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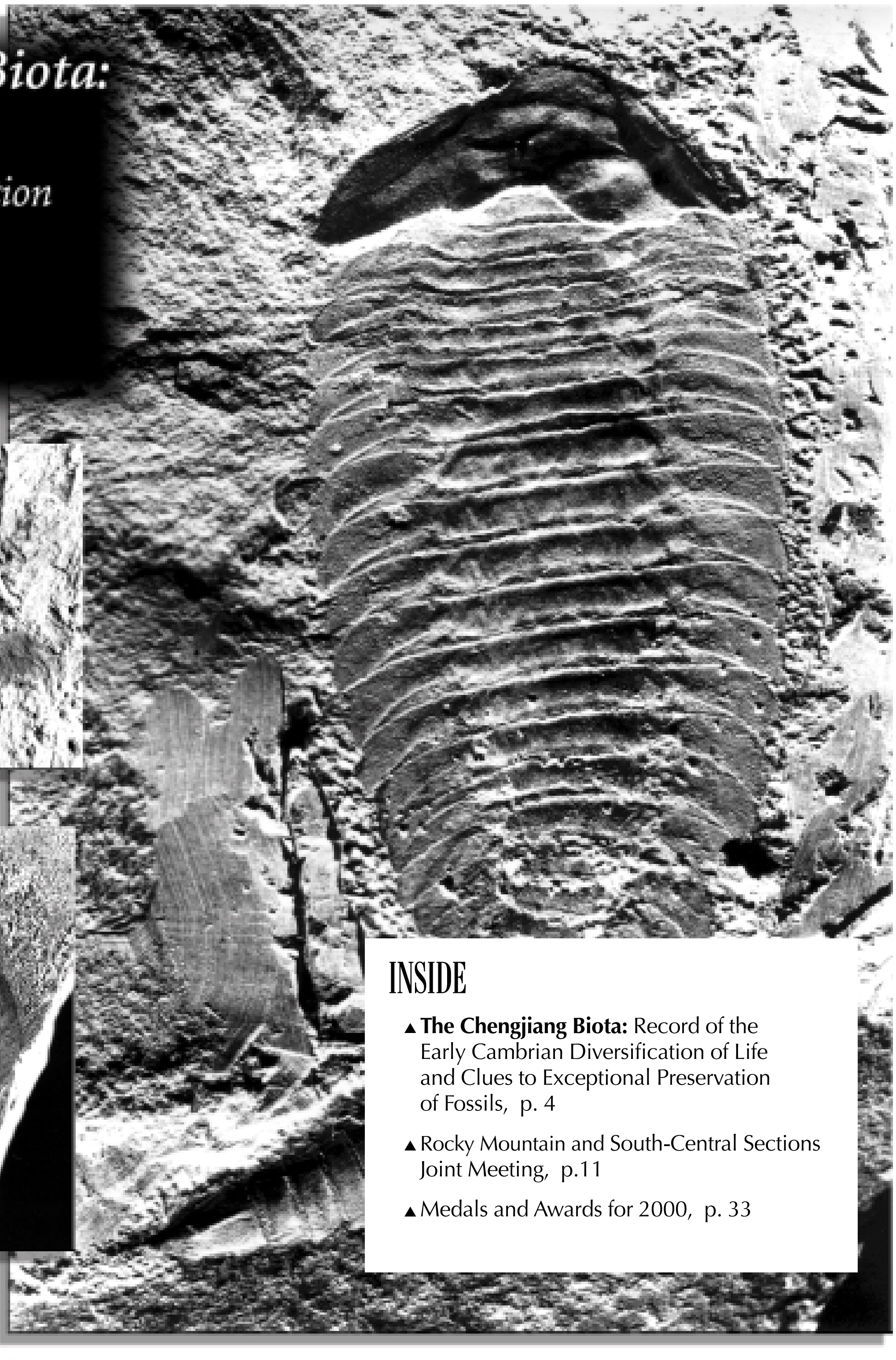
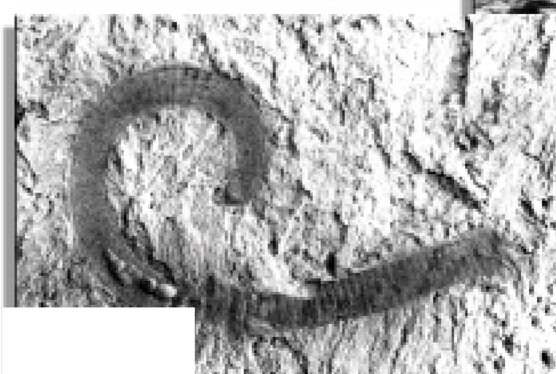
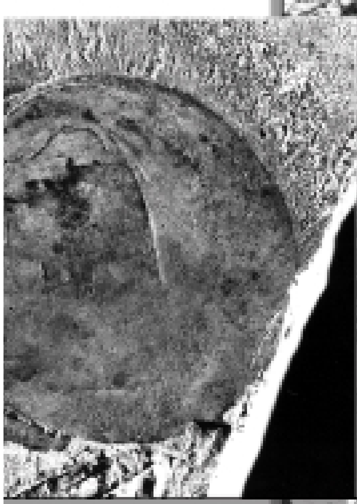
The Chengjiang Biota: Record of the Early Cambrian Diversification of Life and Clues to Exceptional Preservation of Fossils







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science article

The Chengjiang Biota:

Record of the Early Cambrian Diversification of Life and Clues to Exceptional Preservation of Fossils

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ABSTRACT

The Chengjiang Biota, from Yunnan, China, is the most diverse assemblage of Early Cambrian marine fossils known. Just like the celebrated Burgess Shale (Middle Cambrian) of British Columbia, Canada, Chengjiang preserves not only fossils having hard skeletal parts (which is typical of most sedimentary deposits), but it also preserves in exquisite detail nonmineralized skeletal parts and internal soft parts of organisms (which is much more unusual in sedimentary deposits). The Chengjiang deposit, and the somewhat younger Burgess Shale, both provide important guides to diversity and evolutionary rates during the early Phanerozoic diversification event known as the Cambrian "explosion." The Chengjiang Biota bridges a critical time between decline of the Late Neoproterozoic (latest Precambrian) Ediacaran biota and the terminal Early Cambrian extinction, and provides further evidence that the Cambrian explosion is part of an evolutionary transition that began in the Late Neoproterozoic. As we seek to understand the circumstances surrounding exceptional preservation generally, not just during the Cambrian, Chengjiang provides an important perspective on depositional conditions. Interpretation of the preservation of Burgess Shale–type organisms has been long dominated by the Burgess Shale model, in which organisms were washed from an oxic environment, where they were living, into an anoxic environment, where they were quickly buried. Anoxia inhibited the destructive activity of biodegraders (scavengers, bacteria, and burrowers) and probably played a role in early diagenesis. Other deposits of exceptional preservation indicate that biodegraders were limited long enough for the early stages of fossilization to occur under at least two other circumstances. First, immobile benthic creatures could be smothered in place by rapidly deposited mud, and then preserved through early diagenetic activity mediated by anoxic conditions developed within the sediment. Second, in Chengjiang muds, exceptional preservation is inferred to have occurred in a restricted-shelf, shallow sea. Here, as in some Carboniferous deposits, factors related to tidally influenced shelf conditions limited the activity of biodegraders, and high sedimentation rates provided for quick burial. With the addition of new models for exceptional preservation in the Cambrian, this phenomenon should be viewed less as a result of extraordinary, one-time-only, depositional conditions, and more the result of minor or short-lived perturbations in depositional circumstances common to epeiric seas. Similar perturbations led to exceptional preservation in similar environments, but at different times, during the Phanerozoic.

Figure 1. A primitive arthropod, *Fuxianhuia protensa*, which had a chitinous (nonmineralized) exoskeleton. This specimen, like all specimens illustrated here, is from Maotianshan, Yunnan, China. Length of specimen as preserved: 5.0 cm.

