres thick, and therefore that the great bulk of subaerially exposed and eroded prisms must have been emplaced by underplating. Recent drilling investigations have fostered better interpretations of subaerially exposed equivalents by further elaborating large-scale processes.

Accretionary Processes: Calibration of Seismic Reflection Images

Over the past decade the quality of seismic reflection images of accretionary prisms has improved dramatically and has provided tantalizing targets for drilling. For example, the seismic reflection profile crossing the deformation front of the Nankai accretionary prism in southwestern Japan outlines a series of imbricate thrusts and a subjacent decollement in unparalleled detail (Fig. 1; Moore et al., 1991). Drilling near the deformation front of this accretionary prism penetrated completely through the incoming sedimentary sequence, transecting the frontal thrust, the decollement zone, and underthrust deposits to the ocean crust (Taira, Hill, Firth, et al., 1991). The drill core characterized the

Ocean Drilling *continued on p. 267*

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IN THIS ISSUE

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Prepared from contributions from the GSA staff and membership.
Executive Director: F. Michael Wahl, Ph.D.
Science Editor: Eldridge M. Moores
Department of Geology, University of California, Davis, CA 95616
Forum Editor: Bruce F. Molnia
U.S. Geological Survey, MS 917, National Center, Reston, VA 22092
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GSA FORUM

Bruce Molnia, Forum Editor

Forum is a monthly feature of *GSA Today* in which many sides of an issue or question of interest to the geological community are explored. Each Forum presentation consists of an informative, neutral introduction to the month's topic followed by two or more opposing views concerning the Forum topic. Selection of future Forum topics and participants is the responsibility of the Forum Editor. Suggestions for future Forum topics are welcome and should be sent to: Bruce F. Molnia, Forum Editor, U.S. Geological Survey, 917 National Center, Reston, VA 22092; (703) 648-4120; fax 703-648-4227.

ISSUE: Confrontational Geology

What is and what should be the relationship between the earth science and environmental communities? The two perspectives presented in this month's Forum present a side of this issue about which many of us are completely ignorant.

PERSPECTIVE 1: An Encounter at Sea

H. Edward Clifton, U.S. Geological Survey (retired), Ponca City, Oklahoma

A year ago, my U.S. Geological Survey (USGS) duties put me in a situation that ranked among the most uncomfortable for me in my career as a research scientist. Physical attempts to block legitimate research jeopardized the safety of individuals and equipment. Arrests were made and private property confiscated, and scientists became involved in the physical restraint of an intruder. The situation raised difficult questions of philosophy and policy that are likely to be faced by other members of the geoscience community. At the time of the incident, I was unprepared to address these questions and I present them here to encourage their consideration in advance of future problems.

The problems centered on a cruise of the M/V *Aloha*, proposed by a federal-state Oregon Placer Minerals Technical Task Force to collect geophysical and sedimentologic information necessary to characterize the sand resources on the southern Oregon inner shelf. The cruise plan also called for biological studies that would provide environmental information to complement the mineralogic characterization. The cruise was funded mostly by the Minerals Management Service, although substantial financial and in-kind contributions, including most of the scientific staff for the cruise, were provided by the USGS, U.S. Bureau of Mines, Oregon State Department of Geology and Mineral Industries, Oregon State Department of Fish and Wildlife, and the Marine Minerals Technology Center of the University of Mississippi.

The task force, beginning in October 1988, held open informational and planning meetings in Oregon coastal communities. A few residents of Curry County, Oregon, attended these meetings and expressed their concern about possible environmental degradation resulting from shelf placer mining. The task force repeatedly (and unsuccessfully) tried to emphasize that characterizing the heavy-mineral resource potential of the shelf was far removed from any offshore mining, which would require substantial further exploration and much detailed environmental analysis.

A July 1990 meeting in Curry County was held in an atmosphere of mounting opposition to the cruise from the coastal communities. It attracted a crowd of local residents who vociferously argued that the cruise would "open the door" to offshore mining with resulting losses to the commercial fishing, sport fishing, and tourist industries that are the foundation of the area's economy. The attendees were clearly frustrated by the task force's refusal to cancel the cruise and rejected the task force's repeated assertion that the purpose of the cruise was research rather than exploration. A representative of Greenpeace voiced that organization's opposition to the cruise and threatened court action against the project.

As a consequence of this opposition, a protest rally was planned to coincide with the mid-September departure of the *Aloha* from Coos Bay, Oregon. A combination of tight security by the Oregon State Police and the U.S. Coast Guard, a refusal by the city of Coos Bay to issue a demonstration permit for the public docks, and a weather-related delay in the arrival of the *Aloha* appeared to defuse the protest. A rally attended by 40–50 people was held two days before the *Aloha*'s departure at a nearby county park, but the cruise began without incident (other than the *Aloha*'s detainment for four hours in Redwood City, California, where it had come to load USGS equipment, by U.S. Customs and Drug Enforcement agents after they received anonymous phone tips that the *Aloha* was "bringing in a shipment of drugs from Colombia").

Just before the cruise began, I learned that the Greenpeace activist vessel *Rainbow Warrior* was moored about 10 miles from our primary area of investigation. Although Greenpeace publicly asserted that it would not interfere with the cruise, I suspected otherwise and sought counsel on an appropriate stance should problems occur. The Minerals Management Service agreed with me that the cruise should proceed in a nonconfrontational manner, collecting data as possible. The Coast Guard said that it could act only if a law was broken but requested notification if Greenpeace or others attempted to interfere with our operation.

After departing from Coos Bay, we arrived early in the afternoon at our primary target area, where we were met by the *Rainbow Warrior* and about 10 fishing vessels. A spokesperson for Greenpeace radioed a request that we withdraw from the operation. We declined. Immediately, three inflatable boats from the *Rainbow Warrior* and several of the fishing vessels approached the *Aloha* so closely as to preclude safe deployment of sampling or geophysical gear. We refused to react to insults and threats shouted at us from vessels that cut across our bow and stern, but the situation was tense and unpredictable. Repeated attempts by the captain of the *Aloha* to contact the Coast Guard on various radio channels were thwarted by interference (jamming?). Fortunately, navigational support personnel on an adjacent headland relayed a call for help to the Coast Guard in Coos Bay, about 40 miles to the north.

After surveying the scene by helicopter, the Coast Guard deployed a cutter and established a 500-yard safety perimeter around the *Aloha*, for as long as we remained within the three-mile limit. The protesters were notified that violation of the safety perimeter would result in arrest and confiscation of any offending vessel. Although the fishing vessels and the *Rainbow Warrior* complied with this directive, the inflatables (which according to Greenpeace were "operating independently") did not. Instead, they remained alongside the *Aloha* and eluded subsequent Coast Guard attempts at apprehension. I felt this to be a highly significant turn of events, in that it shifted the focus of the protesters' confrontation from us to the Coast Guard.

Late in the afternoon of the first day, with the Coast Guard vessel immediately off our stern, we felt that we could safely initiate sampling. Heavy wind and fog at dusk, however, precluded coring and provided cover for the Greenpeace inflatables (one of which was apprehended by the Coast Guard in a sudden strike after dark). The continued presence through most of the night of two other inflatable boats a few yards off the *Aloha*'s stern dissuaded us from deploying geophysical systems, which could be lost if their cables were severed. We spent the first night without further incident, not working, but standing watch over the scientific gear stored openly on the afterdeck.

With daylight, all activists withdrew to the *Rainbow Warrior*, which continued to shadow our operation from beyond the 500-yard perimeter. We proceeded with the research program including the deployment of a USGS magnetometer from a float towed 700 feet behind the *Aloha*. This deployment seemed risky, but no protester interference developed while the Coast Guard cutter remained nearby. Although our initial plans called for the survey to extend about five miles offshore, we only remained under Coast Guard protection within the three-mile limit, which fortunately included most of the previously identified targets.

In part because of operational problems with the coring equipment, we shifted the site of our operation during the second night to the calmer shelf environment off Gold Beach, about 40 miles to the south. The Coast Guard accompanied us; the *Rainbow Warrior* did not. We continued coring efforts at daybreak of the third day and proceeded without interruption, although at mid-morning we were rejoined by the *Rainbow Warrior* and a fleet of about a dozen fishing vessels, which circled us at the margin of the safety perimeter. At this point, four Coast Guard vessels and a helicopter were present. Our more-or-less successful attempts to ignore these distractions stopped abruptly when three Greenpeace inflatable boats suddenly raced alongside the *Aloha*. Two activists quickly boarded the *Aloha*. One climbed unimpeded onto the A-frame, intending to chain herself to the vessel. The intent of the other was not clear; as he approached an unaware member of the scientific staff, he was tackled by a member of the ship's crew who feared for the scientist's safety. This activist was restrained and subsequently bound by members of the ship's crew and the scientific staff.

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Ocean Drilling *continued from p. 265*

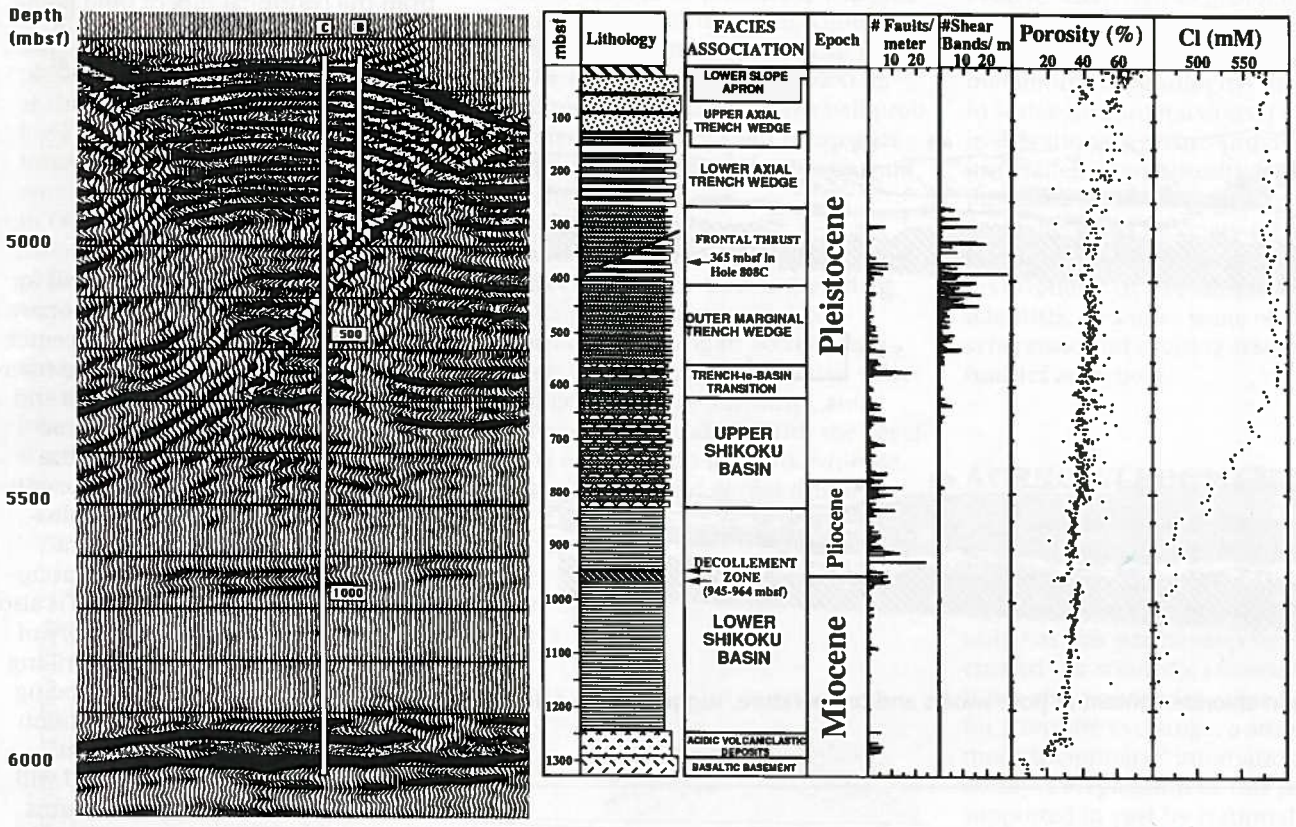

Figure 2. Detail of seismic reflection data showing lithology, structural geology, physical properties, and fluid chemistry from Site 808. Chloride values are millimoles per litre. Note sharp decrease in porosity across decollement zone, apparently due to rapid underthrusting of sediments beneath the accretionary prism (from Taira, Hill, Firth, et al., 1991).

small-scale structural features developing during this initial deformation and allowed measurement of displacement on the frontal thrust and definition of the thickness of the decollement zone. In addition to clarifying the geology of this zone of initial deformation, the core shows a sharp decrease in acoustic velocity and density, leading to a lower acoustic impedance across the decollement and providing an explanation for the reversed reflection polarity of this surface (Fig. 2; G. F. Moore et al., 1990).

Accretionary Processes: Small-scale Structures, Convergence Directions, Fabric Evolution, and Stratal Disruption

The extraordinary core from the toe of the Nankai accretionary prism was largely coherent but contained many small-scale structures reflecting the deformation of the incoming sedimentary section. Most spectacularly, small faults and conjugate shear bands faithfully recorded the geophysically determined direction of plate convergence (Fig. 3). Such verification of the connection between small-scale structural development and plate motions lends a whole new level of credibility to studies that claim this correlation in ancient rocks (e.g., Byrne, 1984).

Where sampled by drilling, the initial deformation of the incoming sediments is largely coherent; however, transects across several accretionary prisms show development of stratal disruption or melange-style deformation at shallow depths. For example, stratal disruption occurs within 14 km of the deformation front of the Barbados Ridge in sediments of 40% to 50% porosity near an out-of-sequence thrust (Figs. 4, 5; Brown and Behrmann, 1990). In aggregate, DSDP and ODP drill cores from accretionary prisms have identified the initial stages of many small-scale structures known from subaerially exposed melanges (stratal disruption, scaly fabric, cataclastic shear zones, disrupted veins) and limited the conditions under which they develop (Lundberg and Moore, 1986).

NONACCRETION AND SUBDUCTION EROSION

In some fore arcs, accretionary prisms are conspicuous by their absence and may have been removed by subduction erosion or strike-slip faulting (von Huene and Scholl, 1991). Drilling results supporting subduction erosion include the small volume and limited age of prisms in spite of prolonged subduction; additionally, drilling has documented the subsidence of fore arc regions, suggesting removal of material (Fig. 6; von Huene et al., 1980; von Huene, Suess et al., 1988). Nonaccretion is difficult to distinguish from subduction erosion, but it may be occurring off Guatemala (Aubouin and von Huene, 1985). Nonaccretion and subduction erosion, like stratigraphic unconformities, leave gaps in the rock record, which if unrecognized radically diminish our understanding of geologic history.

Basal abrasion of the upper plate by horsts and grabens or other irregularities on the downgoing plate, known as the buzz-saw model (Hilde, 1983), has been a popular mechanism for subduction erosion. However, high-quality seismic data show that the decollement rides smoothly over the horsts without obvious basal erosion (Shipley and Moore, 1986). Alternatively, the underthrusting of seamounts may cause local oversteepening and slope failure, and therefore erosion of the toe of the prism (von Huene and Lallemand, 1990; Taira and Pickering, 1991).

BLUESCHISTS, EXOTIC BLOCKS, SERPENTINE DIAPIRS, AND TERRANES

How high-grade exotic blocks are mixed with materials of lower metamorphic grade is a perennial problem of accretionary tectonics. Recent penetrations of serpentine diapirs and serpentine volcanoes in the Mariana fore arc (Fryer, Pearce, Stokking, et al., 1990) document intermixed blocks of mid-ocean ridge basalt (MORB) (Johnson et al., 1991) and blueschist (Maekawa et al., 1992). The metamorphic grade indicates transport of the blueschists from sources 13–18 km below the serpentine volcano (Fig. 7). The serpentine diapirs penetrate island-arc volcanic rocks at the surface about 50 km arcward of the modern trench; oceanic rocks have been recovered in drill cores and dredges from the lower trench slope (Johnson et al., 1991). Apparently, the source of the MORBs and blueschists in the serpentine diapir is some of these accreted rocks that extend beneath the fore arc.

Exotic tectonostratigraphic terranes are interpreted as rafted fragments of oceanic plateaus or island

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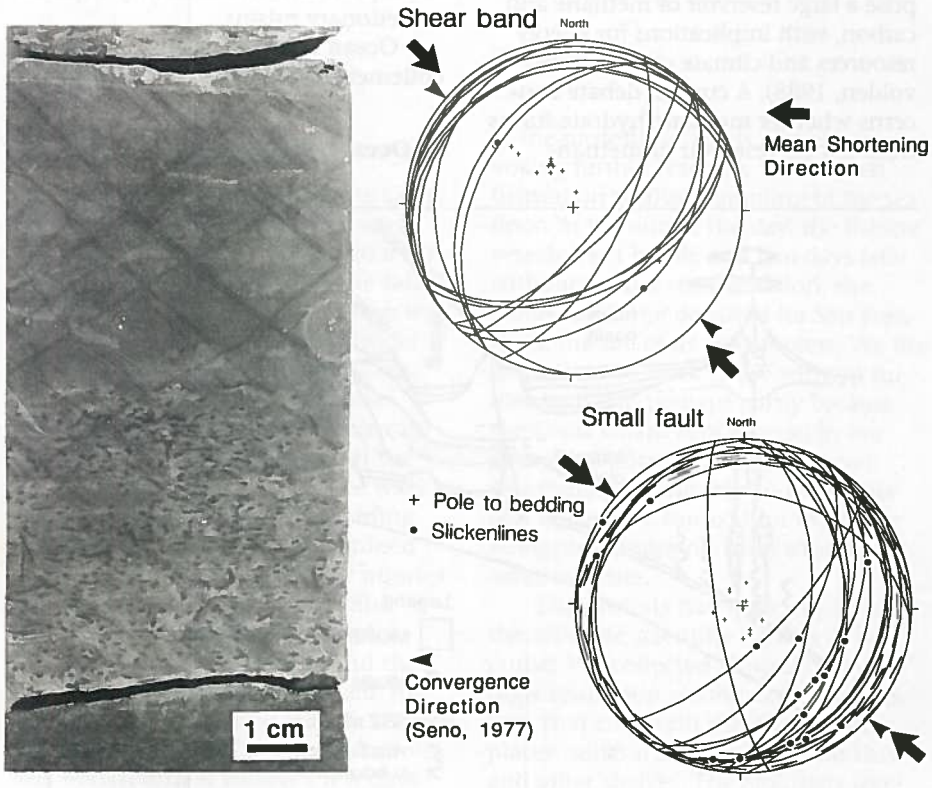

Figure 3. Conjugate shear bands and lower-hemisphere stereonets of paleomagnetically reoriented conjugate shear bands and faults (after Taira, Hill, Firth, et al., 1991). Shortening direction from these structures (northwest-southeast) coincides with the local plate-tectonic convergence direction (Seno, 1977).

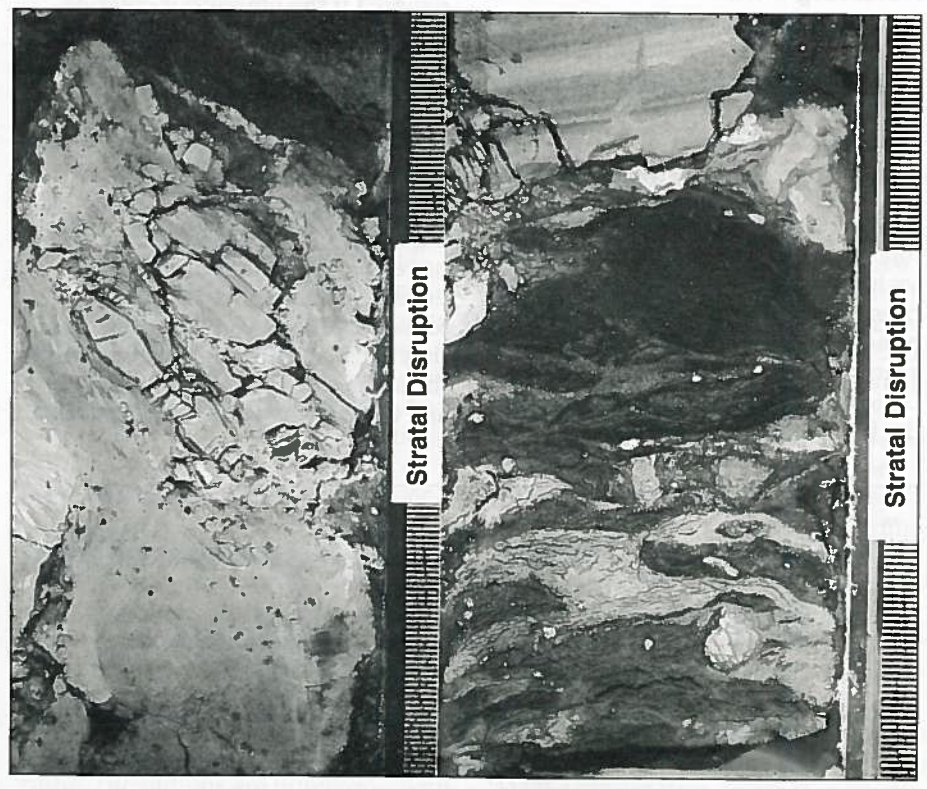

Figure 4. Stratal disruption developed cores sampled from 260 m subbottom from Site 674 of the northern Barbados Ridge (Brown and Behrmann, 1990). Stratal disruption developed adjacent to an out-of-sequence thrust (Fig. 5). Some of the horizontal banding in the core section to the right is due to drilling deformation, but geologic processes caused the dispersion of sandstone fragments. Scale to right of the core is in millimetres.

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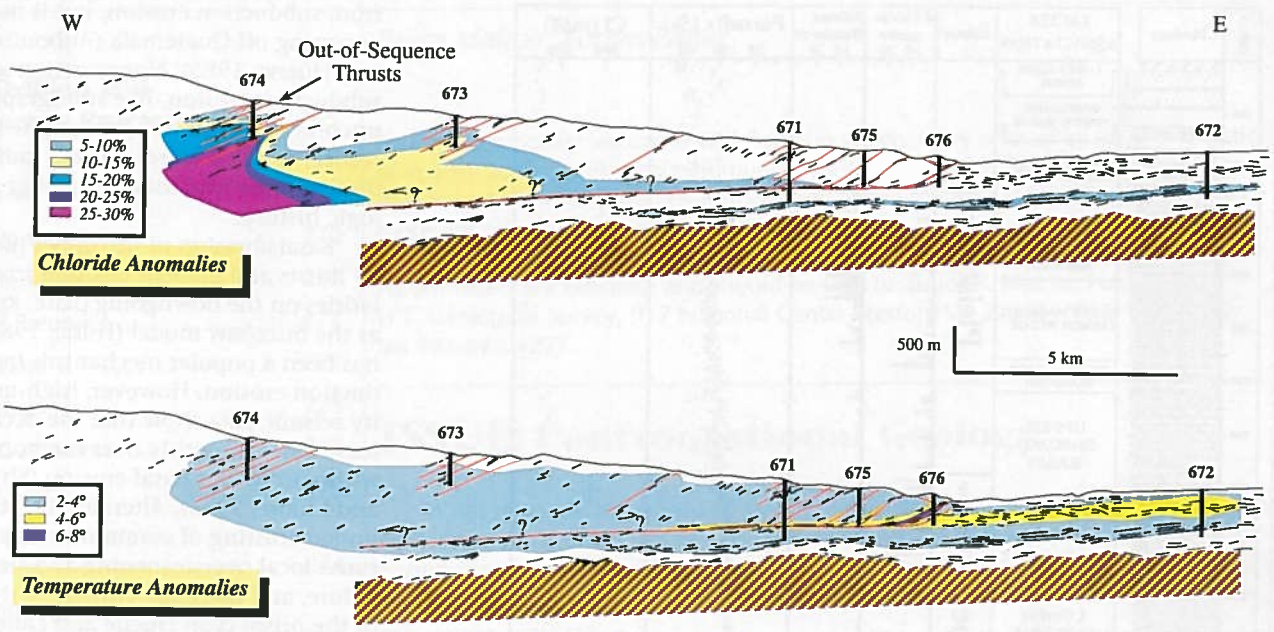

Figure 5. Barbados cross section showing anomalies in chloride content of pore waters and temperature, suggesting fluid flow, especially along faults (after Vrolijk et al., 1991).

arcs. Recent drilling in the Vanuatu fore arc of the southwest Pacific has unequivocally demonstrated the accretion of sediments and MORB volcanic rocks from an incoming oceanic high as discrete thrust sheets, in a sense, forming a tectonostratigraphic terrane (Collot, Green, Stokking, et al., 1992).