INTRODUCTION

The Neoproterozoic-Cambrian transition was a time of fundamental change in the history of life. Between the Late Neoproterozoic (ca. 570 Ma) and the late Early Cambrian (ca. 510 Ma), representatives of most important, multicellular marine animals and plants had evolved sufficiently to leave a fossil record, and had undergone early experimentation with body plans and habitats. During the transition interval, predation had emerged as a significant factor in evolution (McMenamin, 1986; Babcock, 1993; Bengtson, 1994), and probably had a causal link, along with geochemical factors, to the appearance and later development of mineralized skeletons. By the Early Cambrian, a transition from a microbial mat-dominated sediment-water interface to a more blurry, burrowed interface in shallow-marine settings was well under way (Seilacher and Pfluger, 1994; Bottjer et al., 2000). This time of rapid diversification among marine animals, experimentation with new body plans, and shifting ecological setting, is referred to as the Cambrian "explosion." In terms of macroscopic organisms, this rather protracted "event" is represented in the rock record by a transition (Bengtson, 1994; Grotzinger et al., 1995) from Neoproterozoic strata yielding nonmineralized Ediacaran-type organisms (Seilacher, 1989; Fedonkin, 1994; Narbonne, 1998), a few small, hard part–secreting organisms (Grant, 1990; Bengtson, 1994; Gehling and Rigby, 1996; Grotzinger et al., 2000), and a limited number of trace fossils (e.g., Corsetti and Hagadorn, 2000) to Lower Cambrian strata having an increasing array of fossils (Figs. 1, 2). Lowermost Cambrian strata (Nemakit-Daldynian to Tommotian stages) yield small, isolated plates (small shelly fossils, which are disarticulated multielement skeletons) and few trace fossils, but overlying strata of the Atdabanian and Botomian stages have more abundant and diverse fossils comprising shelly skeletons of invertebrates (mollusks, brachiopods, echinoderms, hyoliths, and reef-forming archaeocyathid sponges) and an increasing number of trace fossils (Fig. 2). In this interval, the rich fossil record of the Phanerozoic begins. By about 518 Ma, and in the midst of this dramatic biological change, siliciclastic muds in present-day Chengjiang County and surrounding areas of Yunnan Province, China (Figs. 3, 4), buried and preserved in great anatomical detail the remains of animals, plants, and macroscopic bacterial colonies that comprise the Chengjiang Biota (Figs. 1, 5, 6; Table 1).

Biological changes that occurred during the Neoproterozoic-Cambrian transition closely followed major physical and chemical changes of global scale. The Late Neoproterozoic witnessed the breakup of Rodinia, and collisional events that resulted in partial assembly of Gondwana (Hoffman, 1992; Unrug, 1997; Karlstrom et al., 1999).

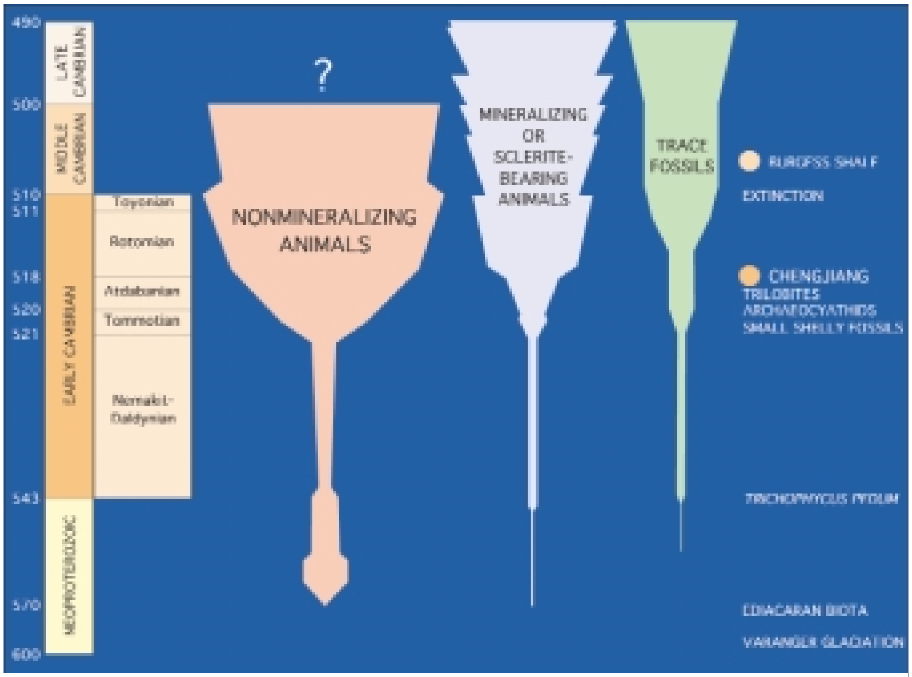

Figure 2. Generalized Late Neoproterozoic–Cambrian stratigraphy and biotic record showing the position of the Chengjiang Biota. Age estimates are extrapolated from Grotzinger et al. (1995), and Landing et al. (1998, 2000).

High spreading rates and high volumes of mid-ocean ridges fueled expansion of world oceans over many cratonic areas (Nicholas, 1996). Melting of the Varanger (Marinoan) glaciers (Knoll and Walter, 1992) also played a role in marine flooding of the continents. Flooding of the continents led to increased erosion rates (Montañez et al., 2000), and changes in ocean chemistry (Knoll and Walter, 1992; Nicholas, 1996; Montañez et al., 2000). Notably, increased oxygenation of the world ocean (Canfield and Teske, 1996) helped set the stage for the rise and later diversification of multicellular animals.

The Cambrian explosion is one of the most remarkable biological phenomena documented in the fossil record. Based on recent recalibration of the Cambrian time scale (Grotzinger et al., 1995; Bowring and Erwin, 1998; Landing et al., 1998, 2000), most of the development of skeletonized animals occurred during a relatively short interval of Early Cambrian time (Tommotian-Botomian; ca. 521–511 Ma; Fig. 2). The combination of major biological changes and propitious sedimentary conditions (Butterfield, 1995) has led to the preservation of an impressive, and rather detailed, record of the diversification event. At the end of the Early Cambrian, ca. 510 Ma, the major trilobite groups in Laurentia and Gondwana became extinct (Palmer, 1998). This, perhaps the first major extinction event of the Phanerozoic (Fig. 2), probably had some effect on animals lacking mineralized skeletons, but that effect has not been evaluated in detail. About 4 m.y. after the terminal Early Cambrian extinction, the well-known Burgess Shale (Fig. 2) of British Columbia, Canada (ca. 506 Ma) was deposited. The Burgess Shale provides an outstanding record of Middle Cambrian life forms (Conway Morris, 1985; Whittington, 1985; Briggs et al., 1994). Unlike most deposits, which contain only fossils with hard parts, the Burgess Shale contains many fossils retaining nonmineralized skeletal parts and internal soft parts. Because of this unusual preservation, we know significantly more about Cambrian life forms than we could possibly infer from the fossil record of hard parts alone. Were it not for the Burgess Shale and other Burgess Shale–type deposits, we would substantially underestimate the magnitude of the Cambrian explosion, because the record of shelly (or hard-part-bearing) fossils comprises only an estimated 3%–20% of the Cambrian biota (Conway Morris, 1986; Leslie et al., 1996).