FLUIDS IN ACCRETIONARY PRISMS

Although it has long been recognized that high fluid pressures facilitate thrust faulting and therefore are important in accretionary prisms (e.g., von Huene and Lee, 1982), only recently did earth scientists fully appreciate the important role of fluids in water-rock interactions, compositional changes, and solute and heat transfer. In retrospect the importance of fluids is obvious because accretionary prisms consist of partially consolidated sediments being rapidly deformed and buried in a water-saturated environment. However, documentation of fluid-flow paths, sources, rates, and effects has just begun.

Detecting Fluid Flow: Defining Conduits

The conduits of fluid flow have been best detected through mapping anomalies in pore-water chemistry and temperature (Fig. 5; Gieskes et al., 1990; Kastner et al., 1991; Fisher and Hounslow, 1990). In each case the fluid geochemistry or in situ temperature deviated from background values; such deviations would be lost to either chemical or thermal diffusion within hundreds to hundreds of thousands of years unless continually resupplied. Generally, drilling results indicate that the fluid is flowing along faults, probably via fracture permeability (Moore, Mascle, et al., 1988; Suess, von Huene, et al., 1988; Taira, Hill, Firth, et al., 1991). Other investigations of modern accretionary prisms have argued for diffuse fluid flow through intergranular permeability (Davis et al., 1990; Han and Suess, 1989) or focused flow along sand layers (J. C. Moore et al., 1990). Studies of modern accretionary prisms are focused on understanding of their overall plumbing over a range of lithologic variations and structural styles. Although geochemical and temperature data have revealed much about the geometry of fluid flow, little is known about pore pressures, fracture permeability, and flow rates.

Long-Distance Migration of Fluids

Drilling results indicate long-distance migration of fluids over tens of kilometres. The pore waters along the decollement near the deformation front of the northern Barbados Ridge (Fig. 5) contain thermogenic methane, requiring formation temperatures of more than 100 °C and deep sources many tens of kilometres arcward from the deformation front (Vrolijk et al., 1990). Similarly, deep sources are required if the ubiquitous chloride-poor waters (Fig. 5) are derived from dehydration of smectite, which also must occur above at least 100 °C (Pytte and Reynolds, 1989). These chemically exotic fluids are but a small proportion of the water produced by the total volume of fluid expelled during burial of a sediment package (Kastner et al., 1991); they must be produced after substantial porosity reduction due to consolidation, and they must be efficiently transported to the surface to avoid dilution. Thus, any faults along which the fluids flow must root deeply and be of relatively high permeability (Fig. 8). The serpentine volcanoes of the Mariana fore arc (Fig. 7) expel fluids containing thermogenic hydrocarbons probably derived from sedimentary organic matter (Haggerty, 1991). Because the rocks surrounding the serpentine volcanoes are volcanic basement, the logical source of the organic matter is underthrust or underplated material, implying many kilometres of vertical fluid migration (Haggerty, 1991).

Bottom-Simulating Reflectors, Methane Hydrate, Energy Resources, and Global Change

Bottom-simulating reflectors that cut across stratigraphic layering and faults are widespread along outer continental slopes (BSR reflector in Fig. 1). Both DSDP and ODP drilling principally in fore arcs has shown that these reflections arise from the phase boundary between methane hydrate (a methane-water ice) above and liquid water and methane below (Shipley and Didyk, 1982; Kvenvolden and McDonald, 1985; Kvenvolden and Kastner, 1990). The solid methane hydrate contains up to 160 times its volume in free gas, and its widespread distribution may comprise a large reservoir of methane and carbon, with implications for energy resources and climate change (Kvenvolden, 1988). A current debate concerns whether methane hydrate forms from a local reservoir of methane (Kvenvolden and Kastner, 1990) or from the continual flux of fluid being expelled from a consolidating sedimentary sequence (Hyndman et al., 1991).

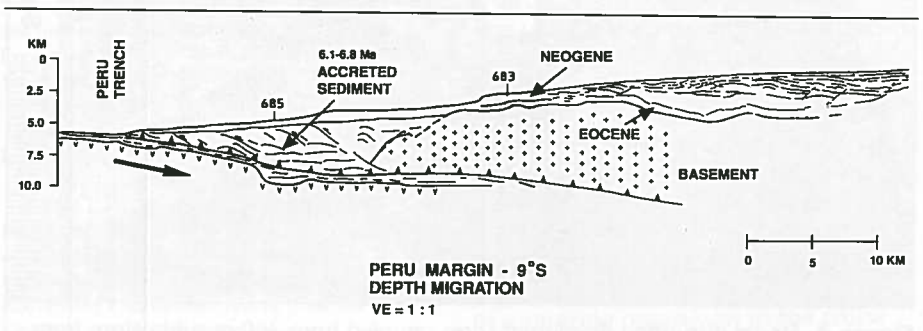

Figure 6. Peru margin cross section based on results of ODP Leg 112 (von Huene, Suess, et al., 1988). Note the limited development of the extent of the accretionary complex. A mid-slope sedimentary sequence has undergone considerable subsidence during the Tertiary, presumably due to subduction erosion.

FUTURE PLANS

1992 Drilling: Chile Triple Junction and Cascadia

The Chile drilling program will for the first time penetrate an accretionary prism where an active spreading center is being underthrust. The expected interaction of both the basaltic magma and high-temperature fluids in this structurally complex environment of the accretionary prism should provide critical uniformitarian models for evaluation of inferred ridge-trench interactions in the geologic record. The accretionary prism of the Chile trench is also of limited volume, despite a history of subduction from the Mesozoic; drilling should provide a better understanding of the processes of subduction erosion or nonaccretion along this margin.

Drilling off Vancouver Island will test whether methane hydrate forms by flow of fluids from depth, with the progressive scavenging of methane from fluid and its concentration in the solid hydrate layer. Off Oregon, faults that supply fluid to prism vent communities will be penetrated; these faults show anomalous seismic reflections, suggesting overpressuring, dilation, and active fluid flow. Here drilling may calibrate the seismic reflection data to allow remote mapping of hydrological properties of faults. Long-term monitoring of pressure and temperature is planned in boreholes in the Cascadia prism.

Down-hole Measurements and Long-term Monitoring

Ocean drilling has been very successful in obtaining cores to depths greater than 1300 m in the fore-arc environment. Thus, the basic geologic features of this environment are becoming well defined. True understanding of the processes active during the development of these features requires down-hole measurements of temperature, stress, fluid pressure, permeability, and in situ pore-water chemistry. These measurements are difficult to achieve but are essential to interpret completely both the drill cores and the rocks preserved in subaerially exposed accretionary prisms.

Ocean drilling through the decollement zone transects convergent

Ocean Drilling *continued on p. 269*

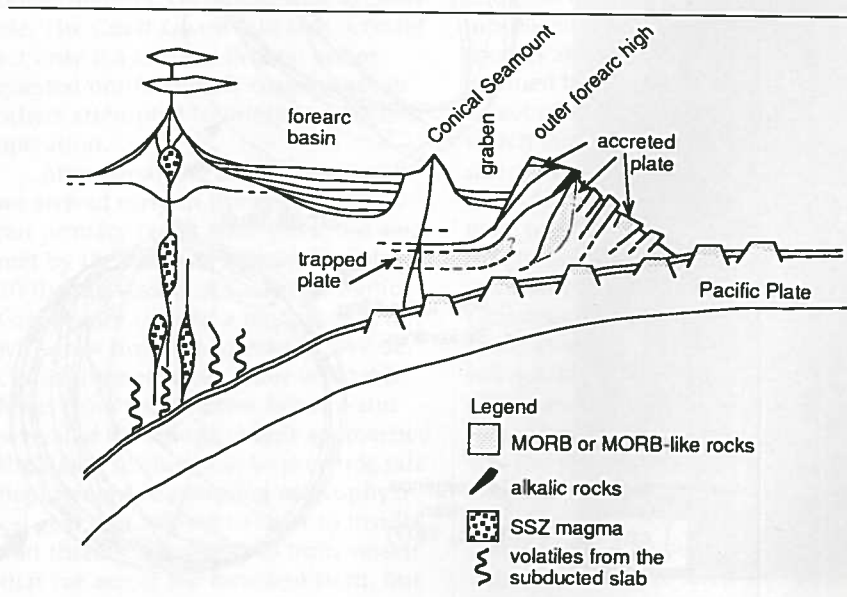

Figure 7. Schematic cross section through the Mariana fore arc showing serpentine volcanoes (conical seamount) and possible source depths for MORBs and blueschists included in serpentine of drill cores (Johnson et al., 1991).

Ocean Drilling *continued from p. 268*

plate boundaries, which at depth produce Earth's largest earthquakes. The presence of fluids from deep sources at shallow depths demonstrates a hydrologic connection to the seismogenic interval of the plate boundary. By emplacement of appropriate sensors in faults accessible by drilling, we can monitor fluid pressure variations and perhaps correlate these variations to the earthquake cycle.

Deeper Drilling

Although high-quality down-hole measurements are a must for understanding processes in accretionary prisms, deeper drilling is necessary to link these insights more effectively with exposures of subaerially exposed equivalents. The current maximum depth of more than 1300 m can probably be extended to 1500 to 2000 m. Drilling beyond these depths will probably require some system to equalize lateral stresses, probably a heavy mud system.

Broadening of the Constituency of Accretionary Prism Drilling

Currently the principal constituency of drilling in accretionary prisms consists of geophysicists, structural geologists, geochemists, and geotechnical specialists. With the developing emphasis on fluids, down-hole measurements, and deeper drilling, participation is needed from hydrogeologists interested in geologic problems, from petroleum geologists interested in fluid migration, and from metamorphic petrologists interested in water-rock interactions. Drilling in accretionary prisms provides the unparalleled opportunity to evaluate processes while they are occurring. The problems of accretionary prism evolution are multidisciplinary, require the involvement of a broad group of earth scientists, and offer some of the most synergistic and exciting research opportunities anywhere.

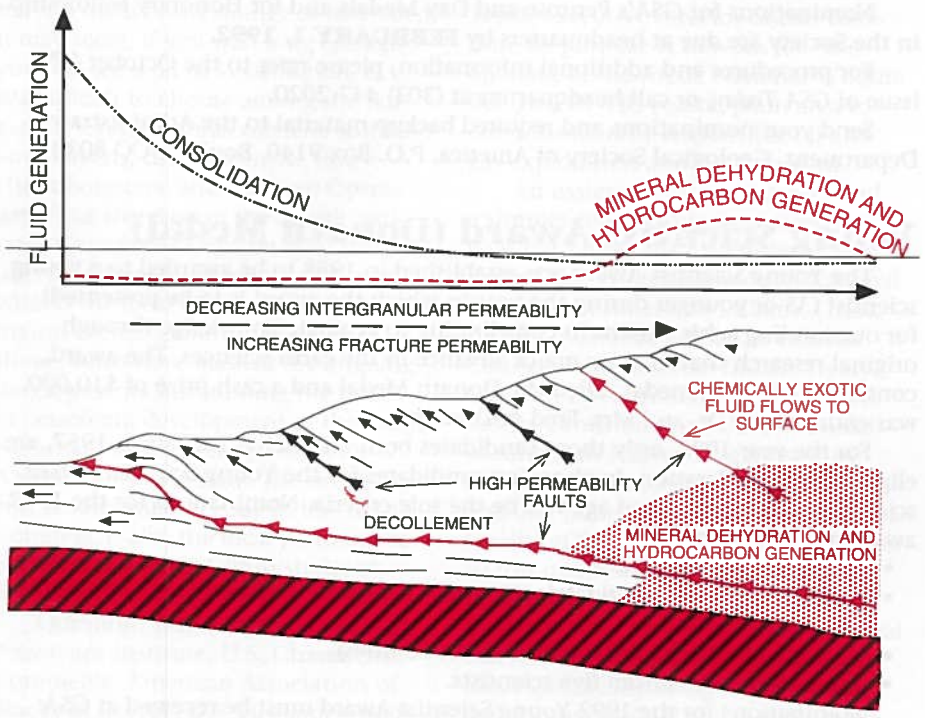

Figure 8. Diagram showing how faults tap deep sources, even in a sandy accretionary prism. Faults and stratigraphic layers have approximately equivalent permeabilities near a deformation front; active faults maintain high permeabilities landward through the accretionary prism. Conversely, stratigraphically controlled conduits decrease substantially in permeability landward because of cementation, consolidation, and deformation. Fluid generation due to consolidation decreases sharply landward and is relatively small at the onset of fluid production due to mineral dehydration and generation of thermogenic hydrocarbons. Active faults cutting into regions of fluid generation by mineral dehydration and hydrocarbon generation can transport chemically exotic fluids to the surface. Arrow length is approximately proportional to the log of permeability.

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REFERENCES CITED

Aubouin, J., and von Huene, R., 1985, Summary: Leg 84, Middle America Trench transect off Guatemala and Costa Rica, *in* von Huene, R., Aubouin, J., et al., Initial reports of the Deep Sea Drilling Project, Volume 84: Washington, D.C., U.S. Government Printing Office, p. 939–957.

Brown, K.M., and Behrmann, J., 1990, Genesis and evolution of small-scale structures in the toe of the Barbados Ridge accretionary wedge, *in* Moore, J. C., Mascle, A., et al., Proceedings of the Ocean Drilling Program, scientific results, Volume 110: College Station, Texas, Ocean Drilling Program, p. 229–244.

Byrne, T., 1984, Early deformation in melange terranes of the Ghost Rocks Formation, Kodiak Islands, Alaska, *in* Raymond, L.A., ed., Melanges: Their nature, origin, and significance: Geological Society of America Special Paper 198, p. 21–52.

Collot, J.-Y., Green, G., Stokking, L., et al., 1992, Proceedings of the Ocean Drilling Program, initial reports, Volume 125: College Station, Texas, Ocean Drilling Program (in press).

Davis, E., Hyndman, R.D., and Villinger, H., 1990, Rates of fluid expulsion across the northern Cascadia accretionary prism: Constraints from new heat flow and multichannel seismic reflection data: Journal of Geophysical Research, v. 95, p. 8869–8889.

Fisher, A.T., and Hounslow, M., 1990, Heat flow through the toe of the Barbados accretionary complex, *in* Moore, J. C., Mascle, A., Taylor, E., et al., Proceedings of the Ocean Drilling Program, initial reports, Volume 110, Part B: College Station, Texas, Ocean Drilling Program, p. 345–363.

Fryer, P., Pearce, J.A., Stokking, L.B., and 24 others, 1990, Summary of results from Leg 125, *in* Proceedings of the Ocean Drilling Program, initial reports., Volume 125: College Station, Texas, Ocean Drilling Program, p. 367–380.

Gieskes, J.M., Vrolijk, P., and Blanc, G., 1990, Hydrogeochemistry of the Northern Barbados Accretionary complex transect: Ocean Drilling Program Leg 110: Journal of Geophysical Research, v. 95, p. 8809–8818.

Haggerty, J.A., 1991, Evidence from fluid seeps atop serpentine seamounts in the Mariana Forearc: Clues for emplacement of the seamounts and their relationship to forearc tectonics: Marine Geology, v. 102.

Han, M.W. and Suess, E., 1989, Subduction-induced pore fluid venting and the formation of authigenic carbonates along the Cascadia continental margin: Implications for the global Ca-cycle: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 71, p. 97–118.

Hilde, T.W.C, 1983, Sediment subduction versus accretion around the Pacific: Tectonophysics, v. 99, p. 381–397.

Hyndman, R.D., Davis, E.E., and Bornhold, B., 1991, A mechanism for the formation of methane hydrate and seafloor bottom simulating reflectors by vertical fluid expulsion: Journal of Geophysical Research, v. 96.

Johnson, L., Fryer, P., Taylor, B., Silk, M., Jones, D.L., Sliter, W.V., Tetsumaru, I., and Teruaki, I., 1991, New evidence for crustal accretion in the outer Mariana forearc: Cretaceous radiolarian cherts and mid-ocean ridge basalt-like lavas: Geology, v. 19, p. 811–814.

Kastner, M., Elderfield, H., and Martin, J.B., 1991, Fluids in convergent margins: What do we know about their composition, origin, role in diagenesis and importance for oceanic chemical fluxes?: Royal Society of London Philosophical Transactions, ser. A, v. 335, p. 275–288.

Kvenvolden, K.A., 1988, Methane hydrates and global climate: Global Biogeochemical Cycles, v. 2, p. 221–229.

Kvenvolden, K.A., and Kastner, M., 1990, Gas hydrates of the Peruvian outer continental margin, *in* Suess, E., von Huene, R., et al., Proceedings of the Ocean Drilling Program, scientific results, Volume 112: College Station, Texas, Ocean Drilling Program, p. 517–526.

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During the commotion, the Coast Guard apprehended the remaining Greenpeace inflatable boats and a fishing boat that strayed within the safety perimeter, and the demonstration was curtailed. When the bound intruder was taken into custody by the Coast Guard, he repeatedly spat on the arresting officer, possibly to provoke retaliation. Taken onshore with the other activist (who was cut free with little ado), he demanded, according to the Coast Guard, to be examined in the Gold Beach hospital for injuries sustained from being "beaten and kicked by the ship's crew." A total of 15 persons were arrested, and the apprehended vessels confiscated. All protesters were released shortly after being jailed in Gold Beach, and all vessels were returned within a few days.

In the hours following the direct confrontation, I elected not to run planned geophysical surveys that would potentially take the *Aloha* into the course of the protesting vessels, thereby provoking further reaction. We focused instead on surficial sampling of the sea floor. At the end of the day, the fishing vessels went home, and two days later, without further confrontation, the *Rainbow Warrior* departed for San Francisco, the site of its next protest. We finished the two-week cruise without further incident, perhaps partly because the Coast Guard kept a vessel in our general vicinity. Onshore, however, threatening phone calls to the owner of a trailer park caused him to ask our navigational support team to seek other facilities.

The protests had little impact on the ultimate scientific success of the cruise. We collected a superb set of high-resolution seismic and magnetic data that constrain the models for placer-mineral accumulation on this and other shelves. The biologists were pleased with their results, which provided fresh information on the living resources of the area. The integration of biological data and geological substrate results was particularly gratifying. Coring in the secondary work area resolved its placer resource potential as minimal. Our major disappointment was that a combination of sea conditions and operational problems prevented coring in the primary work area. Ironically, after we reported the general success of the study in a post-cruise press conference, a Greenpeace spokesperson notified the press that, irrespective of our assessment, we had gotten little information and the cruise was "an immense waste of the taxpayers' money."

The encounters on the Oregon shelf make for some good story-telling, but they also raise philosophical and procedural questions that warrant consideration by the geoscience community. Such circumstances demand a continuing succession of field decisions. The options are numerous: withdrawal, proceeding but avoiding confrontation, engaging in a battle of wits with the protesters, physical confrontation. Considerations include the physical safety of ourselves, our colleagues, and the protesters; the security of scientific equipment; the cost and importance of the mission; the probability of completing work in the face of protest. Discussion of these possibilities with colleagues yields no consensus. I employed all of the options save withdrawal, and in retrospect, I would do nothing differently. Yet, I suspect that the decisions would have differed as the cruise progressed and the circumstances changed. Some choices, which were probably right at the time, were troubling. I didn't like to admit that a few people in inflatable boats could keep us from proceeding with our research. Because the incidents occurred early in the cruise, I correctly felt that we could afford to be patient. If the situation had prevailed until late in the cruise, I might have been willing to take greater risks. Every new situation will demand its own set of decisions; I think the scientist's most important assets in any case are a cool head

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Kvenvolden, K.A., and McDonald, T.J., 1985, Gas hydrates of the Middle America Trench—Deep Sea Drilling Project Leg 84, *in* von Huene, R., Aubouin, J., et al., Initial reports of the Deep Sea Drilling Project, Volume 84: Washington, D.C., U.S. Government Printing Office, p. 667–682.

Lundberg, N., and Moore, J.C., 1986, Macroscopic structural features in Deep Sea Drilling Project cores from forearc regions, *in* Moore, J.C., ed., Structural fabrics in Deep Sea Drilling Project cores from forearcs: Geological Society of America Memoir 166, p. 13–44.

Maekawa, H., Shozui, M., Ishii, T., Saboda, K., and Ogawa, Y., 1992, Metamorphic rocks from the serpentine seamounts in the Mariana and Izu-Ogasawara forearcs, *in* Fryer, P., Pearce, J.A., et al., Proceedings of the Ocean Drilling Program, scientific results, Volume 125: College Station, Texas, Ocean Drilling Program (in press).

Moore, G.F., Shipley, T.H., Stoffa, P.L., Karig, D.E., Taira, A., Kuramoto, H., Tokuyama, H., and Suyehiro, K., 1990, Structure of the Nankai Trough accretionary zones from multichannel seismic reflection data: Journal of Geophysical Research, v. 95, p. 8753–8765.

Moore, G.F., Karig, D.E., Shipley, T.H., Stoffa, P.L., and Wood, W.T., 1991, Structural framework of the ODP Leg 131 area, Nankai Trough, *in* Taira, A., Hill, I., Firth, J.V., et al., Proceedings of the Ocean Drilling Program, initial reports, Volume 131: College Station, Texas, Ocean Drilling Program, p. 15–20.

Moore, J.C., Orange, D.L., and Kulm, L.D., 1990, Interrelationship of fluid venting and structural evolution, Oregon margin: Journal of Geophysical Research, v. 95, p. 8795–8808.

Moore, J.C., Brown, K.M., Horath, F., Cochrane, G., Mackay, M., and Moore, G., 1991, Plumbing accretionary prisms: Effects of permeability variations: Royal Society of London Philosophical Transactions, ser. A, v. 335, p. 275–288.

Moore, J.C., Mascle, A., Taylor, E., Andreieff, P., Alvarez, F., Barnes, R., Beck, C., Behrmann, J., Blanc, G., Brown, K., Clark, M., Dolan, J., Fisher, A., Gieskes, J., Hounslow, M., McLellan, P., Moran, K., Ogawa, Y., Sakai, T., Schoonmaker, J., Vrolijk, P., Wilkens, R., and Williams, C., 1988, Tectonics and hydrogeology of the northern Barbados Ridge: Results from Ocean Drilling Program Leg 110: Geological Society of America Bulletin, v. 100, p. 1578–1593.

Moore, J.C., Watkins, J.S., et al., 1979, Progressive accretion in the Middle America Trench, southern Mexico: Nature, v. 281, p. 638–642.