Circumstances leading to exceptional preservation are not unique to the Burgess Shale. Such preservation is now known from about 40 Cambrian sites globally (e.g., Conway Morris, 1985; Allison and Briggs, 1991), although most of the sites yield few exceptionally preserved fossils. The quality of preservation in many of these deposits is high, but of them, only the Chengjiang deposit rivals the Burgess Shale in diversity of preserved species (approximately 170 species; e.g., Zhang and Hou, 1985; Zhang, 1987; Chen et al., 1997; Babcock and Chang, 1997; Chen and Zhou, 1997; Hou and Bergström, 1997; Hou et al., 1999; Shu et al., 1999). By the end of the Middle Cambrian (ca. 500 Ma), sedimentary, geochemical, and ecological conditions favoring the exceptional preservation of nonmineralized organisms in nonconcretionary strata declined (Butterfield, 1995). Marine sedimentary environments suitable for exceptional preservation reappeared during other intervals of the Phanerozoic (for example, during the Late Silurian and Pennsylvanian), but ecological changes such as deeper and more extensive burrowing (Droser and Bottjer, 1988; Bottjer et al., 2000), evolving predator-prey interactions (Babcock, 1993; Pratt, 1998), and extinction of some forms and evolution of others, resulted in the appearance of new casts of characters in the younger deposits.

PALEOECOLOGY AND PRESERVATION

The Chengjiang Biota is the most diverse assemblage of Cambrian organisms from Gondwana, and its component species have evolutionary links to the Precambrian as well as to the post-Cambrian Phanerozoic. Fossils of the Chengjiang Biota include some that have a documented fossil record dating to the Ediacaran (Neoproterozoic) or earlier biotas of the Precambrian. Spiraled, twisted colonies of blue-green bacteria represent a prokaryotic lineage that evolved in the Archean. Probable green algae, brown algae, and sponges have evolutionary roots in the Proterozoic. The fine quality of preservation at Chengjiang allows some large, predatory animals to be linked with arthropods recognized from the Burgess Shale and elsewhere (Chen et al., 1994). Brachiopods (Fig. 6), sponges, and a variety of worms (Chen et al., 1997; Chen and Zhou, 1997; Fig. 5), share common ancestries with animals that played important ecological roles later in the Phanerozoic. Even early chordates are present in the Chengjiang Biota (Shu et al., 1999).

Figure 3. Map showing Maotianshan and other localities in Yunnan Province, China, yielding exceptionally preserved fossils of the Chengjiang Biota. Triangles represent some of the known localities, and show that examples of exceptional preservation are widely distributed.

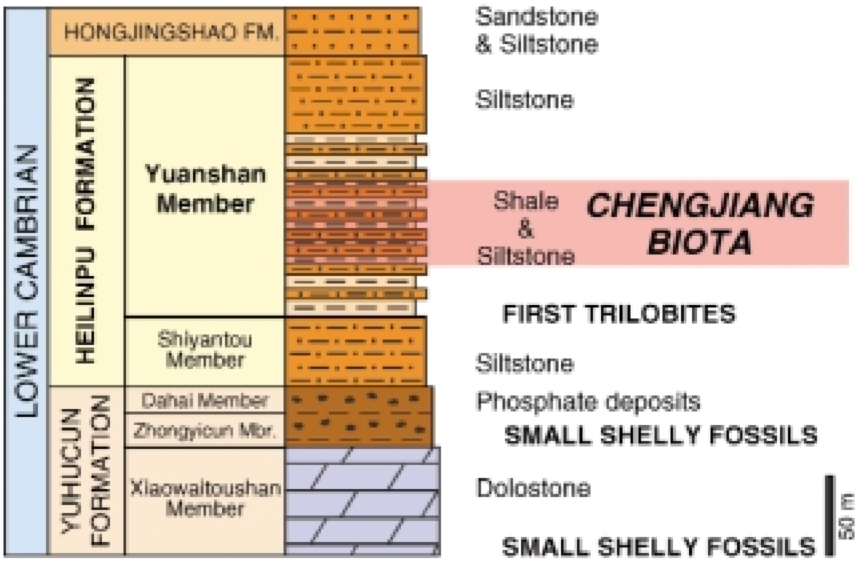

Figure 4. Generalized Lower Cambrian stratigraphy of Yunnan, China, showing the position of beds yielding exceptionally preserved fossils of the Chengjiang Biota, and the relationship of these fossils to some other important fossil occurrences.

The Chengjiang Biota provides a significant point of comparison for other major Burgess Shale–type sites, most of which are in Laurentia and most of which are younger in age. Approximately 15% of genera and 85% of phylum-level groups from the Middle Cambrian Burgess Shale also are present in the Early Cambrian Chengjiang deposit. The only major groups present in the Burgess Shale but absent, or nearly so, from Chengjiang, are echinoderms and mollusks (Table 1). The reason for the near-absence of these animals from Chengjiang is more likely the result of environmental conditions than true biogeographic differences. Indeed, in other respects, there is a rather striking biogeographic similarity among Cambrian nonmineralizing organisms between Laurentian biotas (including that of the Burgess Shale) and Gondwanan biotas (including that of Chengjiang). Representatives of the Burgess Shale–type organisms were clearly widespread during the Early and Middle Cambrian, and also persistent during that interval of time (Conway Morris, 1985).

Approximately 65% of all macroscopic fossils from Chengjiang and more than 50% of the described species are arthropods (Fig. 1). Numerically, arthropods (trilobites, crustaceans, etc.) had become the dominant animals on Earth near the beginning of the Phanerozoic, and they have remained in that position ever since. In the modern world, however, terrestrial insects, which were not present during the Cambrian, outnumber all other animals combined. Among arthropods, the most abundant forms are small bivalved forms (called bradoriids) having variably pliable exoskeletons. Few of the Chengjiang arthropods developed hard, mineral-reinforced exoskeletons of the type known from trilobites and some of the post-Cambrian crustaceans (e.g., ostracodes, crabs, and lobsters). Instead, most Early Cambrian arthropods had relatively pliable, nonmineralized exoskeletons that more closely resembled those of modern insects.

Overall, census information indicates that more than 97% of Chengjiang organisms lacked hard skeletal parts (Leslie et al., 1996). That is to say, fewer than 3% of the organisms known from the Chengjiang deposit are present in contemporaneous strata that contain only shelly fossils. The most common of the shelly fossils in Chengjiang are trilobites (Zhang, 1987), but they comprise fewer than 5% of the total number of animal fossils.

Nearly all of the Chengjiang animals were bottom dwellers, and show evidence of short-distance transportation following death. Some, such as sponges, were filter feeders that in life were partly buried in sediment. Sponges, however, are characteristically preserved flat and often current-aligned along bedding planes, indicating that they were uprooted prior to burial. Burrowing organisms such as some of the worms, which had a range of feeding styles, are rarely preserved in their burrows; rather, they too are laid out along bedding planes (Fig. 5). Arthropods were mobile and had diverse feeding habits ranging from carnivory and scavenging through herbivory, filter feeding, and sediment deposit feeding. Predator-prey interactions are represented by anomalocaridid arthropods and trilobites showing healed bite marks. Occasionally, clusters of fossils are arranged as if in coprolites (e.g., Hou et al., 1999). These clusters often contain small bradoriid arthropods, which probably lived in large swarms (similar to modern krill) along Gondwanan shelf areas, and served as a major food source for certain predators. Mollusks and undoubted echinoderms are rare in Chengjiang, perhaps because the restricted shelf setting of Chengjiang lacked a consistent, normal-marine–salinity environment that many Cambrian species of the groups required.

Chengjiang organisms were mostly buried and preserved in thin-bedded muds, but rarely immobile benthic organisms were rapidly smothered under a layer of silt or fine sand. These sediment-smothering beds (or "obrution beds"; Seilacher et al., 1985) are comparable to deposits that buried articulated echinoderms and other animals in the Cambrian of Laurentia (e.g., Robison, 1991; Liddell et al., 1997), and in other intervals of the Paleozoic (e.g., Taylor and Brett, 1996). Sediment smothering, along with stabilization of sediment surfaces by microbial mats, was also important in preserving Ediacaran-type organisms during the Neoproterozoic (Seilacher, 1989; Seilacher and Pfluger, 1994; Gehling, 1999).