Pytte, A.M., and Reynolds, R.C., 1989, The thermal transformation of smectite to illite, *in* Naeser, N.D., and McCulloh, T.H., eds., Thermal history of sedimentary basins: Methods and case histories: New York, Springer-Verlag, p. 33–40.

Seno, T., 1977, The instantaneous rotation of the Philippine Sea plate relative to the Eurasian plate: Tectonophysics, v. 42, p. 209–226.

Shipley, T.H., and Didyk, B.M., 1982, Occurrence of methane hydrates offshore southern Mexico, *in* Watkins, J.S., Moore, J.C., et al., initial reports of the Deep Sea Drilling Project, Volume 66: Washington, D.C., U.S. Government Printing Office, p. 547–555.

Shipley, T.H., and Moore, G.F., 1986, Sediment accretion, subduction, and dewatering at the base of the trench slope off Costa Rica: A seismic reflection view of the decollement: Journal of Geophysical Research, v. 91, p. 2019–2028.

Suess, E., von Huene, R., et al., 1988, Ocean Drilling Program Leg 112, Peru continental margin: Part 2, Sedimentary history and diagenesis in a coastal upwelling environment: Geology, v. 16, p. 939–943.

Taira, A., and Pickering, K.T., 1991, Sediment deformation and fluid activity in the Nankai, Izu-Bonin and Japan forearc slopes and trenches: Royal Society of London Philosophical Transactions, ser. A, v. 335, p. 289–313.

Taira, A., Hill, I., Firth, J., et al., 1991, Proceedings of the Ocean Drilling Program, initial reports, Volume 131, Part A: College Station, Texas, Ocean Drilling Program.

von Huene, R., and Lallemand, S., 1990, Tectonic erosion along the Japan and Peru convergent margins: Geological Society of America Bulletin, v. 102, p. 704–720.

von Huene, R., and Lee, H., 1982, The possible significance of pore fluid pressure and subduction zones, *in* Studies of continental margin geology: American Association of Petroleum Geologists Memoir 34, p. 781–791.

von Huene, R., and Scholl, D.W., 1991, Observations at convergent margins concerning sediment subduction, subduction erosion, and the growth of continental crust: Reviews in Geophysics, v. 29, p. 279–316.

von Huene, R., Langseth, M., Nasu, N., and Okada, H., 1980, Summary, Japan Trench transect, *in* Lee, M., and Stout, L, Initial reports of the Deep Sea Drilling Project, Volumes 56 and 57, Part 1: Washington, D.C., U.S. Government Printing Office, p. 473–488.

von Huene, R., Suess, E., et al., 1988, Ocean Drilling Program Leg 112, Peru continental margin: Part 1, Tectonic history: Geology, v. 16, p. 934–938.

Vrolijk, P., Chambers, S., Gieskes, J., and O'Neil, J., 1990, Stable isotope ratios of interstitial fluids from the northern Barbados accretionary prism, ODP Leg 110, *in* Moore, J.C., Mascle, A., et al., Proceedings of the Ocean Drilling Program, scientific results, Volume 110: College Station, Texas, Ocean Drilling Program, p. 189–205.

Vrolijk, P., Fisher, A., and Gieskes, J., 1991, Geochemical and geothermal evidence for fluid migration in the Barbados accretionary prism (ODP Leg 110): geophysical Research Letters, v. 18, p. 947–950.

Watkins, J.S., Moore, J.C., Shipley, T., et al., 1981, Accretion, underplating, and tectonic evolution, Middle America Trench, southern Mexico: Results from Leg 66 Deep Sea Drilling Project, *in* Blanchet, R., and Montadert, L., eds., Geology of continental margins: International Geological Congress, 26th, Paris, Colloque 3, Oceanologica Acta, p. 213–224. ■

Reminders

CALL FOR NOMINATIONS

Officers and Councilors

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

Nominations for 1993 officers and councilors must be received at GSA headquarters no later than **FEBRUARY 15, 1992**. Please send nominations and backup material to the Administrative Department, Geological Society of America, P.O. Box 9140, Boulder, CO 80301.

Penrose and Day Medals, and Honorary Fellowship

Nominations for GSA's Penrose and Day Medals and for Honorary Fellowship in the Society are due at headquarters by **FEBRUARY 1, 1992**.

For procedures and additional information, please refer to the October 1991 issue of *GSA Today*, or call headquarters at (303) 447-2020.

Send your nominations and required backup material to the Administrative Department, Geological Society of America, P.O. Box 9140, Boulder, CO 80301.

Young Scientist Award (Donath Medal)

The Young Scientist Award was established in 1988 to be awarded to a young scientist (35 or younger during the year in which the award is to be presented) for outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the earth sciences. The award, consisting of a gold medal called the Donath Medal and a cash prize of $10,000, was endowed by Dr. and Mrs. Fred A. Donath.

For the year 1992, only those candidates born on or after January 1, 1957, are eligible for consideration. In choosing candidates for the Young Scientist Award, scientific achievement and age will be the sole criteria. Nominations for the 1992 award must include

- biographical information,
- a summary of the candidate's scientific contributions to geology (200 words or less),
- a selected bibliography (no more than 10 titles),
- supporting letters from five scientists.

Nominations for the 1992 Young Scientist Award must be received at GSA headquarters by **FEBRUARY 1, 1992**. For procedures and additional information, please refer to the October 1991 issue of *GSA Today*, or call headquarters at (303) 447-2020.

Distinguished Service Award

The GSA Distinguished Service Award was established by Council in 1988 to recognize individuals for their exceptional service to the Society. GSA Members, Fellows, Student Associates, or, in exceptional circumstances, GSA employees may be nominated for consideration. Any GSA member or employee may make a nomination for the award. Awardees will be selected by the Executive Committee, and all selections must be ratified by the Council. Awards may be made annually, or less frequently, at the discretion of Council. This award will be presented during the Annual Meeting of the Society. Nominations and any supporting information may be addressed to Executive Director, Geological Society of America, P.O. Box 9140, Boulder, CO 80301.

Deadline for nominations for 1992 is **MARCH 1, 1992**. ■

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and common sense. My training provided little else. Law-enforcement agency assistance from the earliest opportunity was vital.

All of us involved with the *Aloha* cruise were perplexed at the intensity of the local reaction. The residents of Curry County were concerned that information we collected could lead to decisions potentially inimical to them and their community. After reflecting on it, I realize that they misperceived the problem; it was not between us and them, but rather between them and their decision-makers.

This raises an issue: we, the USGS and other federal and state scientific agencies, exist to provide credible objective information to decision-makers. How can we convince the public that informed decision-making is better than the alternative? The protesters from Curry County felt that having no information would prevent a decision that they feared. "We clearly stated our strong opposition to this cruise, and you chose to undertake it anyway," they complained. Yes, we did—put simply, it is our job. But it proved virtually impossible to make this point to outraged fishermen and community residents. How does the geologist communicate the rationale for his or her responsibility to such a community?

I suspect that the problems we faced on the Oregon shelf will recur with increasing frequency in the future, and not only at sea. Activist organizations are establishing a position of opposition to any sea-bed development of nonliving resources, and their opposition can be directed toward defining the nation's or a state's resource potential. The geoscience community seems to be increasingly involved in issues that are opposed by segments of local communities and/or activist organizations. I urge that we consider how best to prepare ourselves, and our agencies and institutions, to face such difficulties and to conduct our research with minimal jeopardy of lives, of instrumentation, and without public embarrassment.

PERSPECTIVE 2: Georesearch

William R. Dickinson,
University of Arizona, Tucson

The cautionary tale told by Ed Clifton should be taken to heart by geoscientists with legitimate research interests on public lands. In my experience, most ordinary people assume that nearly all geological field work, unless related to specific construction sites or paleontological quarries, is directed toward exploration for gold or oil. As mines and oilfields are an anathema to many environmentalists for multiple reasons, including visual impact and degradation of habitat, it is predictable that environmental activists will be tempted to transfer attitudes and tactics applied to offshore geological research to onshore geological field work on public lands. We need to explore ways to avoid or restrict future confrontations that would be unhealthy for both science and the public interest.

One critical need is to make the obvious point that most geological field research, including geologic mapping, is conducted to improve scientific knowledge or to test scientific concepts. It is exploration in the scientific sense but not in the commercial sense. We need a new descriptor for this type of activity. I suggest *georesearch*. Georesearch seeks to widen scientific knowledge of natural resources and environments and to strengthen intellectual resources, rather than to foster specific resource development. The real fruits of georesearch are facts and ideas, not commodities.

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WASHINGTON REPORT

Bruce F. Molnia

Washington Report provides GSA membership with a monthly window on the activities of the federal agencies, Congress and the legislative process, and international interactions that could impact the geoscience community. In future issues, Washington Report will present summaries of agency and interagency programs, track legislation, and present insights into Washington, D.C., geopolitics as they pertain to the geosciences.

ANWR Makes for Some Strange Bedfellows!

The past few weeks have confirmed that no matter how strange or farfetched it may seem, if you wait long enough you will see it all in Washington, D.C. It's difficult to choose among the Burgergate Congressional cafeteria scofflaws and mavens, the Rubbergate House check bouncers, and the Soap Operagate final five days of the Senate Judiciary Committee Confirmation Hearings for Clarence Thomas to determine what is the most bizarre of recent Washington events. Unfortunately, all of these events have masked the ongoing developments surrounding the issue of petroleum development in the Arctic National Wildlife Refuge (ANWR). ANWR, in its own right, the single biggest environmental issue in the 102nd Congress, is also the focal point of the battle for the Bush Administration's new energy strategy.

Question: What do the American Petroleum Institute, U.S. Chamber of Commerce, American Association of Blacks in Energy, U.S. Hispanic Chamber of Commerce, Transportation Institute, National Tour Association, National Engineers Beneficial Association, National Grange, National Association of Realtors, National Association of Home Builders, American Sheep Industries Association, American Trucking Association, Alaska Oil and Gas Association, National Council of Farmer Cooperatives, and NAACP (Anchorage Branch) have in common? The answer is that these 15 organizations and an additional 39 trade associations, corporations, and interest groups are aligned in a Washington, D.C.–based coalition, the Coalition for American Energy Security. To quote from a letter and a legislative action-gram that I received from M. Isabelle Tapia, executive director of this coalition, its purpose is to work for "the opening of the Arctic National Wildlife Refuge (ANWR) coastal plain area to environmentally responsible oil and gas exploration and development."

An easier question to answer and a simpler relationship to understand is: What brings the Audubon Society, Sierra Club, Wilderness Society, National Congress of American Indians, Ozark Society, National Resources Defense Council, International Indian Treaty Council, Environmental Action, Minnesota Ornithologists' Union, Union of American Hebrew Organizations, and more than 60 other organizations together under the banner of the Alaska Coalition? Not surprisingly, the answer to this question also revolves around ANWR. The purpose of the Alaska Coalition is to "preserve Alaska's National Interest Wildlands," with the present focus specifically being to prevent any development of ANWR. A letter from Mike Matz, the chairman of the Alaska Coalition, that arrived the same day as the letter from Ms. Tapia, stated that unless action is taken now to prevent "strong pro-oil forces" from ramming bills through both houses of Congress, ANWR's "pristine wilderness" would be turned "into an industrial wasteland." Are both coalitions describing the same issue?

The two coalitions contacted me because they both wanted the same thing—that I write letters and cards to my elected representatives in Congress. Both coalitions believe that the outcome of the ANWR issue can still be influenced by public opinion.

The Coalition for American Energy Security has taken a key step to simplify my task of notifying my elected representatives by sending me four preaddressed, preprinted, stamped postcards. Three of the cards are for me to send my preprinted prodevelopment message to my elected representatives, the fourth is to report back to the coalition that my mission has been accomplished. The letter from the Alaska Coalition, a less well funded group, only sent Congressional addresses.

As we go to press, the Senate Environment Committee is about to mark up legislation (S. 39) that would enhance ANWR's status as protected wilderness. This legislation, introduced by Senator William Roth, a Delaware Republican, will be cosponsored by about half of the 16-member Environment Committee. One possible purpose of the Environment Committee's action is to weaken the focal point of the Bush Administration's new energy policy, the Johnson-Wallop National Energy Security Act (S. 1220), adopted by the Senate Energy and Natural Resources Committee on May 23, 1991, by a vote of 17 to 3. As described in earlier Washington Reports, the proposed National Energy Strategy legislation would open several areas, including ANWR, to drilling.

ANWR action by the 102nd Congress has been hot and heavy. ANWR activities started in early January, when bills were introduced in both houses that would designate ANWR's coastal plain as protected wilderness. In late April, Representative Robert Mrazek of New York introduced House Joint Resolution 239, also stipulating that the coastal plain area be protected as wilderness. In January, Senator Frank Murkowski and Representative Don Young, both of Alaska, introduced S. 109 and HR. 759, proposed legislation that would open ANWR's coastal plain to petroleum exploration and production, while instituting some elements of environmental protection to the overall area.

On February 5, Senator Roth introduced S. 344, a bill that would include ANWR in an international wildlife refuge that would span the U.S.–Canadian border. Other proposed legislation, such as HR. 1199, introduced by Representative Wayne Owens of Utah attempted to create tax disincentives for any drilling in ANWR, but included provisions for tax incentives for enhanced oil recovery activities outside of ANWR. The House Merchant Marine and Fisheries Committee's Subcommittee on Fisheries and Wildlife Conservation and the Environment held four ANWR hearings between May and August.

All of these actions are a prelude to the major battle over S. 1220, expected on the floor of the Senate before Congress recesses for the upcoming holidays. Stay tuned for the next round of developments. ■

Memorial Preprints

The following memorial preprints are now available, free of charge, by writing to GSA, P.O. Box 9140, Boulder, CO 80301.

Manuel Alvarez, Jr.
Mariano Ruiz Vásquez and Alejandro Calderón Garcia

Wallace M. Cady
Bruce Bryant

Preston Cloud
John Rodgers

Lyle H. Henderson
Joseph F. Friedkin

Harry Christison Kent
John B. Curtis, John D. Haun, and Colleen Kent de Ruiz

Henry Lepp
David L. Southwick

Harold Meisler
I. G. Grossman

C. Richard Murray
George C. Taylor, Jr.

William Albert Waldschmidt
George R. Gibson

Stanley G. Wissler
William R. Moran and F. Douglas Crawford

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History shows that georesearch benefits the environmental movement so much that environmental groups should logically be motivated to foster georesearch (rather than hindering it), as a means to develop valid environmental perspectives. Individual geoscientists, and there are many, who are bona fide and earnest members of environmental organizations should make it their business to argue the positive case for the value of georesearch within the internal councils of the environmental movement. Those who doubt the necessity of taking preventive steps to forestall the growth of misguided criticism overlook the fact that time is currently racing in the environmental field, which is fast becoming a broadly based political movement. Groups that delay response to developing trends in environmental affairs will come to regret their inattention.

The past and continuing contributions of georesearch to environmental concerns need special emphasis. The great scenic resources of the country have been brought to general attention by geoscientists as much as by any other group. Places of unique scientific interest have been identified for special preservation by geologists as much as by archaeologists or ecologists. More than any other group, geoscientists have established the location and nature of critical mineral and energy resources precisely enough to allow measured consideration of the wisdom of their development, and to identify tracts of ground unneeded for resource development.

Addressing a whole host of practical environmental concerns also depends on knowledge gained by vigorous continuance of georesearch: sound management of ground-water resources, reduction of damage from coastal erosion, recognition of flood hazards, appraisal of landslide risk, control of waste contamination, limiting the impact of needed mines and quarries on the landscape, gauging the threats posed by volcanic eruptions, and so forth; any geoscientist could add to my list.

Unless we begin soon to justify the pursuit of georesearch in explicit terms, I fear that restrictions of benefit to no one may be proposed by environmental activists with a sincere focus on current uses and misuses of public lands. Rising interest in the management of public lands is reflected by recent criticism of traditional mining laws, attacks on the concept of multiple land use, awkward requirements for collecting permits of various kinds, and local restrictions on access that seem arbitrary or gratuitous from a geological standpoint. I believe that we have a responsibility to argue that our ability as geoscientists to make important future contributions to the human endeavor depends upon continued access to public lands. In return, we must accept personal responsibility to avoid any potential negative impacts of georesearch on public lands by adopting a stringent field ethic for professional behavior that avoids damage to scenic or other resources.

Presumably, no one can legislate away the carrying of compasses and pencils, or prevent us from drawing lines on maps if we wish, but other severe hindrances could be imposed upon georesearch by laws or edicts thought mistakenly to be in the public interest, and the threat of potential guerrilla disruption of field work is implicit in the experiences that Ed Clifton has recounted. Let us quickly and effectively espouse the crucial cause of georesearch on public lands before we find that it is too late. ■

Robert L. Fuchs

Money Isn't Everything

While the bulk of contributions to the GSA Foundation comes directly as cash, either in the form of checks made payable to the Foundation or through the GSA annual dues statement, there is a universe of noncash gifts that can function as well as (in some instances even better than) cash in meeting the needs of both donor and recipient. In November's GSAF Update two of these noncash forms were described—appreciated securities and life insurance. Contributions to charitable organizations can also include gifts of property—real, personal, and even intellectual. In the case of the scientists who compose GSA's membership, such gifts can often be particularly appropriate.

Real property consists of land, buildings, and special rights such as fee minerals and oil, gas, and mineral landowners' and overriding royalties. Homes and farms, office buildings, and raw land can be donated to the GSA Foundation, the amount of the gift being the appraised value of the property at the time of transfer.

Somewhat particular to geoscientists is the ownership of mineral royalties. Quite often a geologist will receive or retain a royalty or other form of mineral ownership as a result of exploration work carried out for a company or client, or even for the geologist himself or herself. Where there has been successful discovery, such as a gas well or a gold mine, this royalty may have considerable value in terms of both current cash flow and underlying assets. Part or all of this royalty can be given to the Foundation. Similarly, royalties on publications and other patented property can be valued by appraisal and contributed to the GSA Foundation.

Purely personal property such as vehicles and works of art can also be given to a charitable institution. Again, an appraisal of the value of the gift must be done at the time of the contribution.

There are several points of caution that must be addressed where property gifts are concerned. Foremost is the matter of value. In the case of cash, stocks, and bonds, this is not a point of conjecture, but noncash gifts require an appraisal that is generally conducted by a third party. The donor needs to have this value in order to establish his or her tax deduction; the Foundation needs to know what amount will be added to the endowment. Other concerns that must be addressed are title and liability, particularly the latter, because there could be liability to other parties with respect to some preexisting damage. The growing importance of environmental liability makes an assessment of this aspect critical to the final transfer and acceptance of property.

The Board of Trustees of the GSA Foundation is empowered to accept or reject all gifts of property, particularly real estate. In making this decision, the board will review each potential gift on a case-by-case basis with respect to its valuation and any potential or actual liabilities.

After reading the foregoing, you may conclude that a gift of property to the GSA Foundation could be particularly appropriate for you and would also benefit GSA over the long term. Please call (303) 447-2020 or write to the Foundation to discuss the property gift you are contemplating so that a plan for effecting the transfer can be developed.

Howard Fund to Benefit Quaternary Division

GSA's Quaternary Geology and Geomorphology Division will benefit from a new Foundation fund that will be established during 1992. The fund is the result of a bequest to GSA from the estate of Arthur D. Howard.

Arthur D. Howard died in 1986 at the age of 80. He was a GSA Fellow and chaired the Quaternary Geology and Geomorphology Division from 1969 to 1970. Howard received B.S. and M.S. degrees from New York University, and a Ph.D. degree in 1937 from Columbia University. His thesis work included a five-year study that resulted in GSA Special Paper 6, *History of the Grand Canyon of the Yellowstone.*

Arthur Howard's professional career included faculty positions at New York University; at Stanford University, where he was chairman; and at North Carolina State University. He also worked for the U.S. Geological Survey, the U.S. Coast and Geodetic Survey, and, during World War II, the Office of Strategic Services. In addition to geomorphology studies in the western United States, Howard's work took him to foreign areas, including mainland China, Taiwan, Brazil, Antarctica, and Europe. He received numerous awards throughout his career, both from academia and government.

The bequest stipulates that the income from the $25,000 Arthur D. Howard Fund will be used for research grants and other purposes. Although the principal of the fund will reside at the GSA Foundation, the Quaternary Geology and Geomorphology Division will direct the awarding of grants and other disbursements. It is anticipated that the first application of income from this fund will occur in 1993. ■

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Edward E. "Dr. Ed" Geary, Educational Programs Coordinator

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As the holiday season approaches and your thoughts turn toward family, friends, reindeer, elves, and snowflakes, the inevitable question arises as to what to give to those you care about.

This holiday I ask that you consider giving to the teachers and students in your local schools. I'm sure that today's teachers and students would appreciate gifts of gold more than gifts of frankincense or myrrh. However, few of us have significant amounts of gold, frankincense, or myrrh lying around our houses. What we do have is a gift far beyond any of these items in value—our time and knowledge. Whether you can find one day per week, one day per month, or one day per year to give, you can help excite and inform students about earth science by becoming personally involved in their education. Yes, it is a sacrifice, your time is precious and there are already too few hours in each day, but just imagine the impact that 10,000, 20,000, or 30,000 earth scientists and engineers could have on precollege earth science education if each of us found the time to get personally involved.

To learn more about how you can help to improve precollege earth science education, please write to SAGE, Partners for Excellence Program, Geological Society of America, P.O. Box 9140, Boulder, CO 80301 or call 1-800-824-SAGE. ■

The Geological Society of America

Research Grants Program 1992

The primary role of the Research Grants Program is to provide partial support for research by graduate students who are candidates for the M.S. or Ph.D. degree at universities in the United States, Canada, Mexico, and Central America. GSA strongly encourages women, minorities, and persons with disabilities to participate fully in this grants program. Eligibility is not restricted to GSA members. New application forms for the current year and detailed requirements are available each fall in the geology departments of colleges and universities offering graduate degrees in earth sciences. Forms are mailed annually to GSA Campus Representatives and department secretaries and chairmen in the United States and Canada. They are also available upon request from the Research Grants Administrator, Geological Society of America, P.O. Box 9140, Boulder, Colorado 80301. *Please use only the 1992 application and appraisal forms.*

Confidential evaluations from two faculty members are required from candidates for the M.S. or Ph.D. degree and must accompany applications submitted. PLEASE USE THE "APPRAISAL OF APPLICANT" FORMS, WHICH ACCOMPANY THE 1992 APPLICATION FORMS. Application forms will not be accepted by facsimile.

The Geological Society of America awarded $278,500 in grants in 1991. The grants went to 240 students doing research for advanced degrees. The average amount awarded was $1161. The largest grants were $2000, but there is no predetermined maximum amount.

The Committee on Research Grants will meet in March to evaluate applications and award grants. In April, all applicants for grants will be informed of the committee's actions by the Executive Director of the Geological Society of America.

ALL APPLICATIONS MUST BE SUBMITTED ON THE 1992 FORMS AND POSTMARKED BY FEBRUARY 15, 1992

Penrose Conference

Fluid-Volcano Interactions

A Geological Society of America Penrose Conference, Fluid-Volcano Interactions, will be held October 4–9, 1992, at Kahneeta Resort, Warm Springs, Oregon. Participants will include volcanologists, hydrogeologists, geochemists, geomorphologists, geophysicists, and other scientists who share an interest in volcano-related physical and chemical processes. The organizers hope to promote interdisciplinary discussion by an introductory half-day tutorial session, by holding sessions that focus on specific volcanoes, and by including representatives of diverse subdisciplines in topical sessions.

The presence and circulation of fluids profoundly affect volcanic processes and landforms. Volatiles dissolved in magma influence eruption styles and cycles, as do pressure-temperature–fluid saturation conditions in the country rock. The presence of magma in turn influences groundwater pressures, temperatures, and chemistry. Advective heat and mass transport affect and locally dominate the thermal and chemical regimes of volcanoes. Subaerial volcanoes deform in response to changes in water-table elevation, and microseismicity can be related to boiling. These observations suggest links between fluid flow and mechanical deformation.

A more comprehensive understanding of processes influenced by the presence of fluids in volcanoes is needed to address scientific, economic, and public safety concerns. Such an understanding requires integrating observations and theory developed within several subdisciplines of the earth science community, and development of the conceptual and numerical models needed to link and evaluate observation-based inferences. This conference will emphasize field- and laboratory-based observations, as well as the quantitative description and explanation of such observations. The organizers hope that it will lead to increased interdisciplinary understanding and collaboration.

Questions to be addressed include:
- What are the modes of heat and mass transfer from magma to the shallow subsurface?
- What are the pressure, temperature, and fluid-saturation conditions between magma and the land surface?
- What controls the permeability of volcanoes? How does it vary in space and time? What role do temporal variations in permeability play in the evolution of volcanogenic hydrothermal systems? How important is intrusive and explosive eruptive activity to the creation of fracture permeability within a volcano?
- What are the sources of fluids and solutes in volcanic systems? How can we distinguish their origins, and what processes affect their evolution?
- Can temporal variations in the discharge of magmatic components be related to eruptive cycles? Are there consistent precursory indicators?
- How important is the role of meteoric water in eruption processes? Can we infer the volume and location of water sources through the study of deposits from explosive eruptions? How dependable is accelerated phreatic activity as an eruption precursor?
- How well coupled are various fluid flow, transport, and mechanical deformation processes?
- Current numerical models cannot rigorously simulate the coupled problem of heat and fluid flow, solute transport, and deformation within a volcano. Do relatively simple models that simulate a subset of these processes provide useful insight into transport processes?
- How can we evaluate hydrothermal systems in composite cones dominated near the surface by cold-water recharge?
- How important is knowledge of a volcano's hydrology to evaluating and mitigating volcanic hazards?

Conveners are Steve Ingebritsen, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025, (415) 329-4422, fax 415-329-4463; Bruce Christenson, DSIR, Geothermal Research Centre, Private Bag 2000, Taupo, New Zealand, fax 647-374-8199; Craig Forster, Dept. of Geology and Geophysics, University of Utah, 719 W.C. Browning Building, Salt Lake City, UT 84112, (801) 581-3864, fax 801-581-7065; Grant Heiken, Los Alamos National Laboratory, MS D462, Los Alamos, NM 87545, (505) 667-8477, fax 505-665-3285; Craig Manning, Dept. of Earth and Space Sciences, University of California, 405 Hilgard Ave., Los Angeles, CA 90024, (213) 206-3290, fax 213-825-2779.

Prospective participants should apply by submitting a letter to Steve Ingebritsen stating the relevance of their research to the conference topic. The **DEADLINE FOR APPLICATIONS IS APRIL 15, 1992**. The fee for the conference will be approximately $600, including registration, food, and lodging. Limited support will be available for qualified graduate students. ■

Final Announcement

SOUTHEASTERN SECTION, GSA 41st Annual Meeting

Winston-Salem, North Carolina
March 18–20, 1992

The Southeastern Section of the Geological Society of America, with the Eastern Section of SEPM, the Southeastern Section of the Paleontological Society, and the Southeastern Section of the National Association of Geology Teachers (NAGT), will meet at the Stouffer Winston Plaza Hotel in Winston-Salem, North Carolina. The meeting will be hosted by the Department of Geology, University of North Carolina at Chapel Hill, with the cooperation of the Department of Geology and Earth Science, Guilford College, Greensboro, North Carolina.

SETTING

Winston-Salem is in the central Piedmont of North Carolina on the boundary between the Charlotte and Milton geologic belts. The Blue Ridge Parkway in Virginia is a one-hour drive from Winston-Salem, and North and South Carolina beaches are approximately four hours from Winston-Salem by car. Travel to and around the Winston-Salem area affords an opportunity to view a variety of geologic and scenic features.

The city of Winston-Salem was settled by Moravians from Czechoslovakia and Germany in 1753. The name Salem, a place of peace, was given to the settlement where each inhabitant lived and worked in a church-governed community. The town of Winston, just a few miles north, was a commercial center, which eventually encircled Salem. In 1913 Salem was joined to Winston to form Winston-Salem.

The Moravians' reverence of an industrious and forthright approach to business and personal dealings was combined with a love of education, music, and craft. The area remains an industrial, commercial, and cultural center for the central and western Piedmont of North Carolina. Major educational institutions include the North Carolina School of the Arts, Salem College, Wake Forest University, and Winston-Salem State College.

TRAVEL ARRANGEMENTS

Winston-Salem is located on Interstate 40, 25 miles west of the I-85 and I-40 intersection in Greensboro. The meeting will be held at the Stouffer Winston Plaza Hotel in downtown Winston-Salem, four blocks north of Interstate 40 on Cherry Street, between 4th and 5th Streets. American, Continental, Delta, U.S. Air, and United are among the major airlines that serve the Piedmont Triad International Airport located east of Winston-Salem. Air Transportation Service (ATS) provides ground transportation to and from the downtown area.

PARKING

Parking, with in-out privileges, is available at the Stouffer Winston Plaza Hotel for hotel guests; daily rates are $4.50/day. Other parking is available at the same rate in municipal parking lots: the Cherry-6th-Trade Street lot, accessible from each of those streets, and another at 460 Cherry Street, accessible from Cherry, 5th, and Marshall Streets, adjacent to The Marque of Winston-Salem.

WELCOMING PARTY

A Welcoming Party will be held in the Sawtooth Center for Visual Design on Wednesday, March 18, 7:00–9:30 p.m. The Sawtooth Center, located in downtown Winston-Salem at 226 North Marshall, two blocks southwest of the Stouffer Winston Plaza Hotel, is owned and operated by the Arts Council, Inc. of Winston-Salem and Forsyth County. This old textile mill has been attractively renovated and restored and is used for art exhibits and instructional classes. A parking lot directly across the street provides ample free parking for this event.

The Welcoming Party is for all who will be attending the meeting plus friends and guests. It will not be necessary to have registered for the meeting in order to attend the Welcoming Party. Plan to attend—visit with old friends, make new ones, and browse through the paintings and photographs on display in the galleries. Light refreshments will be served at this event.

TECHNICAL PROGRAM

Technical sessions will be scheduled as oral or poster presentations on Thursday and Friday, March 19 and 20.

Symposia

Symposia will include invited as well as volunteered papers. Scheduled symposia and their conveners are:

1. **Geology of the Savannah River Site Area**. Van Price, Environmental Monitoring Section, Building 735-A, Westinghouse Savannah River Company, Aiken, SC 29801; Paul A. Thayer, Dept. of Earth Sciences, University of North Carolina at Wilmington, Wilmington, NC 28403-3297.
2. **Man-Induced Coastal Evolution**. Orrin H. Pilkey, Dept. of Geology, Duke University, 206 Old Chemistry Building, Durham, NC 27706; Paul Gayes, Center for Marine and Wetland Studies, Coastal Carolina College, Conway, SC 29526; William J. Cleary, Dept. of Earth Sciences, University of North Carolina at Wilmington, Wilmington, NC 28403-3297.
3. **Southeastern U.S. Mineral Deposits**. Dennis J. LaPoint, Cominco American Resources Incorporated, P.O. Box 3810, Chapel Hill, NC 27515; C. Michael Lesher, Dept. of Geology, University of Alabama, Tuscaloosa, AL 35487-0338.
4. **Suspect Terrane Analyses: What Role for Sedimentary Geologists?** *Cosponsored by SEPM Eastern Section.* Frederick L. Schwab, Dept. of Geology, Washington & Lee University, Lexington, VA 24450; Michael F. Follo, Dept. of Geology, University of North Carolina at Chapel Hill, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315.
5. **Tectono-Stratigraphic Evolution of the Laurentian-Iapetus Margin in the Southern Appalachians**. *Cosponsored by SEPM Eastern Section.* Dan Walker, Kentucky Geological Survey, 228 Mining and Mineral Resources Building, University of Kentucky, Lexington, KY 40506-0107; William A. Thomas, Dept. of Geological Sciences, University of Kentucky, Lexington, KY 40506-0059.
6. **Thermotectonic Evolution of the Appalachians**. A. Krishna Sinha, Dept. of Geological Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061; Steven A. Goldberg, Dept. of Geology, University of North Carolina at Chapel Hill, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599; Harold H. Stowell, Dept. of Geology, University of Alabama, Tuscaloosa, AL 35487.
7. **Workshop on North Carolina Geology for Middle and High School Teachers**. *Cosponsored by the National Association of Geology Teachers.* C. Q. Brown, Dept. of Geology, East Carolina University, Greenville, North Carolina 27858-4353.
8. **Cleanup of Petroleum-Contaminated Groundwater: Geologic Barriers and Innovative Solutions**. Paul A. Washington and Michael D. Cleary, North Carolina Division of Environmental Management, Groundwater Section, 441 North Harrington Street, Raleigh, NC 27603.
9. **National Association of Geology Teachers Symposium: Earth Science Education**. Gail S. Russell, Dept. of Geology, University of Southern Mississippi, Hattiesburg, MS 39406-5044; Thomas J. Carrington, Dept. of Geology, Auburn University, Auburn, AL 36849.
10. **Biostratigraphy and Evolution in the Coastal Plain**. *Cosponsored by the Southeastern Section of the Paleontological Society.* Warren D. Allmon and H. Cliff Harrison, Dept. of Geology, University of South Florida, Tampa, FL 33620.

Theme Sessions

The 1992 Southeastern Section of GSA will feature papers related to broad themes of current interest. If sufficient papers are received, the specific theme sessions will be scheduled under the titles listed below. If insufficient papers are received, submitted papers will be included in appropriate discipline sessions.

1. **Subsurface Basins of Southeastern USA.**
2. **Sr Isotope Stratigraphy.**
3. **Hydrogeology of Southeastern USA.**
4. **Geology of Basement Rocks from Beneath the Coastal Plain Compared to Piedmont and Blue Ridge Exposures.**
5. **Engineering Geology—A Potpourri.**

FIELD TRIPS

Both premeeting and postmeeting field trips are planned. For details, contact the field trip leader indicated by an asterisk (*) in the listing. General field trip questions may be addressed to the chair of the Field Trip Committee, John M. Dennison, Dept. of Geology, University of North Carolina at Chapel Hill, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315. *All field trip registrants must preregister for the meeting.* Registration procedures and the preregistration form are provided in this announcement.

Thirteen field trips are scheduled. These will provide participants with opportunities to examine a wide variety of geologic features in North and South Carolina, Virginia, and Tennessee. All trips will begin and end in Winston-Salem at the Stouffer Winston Plaza Hotel unless otherwise noted. Participants are accepted on a first-come, first-served basis with a limit of 24 people, or fewer for some trips; trips will be conducted if there are five or more paying participants. Participants will be asked to sign the GSA General Release and Save Harmless Waiver. Conventional auto insurance for the vehicles will be in force, as well as GSA insurance liability coverage.

If GSA must cancel a field trip due to logistical difficulties, a full refund will be issued *after* the meeting. Cancellation deadline for a full refund is *February 28, 1992*. No refunds will be made after February 28 unless the trip is canceled.

Premeeting Trips

1. **The Grandfather Mountain Window, North Carolina**. Wednesday, March 18. Loren A. Raymond (*), Dept. of Geology, Appalachian State University, Boone, NC 28608; (704) 262-2749.

Among the best known Late Proterozoic rift facies of the Iapetus margin in the southeastern United States are those represented by the Grandfather Mountain Formation. Weakly metamorphosed mafic and felsic flows and felsic tuffs, interlayered with a thick sequence of similarly metamorphosed quartz and feldspathic arenites, polymict conglomerates, mudrocks, and minor carbonate rocks overlie Middle Proterozoic basement gneisses within a duplex window—the Grandfather Mountain window—bounded by the Linville Falls thrust fault. Leave Winston-Salem 7:00 a.m., March 18; return Winston-Salem 7:00 p.m., March 18. Cost:$30, includes transportation, lunch, and guidebook.

2. **Stratigraphy and Structure of the Lower Ashe Formation (Upper Precambrian) Along the Fries Fault in Southwestern Virginia**. Wednesday, March 18. Robert C. Whisonant (*), Dept. of Geology, Radford University, Radford, VA 24142, (703) 831-5224; Jonathan L. Tso.

Participants will see stratigraphy and structure of the Ashe Formation along the Fries fault zone, and associated rocks of the Unicoi Formation and Cranberry Gneiss. The Ashe depositional environments will be explained, and revised interpretations of stratigraphy and structure will be presented. The Ashe sedimentary tectonic setting will be tied into late Precambrian development of the North American continental margin and the timing of rifting. Leave Winston-Salem 8:00 a.m., March 18; return to Winston-Salem 5:00 p.m., March 18. Cost: $25, includes transportation, lunch, and guidebook.

3. **Geology of Construction Materials in the Triad Area of North Carolina**. Wednesday, March 18. Charles C. Almy (*), Dept. of Geology and Earth Science, Guilford College, Greensboro, NC 27410; (919) 316-2263.

The quarries visited will give insight into the economic, environmental, and geologic problems of providing dimension stone, crushed stone, and lightweight aggregate to the dynamic urban centers of the central Piedmont region of North Carolina and Virginia. Geologists or teachers interested in environmental solutions to mineral production problems in the supply of basic raw materials or in sampling good exposures of the sedimentary, metamorphic and igneous rock types that underlie the Piedmont are encouraged to attend. Leave Winston-Salem 8:00 a.m., March 18; return to Winston-Salem by 6:00 p.m., March 18. Cost: $22, includes transportation, lunch, and guidebook.

4. **Gold in the Kings Mountain Belt of the Carolinas**. Wednesday, March 18. Dennis J. LaPoint (*), Cominco American Resources Incorpo-

rated, P. O. Box 3810, Chapel Hill, NC 27515; (919) 929-0006.

Gold-tellurium mineralization is found in carbonate rocks associated with felsic volcanics and intrusives of the Kings Mountain Belt in Cleveland County, North Carolina. The trip will study the geologic setting of gold mineralization and examine core from the Kings Mountain Gold Mine. Leave Winston-Salem at 7:00 a.m., March 18 (or meet at Holiday Inn in Kings Mountain, North Carolina at 9:00 a.m.); return to Winston-Salem by 6:00 p.m., March 18. Cost: $47, includes transportation, lunch, and guidebook.

5. **Heavy-Mineral Deposits in the Bailey Area, Nash and Wilson Counties, North Carolina**. Wednesday, March 18. Charles W. Hoffman (*), North Carolina Geological Survey, 4100 Reedy Creek Road, Raleigh, NC 27607, (919) 733-7353; Robert H. Carpenter.

This trip will provide an overview of stratigraphy, economic geology, and physiography of an area near the southern limit of recently discovered heavy-mineral deposits along the Fall Zone of North Carolina and Virginia. Sediments containing the heavy mineral deposits are interpreted to be nearshore sands deposited during the regressive phase of an early to mid-Pliocene sea-level highstand that deposited the Yorktown Formation. The trip will illustrate relations between crystalline basement rocks, the Orangeburg(?) Scarp, transgressive and regressive marine sediments, and the economic heavy-mineral deposits. Leave Sheraton Raleigh Hotel 7:00 a.m., March 18; return to Raleigh 4:30 p.m., March 18 and arrive in Winston-Salem 7:00 p.m., March 18. Cost: $33, includes transportation, lunch, and guidebook. Pretrip lodging on night before trip is not included.

6. **Geology of Waste Management in the Triad Area**. Wednesday, March 18. George L. Bain, A. Barry Nelson, and John M. Stewart (*), Bain and Palmer Associates, 2641-G Randleman Road, Greensboro, NC 27406; (919) 272-9713.

On this trip we will visit the Mineral Research and Development Company, located within the Cabarrus County Ring Dike Complex, that formulates inorganic chemicals used in the wood-preserving industry. The facility is a Resource Conservation and Recovery Act TSD permittee for hazardous waste management. Four surface impoundments have been remediated in situ by means of batch chemical fixation to render hazardous sludges and contaminated soils nonhazardous. A 35-acre plume of contaminated ground-water remains beneath the site. Natural soil attenuation, chemical fixation, and dilution and dispersion of the contaminants in the nearby Rocky River have effectively mitigated the pollutant plume to a degree where active ground-water remediation has not been required by the regulatory agencies. Leave Winston-Salem 8:00 a.m., March 18; return to Winston-Salem by 6:00 p.m., March 18. Cost: $35, includes transportation, lunch, and guidebook.

7. **Silurian and Devonian Unconformities in Southwestern Virginia**. *Sponsored by Eastern Section, SEPM*. Tuesday and Wednesday, March 17–18. John M. Dennison (*), Dept. of Geology, University of North Carolina at Chapel Hill, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315, (919) 966-0686; Steven L. Dorobek, Richard K. Bombach, Jonathan K. Filer, and Jesse A. Shell.

The area examined on this trip will span Bluefield, Duffield, Wytheville, Salem, and Newcastle, Virginia. Stops include unconformities situated in the pre–Lower Silurian, pre–upper Helderberg, pre-Oriskany, pre-Huntersville, within the Millboro Shale, and pre-Rhinestreet part of Chattanooga Shale strata. These are probably mixed tectonic and eustatic in origin, and will be discussed in a systems tract context. Leave Winston-Salem 7:00 a.m., March 17; return to Winston-Salem by 6:00 p.m., March 18. Cost: $99, includes transportation, lodging at Wytheville for the night of March 17, two lunches, and guidebook.

8. **Eocene-Miocene Molluscan Biostratigraphy of the Coastal Plain of North Carolina**. *Sponsored by Southeastern Section of the Paleontological Society*. Tuesday and Wednesday, March 17–18. Joseph G. Carter (*), Dept. of Geology, University of North Carolina at Chapel Hill, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315, (919) 962-0685; Lauck W. Ward, Thomas J. Rossbach, and Lyle D. Campbell.

Participants will collect at classic Eocene, Oligocene, and lower Miocene fossil localities in eastern North Carolina between Wilmington and New Bern, including the Castle Hayne Limestone, River Bend Formation, and Belgrade Formation. Additional collecting localities for Pliocene and Pleistocene fossils will be included in the guidebook. Orientation session at Wilmington Holiday Inn 8:00 p.m., March 16. Leave Wilmington Holiday Inn at 8:00 a.m., Tuesday March 17; overnight in New Bern, North Carolina on March 17; arrive Winston-Salem at 5:00 p.m., March 18. Cost: $60, includes transportation, two lunches, and guidebook. Arrangements can be made with trip leader to sign up for optional block reservations in motels on evenings of March 16 and 17 and for transportation from Winston-Salem or Raleigh-Durham Airport to Wilmington.

Postmeeting Trips

9. **Carbonate Cycles, Sequence Stratigraphy, and Drowning of Appalachian Cambro-Ordovician Platform**. Saturday, March 21. J. Fred Read (*), Dept.of Geological Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061; (703) 231-5124.

On this field trip we will visit southwestern Virginia to examine superb sections of tidal-flat to deep-water carbonate cycles, their stacking patterns, and their relation to depositional sequences, using field data, Fischer plots, and stratigraphic computer modeling. We will also examine off-shelf periplatform talus of the Cambrian margin and facies associated with Middle Ordovician subduction and drowning. Leave Winston-Salem 7:30 a.m., March 21; return to Winston-Salem 6:00 p.m., March 21. Cost: $50, includes transportation, lunch, and guidebook.

10. **Cretaceous and Tertiary Stratigraphy of Sand Hills Area, North Carolina**. Saturday, March 21. Suellen Cabe (*), Dept. Geology and Geography, Pembroke State University, Pembroke, NC 28372, (919) 521-4214; Charles W. Hoffman.

We will examine exposures of Cretaceous and Tertiary strata of the coastal plain, including the Cape Fear and Middendorf Formations and the Tertiary high-level gravels and surficial sands. Leave Winston-Salem 5:00 p.m., March 20; return to Winston-Salem 6:00 p.m., March 21. Cost: $80, includes overnight lodging at Southern Pines the night of March 20, transportation, lunch, and guidebook.

11. **Sedimentology of Triassic Dan River Group, North Carolina and Virginia**. Saturday, March 21. Paul A. Thayer (*), Dept. of Earth Sciences, University of North Carolina at Wilmington, Wilmington, NC 28403-3297, (919) 395-3780; Eleanora I. Robbins.

Participants will investigate the stratigraphy, sedimentology, and depositional environments of Upper Triassic nonmarine strata in the Dan River–Danville basin, North Carolina and Virginia. We will examine alluvial fan, fluvial, lacustrine, and swamp deposits at six stops. Leave Winston-Salem 7:30 a.m., March 21; return to Winston-Salem by 6:00 p.m., March 21. Cost: $20, includes transportation, lunch, and guidebook.

12. **Geology of Western End of Sauratown Mountains Window, North Carolina**. Saturday, March 21. Keith I. McConnell (*), U.S. Nuclear Regulatory Commission, Mail Stop 4H-3, Washington, DC 20555, (301) 492-0532; Robert D. Hatcher, Jr.

The Sauratown Mountains window is a composite antiformal window framed by an outer premetamorphic fault (Forbush = Haysville?) and an inner postmetamorphic (Hanging Rock) thrust. Basement and cover successions (Hogan Creek and Sauratown Formations) appear in both windows, and the Ashe Formation of the Inner Piedmont frames the outer window. The Inner Piedmont and eastern Blue Ridge have the same stratigraphy, and the Brevard fault (Bowens Creek) is either a suture or a terrane boundary. The Shacktown fault immediately southeast is a major terrane boundary. Leave Winston-Salem 8:00 a.m., March 21; return Winston-Salem by 6:00 p.m., March 21. Cost: $30, includes transportation, lunch, and guidebook.

13. **Blue Ridge Thrust Complex Northwest of the Grandfather Mountain Window, North Carolina and Tennessee**. Saturday and Sunday, March 21–22. Steven A. Goldberg (*), Dept. of Geology, University of North Carolina at Chapel Hill, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315, (919) 962-0692; J. Robert Butler, Charles H. Trupe, and Mark G. Adams.

This trip demonstrates the major lithologic sequences and the main tectonic and metamorphic features in a segment of the Blue Ridge Thrust Complex. It provides an overview of a Precambrian terrane subjected to Late Proterozoic rifting, the development of oceanic lithosphere, and subsequent Paleozoic orogenies. The focus will be on the conditions of metamorphism and deformation in overthrust sheets and their tectonic boundaries. Leave Winston-Salem 7:30 a.m., March 21; return to Winston-Salem 5:00 p.m., March 22. Cost: $98, includes transportation, lodging in Banner Elk the night of March 21, lunch both days, and guidebook.

REGISTRATION

PREREGISTER TODAY!
DEADLINE: FEBRUARY 21, 1992

1. Note that there is a savings in fees if you preregister! Preregistration also assists the local committee in making final plans for the meeting. The preregistration form is provided in this announcement.

2. Badges must be worn for access to ALL activities except the Welcoming Party.

3. Registration discounts are given to GSA or associated society members. Associated societies that qualify for this discount are indicated on the preregistration form. Please indicate your affiliation(s) and member number to register at member rates.

4. Full payment must accompany the preregistration form. Unpaid purchase orders are not accepted as valid registration. Charge cards are accepted, as indicated on the form. Please recheck the charge card number given; errors will delay your registration. Your confirmation letter from GSA will be your only receipt.

5. Please register only one professional or student per form; keep a copy for your records.

6. Current student ID is required to obtain student rates at both the preregistration and on-site counters. Students must present their current student ID when picking up registration materials in order to receive the student rate.