DEPOSITIONAL SETTING

The Chengjiang deposit provides a new perspective on the processes leading to exceptional preservation in the Cambrian, as explained in the following section. To understand the significance of this perspective, it is important to contrast the depositional settings of the Burgess Shale and Chengjiang. The well-documented depositional scenario of the Burgess Shale (e.g., Whittington, 1985; Briggs et al., 1994) involved an oxic environment teeming with life near the base of a carbonate reef that rimmed the Cordilleran margin of Laurentia. Occasionally, slope instability resulted in rapid downslope movement of mud and organisms in debris flows. Organisms were transported into anoxic waters and buried in oxygen-deficient muds. Decay and scavenging was inhibited by anoxia, and early fossilization occurred (Allison, 1988; Allison and Briggs, 1991).

The Chengjiang Biota, which occurs in the Yuanshan Member of the Heilinpu Formation (Fig. 4), includes life forms that inhabited the Southwest China Platform, one of several Gondwanan terranes. Regional studies

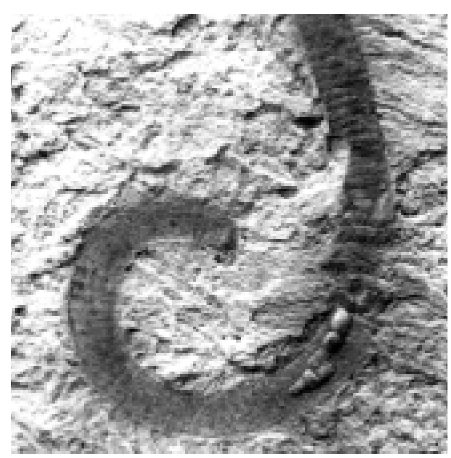

Figure 5. A worm, *Maotianshania cylindrica*, showing remains of an incompletely digested meal in the gut tract. Length of specimen as preserved: 1.4 cm.

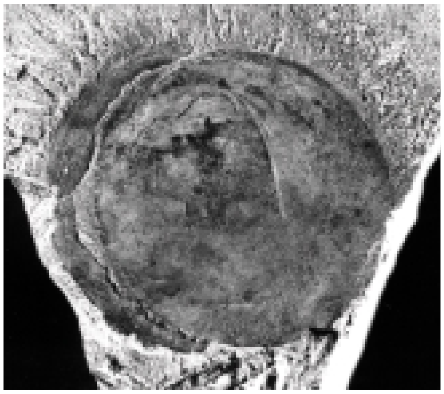

Figure 6. A brachiopod, *Heliomedusa orienta*. The two valves have separated slightly, and around the margins of the valves, fine, threadlike mantle setae (part of the soft anatomy) are evident. Length of specimen: 1.7 cm.

indicate that deposition of Heilinpu Formation sediments took place in relatively shallow, tropical, shelf seas, and above storm wave base in a somewhat restricted basin during a late transgressive to highstand phase of coastal onlap. Exceptionally preserved fossils in the Yuanshan Member usually occur within rhythmically thin-bedded successions of gray-green to yellow shales. Light-dark couplets of millimeter-scale bedding show a periodicity suggesting tidally influenced deposition (Fig. 7), which in places is comparable to tidal rhythmicity inferred from the Carboniferous (e.g., Feldman et al., 1993).

Burial and fossilization of Chengjiang organisms under thin sheets of sediment occurred during times when areas of the subtidal shelf were stressed, which limited the biota that depended on conditions of normal marine salinity. During times when shelf environments were normal, most non-shelly Chengjiang-type organisms would have undergone rapid breakdown through scavenging and microbial decay. Although shallow burrowing occurred in some intervals of the Yuanshan Member, indicating that conditions fluctuated between tolerable and intolerable for living organisms, beds yielding exceptionally preserved fossils are rarely burrowed.

In Chengjiang, inferred proximity to an ancient coastline, and evidence pointing to tidal pumping and occasional fresh water influxes to the shelf evidently played important roles in exceptional preservation. Nonmineralizing organisms were preserved over a wide geographic area of what is now eastern Yunnan Province (Fig. 3). At present, we can only infer what set of factors was proximally responsible for restriction of scavenging activity and retardation of bacterial decay. In the nearshore, restricted shelf area, however, salinity could have fluctuated at times between normal marine and brackish (or perhaps even fresh?) water, and therefore may have played a significant role in the process of exceptional preservation. Salinity was inferred to have played a similar role in exceptional preservation in some Carboniferous and Permian deposits (Babcock et al., 2000). Laboratory experiments involving the exposure of dead marine organisms to fresh water conditions show that the decay process is significantly lengthened (Babcock, 1998) because the activity of microbial biodegraders is inhibited. By implication, the occasional influx of fresh or brackish water to the Southwest China shelf during the Early Cambrian might have slowed the decay process long enough for burial, possible exposure to anoxic conditions below the sediment-water interface, and early diagenesis of organic remains to occur. Furthermore, salinity fluctuation would have, at times, limited the presence of burrowers, resulting in the preservation of thinly laminated muds. Noteworthy is the near exclusion of stenohaline echinoderms and mollusks from the Chengjiang Biota, as it suggests a lack of constant normal marine conditions in this setting.

DEPOSITIONAL MODELS FOR BURGESS SHALE–TYPE DEPOSITS

Combined evidence from Chengjiang, China, and western North America indicates that Burgess Shale–type preservation in nonconcretionary Lower and Middle Cambrian strata developed under at least three conditions (Fig. 8). The conditions were not necessarily mutually exclusive. Deposition of the Burgess Shale involved rapid downslope transportation of live and recently dead organisms from an oxic marine environment into an adjacent anoxic environment (e.g., Whittington, 1985; Briggs et al., 1994; Fletcher and Collins, 1998). Here, we refer to this as the anoxic model of exceptional preservation (Fig. 8). The relationship between an anoxic environment and exceptional preservation has been well documented for the Burgess Shale (e.g., Whittington, 1985; Briggs et al., 1994; Fletcher and Collins, 1998); that model seems to explain the occurrence of some, but not all, Cambrian deposits of exceptional preservation. Preservation of nonmineralized organisms is also associated with anoxic environments in a number of other Phanerozoic deposits, notably Pennsylvanian black shales of the United States (Zangerl and Richardson, 1963). Many Cambrian occurrences of exceptional preservation, however, do not seem to be associated with anoxic environments and black shale deposition, although after burial, oxygen deficiency within the sediment may have mediated the fossilization process. At least two other circumstances of exceptional preservation seem to have operated in the Cambrian, and both have analogs in the post-Cambrian. Deposition of the shales in which most Chengjiang organisms were preserved is referred to as the tidal model of exceptional preservation (Fig. 8). Tidal fluctuation across broad shelf areas during the Cambrian are inferred to have generated fluctuations in salinity that occasionally reached levels inimical to scavengers and other marine biodegraders. An analogous mechanism may be responsible in part for exceptional preservation associated with various tidally influenced, marginal-marine, or shelf environments of the Carboniferous (e.g., Baird et al., 1985; Feldman et al., 1993; Maples and Schultze, 1988). Lastly, sediment smothering, or the obrution model, constitutes the third major process leading to exceptional preservation in the Early and Middle Cambrian (Fig. 8). Sediment smothering of live, benthic animals has led to the preservation of remarkably dense associations of articulated echinoderms, sponges, trilobites, and other fossils most notably in the Cambrian (Robison, 1991; Liddell et al., 1997), Silurian (e.g., Taylor and Brett, 1996), and Devonian (e.g., Bartels et al., 1998).