CANCELLATIONS, CHANGES, AND REFUNDS

All requests for registration additions, changes, and cancellations must be made in writing and received by *February 28, 1992*. GSA will refund advance registration fees for cancellations received in writing by that date. NO REFUNDS WILL BE MADE ON CANCELLATION NOTICES RECEIVED AFTER THAT DATE. Refunds will be mailed from GSA *after* the meeting. Refunds for fees paid by credit card will be credited to the card number on the preregistration form. NO refunds will be given for on-site registration.

ON-SITE REGISTRATION SCHEDULE STOUFFER WINSTON PLAZA HOTEL

Wednesday,
March 18 ..... 2:00 p.m.–6:00 p.m.

Thursday,
March 19 ..... 7:30 a.m.–4:30 p.m.

Friday,
March 20 ..... 7:30 a.m.–11:30 a.m.

For registration information, please call the GSA registration coordinator at (303) 447-2020.

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REGISTRATION FEES

	Advance (By Feb. 21)	On-Site	One-Day
Professional—Member	$45.00	$55.00	N/A
Professional—Nonmember	55.00	65.00	N/A
Student—Member	15.00	25.00	N/A
Student—Nonmember	20.00	30.00	N/A
Secondary School Teacher	N/A	N/A	10.00
Guest	10.00	10.00	10.00

Southeastern *continued from p. 275*

HOUSING

A large block of rooms has been reserved for meeting participants and their guests at the Stouffer Winston Plaza Hotel. The cost for meeting rooms will be determined by the number of guest rooms used by Southeastern Section meeting attendees. Because all "profits" from the meeting are used to support student research grants, members are encouraged to stay at the headquarters hotel if possible. To assist the local committee in planning, and to receive the room rates quoted on the housing form, rooms must be reserved by *February 17, 1992*. **Mail the Housing Form directly to the Stouffer Winston Plaza Hotel.** Written confirmation of your reservation will be mailed from the hotel within two weeks of receipt.

Other area accommodations include Best Western Regency Inn, Comfort Inn, Econo Lodge, Holiday Inn, Howard Johnson's Motor Lodge, Innkeeper Motor Lodge, Motel Six, and Ramada Hotel. If you will not be staying at the headquarters hotel, please contact the hotel or motel of your choice directly. For those who prefer to camp, Tanglewood Park, located in Clemmons, North Carolina, approximately ten miles west of Winston-Salem, offers extraordinary facilities and reasonable daily rates.

STUDENT ARRANGEMENTS

Travel Grants

Support for travel expenses of students presenting papers at the meeting is available from the Southeastern Section. For information, contact Michael J. Neilson, Dept. of Geology, University of Alabama at Birmingham, Birmingham, AL 35294, (205) 934-5102.

Student Accommodations

A limited number of rooms are available for students at the headquarters hotel, at $69 plus 12% tax per night, with a maximum of five students per room. If the demand for these rooms exceeds the number of rooms available, the Stouffer Winston Plaza Hotel will obtain space in a nearby hotel at a rate equal to or less than that quoted. To reserve a student block room at the Winston Stouffer Plaza Hotel, please indicate "Student block" on the housing form.

Graduate Student Recruitment

The poster session booths will be available on Thursday afternoon, March 19, to any graduate program in the geosciences that wishes to have representatives available to talk with prospective graduate students. Details will be posted at the meeting. There will be no charge for participating. Representatives may wish to bring a sign to identify their program as well as information to distribute to students.

PUBLICATIONS

Abstracts are published in the *GSA Abstracts with Programs*. Advance purchase orders must be received by *January 17, 1992*; prepayment is required. An order form is provided in this announcement. These advance copies will be mailed about three weeks prior to the meeting. Refunds for duplicate orders will not be given; members should check their records carefully to make sure that they have not previously purchased a copy of this publication on either their dues statement or through GSA Publication Sales. Meeting attendees may purchase copies of *Abstracts with Programs* on-site, while the supply lasts, in the registration area of the Stouffer Winston Plaza Hotel.

A limited number of field trip guidebooks will be available for sale at the meeting. An order form will be available at the registration desk for anyone who might wish to order a prepaid copy of the guidebook. After the meeting, a limited number of guidebooks will be available through the North Carolina Geological Survey, Dept. of Natural Resources and Community Development, P.O. Box 27687, Raleigh, NC 27611-7687.

EQUIPMENT AND FACILITIES

All slides used in oral presentations must be 2" × 2" and fit a standard 35 mm carousel projector. Only *ONE* projector, screen, and pointer will be available in each meeting room. *Please bring your own loaded carousel trays*, identified with your name, session, and speaker number to the appropriate session projectionist *at least* 15 minutes before the session begins.

Poster sessions will be located in an area adjacent to the exhibits and coffee bar. Poster booths will be constructed of three pieces of 4' × 8' pegboard mounted horizontally on a frame 3' above the floor. The two side pieces will be mounted perpendicular to the back, creating an 8' × 8' display area.

A speaker ready room equipped with projectors and screens will be available for reviewing slides.

CAMERAS, SOUND EQUIPMENT, AND SMOKING POLICY

GSA meeting policy prohibits the use of cameras or sound recording equipment at technical sessions. A no-smoking policy has been adopted by the Local Committee and will be followed in all meeting rooms for technical sessions as well as the Welcoming Party.

EXHIBITS

Geological exhibits pertaining to education, research, and industry will be displayed near the technical sessions area in the Stouffer Winston Plaza Hotel. Rental fees for exhibit booths are $150 for educational and nonprofit organizations and $300 for businesses. Standard booth size will be 6' × 8'. For further information, contact Steven Goldberg, Dept. of Geology, University of North Carolina at Chapel Hill, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315.

SPECIAL EVENTS AND ACTIVITIES

Scheduled Meetings

All meetings will be held in the Stouffer Winston Plaza Hotel. Times and locations of the following will be announced in the meeting program:

1. **GSA Southeastern Section Management Board Meeting**
2. **GSA Southeastern Section Business Meeting**
3. **Meeting of Geoscience Department Chairs**
4. **SEPM Eastern Section Officers Breakfast Meeting and SEPM Eastern Section Business Meeting**
5. **Southeastern Section of the National Association of Geology Teachers Annual Business Meeting**

Any other group that wishes to meet in Winston-Salem should contact the Local Committee by December 15, 1991, if they wish to have the meeting publicized in the meeting program.

Graduate Student Recruitment. The poster session booths will be available on Thursday afternoon, March 19, to any graduate program in the geosciences that wishes to have representatives available to talk with prospective graduate students. Details will be posted at the meeting. There will be no charge for participating.

Survivors' Party. To encourage meeting participants to stay through late afternoon sessions on Friday, there will be a Survivors' Party in the hotel foyer outside the meeting rooms immediately following the last session. Refreshments will be provided. The Stouffer Winston Plaza Hotel will provide luggage storage for any participants staying late.

THINGS TO DO IN WINSTON-SALEM

The Winston-Salem Convention & Visitors Bureau will provide additional and updated information in the registration area in the Stouffer Winston Plaza Hotel. Purchase tickets or pay admission fees at the tour destination.

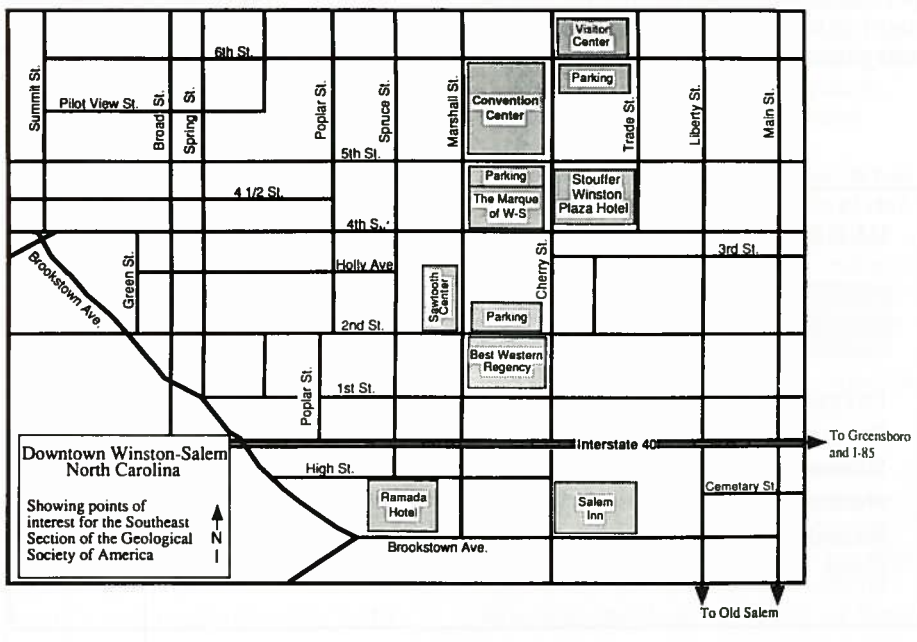
Old Salem, 600 South Main Street. The town of Salem was settled by Moravians in 1753. Many original shops, homes, and gardens have been preserved, and Old Salem is recognized today as one of America's authentic colonial sites. More than 80 structures have been restored and, unlike many restorations, these buildings are interspersed with restored private homes, giving the historic district of Old Salem the atmosphere of a living museum. There is no charge for a self-guided walking tour of the area; formal tours are offered Monday–Saturday, 9:30 a.m.–4:30 p.m. Tour admission: adults $10, children $5.

Museum of Early Southern Decorative Arts (MESDA), 924 South Main Street. MESDA is the nation's only museum dedicated to the research and preservation of the distinctive decorative styles of the early South. The museum's 19 period rooms and six galleries exhibit many rare examples of Southern furniture, textiles, ceramics, paintings, silver, and other metalwares made by artisans working between 1640 and 1820. Hours: Monday–Saturday, 10:30 a.m.–4:30 p.m., Sunday, 1:30–4:30 p.m. Admission: $5; children (6–14) $3.

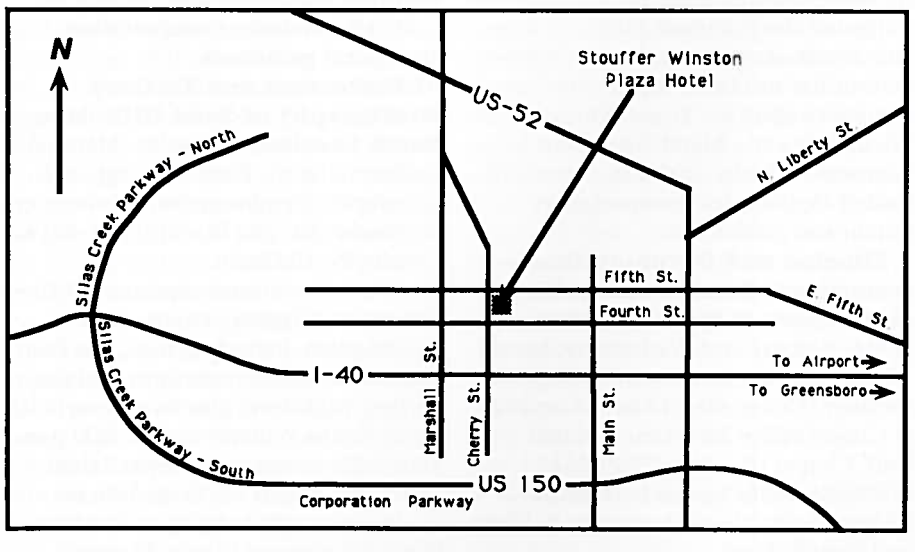
Reynolda House Museum of American Art, Reynolda Road. Reynolda House is the former estate of the late R. J. Reynolds. The house contains approximately 100 rooms, an extraordinary collection of American paintings, prints, and sculptures from the last three centuries, a gallery featuring clothing worn by the family, and many of the family's furnishings and

Southeastern *continued on p. 278*

Downtown Winston-Salem



Stouffer Winston Plaza Hotel Area



HOUSING FORM

Southeastern Section, GSA

Arrival Date _____ Departure Date _____ Arrival Time _____

Person requesting housing (type or print):

_____
Last name First

_____
Name of institution or firm

_____
Street address or P.O. box number

_____
City State ZIP

Phone ( )_____ ( )_____

Type of Room	Rate per Room per Day	Indicate Choice
Single	$72.00	_____
Double	$79.00	_____
Triple	$89.00	_____
Quad	$89.00	_____
Student block*	$69.00	_____

Rates do not include 12% tax.

Sharing room with _____

*The Stouffer Winston Plaza Hotel has reserved a limited number of rooms for students only, maximum of five students per room.

Registered hotel guests have in-out parking privileges at a cost of $4.50/day and complimentary in-room coffee and newspaper.

Public areas as well as several guest rooms in the Stouffer Winston Plaza Hotel are accessible to physically disabled persons. The hotel also features an indoor pool and a state-of-the-art fitness center.

To ensure the conference rate, reservations must be made by *February 17, 1992*. To guarantee a room, either (1) include remittance for one night, check payable in U.S. funds to: Stouffer Winston Plaza Hotel, or (2) provide credit card information below. All major credit cards are accepted.

Type of Card _____ Card Number _____

Exp. Date _____ Signature _____

Send this form and remittance or credit card information to:
Stouffer Winston Plaza Hotel, 425 North Cherry Street, Winston-Salem, NC 27101; (919) 725-3500; fax 919-722-6291

Southeastern Section of the Geological Society of America 1992 *Abstracts with Programs*

Complete this form and return it by *January 17, 1992*, for advance-copy purchases of the Southeastern Section, GSA *Abstracts with Programs*. No refunds for duplicate orders. Members and nonmembers in U.S., Canada, and Mexico only. Price of $9 includes shipment by first-class (priority) mail. Please copy this form for your records.

SHIP TO: ___Check here if GSA Member

Name_____

Address _____

City_____ State___ ZIP_____ Business Phone_____

Quantity _____ at $9 net each (no additional discounts)

Amount enclosed $ _____

Method of Payment (prepayment required):

___ Check ___Credit Card

(Provide information and sign on authorization line. Please print.)

Credit Card_____ Card No._____

Exp. Date _____

Name of Cardholder _____

Signature of Cardholder _____

Send to: GSA Publication Sales, P.O. Box 9140, Boulder, CO 80301
800-472-1988; (303) 447-2020; fax 303-447-1133

ADVANCE-COPY ORDERS MUST BE RECEIVED BY JANUARY 17, 1992

These advance copies will be mailed about three weeks prior to the meeting. The price of $9 includes shipment by first-class (priority) mail.

Refunds for duplicate orders will not be given. Members, check your records carefully to make sure that you have not previously purchased a copy of this publication on either your dues statement or through GSA Publication Sales.

TO PLACE YOUR ORDER

Prepayment is required. Check, money order (in U.S. funds, payable on U.S. banks), or major credit cards are accepted for payment. Order directly from GSA Publication Sales by mail, phone, or fax. To assure receipt prior to the meeting, all orders must be received by January 17, 1992.

By mail... use the form provided.

By phone or fax (credit card purchase)... Call us toll-free at 1-800-472-1988 (outside Colorado), or use our standard business phone, (303) 447-2020, during office hours (8:00 to 4:30 MST). You may also fax your order to us at 303-447-1133 (24-hour line).

ON-SITE PURCHASE

Meeting attendees may purchase copies of *Abstracts with Programs* on-site in the registration area of the Stouffer Winston Plaza Hotel.

PREREGISTRATION FORM

Southeastern Section, GSA
March 18–20, 1992

Please print or type • Copy for your records • Shaded areas are for your badge.

IMPORTANT

1. PREREGISTRATION MUST BE RECEIVED NO LATER THAN FEBRUARY 21, 1992. Full payment must accompany all preregistration requests. Unpaid purchase orders not acceptable
2. Register only one person per form. A receipt of your preregistration payment will be in your packet at the registration desk.

Name (Last) (First) Initial

Employer/University/Affiliation (for badge)

Mailing address of affiliation indicated above

Address

City State ZIP code

Work Phone Home Phone Fax

Guest/Spouse Name (Last) (First)

City State/Country

Membership Affiliation A ☐ GSA B ☐ NAGT C ☐ AWG D ☐ PS E ☐ SEPM

GSA or affiliated society Member No. _____

Section Affiliation F ☐ Southeastern G ☐ Other _____

FOR OFFICE USE

A___ D___ V___ M___

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Refund ck# _____

Payment by (check one):

☐ Cash/Check
☐ American Express ☐ VISA ☐ MasterCard ☐ Diners Club

Card Number _____ Exp. date _____

Cardholder's Signature _____

Personal checks or money orders payable in U.S. funds to: 1992 Southeastern GSA Meeting.

MAIL TO:
1992 GSA Southeastern Meeting, P.O. Box 9140, Boulder, CO 80301

Postmarked on or before February 21, 1992
(Registration required for participation in all exhibits and technical sessions)

	(PLEASE CHECK ONE):		Qty	Amount
PREREGISTRATION FEES				
Professional—GSA Member or affiliate	(1)	$45 ☐	1	$_____
Professional—Nonmember	(3)	$55 ☐	1	$_____
Student—GSA member or affiliated society	(5)	$15 ☐	1	$_____
Student—Nonmember	(7)	$20 ☐	1	$_____
Guest	(9)	$10 ☐	___	$_____
Secondary School Teacher (Friday only)	(42)	$10 ☐	___	$_____
FIELD TRIPS (Meeting registration required)				
1. Grandfather Mountain Window, North Carolina Wednesday, March 18	(100)	$30	___	$_____
2. Stratigraphy and Structure of Lower Ashe Formation (Upper Precambrian) Along Fries Fault in Southwestern Virginia Wednesday, March 18	(101)	$25	___	$_____
3. Geology of Construction Materials in Triad Area of North Carolina Wednesday, March 18	(102)	$22	___	$_____
4. Gold in Kings Mountain Belt of Carolinas Wednesday, March 18	(103)	$47	___	$_____
5. Heavy-Mineral Deposits, Nash and Wilson Counties, North Carolina Wednesday, March 18	(104)	$33	___	$_____
6. Geology of Waste Management in Triad Area Wednesday, March 18	(105)	$35	___	$_____
7. Silurian and Devonian Unconformities in Southwestern Virginia Tuesday and Wednesday, March 17–18	(106)	$99	___	$_____
8. Eocene-Miocene Molluscan Biostratigraphy of Coastal Plain of North Carolina Tuesday and Wednesday, March 17–18	(107)	$60	___	$_____
9. Carbonate Cycles, Sequence and Stratigraphy, and Drowning of Appalachian Cambro-Ordovician Platform Saturday, March 21	(108)	$50	___	$_____
10. Cretaceous and Tertiary Stratigraphy of Sand Hills Area, North Carolina, Saturday, March 21	(109)	$80	___	$_____
11. Sedimentology of Triassic Dan River Group, North Carolina and Virginia, Saturday, March 21	(110)	$20	___	$_____
12. Geology of Western End of the Sauratown Mountains Window, North Carolina Saturday, March 21	(111)	$30	___	$_____
13. Blue Ridge Thrust Complex Northwest of the Grandfather Mountain Window, North Carolina and Tennessee Saturday and Sunday, March 21–22	(112)	$98	___	$_____

TOTAL PAYMENT ENCLOSED (Remit in U.S. funds) $ _____

Full payment must accompany registration.

Southeastern *continued from p. 276*

belongings. The beautiful Reynolda Gardens and the shops of Reynolda Village are also located on the estate. Hours: Tuesday–Saturday, 9:30 a.m.–4:30 p.m., Sunday, 1:30–4:30 p.m. Admission: adults $5; students $3; senior citizens $4.

Southeastern Center for Contemporary Art (SECCA), 750 Marguerite Drive. SECCA is a showcase for the works of painters, sculptors, printmakers, and other contemporary artists in the southeast, located in the English manor that once was the home of industrialist James G. Hanes. A striking addition to the home in 1990 increased the exhibition space to 21,000 square feet in five galleries and a 300-seat auditorium. Hours: Tuesday–Saturday, 10:00 a.m.–5:00 p.m., Sunday, 2:00–5:00 p.m. Admission: adults $3; Students and Senior Citizens $2, Children under 12 free.

Historic Bethabara Park, 2147 Bethabara Road. This frontier trading center is the 1753 birthplace of Winston-Salem and features 18th century homes and the Gemeinhaus (church) that the first Moravian settlers occupied after the town was founded. A reconstructed 1756 palisade fort and the stabilized archeological foundations of the original settlement can also be seen. Hours: Monday–Friday, 9:30 a.m.–4:30 p.m., Saturday–Sunday, 1:30–4:30 p.m. Admission: Free.

Nature Science Center, Museum Drive. The Nature Science Center offers an opportunity to discover the world of science through interactive displays, live animals (including a petting zoo), a planetarium, and nature trails. Hours: Monday–Saturday, 10:00 a.m.–5:00 p.m., Sunday 1:00–5:00 p.m. Admission: adults $3.50; students and senior citizens $2.50; children under 3 free.

The Stroh Brewery, Schlitz Avenue. The brewery is part of America's largest family-owned and operated brewery, which traces its traditions to 17th century Germany. Visitors can observe the production and packaging of beer—5.5 million barrels are rolled out of this facility each year. Hours: Monday–Friday, 11:00 a.m.–4:30 p.m., every half hour. Admission: Free.

Theater, musical, and dance events as well as other activities that are scheduled for March 18–20, 1992, will be listed in the meeting program. The North Carolina School of the Arts, Winston-Salem Symphony, North Carolina Dance Theatre, and Piedmont Opera Company all call Winston-Salem their home. In addition to their superb performances, Winston-Salem offers an abundance of evening entertainment including theater, on-stage comedy, concerts, and a variety of clubs and night spots.

MORE INFORMATION

For other information concerning technical sessions, accommodations, and activities, please contact Paul D. Fullagar and P. Geoffrey Feiss, co-chairmen, (919) 966-4516; or Patsy H. Webb, local committee coordinator, University of North Carolina at Chapel Hill, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315; (919) 962-0679; fax 919-966-4519. ■

Final Announcement

NORTHEASTERN SECTION, GSA
27th Annual Meeting

Harrisburg, Pennsylvania
March 25–28, 1992

The Pennsylvania Geological Survey, the Harrisburg Area Geological Society, Pennsylvania State University, Bloomsburg University, Shippensburg University, Edinboro University, Millersville University, Lock Haven University, West Chester University, Dickinson College, and the Harrisburg Area Community College will host the Northeast Section of the Geological Society of America meeting at the Harrisburg Hilton & Towers. The Eastern Section of the SEPM, the Northeastern Section of the Paleontological Society (NE-PS), the Eastern Section of the National Association of Geology Teachers (ES-NAGT), and the Allegheny-Ohio and Potomac Sections of the Association for Women Geoscientists (AWG) will be meeting with GSA's Northeastern Section.

The meeting will be conducted from 8:00 Thursday morning, March 26, through noon Saturday, March 28.

REGISTRATION

Registration is required for everyone participating in any event connected with the meeting.

Preregistration. All participants are strongly urged to preregister as early as possible. Your preregistration form and payment must be received no later than *February 27, 1992*. Complete the preregistration form and return it with a check or money order in U.S. currency (made payable to Northeastern Section GSA) to Jim Lauffer, Dept. of Geog. & Earth Sciences, Bloomsburg University, Bloomsburg, PA 17815, (717) 389-4108. Refunds on canceled preregistration will be made in full until March 11, 1992. No refunds will be made after this date.