Exceptional preservation in the Cambrian seems to have occurred under at least three circumstances, all of which are known from other intervals of the Phanerozoic, and which are the result of minor environmental perturbations (crossing an oxygen or salinity threshold, or rapid influx of sediment) that

TABLE 1. COMPARISON OF MAJOR FOSSIL GROUPS REPRESENTED IN THE BURGESS SHALE BIOTA OF BRITISH COLUMBIA AND IN THE CHENGJIANG BIOTA OF YUNNAN, CHINA

	Burgess Shale	Chengjiang
Blue-green bacteria	X	X
Algae	X	X
Sponges	X	X
Cnidarians	X	X
Ctenophores	X	X
Brachiopods	X	X
Mollusks	X	absent
Hyoliths	X	X
Priapulid worms	X	X
Annelid worms	X	X
Lobopods	X	X
Arthropods	X	X
Echinoderms	X	absent
Hemichordates	X	X
Chordates	X	X

Note: The Burgess Shale list is compiled from Whittington (1985) and Briggs et al. (1994). The Chengjiang list is compiled from a voluminous literature reflecting the work of numerous scientists. Because of space limitations, only a few citations (Zhang and Hou, 1985; Zhang, 1987; Chen et al., 1994, 1997; Babcock and Chang, 1997; Chen and Zhou, 1997; Hou and Bergström, 1997; Hou et al., 1999; Shu et al., 1999) are provided in the reference list; the reader is referred to these papers for a more complete perspective of the literature. Presence of a group in each biota is indicated by an X.

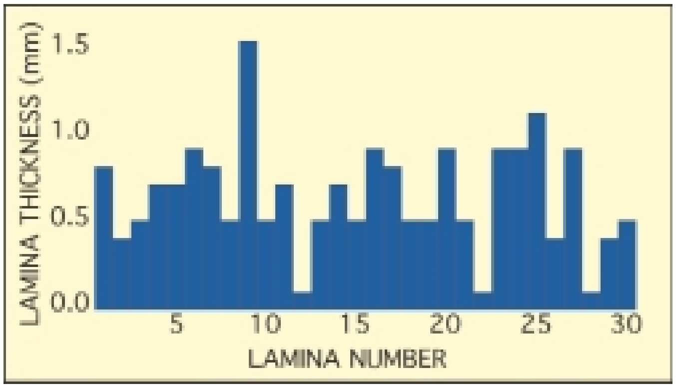

Figure 7. Bar graph showing thicknesses of mud laminae through an interval of the Chengjiang deposit that bears exceptionally preserved fossils (Heilinpu Formation, Yuanshan Member at Maotianshan, China). The laminae show a periodicity resembling that reported in some tidally influenced deposits of exceptional preservation in the Carboniferous (e.g., Feldman et al., 1993, and references therein).

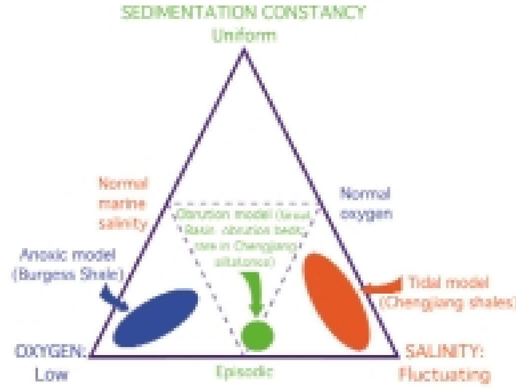

Figure 8. Triangular diagram showing major controls on exceptional fossil preservation in the Early and Middle Cambrian. Example deposits are indicated.

must have been relatively common in epeiric seas. In a sense, then, the phenomenon of exceptional preservation could be viewed as a much more ordinary occurrence, taking place whenever and wherever biodegraders were limited from an area subject to episodic sedimentation. This new perspective on Cambrian deposits of exceptional preservation helps to explain the widespread occurrence of Burgess Shale–type deposits (Conway Morris, 1985), and provides some indication that the best-described biotas (particularly the Burgess Shale and Chengjiang biotas) represent a fair and proportional sampling of Cambrian life forms.

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DIALOGUE

GSA Global Meeting Series Launched

Ian Dalziel, *GSA International Secretary*

Home base for GSA is, of course, the continent of North America. Members and Fellows of the Society from the United States, Canada, and Mexico have, over the years, studied not only their own huge and diverse land mass and its submerged margins, but other continents, the ocean basins, and even the Moon and planets other than Earth, as well as processes that are well expressed worldwide. Recent advances in interdisciplinary Earth and space science emphasize the need to adopt a global perspective in many areas of study and demand that an intellectually healthy Society looks increasingly outward from North America.

GSA's Council has made this approach a high priority in strategic planning, but without abandoning GSA's traditional roots. The Global Review Board has been established to oversee initiatives in this area and will work with the International Secretary in fostering closer relationships with the scientific societies and scientists of other countries. Both will interact closely with the International Division.

Two possibilities currently under review are exchange programs for the support of young scientists to attend foreign meetings and reciprocal memberships with overseas societies. Establishment of a series of overseas, global meetings has already been approved.

In launching a series of global meetings, to be held every two years with the goal of fostering its globalization, GSA does not intend merely to organize meetings at various locations around the world. Geology is a field-based science, even in the era of global satellite data sets. Cooperation with scientists from other continents with their unique knowledge and different perspectives on the earth system is vital. Rather, the Society will cooperate closely with sister societies in other countries to cosponsor these meetings. Each meeting will focus on a specific topic appropriate for the location and matching the mutual interests of the sponsoring societies' membership.

At the first meeting, to be held in Edinburgh, Scotland, June 24–28, 2001, GSA and the Geological Society of London, two of the oldest and largest organizations of earth scientists in the world, jointly present Earth System Processes, a meeting to discuss the emerging global approach to the study of the planet that demands the interaction of traditional geologists with all the other sciences. Both major themes critical to understanding how our planet works will be considered at the meeting: Earth System Linkages, exploring the relationships between the solid Earth, hydrosphere, atmosphere, cryosphere, and biosphere; and Earth System Evolution, examining the way in which processes controlling the nature of the planet have changed since the birth of the solar system 4.5 billion years ago.

Future meetings in the series are being considered in Australia, South Africa, and South America. These and other meetings will address distinctive topics appropriate to the venue. Be a part of this exciting initiative from the start by coming to Edinburgh.

Details of the 2001 Earth Systems Processes meeting were announced in the second circular (see the November 2000 issue of *GSA Today* or visit www.geosociety.org/meetings/edinburgh/index.htm). Join us for a stimulating, interdisciplinary discussion in the unique setting where modern geology began with the publication of James Hutton's *Theory of the Earth* in 1788. The deadline for submitting abstracts is February 28, 2001, and for registration is April 30, 2001.

Site of the global meeting Earth Systems Processes, June 24–28, 2001, Edinburgh, Scotland, is a city where medieval buildings share the pavements with striking modern structures built on ice-sculptured volcanic landforms. Join your colleagues in this magnificent city with close ties to the history of earth science for what promises to be a memorable and significant gathering.

GSA supports efforts to increase awareness of the value of geoscience within the greater scientific community, society at large, and among our own members. This column highlights efforts that contribute to the claim that geoscience matters. To submit information about similar efforts, contact Chief Science Officer Cathleen May at cmay@geosociety.org.

Geoindicators: Common Sense Strikes Again

The common-sense notion that geology can be used to forecast and measure systemic environmental change, frequently before such changes are evident in biologic and/or ecologic systems, is the basis of the geoindicators concept and model. While the notion seems deceptively simple, and its applications obvious, the success of the Geoindicators Initiative reminds us that the most elegantly simple thesis must be conceptualized, formalized, and communicated before it can be appreciated. Even then, a good idea born and incubated in the scientific community must be made accessible to the non-specialist before society can, or will, apply it usefully.

The Right Idea at the Right Time

The geoindicators concept was formalized in the mid 1990s through the efforts of a group of scientists working under the aegis of the Commission on Geological Sciences for Environmental Planning (COGEOENVIRONMENT) of the International Union of Geological Scientists (IUGS). GSA members Tony Berger and Peter Bobrowsky led this effort and also succeeded in bringing GSA into partnership with the IUGS to support the development of the concept and its applications.

In 1999, GSA's Institute for Earth Science and the Environment (IEE) helped its partners in the COGEOENVIRONMENT begin planting the geoindicators seed in what turned out to be quite fertile ground. The 1999 Geoindicators Workshop in Vilnius catalyzed the leap from concept to application in a single bound in Lithuania, where government officials literally bought into the concept before the workshop was over. Within weeks, the commission began to receive requests for similar workshops from other central European nations as well as from African, east Asian, and South American countries. Responding to this obvious statement of global need, GSA's IEE committed five years of seed money to support a series of global workshops. The Geoindicators Initiative and the beneficiaries of these workshops, and indeed the geoscience community, can thank Peter Flawn and his generous support of IEE for our ability to commit to this support. Also, because of the Vilnius workshop, geoscientists in Europe, Africa, and Asia committed to building a tool on the Internet that will become one of the first non-proprietary global working databases for both scientists and land-use decision makers.

Meanwhile, back in North America, the IEE and its partners in the Geologic Resources Division (GRD) of the National Park Service (NPS) brought together a task force that used the geoindicators model as the basis for including geology in the inventory and monitoring backbone of the NPS strategic planning process. IEE and GRD are now working with the IUGS Geoindicators Initiative to begin exporting this model to the Canadian national park system, beginning with a workshop on concepts to be held late this summer in Newfoundland. Responding to the success of the first global workshop, the grassroots support for a global database, and the incorporation of the geoindicators model in a U.S. land management agency, the IUGS voted at its August meeting in Rio de Janeiro to continue to support and to elevate the importance of the Geoindicators Initiative within the COGEOENVIRONMENT.

Ustka, Poland: Geoindicators of Coastal Environmental Change

COGEOENVIRONMENT and IEE sponsored the second global geoindicators workshop in Ustka, Poland. The Marine Geology Branch of the Polish Geological Institute (PGI) organized and hosted the symposium and field meeting, held Sept. 26–29, 2000. Jonas Satkunas (Geoindicators Initiative; Vilnius, Lithuania) and Bobrowsky (IUGS; Victoria, B.C.) led the effort. Joanna Zachowicz and Szymon Uscinowicz of the PGI led the local organizing committee. The meeting attracted 23 participants from Belarus, Bulgaria, Canada, Estonia, Lithuania, Poland, and the United Kingdom, again demonstrating the global interest in the utility of geoindicators. Scientific presentations focused on coastal and marine-related geoindicators. M. Jedrysek, I. Kolosov, et al., discussed water-level changes due to natural and technogenic (human-induced) causes and traced through stable isotopes. A. Witkowski and colleagues, as well as H. Piekarek-Jankowska linked biological indicators in lacustrine and marine environments to geoindicators. Coastal geoindicators along the Baltic Sea, methods of monitoring them, and the effect of storms were presented by S. Musielak, K. Rotnicki, J. Satkunas, et al., Sz. Uscinowicz, and J. Zachowicz. M. Matova discussed the coastal processes of the Black Sea (Nessebar peninsula) in the context of seismotectonics and sea-level change.

E. Tavast reported the results of comprehensive studies of changes along the coast of Lake Peipsi in Estonia. Effects of landslides in the Polish Carpathians and Lithuania were discussed by M. Graniczny and V. Marcinkevicius, et al., respectively. J. Giedraitiene and colleagues discussed the results of groundwater monitoring and variability in water quality as a function of the type of land use in the Lithuanian-Polish cross-border area.

A. Pacesa brought seismicity into the discussion, while B. Karmaza focused on continental aeolian processes. S. Savchik addressed human-induced changes in floodplain sedimentation, and J. Ridgway discussed methodological aspects of sediment geochemistry. A. Piatkowska linked tracing landscape changes apparent in satellite imagery to the geoindicators application.

During a two-day excursion along the Baltic Sea coasts to view the comprehensive results of Polish monitoring and coastal management, participants discussed the net effects of coastal abrasion, shoreline retreat, and beach starvation and nourishment, and the concepts and practices of coastal protection and conservation.

Geoindicators Matter

The Geoindicators Initiative is a prime example of how geoscience can make timely and vital contributions to meeting environmental and societal challenges. If you are interested in reading more about, or contributing your expertise to the initiative, see www.gcrio.org/geo/title and www.lgt.lt/geoin.

Local host institutions join the IUGS/COGEOENVIRONMENT and GSA/IEE to sponsor workshops, and participants pay many of their own costs, however support is needed to bring workshops to other venues. If you are interested in supporting this initiative, please contribute to the Flawn Fund for IEE through the GSA Foundation.

I thank my colleagues Jonas Satkunas and Peter Bobrowsky for their report on the Ustka workshop, which I excerpted for this column. ▲

***Cathleen May**, GSA Chief Science Officer*

FINAL ANNOUNCEMENT

Rocky Mountain (53rd) and South-Central (35th) Sections, GSA, Joint Annual Meeting

Albuquerque, New Mexico
Sheraton Old Town Hotel
April 30–May 2, 2001

The Rocky Mountain and South-Central Sections of GSA will meet jointly in Albuquerque, New Mexico, in 2001. The meeting is sponsored by the Department of Earth and Planetary Sciences, University of New Mexico, and the Department of Geology, Sul Ross State University.

Registration & complete information—accommodations, symposia, theme sessions, field trips, short courses, etc.—will be posted at the GSA Web site, www.geosociety.org. Please visit the site to register. Complete information will be published in the March 2001 issue of *GSA Today*.

Requests for additional information should be addressed to the General Chair, John W. Geissman, jgeiss@unm.edu, (505) 277-3433, or Technical Program Chair, Michael E. Campana, aquadoc@unm.edu, (505) 277-3269.

2001 GSA SECTION MEETINGS

NORTHEASTERN SECTION

March 12–14, 2001 — Sheraton Burlington Hotel, Burlington, Vermont. Information: Tracy Rushmer, Dept. of Geology, University of Vermont, Perkins Hall, Burlington, VT 05405-0122, (802) 656-8136, trushmer@zoo.uvm.edu.
***Preregistration deadline:* Feb. 2, 2001.**

SOUTHEASTERN SECTION

April 5–6, 2001 — Sheraton Capital Center, Raleigh, North Carolina. Information: Edward Stoddard, Dept. of Marine, Earth & Atmospheric Sciences, North Carolina State University, Raleigh, NC 27695-8208, (919) 515-7939, skip_stoddard@ncsu.edu.
***Preregistration deadline:* Feb. 23, 2001.**

CORDILLERAN SECTION

April 9–11, 2001 — Sheraton Universal Hotel, Universal City, California. Information: Peter W. Weigand, Dept. of Geological Sciences, California State University–Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8266, (818) 677-2564, peter.weigand@csun.edu.
***Preregistration deadline:* Mar. 2, 2001.**

NORTH-CENTRAL SECTION

April 23–24, 2001 — Bone Student Center, Normal, Illinois. Information: Robert S. Nelson, Illinois State University, Dept. of Geography–Geology, Campus Box 4400, Normal, IL 61790-4400, (309) 438-7808, rnelso@ilstu.edu.
***Preregistration deadline:* Mar. 16, 2001.**

ROCKY MOUNTAIN & SOUTH-CENTRAL SECTIONS

April 30–May 2, 2001 — Sheraton Old Town Hotel, Albuquerque, New Mexico. Information: John Geissman, University of New Mexico, Dept. of Earth & Planetary Sciences, 203 Northrop Hall, Albuquerque, NM 87131-1116, (505) 277-3433, jgeiss@unm.edu.
***Preregistration deadline:* Mar. 23, 2001.**

Ed. note: With 2001 section meetings just around the corner, now is a great time to look critically at your presentation skills. Part II of this article, covering audiovisual materials, will appear in the March issue.