On-Site Registration. On-site registration, and pick-up of meeting materials for those who have preregistered, will be from 5 to 10 p.m. on Wednesday, March 25; 7 a.m. to 9 p.m. on Thursday, March 26; 7 a.m. to 5 p.m. on Friday, March 27; and 7 a.m. to noon on Saturday, March 28. On-site registration and packet pick-up will be held in the New Governor Board Room on the second floor of the Hilton.

The Northeastern Section of GSA is unable to accept credit cards for preregistration and on-site registration.

Additional copies of the *Abstracts with Programs* for the meeting will be available at the registration desk. Preregistrants will be able to reserve copies for pick-up on site.

TRANSPORTATION

The Harrisburg Hilton & Towers is conveniently located at 2nd and Market Streets in downtown Harrisburg. If arriving by car, Interstate highways 81, 83, and U.S. route 15 are recommended for travelers coming from the north or south; major east-west routes include the Pennsylvania Turnpike (I-76), Interstate 78, U.S. routes 322 and 422. Parking is available at a number of nearby public parking lots. Overnight guests of the Harrisburg Hilton & Towers may park free of charge in the Walnut Street parking garage, which connects to the Hilton via the Strawberry Arcade (Strawberry Square area). The Amtrak rail system has regular stops at the Harrisburg Station, a five minute walk from the Hilton.

Harrisburg International Airport is located southeast of the city, approximately 2 miles south of Pennsylvania route 283. The airport is 15 minutes from downtown by car. Taxi and shuttle service to the Hilton is available.

TECHNICAL PROGRAM

Symposia and general technical sessions will run from 8 a.m. Thursday, March 26, through noon, Saturday, March 28. Oral and poster sessions will be held on the second and third floors of the Hilton.

Symposia

1. **Coal Geology of the Northern Appalachian Basin**. Alan Davis, Dept. of Geosciences, 339 Deike Building, Pennsylvania State University, University Park, PA 16802; (814) 865-6544.
2. **Fabric Analysis in the Study of Argillaceous Sediment and Rock**. *Sponsored by ES-SEPM*. Richard W. Faas, Dept. of Geology, Lafayette College, Easton, PA 18042; (215) 250-5193.
3. **Stratigraphic Utility and Geochemical Discrimination of K-bentonites in Eastern North America**. *Sponsored by ES-SEPM*. James R. Ebert, Dept. of Earth Sciences, SUNY—College at Oneonta, Oneonta, NY 13820; (607) 431-3065.
4. **Gradients in Fossil and Recent Communities**. *Sponsored by Paleontological Society, Northeast Section*. Dale A. Springer, Dept. of Geography and Earth Sciences, Bloomsburg University, Bloomsburg, PA 17815, (717) 389-4108 or (717) 387-1126; Carlton E. Brett, Dept. of Geological Sciences, University of Rochester, Rochester, NY 14627; (716) 275-5713.
5. **Geology and Industrial Archeology in the Northeastern U.S.** *Poster Session sponsored by the Society for Industrial Archeology*. Jon Inners, Pennsylvania Geological Survey, P.O. Box 2357, Harrisburg, PA 17105; (717) 787-2169.
6. **Earthquake Hazard in Eastern North America**. Shelton S. Alexander, Dept. of Geosciences, 503 Deike Building, Pennsylvania State University, University Park, PA 16802; (814) 865-6711.
7. **Revisions of Geology Curriculum to Meet the Needs of the 90's**. Larry Malinconico, Dept. of Geology, Lafayette University, Easton, PA 18042; (215) 250-5193. See also: Special Poster Session 2, Theme Session 1, and Workshops 1 and 2.
8. **Geologic Record of Global Change**. Eric J. Barron, Earth System Science Center, 248 Deike Building, Pennsylvania State University, University Park, PA 16802; (814) 865-1619. See also: Short Course 1.

Theme Sessions

1. **Earth Scientists and Earth Science Educators: An Alliance for Geological Education**. See also: Special Poster Session 2, Symposium 7, and Workshops 1 and 2.
2. **Hydrology/Hydrogeology and Geological Processes in the Central and Northern Appalachians**.
3. **Surface and Ground-Water Contamination: Geochemistry, Modeling, Evaluation, and Treatment**.
4. **Iapetan Rifting and Terrane Accretion**.
5. **Sedimentary Characterization of the Taconic/Acadian Orogens.**
6. **Geologic Controls on Siting Low-level Radioactive Waste Facilities in Northeastern North America**.
7. **Quaternary/Neotectonics of the Central Appalachians and Coastal Plain**.
8. **Pressure-Temperature-Time Deformation in Metamorphic Rocks**.
9. **Computer Applications in Geology**.
10. **Modeling Sedimentary Basins in the Appalachians**. See also Short Course 2.

Poster Sessions

1. **Undergraduate Research**. The Organizing Committee is inviting undergraduates to participate in this session. Posters must be authored by student(s) *only*. Topic emphasis on undergraduate research for any subdiscipline of geology.
2. **Laboratory and Field Techniques in Geoscience Education**. *Sponsored by the ES-NAGT*; scheduled for Friday. Brian B. Tormey, Dept. of Environmental Science, Pennsylvania State University, Altoona Campus, Altoona, PA 16601; (814) 949-5272.

PROJECTION EQUIPMENT

All slides must fit in a standard Kodak 35 mm carousel tray. Two projectors and two screens will be provided in each of the technical sessions. Overhead projectors will not be used in the technical program. Speakers are expected to bring their own loaded tray to the meeting. Please label trays with your name, session, left and/or right screen, and time of paper; give trays to the projectionist at least 20 minutes before the beginning of the session. A speaker-ready room for previewing slides will be provided. Extra trays will be available.

SHORT COURSES

Two short courses will be offered. The short courses will be held on Wednesday, March 25. *Preregistration is required for all short courses*. For further information, contact the identified short course leader(s) directly.

Northeastern *continued on p. 279*

Northeastern *continued from p. 278*

1. **Applications of Climate Models to Environmental Prediction.**

This one-day course will focus on factors that govern climate change in Earth history, case studies of the application of climate models, model predictions and observations for the mid-Cretaceous of North America, and other areas of research including stratigraphic reconstructions utilizing climate models, high-resolution atmospheric and basin-scale circulation models, and the development of a global paleoenvironment model database. This course is ideally suited for individuals who are interested in climate model results and interpretation but who are not actively involved in climate modeling. Computer expertise is not required. Course limited to 75. Cost $60. Convener: Eric J. Barron, Earth System Science Center, 248 Deike Building, Pennsylvania State University, University Park, PA 16802; (814) 865-1619.

2. **Simulating Clastic Sedimentary Basins: Physical Fundamentals and Computing Procedures.**

This one-day course will cover mathematical modeling of clastic sedimentary basins, translate sedimentary and tectonic processes into dynamic models, and use modeling experiments to interpret ancient stratigraphic sequences. The intended audience is upper-level undergraduates, graduate students, and professionals. A basic familiarity with sedimentary geology and a modest recollection of freshman calculus are suggested. Course limited to 30. Cost $60. Conveners: Rudy Slingerland and Kevin Furlong, Dept. of Geosciences, 204A Deike Building, Pennsylvania State University, University Park, PA 16802; (814) 865-6892.

WORKSHOPS

1. **Field Techniques and Instrumentation in the Geosciences.** *Sponsored by ES-NAGT.*

This half-day indoor/outdoor workshop will illustrate a variety of geological field research techniques and instruments; seismic profiling, resistivity, monitoring and sampling, etc. This workshop is scheduled for Friday or Saturday, March 27 or 28 (depending on weather) and will be held at the Harrisburg Area Community College. There is no cost. Convener: Brian B. Tormey, Dept. of Environmental Science, Pennsylvania State University, Altoona Campus, Altoona, PA 16601; (814) 949-5000.

2. **Integration of Personal Computers in Geologic Education.** *Sponsored by ES-NAGT.*

Participants in the morning session will investigate the applications of general commercial software to geologic education and student research. Those in the afternoon session will concentrate on geologically specific software that is either available commercially or distributed free of charge. Both sessions will begin with demos of software and applications, followed by time for experimentation by participants. Participants should bring a supply of blank disks as some software will be available for copying. Two separate workshops following this plan will be offered concurrently—a Mac version and an IBM version. This workshop is intended for all geologists and earth science teachers. Registration is limited to 22 for the Mac session; 22–24 for the IBM session. The course will take place at the Harrisburg Area Community College on Saturday, March 28. There is no cost. Conveners: (Macintosh workshop) H. Robert Berger, Dept. of Geology, Smith College, Northampton, MA 01063, (413) 585-3942; (IBM workshop) John J. Thomas, Dept. of Geology, Skidmore College, Saratoga Springs, NY 12866, (518) 584-5000 or (518) 584-6393 (leave a message).

FIELD TRIP

Tectonic Geomorphology and Fluvial Evolution of the Lower Susquehanna River Basin.

Participants in this field trip will examine late Cenozoic base-level changes attributed to both eustasy and vertical crustal deformation and their effects on the fluvial evolution and geomorphic development of this region. We will stop to examine upland gravel deposits on the Coastal Plain and Fall Zone, Piedmont strath terraces, and Pleistocene outwash terraces. Convener: Frank J. Pazzaglia, Dept. of Geosciences, 801 Deike Building, Pennsylvania State University, University Park, PA 16802; (814) 865-1178 or (814) 865-6393.

This two-day field trip is being conducted *before* the meeting and will be starting in Maryland. Travel will be by private car. Approximate cost of the field trip is $60. Beverages and snacks for both days, field guidebook, and one night's lodging are included in the cost. Registration is on a first-come, first-served basis. Those wishing to attend the field trip are to register with, and make payments directly to Frank Pazzaglia. Registration deadline is *February 1, 1992.*

PUBLIC FORUM

A forum on Geology and Public Policy is scheduled for Friday evening, March 27, at 8 p.m. in the Hilton Ballroom. The forum is addressed to the registrants but will be open to the public and will focus on the role of geology on current environmental issues such as the siting of low-level radioactive and hazardous waste disposal areas. A panel of speakers representing various government and technical groups will offer discussion and response to questions from a mediator and from the audience. A reception for public forum attendees will follow.

1992 NEGSA SCIENCE THEATRE

A wide variety of scientific films and videos of geologic interest will be shown Thursday through Saturday in the William Penn Board Room during the meeting. A complete schedule of films will be included in the registration packet.

EXHIBITS

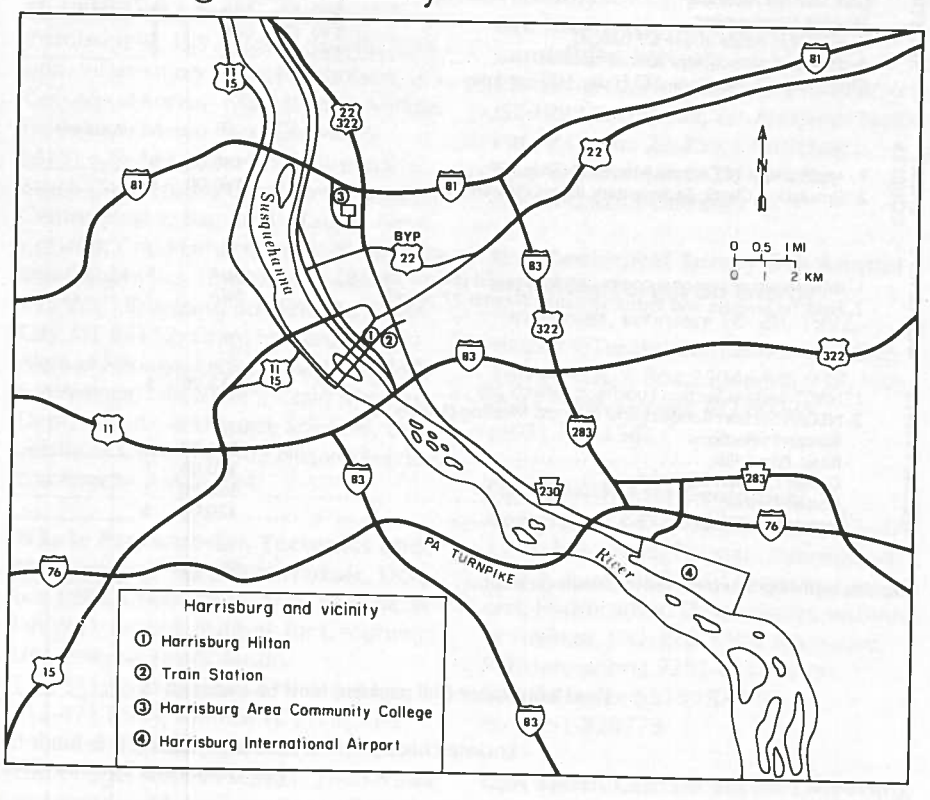
Exhibits of geological research equipment and educational material will be on display in the Carlisle Room. Booths will be framed with pipe and drape and contain table and chairs. The cost is $400; a special half-price rate of $200 will be charged to nonprofit and educational organizations. For additional information, contact Wally Drexler, 104 Shearer Hall, Shippensburg University, Shippensburg, PA 17257; (717) 532-1310.

FOCUS ON CAREER DEVELOPMENT

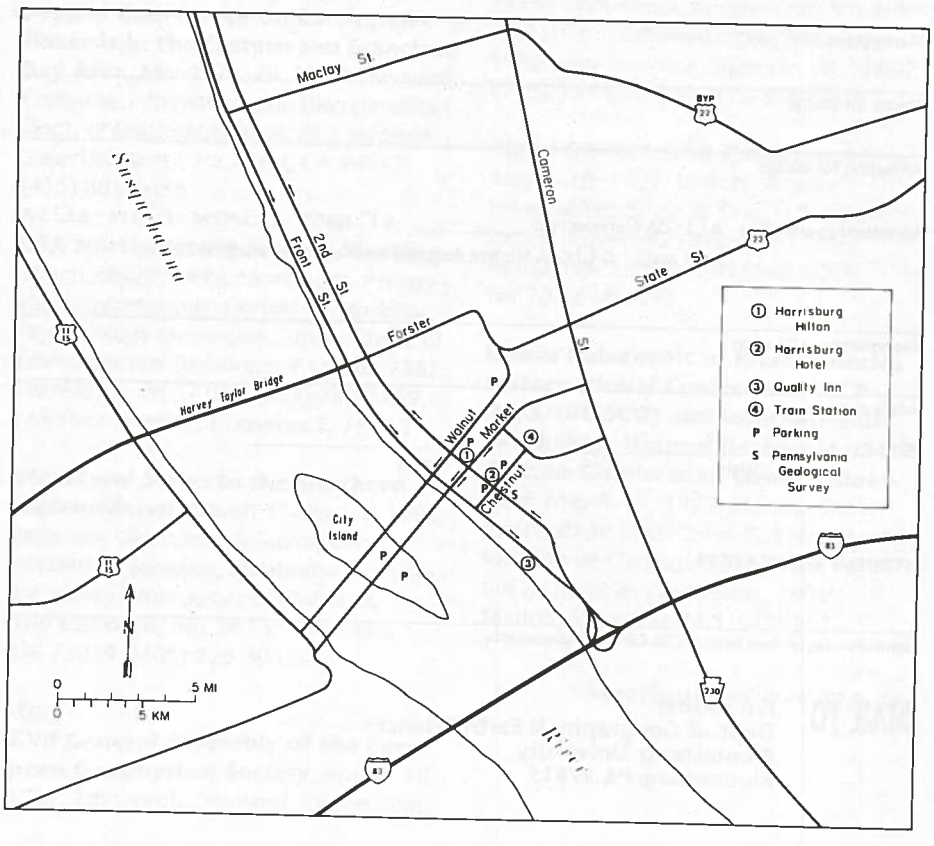
The Allegheny-Ohio and Potomac Chapters of the Association for Women Geoscientists (AWG) will sponsor an informal discussion on careers in the geosciences on Friday, March 27, from 5 to 6:30 p.m. The program will include brief presentations from invited professional geologic consultants and a question and answer period. Food and refreshments will be provided.

Northeastern *continued on p. 280*

Harrisburg and Vicinity



Harrisburg Hilton Hotel Area



Northeastern *continued from p. 279*

Conveners: Tania Brice, Geoservices Ltd., (717) 541-0799; Helen Delano, Pennsylvania Geological Survey, (717) 787-5828.

PHOTO EXHIBIT

A photographic competition and exhibit will be held at this meeting. Entries will be judged on the basis of impact, content, composition, and overall presentation. Photographs will be exhibited during the entire meeting. First, second, and third place prizes will be awarded.

Guidelines:

- Photographs must be taken within the boundaries of the Northeastern or Southeastern sections of the GSA.
- Photographs may be either color or black and white. Prints must be 8" × 10" or larger, firmly matted (with border), not to exceed 16" × 20".
- Your name, address, and telephone number must be on the back of each matte board.
- No more than three entries per photographer.
- Entries must be picked up from the display area between 8 a.m. and noon on Saturday, March 28.

Entries may be delivered to the registration area between 5 and 9 p.m. on Wednesday, March 25 or sent to William D. Sevon, Pennsylvania Geological Survey, P.O. Box 2357, Harrisburg, PA 17105. Call William Sevon at (717) 787-6029 for further information.

SPECIAL EVENTS

Wednesday, March 25
Welcoming Party, Hilton & Towers Atrium, 7–9 p.m. NEGSA Management Board Meeting, 7–9 p.m.

Thursday, March 26
NAGT Luncheon 11:30 a.m.–12:30 p.m.
Annual Banquet, 7:30–10 p.m.

Friday, March 27
AWG Focus on Career Development, 5–6:30 p.m. Public Forum and reception, Hilton Ballroom, 8–11 p.m.

Organizations with specific needs for meeting rooms should contact Don Hoskins, Pennsylvania Geological Survey, P.O. Box 2357, Harrisburg, PA 17105.

HOUSING—*see Housing Form to left*

Important: If room reservations with the Harrisburg Hilton & Towers are made by phone, it is very important that you state you are attending the Northeastern Section GSA meeting in order for the Section to receive credit against session room charges.

Other accommodations within 5–10 minutes walking distance:

Harrisburg Hotel
(formerly the Holiday Inn)
(717) 234-5021

Quality Inn—Riverfront
(717) 233-1611
800-228-5151 (toll free—PA only) ■

HOUSING FORM

Harrisburg Hilton & Towers

Northeastern Section, GSA, March 25–28, 1992

Arrival Date _____ Departure Date _____ Arrival Time _____

Person requesting housing (type or print):

_____
Last name First

_____
Name of institution or firm

_____
Street address or P.O. box number

_____
City State ZIP

Phone ( )_____ ( )_____

Sharing room with _____

Type of Room	Rate per Room per Day	Indicate Choice
Single	$84.00	_____
Double	$86.00	_____
Triple	$88.00	_____
Quad	$88.00	_____
Extra Adult	$10.00	_____
Cot	$10.00	_____

Rates do not include 6% tax.

- All reservations must be accompanied by a credit card guarantee or a deposit of one night in advance.
- Rooms may not be available for occupancy until 3 p.m. on the day of arrival. Check-out time is 12 noon.
- If your reservation is not received by *February 25, 1992*, availability cannot be guaranteed.

Type of Card _____ Card No. _____

Exp. Date _____ Signature _____

Send this form and remittance or credit card information to:
Reservation Department, Harrisburg Hilton & Towers
One North Second Street, Harrisburg, PA 17101

PREREGISTRATION FORM

Northeastern Section, GSA
March 25–28, 1992

Please print or type • Copy for your records

IMPORTANT

1. PREREGISTRATION MUST BE RECEIVED NO LATER THAN FEBRUARY 27, 1992.
2. Full payment must accompany all preregistration requests. Unpaid purchase orders are not acceptable.
3. Cancellation deadline: March 11, 1992. No refunds after this date.
4. Register only one person per form. A receipt of your preregistration payment will be in your packet at the registration desk.

PLEASE PRINT OR TYPE

_____
Name (Last, First, M.I.)

_____
Name for badge

_____
Affiliation for badge

Membership affiliation A ☐ GSA Member No. _____ B ☐ NAGT C ☐ SEPM D ☐ PS E ☐ SIA
F ☐ AWG G ☐ GSA Student Associate (see verification below)

_____
Nonmember affiliation

_____
Mailing address

Phone ( )_____ ( )_____
Work Home

STUDENT VERIFICATION

_____
Signature—department head or GSA Campus Representative

MAIL TO: Jim Lauffer
Dept. of Geography & Earth Sciences
Bloomsburg University
Bloomsburg, PA 17815

PREREGISTRATION

Postmarked on or before February 27, 1992	(PLEASE CHECK ONE): Full Meeting	or 1 Day	Amount
Professional, GSA Member or affiliate	$55 ☐	$30 ☐	$ _____
Professional, Nonmember	$70 ☐	$40 ☐	$ _____
GSA Student Associate	$20 ☐	$15 ☐	$ _____
Student Nonmember	$30 ☐	$25 ☐	$ _____
Guest (fill in name above for badge)	$20 ☐	N/A	$ _____
Professional, pre-college science teacher	$25 ☐	N/A	$ _____

Check day: ☐ Thursday ☐ Friday ☐ Saturday

REGISTRATION

Postmarked after February 27, 1992, or on-site	(PLEASE CHECK ONE): Full Meeting	or 1 Day	Amount
Professional, GSA Member or affiliate	$75 ☐	$45 ☐	$ _____
Professional, Nonmember	$90 ☐	$55 ☐	$ _____
GSA Student Associate	$30 ☐	$25 ☐	$ _____
Student Nonmember	$40 ☐	$35 ☐	$ _____
Guest (fill in name above for badge)	$30 ☐	N/A	$ _____
Professional, pre-college science teacher	$35 ☐	N/A	$ _____

Check day: ☐ Thursday ☐ Friday ☐ Saturday

		Amount
SHORT COURSES		
1. Applications of Climate Models (March 25)	$60.00	$ _____
2. Simulating Clastic Sedimentary Basins (March 25)	$60.00	$ _____
WORKSHOPS		
1. Integration of personal computers in Geo. Ed (March 28)	N/A	$ _____
2. Field Techniques and Instrumentation (March 27 or 28)	N/A	$ _____
SPECIAL EVENTS		
1. NAGT Eastern Section Luncheon (March 26)	$13.00	$ _____
2. NEGSA Section Banquet and Business Meeting (March 27) Banquet selections		
Roast Prime Rib	$24.00	$ _____
Grilled Chicken Dijonaisse	$20.00	$ _____
Kosher Dinner	$20.00	$ _____
Vegetarian Dinner	$20.00	$ _____
Abstracts with Programs (reserved for on-site pick-up)	$12.00	$ _____

Total Remittance (full payment must be enclosed) $ _____

Enclose check or money order payable in U.S. funds to
Northeastern Section GSA

MEETINGS

■ Indicates new or changed information

GSA Penrose Conferences

March 1992

Continental Tectonics and Magmatism of the Jurassic North American Cordillera, March 28–April 3, 1992, Lake Havasu City, Arizona. Information: David M. Miller, U.S. Geological Survey, 345 Middlefield Road, MS-975, Menlo Park, CA 94025; (415) 329-4923; fax 415-329-4936; or Richard M. Tosdal (same address); (415) 329-5423.

May 1992

The Origin and Evolution of the Coast Mountains, British Columbia, Yukon, and Alaska, May 16–22, 1992 (tentative), Whistler, British Columbia. Information: George E. Gehrels, Dept. of Geosciences, University of Arizona, Tucson, AZ 85721; (602) 621-6026; fax 602-621-2672; Maria Luisa Crawford, Dept. of Geology, Bryn Mawr College, Bryn Mawr, PA 19010; (215) 526-5111; fax 215-526-5086; James W.H. Monger, Geological Survey of Canada, 100 West Pender Street, Vancouver, B.C. V6B 1R8, Canada; (604) 666-6743 or 0529; fax 604-666-1124.

September 1992

Applications of Strain: From Microstructures to Mountain Belts, September 8–12, 1992, Liscomb Mills, Nova Scotia, Canada. Information: Mark Brandon, Dept. of Geology and Geophysics, Yale University, P.O. Box 6666, New Haven, CT 06511-8130, (203) 432-3135; or Scott R. Paterson, Dept. of Geological Sciences, University of Southern California, Los Angeles, CA 90089-0740; (213) 740-6130.

■ **Origin and Emplacement of Low-K Silicic Magmas in Subduction Settings**, September 25–30, 1992, Chelan, Washington. Information: James S. Beard, Virginia Museum of Natural History, Martinsville, VA 24112, (703) 666-8611; George W. Bergantz, Dept. of Geological Sciences, University of Washington, Seattle, WA 98195, (206) 545-4972; Marc J. Defant, Dept. of Geology, University of South Florida, Tampa, FL 33620, (813) 974-2238, fax 813-974-2668; Mark S. Drummon, Dept. of Geology, University of Alabama, Birmingham, AL 35294, (205) 934-8130.

October 1992

Fluid-Volcano Interactions, October 4–9, 1992, Warm Springs, Oregon. Information: Steve Ingebritsen, U.S. Geological Survey, MS 439, 345 Middlefield Road, Menlo Park, CA 94025, (415) 329-4422, fax 415-329-4463; Bruce Christenson, Geothermal Research Centre, Private Bag 2000, Taupo, New Zealand; Craig Forster, Dept. of Geology and Geophysics, University of Utah, 719 W.C. Browning Building, Salt Lake City, UT 84112; Grant Heiken, Los Alamos National Laboratory, MS-D462, Los Alamos, NM 87545; Craig Manning, Dept. of Earth and Space Sciences, University of California, 405 Hilgard Avenue, Los Angeles, CA 90024.

■ **Late Precambrian Tectonics and the Dawn of the Phanerozoic**, October 1992, Death Valley area. Information: Ian W.D. Dalziel, Institute for Geophysics, University of Texas, Austin, TX 78759-8345, (512) 471-6156, fax 512-471-8844; Andrew H. Knoll, The Botanical Museum, Harvard University, Cambridge, MA 02138, (617) 495-9306; and Eldridge M. Moores, Dept. of Geology, University of California, Davis, CA 95616, (916) 752-0352 or 752-0350, fax 916-752-6363.

Other Meetings

December

Paleozoic-Mesozoic Inversion Tectonics, Southern Africa, December 2–6, 1991, Cape Town, South Africa. Information: Maarten de Wit or Ian Ransome, Dept. of Geology, University of Cape Town, Rondebosch 7700, South Africa; phone 021-6502921/25; fax 021-6503783.

IGCP 264 Remote Sensing Spectral Properties (5th Meeting)—Geological Applications of Remote Sensing with Emphasis on Spectral Properties, December 2–12, 1991, Pune, India. Information: Melvin Podwysocki, Co-Chairman IGCP264, USGS, National Center, MS 913, Reston, VA 22092; fax 703-648-6057.

Third Conference on Hydrogeology, Ecology, Monitoring, and Management of Ground Water In Karst Terranes, December 4–6, 1991, Nashville, Tennessee. Information: National Water Well Association, 6375 Riverside Drive, Dublin, OH 43017; (614) 761-1711.

Mining Indonesia '91, December 4–7, 1991, Jakarta, Indonesia. Information: Eileen M. Lavine, Information Services, Inc., 4733 Bethesda Ave., #735, Bethesda, MD 20814; (301) 656-2942; fax 301-656-3179.

Second Forum for Continental Scientific Drilling, December 8, 1991, San Francisco, California. Information: John C. Eichelberger, chairman, Geophysical Institute, University of Alaska, Fairbanks, AK 99775-0800; (907) 474-5530; fax 907-474-7290.

American Geophysical Union Fall Meeting, December 9–13, 1991, San Francisco, California. Information: 1991 Fall Meeting, American Geophysical Union, 2000 Florida Ave., N.W., Washington, DC 20009.

1992

February

6th International Symposium on Landslides, February 10–14, 1992, Christchurch, New Zealand. Information: ISL 1992 Secretariat, c/o Guthreys Pacific Ltd., P.O. Box 22-255, Christchurch, New Zealand; fax 643-790-175; telex: NZ4243 Guthreys.

U.S. Geological Survey 8th Annual McKelvey Forum on Energy Resources, February 18–20, 1992, Houston, Texas. Information: Christine Turner, USGS, Box 25046 MS 939, Federal Center, Denver, CO 80225; (303) 236-1561.

First South Asia Geological Congress—GEOSAS-I, February 23–27, 1992, Islamabad, Pakistan. Information: Hilal A. Raza, GEOSAS-I Secretary General, Hydrocarbon Development Institute of Pakistan, P.O. Box 1308, Islamabad, Pakistan; phone 9251-823690 or 821417; telex 5516 HDIP PK; fax 9251-828773.

GSA South-Central Section Meeting, February 24–25, 1992, Houston, Texas. Information: Hans G. Avé Lallemant, Dept. of Geology and Geophysics, P.O. Box 1892, Rice University, Houston, TX 77251; (713) 527-4889.

Society for Mining, Metallurgy, and Exploration Annual Meeting, February 24–27, 1992, Phoenix, Arizona. Information: Meetings Department, SME, P.O. Box 625002, Littleton, CO 80162; (303) 973-9550; fax 303-979-3461.

■ **American Society of Photogrammetry and Remote Sensing–American Congress of Surveying and Mapping Annual Meeting**, February 29–March 5, 1992, Albuquerque, New Mexico. Information: Registration Coordinator, ASPRS/ACSM, 5410 Grosvenor Lane, Suite 100, Bethesda, MD 20814-2122; fax 301-493-8245.

March

21st Computer Simulated Mineral Exploration Workshop, March 3–30, 1992, Fontainebleau, France. Information: L. Zanone, Ecole des Mines de Paris, CGGM-IGM, 35, rue Saint-Honoré, 77305 Fontainebleau Cédex, France; phone (33 1) 64 69 49 30; telex 694 736 F; fax (33 1) 64 69 47 01.

Circum-Pacific Council for Energy and Mineral Resources Symposium, Sustainable Development: Energy and Mineral Resources and the Environmental Impact of Their Utilization in the Circum-Pacific Region, March 9–12, 1991, Bangkok, Thailand. Information: Mary Stewart, Circum-Pacific Council, 5100 Westheimer, Suite 500, Houston, TX 77056; fax 713-622-5360.

GSA Southeastern Section Meeting, March 18–20, 1992, Winston-Salem, North Carolina. Information: Paul D. Fullager, Dept. of Geology, CB 3315 Mitchell Hall, University of North Carolina, Chapel Hill, NC 27599-3315; (919) 962-0677.

AGU Chapman Conference on Climate, Volcanism, and Global Change, March 23–27, 1992, Hilo, Hawaii. Information: Stephen Self, Dept. of Geology and Geophysics, University of Hawaii at Manoa, Honolulu, HI 96822; or Richard P. Turco, Dept. of Atmospheric Sciences, University of California, Los Angeles, CA 90024-1565.

Second Conference on Earthquake Hazards in the Eastern San Francisco Bay Area, March 25–28, 1992, Hayward, California. Information: Sue Ellen Hirschfeld, Dept. of Geological Sciences, California State University, Hayward, CA 94542; (415) 881-3486.

GSA Northeastern Section Meeting, March 26–28, 1992, Harrisburg, Pennsylvania. Information: Donald M. Hoskins, Pennsylvania Geological Survey, Dept. of Environmental Resources, P.O. Box 2357, Harrisburg, PA 17105; (717) 787-2169. (*Abstract deadline: December 5, 1991.*)

Structural Styles in the Southern Midcontinent, March 31–April 1, 1992, Norman, Oklahoma. Information: Kenneth S. Johnson, Oklahoma Geological Survey, University of Oklahoma, 100 East Boyd, Rm. N-131, Norman, OK 73019; (405) 325-3031.

April

XVII General Assembly of the European Geophysical Society, April 6–10, 1992, Edinburgh, Scotland. Information: EGS Office, Postfach 49, 3411 Katlenburg-Lindau, Germany; phone (49) 5556-1440; fax 49-5556-4709; telex 965564 zil d; E-mail SPAN: LINMPI::EGS; EARN: U0085@DGOGWDG5.

1992 SEPM Permian Basin Section Annual Fieldtrip, Paleokarst, Karst-related Diagenesis, and Reservoir Development: Examples from Ordovician-Devonian–Age Strata of West Texas and the Mid-Continent, April 9–11, 1992. Information: Magell Candelaria, Arco Oil & Gas Co., P.O. Box 1610, Midland, TX 79702; (915) 688-5254; fax 915-688-5756.

American Association of Petroleum Geologists Southwest Section, April 12–14, 1992, Midland, Texas. Information: West Texas Geological Society, P.O. Box 1595, Midland, TX 79702; (915) 683-1573. (*Abstract deadline: December 1, 1991.*)

1992 International High-Level Radioactive Waste Management Conference, April 12–16, 1992, Las Vegas, Nevada. Information: James Tulenko, Attn: TRANSACTIONS Office, American Nuclear Society, 555 N. Kensington Avenue, La Grange Park, IL 60525.

Fifth Annual Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP), April 26–29, 1992, Oakbrook, Illinois. Information: Mark Cramer, 11100 E. Dartmouth Ave., Suite 190, Aurora, CO 80014; (303) 752-4951.

GSA North-Central Section Meeting, April 30–May 1, 1992, Iowa City, Iowa. Information: Raymond R. Anderson, Iowa DNR, Geological Survey, University of Iowa, 123 N. Capital St., Iowa City, IA 52242; (319) 335-1575. (*Abstract deadline: December 30, 1991.*)

May

First Canadian Symposium on Geotechnique and Natural Hazards, May 6–9, 1992, Vancouver, British Columbia. Information: Organizing Secretary, Geohazards '92, 970 Burrard St., Vancouver, BC V6Z 1Y3, Canada; (604) 663-1651; fax 604-663-1940.

Institute on Lake Superior Geology Annual Meeting, May 7–9, 1992, Hurley, Wisconsin. Information: Albert B. Dickas, 203 Administration, University of Wisconsin–Superior, Superior, WI 54880; (715) 394-8311; fax 715-394-8107.

Third Goldschmidt Conference, May 8–10, 1992, Reston, Virginia. Information: Bruce R. Doe, U.S. Geological Survey, 923 National Center, Reston, VA 22092; (703) 648-6205; fax 703-648-6191.

Lower Palaeozoic of Ibero-America (International Conference, IGCP-IUGS/UNESCO) and International Workshop: Natural Resources of the Circum-Gondwanan Lower Palaeozoic, May 8–12, 1992, Mérida, Spain. Information: Juan Carlos Gutiérrez-Marco, Instituto de Geología Económica, Facultad de Ciencias Geologicas, 28040-Madrid, Spain; fax 34-1-5439162.

Meetings *continued on p. 282*

GSA Cordilleran Section Meeting, May 11–13, 1992, Eugene, Oregon. Information: A. Dana Johnston, Dept. of Geological Sciences, University of Oregon, Eugene, OR 97403-1272; (503) 346-5588. (*Abstract deadline: January 21, 1992.*)

GSA Rocky Mountain Section Meeting, May 13–15, 1992, Ogden, Utah. Information: Sidney R. Ash, Dept. of Geology, Weber State University, Ogden, UT 84408-2507; (801) 626-6908. (*Abstract deadline: January 29, 1992.*)

International Congress on Technology and Technology Exchange, May 13–15, 1992, Evry, France. Information: Janet Weisgerber, (412) 391-2913, or Ruby Glasgow, (412) 795-5300, 7125 Saltsburg Rd., Pittsburgh, PA 15235-2297; fax 412-795-5302.

Pan-American Current Research on Fluid Inclusions (PACROFI IV), May 22–24, 1992, Lake Arrowhead, California. Information: Michael A. McKibben, Department of Earth Sciences, University of California, Riverside, CA 92521-0423; (714) 787-3444; fax 714-787-4324. (*Abstract deadline: March 1, 1992.*)

The Euramerican Coal Province: Controls on Tropical Peat Accumulation in the Late Paleozoic, May 24–27, 1992, Wolfville, Nova Scotia, Canada. Information: John H. Calder, Nova Scotia Dept. of Mines and Energy, P.O. Box 1087, Halifax, Nova Scotia B3J 2X1, Canada; (902) 424-5364; fax 902-424-0528; or Martin R. Gibling, Dept. of Geology, Dalhousie University, Halifax, Nova Scotia B3H 3J5, Canada; (902) 494-2355.

Project PANGEA (GSGP) Research Workshop, May 24–29, 1992, Lawrence, Kansas. Information: Project PANGEA, P.O. Box 5061, Station A, Champaign, IL 61825-5061; (217) 333-2076.

■ **Geological Association of Canada/Mineralogical Association of Canada Joint Annual Meeting**, May 25–27, 1992, Wolfville, Nova Scotia, Canada. Information: Wolfville '92, Gary Sonnichsen, Acadia University, Wolfville, Nova Scotia B0P 1X0, Canada; (902) 542-1902; fax 902-542-1454; E-mail: WFVILL92@ace.acadiau.ca. (*Abstract deadline: January 15, 1992.*)

Third International Conference on Engineering, Construction and Operations in Space, May 31–June 4, 1992, Denver, Colorado. Information: Stein Sture, SPACE 92 Technical Co-Chairman, Dept. of Civil, Environmental, & Architectural Engineering, University of Colorado, Boulder, CO 80309-0428; (303) 492-7651; fax 303-492-7317.

June

33rd U.S. Symposium on Rock Mechanics, June 8–10, 1992, Santa Fe, New Mexico. Information: Wolfgang R. Wawersik, Geomechanics Division 6232, Sandia National Laboratories, Albuquerque, NM 87185; (505) 844-4342; fax 505-844-7354.

6th Symposium on the Geology of the Bahamas, June 11–15, 1992, Bahamian Field Station, San Salvador, Bahamas. Information: Donald T. Gerace, Executive Director, Bahamian Field Station, Ltd., P.O. Box 2488, Port Charlotte, FL 33949.

American Association of Petroleum Geologists Annual Meeting, June 21–24, 1992, Calgary, Alberta, Canada. Information: George Eynon, General Chairman, Bow Valley Industries, Ltd., P.O. Box 6610, Postal Station D, Calgary, Alberta T2P 3R7, Canada; (403) 261-6100; or AAPG Convention Department, P.O. Box 979, Tulsa, OK 74101; (918) 584-2555.

Interpraevent 1992—Protection of Habitat against Floods, Debris Flows and Avalanches, June 29–July 3, 1992, Berne, Switzerland. Information: Interpraevent 1992, c/o Bundesamt für Wasserwirtschaft, Postfach 2743, CH-3001 Berne, Switzerland.

July

7th International Symposium on Water-Rock Interaction, July 13–22, 1992, Park City, Utah. Information: Yousif Kharaka, Secretary-General, U.S. Geological Survey, MS 427, 345 Middlefield Road, Menlo Park, CA 94025; (415) 329-4535; fax 415-329-5110.

Society for Industrial and Applied Mathematics Annual Meeting, July 19–24, 1992, Los Angeles, California. Information: SIAM Conference Department, 3600 University City Science Center, Philadelphia, PA 19104-2688; (215) 382-9800; fax 215-386-7999; E-mail: siamconfs@wharton.upenn.edu. (*Abstract deadline: January 6, 1992.*)

International Committee for Coal Petrology 44th Meeting, July 20–24, 1992, University Park, Pennsylvania. Information: Alan Davis, Penn State University, 205 Research Bldg. E, University Park, PA 16802; (814) 865-6544; fax 814-865-3573.

Society for Organic Petrology, 9th Annual Meeting, University Park, Pennsylvania, July 23–24, 1992. Information: Jim Hower, Center for Applied Energy Research, 3572 Iron Works Pike, Lexington, KY 40511; (606) 257-0261; fax 606-257-0302.

Northeastern Science Foundation–History of Earth Sciences Society Meeting on the History of Geology, July 29–August 1, 1992, Troy, New York. Information: Gerald M. Friedman, Northeastern Science Foundation, P.O. Box 746, Troy, NY 12181-0746; (518) 273-3247; fax 518-273-3249.

August

■ **10th International Conference on Basement Tectonics**, August 3–7, 1992, Duluth, Minnesota. Information: Richard Ojakangas, Dept. of Geology, University of Minnesota, Duluth, MN 55812; (218) 726-7238; fax 218-726-6360.

■ **13th Caribbean Geological Conference**, August 10–14, 1992, Pinar del Rio, Cuba. Information: Grenville Draper, Florida International University, Geology Dept., University Park, Miami, FL 33199; (305) 348-3572; fax 305-348-3877; Bitnet: DRAPER@SERVAX.

29th International Geological Congress, August 24–September 3, 1992, Kyoto, Japan. Information: Secretary General, IGC-92 Office, P.O. Box 65, Tsukuba, Ibaraki 305, Japan; phone 81-298-54-3627; fax 81-298-54-3629; telex 3652511 GSJ J.

Second International Conference on Asian Marine Geology, August 19–22, 1992, Tokyo, Japan. Information: Shin'ichi Kuramoto, Ocean Research Institute, University of Tokyo, 1-15-1, Minamidai, Nakano-ku, Tokyo, 164 Japan; phone 03-3376-1251; fax 03-3375-6716; telex 25607/ORIUT; E-mail: kuramoto@tansei.cc.u-tokyo.ac.jp *or* kuramoto@jpnoriut.bitnet. (*Abstract deadline: March 31, 1992.*)

IAS/SEPM Research Conference on Carbonate Stratigraphic Sequences: Sequence Boundaries and Associated Facies (Emphasis on Outcrop and Processes Studies), August 30–September 3, 1992, La Seu, Spain. Information: Toni Simo, Dept. Geology and Geophysics, University of Wisconsin, 1215 W. Dayton St., Madison, WI 53706; (608) 262-5987; fax 608-262-0693; E-mail: simo@geology.wisc.edu; or Mark Harris, Dept. Geosciences, University of Wisconsin, P.O. Box 413, Milwaukee, WI 53201; (414) 229-5452; or Evan Franseen, Kansas Geological Survey, 1930 Constant Ave., Lawrence, KS 66047; (913) 864-5317.

International Conference on Large Meteorite Impacts and Planetary Evolution, August 31–September 2, 1992, Sudbury, Ontario, Canada. Information: B. O. Dressler, Ontario Geological Survey, 77 Grenville St., 9th Floor, Toronto, Ontario M7A 1W4, Canada; (416) 965-7046; fax 416-324-4933.

September

International Conference on Arctic Margins, September 2–4, 1992, Anchorage, Alaska. Information: David Steffy or Dennis Thurston, U.S. Minerals Management Service, 949 E. 36th Ave., Anchorage, AK 99508; (907) 271-6553; fax 907-271-6805. (*Abstract deadline: February 1, 1992.*)

5th International Symposium on Seismic Reflection Profiling of the Continental Lithosphere, September 6–12, 1992, Banff, Alberta, Canada. Information: R. M. Clowes, Lithoprobe Secretariat, 6339 Stores Road, University of British Columbia, Vancouver, BC V6T 1Z4, Canada; (604) 822-4202; fax 604-822-6958; or A. G. Green, Geological Survey of Canada, 1 Observatory Crescent, Ottawa, Ontario K1A 0Y3, Canada; fax 613-992-8836.

International Symposium on the Geology of the Black Sea Region, September 7–11, 1992, Ankara, Turkey. Information: ISGB Sekreterliği, MTA Genel Müdürlüğü, 06520 Ankara, Türkiye; phone (90)-(4)-223 69 27; fax 90-(4)-222 82 78. (*Abstracts deadline: March 1, 1992.*)

The Transition from Basalt to Metabasalt: Environments, Processes, and Petrogenesis, September 9–15, 1992, Davis, California. Information: Peter Schiffman, Dept. of Geology, University of California, Davis, CA 95616; (916) 752-3669; E-mail: PSchiffman@UCDavis.edu.

■ **3rd International Conference on Plasma Source Mass Spectrometry**, Durham, England, September 13–18, 1992. Information: Grenville Holland, Dept. of Geological Sciences, The University Science Laboratories, South Road, Durham DH1 3LE, England; phone: 091-374-2526.

4th International Conference on Paleoceanography, September 21–25, 1992, Kiel, Germany. Information: ICP IV Organizing Committee c/o GEOMAR, Wischhofstrasse 1-3/Bldg. 4, D-2300 Kiel 14, Germany.

23rd Annual Binghamton Geomorphology Symposium: Geomorphic Systems, September 25–27, 1992, Oxford, Ohio. Information: Bill Renwick, Dept. of Geography, Miami University, Oxford, OH 45056; (513) 529-1362; E-mail: BRENWICK@MIAMIU.BITNET, or Jonathan Phillips, Dept. of Geography, East Carolina University, Greenville, NC 27858; (919) 757-6082; E-mail: GEPHILLI@ECUVM1.BITNET.

American Institute of Professional Geologists Annual Meeting, September 27–October 1, 1992, Lake Tahoe, Nevada. Information: Jon Price, AIPG, P.O. Box 665, Carson City, NV 89702; (702) 784-6691.

October

Association of Engineering Geologists Annual Meeting, October 3–9, 1992, Long Beach, California. Information: John Byer, Kovacs-Byer, Inc., 11430 Ventura Blvd., Studio City, CA 91604; (818) 980-0825.

2nd International Congress on Energy, Environment and Technological Innovation, October 12–16, 1992, Rome, Italy. Information: Secretaria CPA: Comisión de Promoción Académica, Facultad de Ingeniería, Universidad Central de Venezuela, Edif. Decanato, Caracas 1050, Venezuela; phone 58-2-6627538/7612; fax 58-2-6627327.

Geological Society of America Annual Meeting, October 26–29, 1992, Cincinnati, Ohio. Information: GSA, Meetings Dept., P.O. Box 9140, Boulder, CO 80301; (303) 447-2020; fax 303-447-1133. (*Abstract deadline: July 8, 1992.*)

Send notices of meetings of general interest, in format above, to Editor, *GSA Today*, P.O. Box 9140, Boulder, CO 80301.

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GSA ANNUAL MEETINGS

■ 1992

GSA Annual Meeting, Cincinnati, Ohio
October 26–29

CINCINNATI
THE VOYAGE CONTINUES
From Columbus to Magellan

General co-chairmen: Raphael Unrug and J. Barry Maynard

Field trip chairmen: Thomas Berg and John Rupp

For information call the GSA Meetings Department, (303) 447-2020

Call for Theme Session Proposals

Due January 2, 1992

Discovery: From Columbus to Magellan—The Voyage Continues is the all-embracing theme of the 1992 technical program. Discoveries have always been at the heart of the geologic sciences. In 1992, the quincentenary of Columbus's landing in America, the Magellan satellite is still mapping Venus from space, and the theme is particularly pertinent. In 1492, Columbus journeyed to discover a "new world" on Earth. We are now discovering and charting a new world in space, and in the process we explore worlds of new ideas. To modern geoscientists the impact of new ideas is not only of theoretical importance but of practical and, increasingly, environmental importance as well.

We call for new contributions to the geosciences: descriptive and analytical; terrestrial and extraterrestrial; developmental and preservationist. In this regard, we are soliciting titles of symposia and themes for the 1992 Annual Meeting. Only an associated society or division may submit a proposal for a symposium; however, individuals, as well as the divisions and societies, are encouraged to submit proposals for cognate theme sessions. Theme sessions, with their emphasis on topicality and interdisciplinary aspects of our sciences, are consistent with our 1992 central theme of **Discovery**.