WHEN PRESENTATIONS GO BAD:

A Commentary—Part I

Kristan Cockerill, *Biosphere 2 Center, Columbia University, P.O. Box 689, Oracle, AZ 85623, USA, and* ***Tim F. Wawrzyniec,*** *Bureau of Economic Geology, University of Texas, Austin, TX 78713-8924, USA*

This commentary traces its roots to a fireside chat between the authors as we lamented the state of communication among geologists (and, to be fair, other scientists). We agreed that presentations we witnessed at recent GSA annual meetings supplied infinite fodder for critique. This is not to say that all of the talks were bad; in fact, there were many outstanding ones. But for several minutes, our conversation centered on our recollections of especially poor presentations.

"Remember the guy who just photocopied a page out of a textbook and threw it up on the overhead and then talked to a screen we couldn't read for five minutes?"

"Oh yeah, and what about the speaker who wanted to walk through every detail of five years of research in a 20-minute talk?"

"And then there were the slides that used five colors and four fonts."

"What about that 10-minute talk that whipped through 90 slides…in each carousel! That was two slides every 6.66 seconds."

"Absolutely perfect examples of presentations gone bad."

We decided this socializing could be organized into a useful commentary providing some constructive criticism and giving basic guidelines for public speaking and for designing and using visual aids. We are not attempting to establish ourselves as supreme experts in scientific communication. Rather, our backgrounds have provided us with more insight into designing and delivering good presentations than most scientists typically acquire. Tim is a geologist who started his academic career as an artist and worked several years preparing scientific figures for publication. Kristan conducts research on the connections between scientific communication and public policy and has more than 10 years of experience communicating technical information to diverse audiences. Additionally, we have served as student projectionists at GSA meetings and have been unfairly blamed for many of the shortcomings highlighted in Part II of this paper!

Before you assume that this discussion does not apply to you, consider this: One or both of us attended every GSA meeting from 1994 through 2000 and witnessed presentations spanning every subfield of geology. More than half of these presentations (including some given by the secondary author) would not have received a passing grade in a 100-level communications course. In preparing this commentary, we both learned more about successful presentations and contend that even the most experienced speakers can benefit from reviewing these guidelines.

Two essential components must be considered in critiquing any presentation: the presenter and the presentation itself. When either disregards accepted communication principles, the results are usually boring, poorly delivered, incoherent talks. After our critique of several GSA meetings, we concluded that there is some good news and some bad news to be found on the geologic communication front. We will begin with the positive. Most of the talks we attended fulfilled two crucial rules of communication: The speakers clearly enjoyed their work and their enthusiasm showed, and very few of them read their papers verbatim but rather spoke conversationally about their topic.

Unfortunately, enthusiasm and an extemporaneous style are seldom enough to save a poorly designed or delivered paper. Too many of the presentations violated other basic principles of effective communication. The goals of any professional meeting, conference, or symposium include sharing information, learning about new work, forging new alliances, and generating new ideas. But if your talk does not present information in a comprehensible way, then what is the point in speaking? Why create slides if the audience cannot see or understand them? The content is the most important aspect of any scientific talk; however, we argue that academic thought is only useful when it is communicated and understood by the interested scientific community.

Key Elements in Preparing and Presenting a Talk

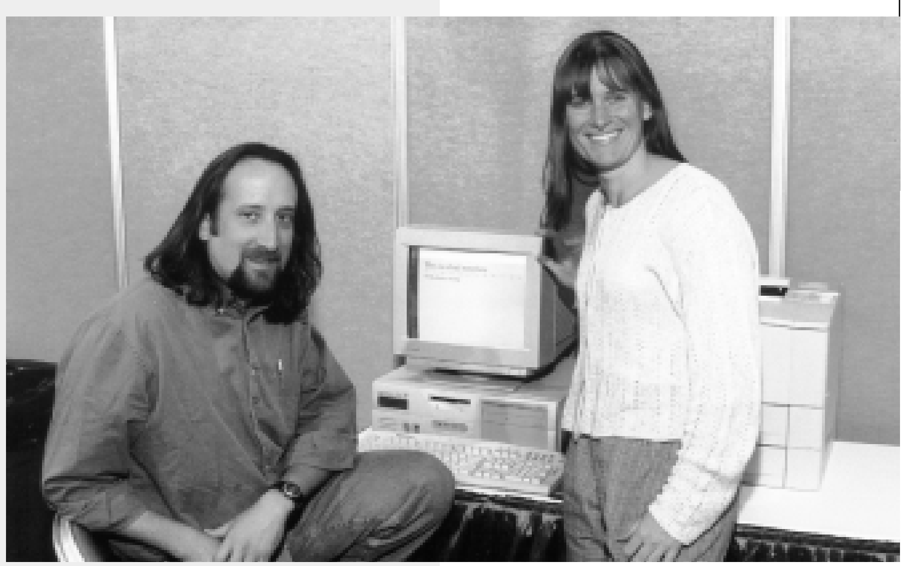
Delivering a talk is not the same as writing a paper and should not be treated as such. Remembering this one point will do wonders for any presentation. Working from this baseline, the following suggestions will help refine and enhance your communication skills.

Introduce, Inform, Conclude

In most introductory communication courses the teacher will instruct the class, "Tell them what you are going to tell them (introduction), tell them (body), and then tell them what you told them (conclusion)."

A typical introduction uses a grabber, such as a rhetorical question, a statistic, or a story to grab the audience's attention. You should then clearly state in ONE sentence the thesis of the talk (e.g., I am here today to demonstrate that the wheel is most effective when patterned after a circle rather than a square). Finally, in ONE sentence, state what the talk will cover. (For example, "This presentation will review wheel design and our wheel construction method, and will demonstrate why the circular design rolls better than the square design.")

In the body of the talk, present your



Tim F. Wawrzyniec and Kristan Cockerill.

information in the same order, using transition statements between each point to review the point just completed and introduce the next. The body should include basic information about your research method and your results. A talk is not being peer reviewed nor is it likely to be the basis for reproducing your research. (How many abstracts did you cite in your last publication?) Therefore, unless your talk is about a new method or a study of a method (methodology), a one- or two-sentence summary is enough. The bulk of the body should be delegated to presenting your findings, which should be the points you listed in your introduction.

The conclusion should repeat the main thesis statement and the primary points covered, then link back to the introduction, perhaps by answering the rhetorical question or finishing the story.

Keep It Simple

Narrow the talk to between two and four key points. Most studies conclude that people cannot mentally organize more than that during a presentation. A common mistake in scientific talks is speakers who try to put several years of research detail into a 20-minute talk. It cannot be done coherently. Details should be left to written materials. Audience members who want more detail will contact you later.

Talk to Me

Use appropriate language and speak conversationally. A talk is not the same as a paper. Your audience cannot go back and review what you said or stop and consult a dictionary for words that are unfamiliar. Use short words whenever possible, decipher acronyms clearly and slowly, and avoid jargon even when speaking to peers. Moreover, creating new terms should be left to manuscripts and should only be done when no other combination of terms is practical. Geology is an incredibly diverse discipline, and it is a mistake to assume that everyone who chooses to attend your talk has enough background to understand the jargon and the acronyms specific to your subfield.

Body Language Matters

Much of an audience's response to you and your talk has nothing to do with what you say, but with how you say it. To ensure that the audience stays focused on what you are saying:

- Look at the audience, not at the podium, floor, or audiovisual screen.
- If you are shaking, do not use a laser pointer or try to brace your arm on the podium for stability.
- If you use a pointer, put it down or turn it off when you do not need it.
- Try not to hide behind the podium.
- Gesture and move naturally.
- Avoid jewelry that clangs on the podium; the microphone will amplify the noise. This also applies to tapping your fingers or repeatedly shuffling notecards and papers.

Watch the Clock

Practice a talk at least once before stepping in front of a podium and time it. Then, watch the clock while speaking. Regardless of how interesting your topic may be, going past your allotted time is rude to your audience and to other speakers. A typical maximum rate of speech is about 100 words per minute, so a 20-minute talk should include no more than 2,000 words.

Next month: Part II—Audiovisual Materials

Congressional Science Fellow Working on Making Communities More Livable

Rachel Sours-Page, *2000–2001*
GSA–U.S. Geological Survey
Congressional Science Fellow

Hello all!