A symposium will consist entirely of invited abstracts, whereas a theme session will be entirely volunteered abstracts. The initiation of a symposium is completely within the purview of the division or associated society, as would be ONE theme session. All other proposed theme sessions compete for time slots with other theme sessions. Nevertheless, we think that the advantages and possibilities of time allocation for theme sessions will appeal to divisions and societies in preparing expanded programs.

Be as innovative as you can in your submittals. If you propose one or more theme sessions, the JTPC Chairmen will select from these the final list of topics most consistent with the overall theme of the meeting: **Discovery**.

Submit proposals (to be received by January 2, 1992) to:

Nicholas Rast, chairman
Dept. of Geological Sciences
University of Kentucky
Lexington, KY 40506-0059
(606) 257-3758

Roy Kepferle
Dept. of Geology
Eastern Kentucky University
Richmond, KY 40475-0953
(606) 622-1273

■ 1993

GSA Annual Meeting, Boston, Massachusetts
Hynes Convention Center, October 25–28

Chairman: James W. Skehan, S. J.

Call for Field Trip Proposals: Please contact the field trip chairmen listed below

John T. Cheney
Dept. of Geology
Amherst College
Amherst, MA 01002
(413) 542-2233 (Dept.)

J. Christopher Hepburn
Dept. of Geology and Geophysics
Boston College
Chestnut Hill, MA 02193
(617) 552-3640 (Dept.)

■ FUTURE

Cincinnati	October 26–29	1992
Boston	October 25–28	1993
Seattle	October 24–27	1994
New Orleans	November 6–9	1995
Denver	October 28–31	1996
Denver	October 25–28	1999

For general information on technical program participation (1992 or beyond) contact: Sue Beggs, Meetings Manager, GSA headquarters.

GSA SECTION MEETINGS

■ 1992

South-Central, Houston, Texas
Rice University, February 24–25

Hans G. Avé Lallemant, Dept. of Geology and Geophysics, P.O. Box 1892, Rice University, Houston, TX 77251; (713) 527-4889

Southeastern, Winston-Salem, North Carolina
Stouffer Winston Plaza, March 18–20

Paul D. Fullagar, Dept. of Geology, CB 3315 Mitchell Hall, University of North Carolina, Chapel Hill, NC 27599-3315; (919) 962-0677

Northeastern, Harrisburg, Pennsylvania
Harrisburg Hilton, March 26–28

Donald M. Hoskins, Pennsylvania Geological Survey, Dept. of Environmental Resources, P.O. Box 2357, Harrisburg, PA 17105; (717) 787-2169

North-Central, Iowa City, Iowa
University of Iowa, April 30–May 1

Raymond R. Anderson, Iowa DNR, Geological Survey, University of Iowa, 123 N. Capital St., Iowa City, IA 52242; (319) 335-1575

Cordilleran, Eugene, Oregon
Eugene Hilton Conference Center, May 11–13

A. Dana Johnston, Dept. of Geological Sciences, University of Oregon, Eugene, OR 97403-1272; (503) 346-5588

Rocky Mountain, Ogden, Utah
Ogden Park Hotel, May 13–15

Note date change

Sidney R. Ash, Dept. of Geology, Weber State University, Ogden, UT 84408-2507; (801) 626-6908

Foundation to Fund Matching Student Travel Grants

The GSA Foundation will award matching grants up to a total of $3500 each to the six GSA Sections. The money, when combined with equal funds from the Sections, will be used to assist students traveling to the 1992 GSA Annual Meeting in Cincinnati in October and to 1992 Section meetings.

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STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
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EDITOR *(Name and Complete Mailing Address)*
F. E. Rogers, P. O. Box 9140, Boulder, Colorado 80301 USA

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F. Michael Wahl
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Positions Open

PALEONTOLOGY / ENVIRONMENTAL OR ENGINEERING GEOLOGY / GEOPHYSICS

Applications are invited for faculty positions in the above fields at NCKU, Taiwan. The level of appointment is open. Positions are tenure tracked, subject to review after 2 and 4 years. Preferred starting dates are 1 February or 1 August 1992. Candidates must have Ph.D. Send resume, three letters of recommendation and copies of publications to Dr. Alan Smith, Department of Earth Sciences, National Cheng Kung University, Tainan, Taiwan.

HYDROLOGIST / ASSISTANT PROFESSOR — TENURE TRACK

The Department of Geosciences of Rutgers University at New Brunswick, New Jersey invites applications for a tenure track position in hydrogeology at the assistant professor, anticipated to begin September 1992. Candidates must have a Ph.D., a demonstrated ability to mount a successful research program, and a strong interest in graduate and undergraduate level teaching. Adjunct areas of expertise might include: Aqueous geochemistry, surficial processes and sedimentation, remote sensing, groundwater flow modeling, magma flow modeling, fluid flow in basins, surface and or bedrock aquifers. Research interaction with other faculty members in Quaternary geology, basin analysis, subsurface stratigraphy, geochemistry or geophysics is desirable. Teaching will include a required major course in hydrogeology and graduate courses in hydrogeology.

Applicants should submit a curriculum vitae, a brief statement of research and teaching interests, and three letters of reference to Robert E. Sheridan, Chair Search Committee, Department of Geological Sciences, Rutgers University, Busch Campus, New Brunswick, NJ 08903. Rutgers University is an equal opportunity/affirmative-action employer.

FACULTY OF GEOLOGY
ILLINOIS STATE UNIVERSITY

Applications are invited for full-time tenure-track position anticipated in geology program, assistant or associate professor. Candidates must have bent for modeling and software, Ph.D. or substantial applied experience in groundwater essential. Responsibilities will include teaching introductory undergraduate courses and portions of graduate courses in geohydrology, especially computer solutions to groundwater and geoenvironmental problems. Future research and publication will be expected. Start August 16, 1992. Applicants send resume and names of three references to Dr. Robert G. Corbett, Chair, Dept. of Geography-Geology, Illinois State University, Normal, IL 61761. Consideration of applicants will be continuous until position is filled. ISU is an equal opportunity-affirmative action employer.

PALEONTOLOGIST
DIRECTOR OF THE PALEONTOLOGICAL RESEARCH INSTITUTION
ITHACA, NEW YORK

The Paleontological Research Institution of Ithaca, N.Y., invites applications for Director. We seek a Ph.D. with dynamic personality who can meet the public and interact with members and sponsors. The Director will have recongized research skills, editorial ability sufficient to maintain the present high quality of publications, and have the ability to manage a business office with a small staff. The upper level of experience is open-ended. Salary will be competitive, and commensurate with experience. Propose starting May, 1992, but date is flexible.

PRI is a privately endowed institution whose goals are to facilitate paleontological research and education. PRI's resources include its building, its research library, and collections that are particularly rich in Devonian fossils from New York and Tertiary mollusks and foraminifera from the Gulf of Mexico and Caribbean regions. PRI publishes two major paleontological series, Bulletins of American Paleontology and Palaeontographica Americana.

Interested applicants should submit a vita, letter of application describing yourself and letters from three references by March 1, 1992, to: PRI Search Committee, c/o James Sorauf, Department of Geological Sciences, S.U.N.Y. Binghamton, Binghamton, New York, 13902-6000.

PRI is an affirmative action, equal opportunity employer.

HYDROGEOLOGIST, ASSISTANT PROFESSOR
BATES COLLEGE, LEWISTON, MAINE

Applications are invited for an assistant professorship to begin in September 1992. The individual must possess a strong commitment to undergraduate education and research. The primary interest of the individual should be in hydrogeology. Other interests should include the application of geochemistry or geophysics to topics in hydrogeology. Candidates are expected to develop a program of research involving undergraduates. This is an entry-level, tenure-track position that requires the Ph.D. Women and minority group members are strongly encouraged to apply.

This appointment, a net addition to the geology faculty, is the fourth professorship in the department. It presents a significant opportunity for new curricular directions in geology, for liaisons with colleagues in the natural sciences, and for addressing student interest in environmental studies. Teaching responsibilities include three courses (an introductory course, and two upper-level courses) and supervision of senior thesis research during the regular academic year, and a five-week short term unit (April/May). The short term unit allows off-campus field study or intensive laboratory experiences.

Bates College is a liberal arts college in south-central Maine with a strong field-based and laboratory-supported program in geology. The geology department is housed in a new $10 million science facility. There is ample space for teaching and research laboratories; the successful candidate will be expected to pursue outside support for specialized instrumentaiton. Dedicated laboratories currently support mineralogy, petrology, geochemistry, sedimentology, and SEM-EDS microscopy. The department has a substantial inventory of field equipment; geophysical field equipment for hydrogeologic studies includes a six-channel signal-enhanced seismograph and an earth resistivity system. Access to on-campus mainframe and minicomputers and to national computer networks is through AT&T or Macintosh PCs provided in faculty offices and laboratories.

Applications should include a letter that discusses teaching and research, transcripts of all college work, and the names, addresses, and phone numbers of three referees from whom letters of recommendation may be solicited. The closing date is January 1, 1992. Application materials should be sent to: John W. Creasy, Chair, Department of Geology, Bates College, Lewiston, Maine 04240.

Bates College is an Equal Opportunity/Affirmative Action employer.

RESEARCH SPECTROSCOPIST

A career, professional staff (non-tenure track) position in the Dept. of Soil & Environmental Sciences, available 1 February, 1992 or until filled. Primary responsibilities include operation, method development, maintenance, upgrading, and operator training for an inductively-coupled plasma mass spectrometer (ICP-MS) for trace element analysis of soils, rocks, plants and waters. Also provide technical support for other, related Departmental instruments. Collaborate with faculty in adopting new spectroscopic methods and technologies for use in environmental chemistry research. Qualifications: Ph.D. (or M.S. plus three years experience) in analytical chemistry or related field; background in MS, instrumentation, trace element analysis, and computer hardware/software; experience with ICP-MS desirable. Starting salary range is $37,800 to $42,500 plus University of California benefits package. Send curriculum vitae, official transcripts, and names and addresses of three references by 15 Jan. 1992 to Staff Personnel Office, University of California, Riverside, CA 92521. The University of California, Riverside, is an affirmative action, equal opportunity employer.

VISITING FACULTY MEMBER, GEOLOGY

Visiting Faculty Member/Miami University/Department of Geology. Applications are invited for a full-time, visiting faculty member to teach introductory-level courses in Physical Geology and Geology of the U.S. National Parks during the 9-month 1992–1993 academic year. The successful candidate must have prior experience in effective teaching of lecture courses in a university setting. The anticipated teaching load is 3–4 courses per semester; the position carries no service or research responsibilities.

A Master's degree (for appointment as a Visiting Instructor) or a Ph.D. (for appointment as a Visiting Assistant Professor) in Geology or Geophysics is required. Review of applications will begin in November, 1991 and will continue until the position is filled. Candidates should submit a letter of application that

discusses teaching interests, a resume, transcripts of all college work, and three letters of recommendation to: Dr. Maryellen Cameron, Department of Geology, Miami University, Oxford, Ohio 45056. Women and minority candidates are encouraged to apply. Miami University offers equal opportunity in employment and education (M/F/H).

MARINE GEOLOGIST

Assistant professor, tenure track, Ph.D., start fall 1992. Research interest in aspect of coastal processes, geophysics or paleontology, to involve advanced undergraduates. Teach marine geology and advanced courses in speciality, in rapidly expanding preprofessional undergraudate marine science program. Participate periodically in interdisciplinary general education program. Send resume, undergraduate and graduate transcripts, three recommendation letters by January 30 to Dr. John Ferguson, Eckerd College, P.O. Box 12560, St. Petersburg, FL 33733. EOE.

LOW TEMPERATURE GEOCHEMISTRY
GRAND VALLEY STATE UNIVERSITY

Applications are invited for an entry-level, tenure-track faculty position in low temperature geochemistry at Grand Valley State University, Allendale, Michigan, starting August 1992. Ph.D. must be in hand at the time of appointment. We are anxious to attract a person who is committed to teaching excellence and participation in a strong undergraduate geology program. Research that engages students and enriches teaching is also important.

The successful candidate will be responsible for teaching undergraduate courses in the area of specialization, related areas and elementary courses. In addition, the faculty member will advise students, share departmental duties, and encourage student research participation. Continued professional growth through research and scholarly activities is essential. Opportunities are abundant for water-related research in western Michigan and will be encouraged. Familiarity with computers and analytical equipment is important.

The starting salary is open and is commensurate with qualifications and experience.

The successful candidate will be joining an existing faculty of five in a program of 55 geology/earth science majors.

To apply, send a letter including a vita and the names, addresses and phone numbers of three references to: Dr. Thomas E. Hendrix, Chairman, Department of Geology, Grand Valley State University, Allendale, MI 49401.

Applications will be accepted through March 1, 1992 or beyond that date until the position is filled.

Grand Valley State University is an Equal Opportunity, Affirmative Action Employer.

SUNY—CORTLAND

The Department of Geology invites applications for two tenure-track faculty positions at the assistant professor rank commencing August 1992; Ph.D. or Ed.D. at time of appointment preferred. Specialties sought include: secondary science education (grades 7–12); mineralogy-petrology; stratigraphy-sedimentation-paleontology; hydrogeology–environmental geology. One position must combine preparation and experience in secondary education with strong qualifications in a discipline area listed above. This person will assist with supervision of student teachers and in other secondary science education courses as needed. We are especially interested in candidates who can contribute to summer programs at the Brauer Field Station, and those with familiarity with statistics and computer applications.

Successful candidates for both positions must be committed to excellence in undergraduate liberal arts teaching in their own areas of expertise and the College's general education program. In addition, the appointees will be expected to pursue an active, continuing, self-supported program of research and scholarship.

Applicants should submit a resume, official copies of undergraduate and graduate transcripts, a brief statement of teaching interests, objectives, and research plans, and three (3) letters of reference to: James E. Bugh, Chairman of Search Committees, Department of Geology, P.O. Box 2000, Cortland, NY 13045. Review of applications will begin February 1, 1992 but applications will be received and considered until the positions are filled.

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JOURNAL BACK ISSUES SOUGHT. The Phoenix International Development Foundation, through the United Nations, seeks donations of the *Journal of Geological Education* for use by developing Asian country. Sixteen sets of issues from 1985 to present are desired, partial sets accepted. The Foundation is also looking for multiple sets of *Scientific American* and *National Geographic* for the same period. If you can offer a donation, please call Judy at 301/654-0850.

Opportunities for Students

Graduate Research Assistantships in stratigraphy, sedimentary and petroleum geology (including invertebrate paleontology), shallow reflection seismology, geohydrology, and geologic/geographic information systems. Opportunities for graduate study at M.S. or Ph.D. level while assisting and conducting research with the Kansas Geological Survey. Assistantships available at one-half time during the academic year and full-time during summers starting spring, summer, or fall, 1992. For further information and/or application, please call or write: Dr. Christopher G. Maples, Kansas Geological Survey, 1930 Constant Avenue, Campus West, The University of Kansas, Lawrence, KS 66047, (913) 864-3965. EO/AA Employer.

University of Minnesota. Opportunities with the Interdisciplinary Research Training Group (RTG), for "Paleorecords of Global Change: Understanding the Dynamics of Ecosystem Response." Applications and additional information for the following are available from Sue Julson, University of Minnesota, Ecology, Evolution and Behavior, 318 Church St., S.E., Minneapolis, MN 55455. Phone (612) 625-7677; fax (612) 625-4490.

POSTDOCTORAL FELLOWSHIP: Fellowship available for research training. One year appointment, renewable second year. Application deadline January 1, 1992. GRADUATE TRAINEESHIP: Four-year traineeships available for graduate study in conjunction with interdepartmental RTG in above study. Application deadline January 15, 1992.

An Equal Opportunity Educator and Employer.

Graduate Research — Hydrologic Phenomenon and Geologic Processes. The Department of Geology and Geophysics at the University of Utah is seeking well-qualified graduate students (M.S. or Ph.D.) to participate in interdisciplinary research that explores and exploits, the way that hydrologic phenomenon influence fault evolution, crustal structure, metamorphic environments, evolution of sedimentary basins, geochemical regimes, and geothermal systems. Ongoing research by faculty with expertise in hydrology, structural geology, metamorphic petrology, geochemistry, geothermics, and geophysics, includes the following topics: hydrodynamic controls of surface water geochemistry and sedimentation; migration and thermal evolution of hydrocarbons in sedimentary basins; hydrothermal circulation in subsea sediments—implications for fluid, mass, and heat flux across the seafloor; hydrologic evolution of desert basins and terminal lakes; isotopic and geochemical constraints on fluid flow during contact metamorphism; hydromechanical properties of fault zones; isotopic, geochemical, paleothermal, and paleobarometric constraints on fluid flow during faulting.

For more information and to receive an application packet, contact Craig Forster (801) 581-3864 [INTERNET: gg-cbf@darcy.utah.edu] or Paul Jewell (801) 581-6636 [INTERNET: pwjewell@eddy.utah.edu] at the Department of Geology and Geophysics, 719 W. C. Browning Building, University of Utah, Salt Lake City, UT 84112-1183. The University of Utah is an equal opportunity/affirmative action employer and educational institution.

Summer Research Program for Undergraduates at Columbia University's Lamont-Doherty Geological Observatory. Eight students will be selected to participate in 10-week long research program using Ocean Drilling Program (ODP) cores, well-logs and seismic profiles. Current sophomore and junior science majors who are citizens or permanent residents of the U.S. are eligible. Students will receive $2,200 stipend and housing. Some money is available to defray cost of travel between home institution and Lamont. Program is sponsored by JOI-U.S. Science Support Program associated with ODP. Application deadline is March 1, 1992. For further information contact: Dr. Suzanne O'Connell, Program Coordinator, Dept. of Earth and Environmental Sciences, Wesleyan University, Middletown, CT 06457, Tel. (203) 347-9411 ext. 2044, Fax (203) 343-3903.

Ocean Drilling Summer Research Program for Undergraduates at the University of Hawaii. The School of Ocean and Earth Science and Technology (SOEST) at the University of Hawaii is accepting applications for its 1992 Ocean Drilling Summer Research Program. SOEST will host this program at the University of Hawaii's Manoa campus in Honolulu, Hawaii where the undergraduate participants will be in residence. During the program, undergraduates from around the U.S. and it territories will participate in research, lectures and field trips relating to the science of the Ocean Drilling Program. This program will extend from June 8–July 31. The aim of the ODP summer Research Program at SOEST is to introduce bright and energetic undergraduates to the science of the Ocean Drilling Program and to help prepare them to become research scholars. The program is designed to stimulate serious consideration of graduate studies and to increasing the number of women and minority students in this field. Students with a 3.0 or better grade point average will spend eight weeks engaged in research with a faculty mentor at SOEST. A faculty mentor is assigned to each student based on the student's educational background and interests. In addition, the applicants will participate in weekly lectures and in several field trips on the islands of Oahu and Hawaii. Successful applicants will receive a travel award to cover expenses to and from Hawaii, room and board for the duration of the program, and a student stipend of $2,000. Applications must be postmarked by March 1, 1992.

For applications contact: Craig R. Glenn, Program Coordinator, Ocean Drilling Summer Research Program, University of Hawaii, Department of Geology & Geophysics, 2525 Correa Road, Honolulu, HI 96822, Tel. 808-956-2200. Fax 808-956-2538.

NASA Planetary Biology Internships. The Marine Biological Laboratory, Woods Hole, Massachusetts, invites applications from graduate students and seniors accepted to graduate programs for awards of $2000 plus travel to participate in research at NASA centers and collaborating institutions for approximately 8 weeks. Typical intern programs include: global ecology, remote sensing, microbial ecoloty, biomineralization, and origin and early evolution of life. Application deadline: 1 March 1992. For information/applications, contact: Lorraine Olendzenski, Planetary Biology Internship, Department of Botany, University of Massachusetts, Amherst, MA 01003. email:PBI@botany.umass.edu. An Equal Opportunity/ Affirmative Action Institution.

U.S. Geological Survey
8th Annual

V.E. McKelvey Forum

on

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53 Poster Presentations

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- Basin evolution
- Paleoclimate & rhythms
- Sequence stratigraphy
- Source rocks
- Oil field growth
- Fractured reservoirs
- Computer applications
- Diagenetic studies
- Coal & coalbed methane

Short Course: "Recent Advances in Plate Tectonics and Continental Crustal Evolution" by Warren Hamilton

Houston, Texas
February 18-20, 1992

Technical Program
Christine Turner, USGS
(303) 236-1561

Registration Information
Jan W. Kernan, BAI, Inc.
(301) 588-4177

USGS SUPERVISORY GEOLOGIST/GEOPHYSICIST, GM-15

The U.S. Geological Survey's Office of Energy and Marine Geology, Office of the Chief in Reston, Virginia, seeks candidates for the full-time position of Deputy Office Chief for Energy Programs. Candidates should have a strong background in current field and laboratory research for a broad area of the geosciences, with special emphasis on energy related fields, i.e., oil and gas, coal, uranium, etc. This is a permanent career civil service position at the GM-15 level with a starting salary range of $61,643 to $80,138.

The deputy Office Chief for Energy Programs serves as principal advisor to the Office Chief in overall conduct of energy geology programs. The incumbent integrates present program elements with anticipated and future needs, as well as coordinating programmatic objectives and research results. Incumbent also coordinates activities in energy investigative studies with Branch, Division, Bureau, Department of Interior, other federal and non-federal agencies, state, academic institutions, and in cooperation with other countries.

Applicants should submit an application for Federal Employment (SF-171, available in any Federal Personnel Office). A detailed resume, including education, experience, and bibliography may be submitted initially: however, candidates will be required to file the SF-171 form to receive full consideration. In addition, interested applicants should submit a letter highlighting the applicant's past accomplishments, current pursuits, anticipated research directions, and a list of three or more persons from whom we may solicit references. Applicants must be U.S. citizens.

Applicants must reference vacancy announcement H-91-306 and be received at the following address by December 31, 1991. Mail Stop 215, U.S. Geological Survey, Personnel Office, 12201 Sunrise Valley Drive, Reston, Virginia 22092.

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Forum

Call for Nominations

1992 John C. Frye Environmental Geology Award

In cooperation with the American Association of 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. The award is a $500 cash prize from the endowment income of the GSA Foundation's John C. Frye Memorial Fund.

Criteria for Nomination. Nominations can be made by anyone, based on the following criteria: (1) paper must be selected from GSA or state geological survey publications, (2) paper must be selected from those published during the preceding three full calendar years, (3) nomination must include a paragraph stating the pertinence of the paper, (4) **nominations must be received by the Executive Director of GSA no later than *March 30, 1992*.**

Basis for Selection. Each nominated paper will be judged on the uniqueness or significance as a model of its type of work and report and its overall worthiness for the award. In addition, nominated papers must establish an environmental problem or need, provide substantive information on the basic geology or geologic process pertinent to the problem, relate the geology to the problem or need, suggest solutions or provide appropriate land use recommendations based on the geology, present the information in a manner that is understandable and directly usable by geologists, and addresses the environmental need or resolves the problem. It is prefered that the paper be directly applicable by informed laypersons (e.g., planners, engineers).

1991 Recipients Announced. Recipients of the 1991 award presented at the GSA Annual Meeting in San Diego are Richard C. Berg, Illinois State Geological Survey, and H. Allen Wehrmann and John M. Shafer, Illinois State Water Survey, for their paper "Geological and hydrological factors for siting hazardous or low-level radioactive waste disposal facilities," Circular 546 (1989), Department of Energy and Natural Resources, Illinois State Geological Survey.

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The Geological Society of America
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