I have accepted a position in the office of Representative Earl Blumenauer (D-Oregon, 3rd district—Portland) for the upcoming year. I will be working as a legislative assistant on issues related to water and energy. Specifically, I will be working on reforms to the National Flood Insurance Program, administered by the Federal Emergency Management Agency, and to the Army Corps of Engineers. Issues such as beach preservation, wetlands restoration, disaster mitigation, and flood control are at the forefront of these agencies' agendas. In the past, Congressman Blumenauer has introduced legislation such as "Two Floods and You're Out of the Taxpayers' Pockets." This requires a homeowner who has filed two or more claims with the National Flood Insurance Program to either (a) allow their house to be moved to a less flood prone area, or (b) pay the full market rate for flood insurance, instead of continuing with subsidized insurance through the federal government.

I work closely and share an office with many of Representative Blumenauer's other legislative assistants in the Longworth House Office Building. A House office is typically quite small, both in physical space and number of employees. Our office employs approximately 12 staff members to work on legislative issues, media communications, scheduling and Web site design—all within a two-room office. We work closely with one another and with staff members at the home office in Portland, Oregon, and daily with the representative to keep him updated and well informed of congressional business and upcoming legislation.

I am very pleased to be working in Representative Blumenauer's office (www.house.gov/blumenauer). I feel a strong affiliation with Oregon, having lived there the past five years. The central focus of this office is to work on bipartisan issues related to making communities both within and outside Oregon more livable. These include encouraging smart growth in our urban and suburban population centers; allowing for federal transportation dollars to be spent on public transit options and bicycle paths, as well as highways; and ensuring that our federal dollars do not favor environmentally unfriendly practices. I am enjoying my time here on the Hill and appreciate the opportunity afforded me by the GSA and the USGS.

If you would like to learn more about my experiences on the Hill and those of former GSA Congressional Science Fellows, please look for our articles in *GSA Today.* You will also find links on the GSA Web site (www.geosociety.org) to more general science and public policy issues. In addition, feel free to contact me at any time with your questions!

This manuscript is submitted for publication by Rachel Sours-Page, 2000–2001 GSA–USGS Congressional Science Fellow, with the understanding that the U.S. government is authorized to reproduce and distribute reprints for governmental use. The one-year fellowship is supported by GSA and by the USGS, Department of the Interior, under Assistance Award No. 1434-HQ-97-GR-03188. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. government. Rachel Sours-Page can be reached at Rachel.Sours-Page@mail.house.gov, (202) 225-4792, 1406 Longworth House Office Bldg., Washington, D.C. 20515. ▲

Call for Nominations

Don J. Easterbrook Distinguished Scientist Award

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

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

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

Nominations must be accompanied by supporting documentation, including a statement of the significance of the nominee's research, a curriculum vitae, letters of support, and any other documents deemed appropriate by the nominating committee.

Send nominations by **April 1, 2001**, to Alan Nelson, U.S. Geological Survey, MS 966, P.O. Box 25046, Denver Federal Center, Denver, CO 80225, (303) 273-8592, anelson@usgs.gov.

Keith Kvenvolden (left), honored as the first Michel T. Halbouty Distinguished Lecturer, is congratulated by Richard Ojakangas at Summit 2000, GSA's Annual Meeting held in November 2000.

Farouk El-Baz Award for Desert Research

The GSA Quaternary Geology and Geomorphology Division seeks nominations for the Farouk El-Baz Award for Desert Research. This award rewards excellence in research in desert geomorphology worldwide and is intended to stimulate research in desert environments by recognizing an individual whose research has significantly advanced the understanding of the Quaternary geology and geomorphology of deserts. Although the award primarily recognizes achievement in desert research, the funds that accompany it ($10,000 in 2001) may be used for further research. The award is normally given to one person but may be shared by two people if the recognized research was the result of a coequal partnership.

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

Send nominations by **April 1, 2001**, to Alan Nelson, U.S. Geological Survey, MS 966, P.O. Box 25046, Denver Federal Center, Denver, CO 80225, (303) 273-8592, anelson@usgs.gov.

Laurence L. Sloss Award for Sedimentary Geology

The Sedimentary Geology Division of GSA solicits nominations for the 2001 Laurence L. Sloss Award for Sedimentary Geology. This award is given annually to a sedimentary geologist whose lifetime achievements best exemplify those of Larry Sloss—by contributing widely to the field of sedimentary geology and through service to GSA.

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

Send nominations by **March 1, 2001**, to Paul Karl Link, Secretary, Sedimentary Geology Division, Dept. of Geology, Box 8072, Idaho State University, 1400 E. Terry, Pocatello, ID 83209-8072.

Michel T. Halbouty Distinguished Lecturer

The Michel T. Halbouty Distinguished Lecturer Fund was established to select a top lecturer in broad, overarching topics of natural resources (water, land, energy, and minerals). This lecturer will be a featured speaker at the 2001 GSA Annual Meeting and will receive a check for $1000.

Selection of the lecturer will be on the basis of career accomplishments, reputation, and the lecture topic. Appropriate topics on natural resources could include, but are not limited to: finite limits on worldwide availability; regional overviews (U.S.) of availability, quality, quantity, and use; environmental damage from extraction or exploitation; geologic aspects of environmental remediation; overarching government policies concerning natural resources; regional exploration; and new exploration tools. Papers on specific topics, such as those concerning a particular ore deposit model, a local water quality problem, or the discovery of a new gas field may not be appropriate

The winner of this award must submit a lecture abstract to the 2001 GSA Annual Meeting by July 24, 2001. The hour-long presentation can be scheduled separately or may be part of a Topical Session.

The GSA Joint Technical Program Committee (JTCP) and the Annual Program Committee invite GSA Members and especially Topical Session conveners in the resources area to nominate a lecturer. Self-nomination is not allowed. Nominations should concisely summarize the accomplishments and research field of a nominee. A review panel consisting of members from JTPC will vote

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on the candidates. The nomination form can be found at www.geosociety.org/meetings/2001/halbouty.htm and must be submitted by **May 1, 2001**.

Gilbert H. Cady Award

The Coal Geology Division of GSA seeks nominations for the 2001 Gilbert H. Cady Award, made for outstanding contributions in the field of coal geology. As defined in the bylaws of the Coal Geology Division, "Coal geology refers to a field of knowledge concerning the origin, occurrence, relationships, and geologic characteristics of the many varieties of coal and associated rocks, including economic implications." The first award, established by the division in honor of Gilbert H. Cady, was presented in 1973. Monies for the award are derived from the annual interest income from the Gilbert H. Cady Memorial Fund, administered by the GSA Foundation. The award (a certificate and an engraved silver tray) will be made for contributions considered to advance the field of coal geology within and outside North America and will be presented at the Coal Geology Division Business Meeting at the 2001 GSA Annual Meeting in Boston.

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

Send three copies of the nomination by **February 28, 2001**, to Brenda S. Pierce, U.S. Geological Survey, 956 National Center, Reston, VA 20192-0001, (703) 648-6421, bpierce@usgs.gov.

Reminder: Call for Nominations

The **John C. Frye Environmental Geology Award** is awarded for an outstanding paper on environmental geology published by GSA or by one of the state geological surveys during the preceding three full calendar years. The award's $1,000 cash prize is presented in cooperation with the Association of American State Geologists. Nominated papers must establish an environmental problem or need; provide substantive information on the basic geology or geologic process and relate it to the problem or need; suggest solutions, provide appropriate land-use recommendations, or resolve the problem or need based on the geology; and present the information in a manner that is understandable and directly usable by geologists. Nominations must include a paragraph stating the pertinence of the paper and are due by **March 31, 2001**.

Nominations for the following **National Awards are due April 30, 2001**: The William T. Pecora Award, the National Medal of Science, the Vannevar Bush Award, and the Alan T. Waterman Award.

Materials and supporting information for any of the nominations may be sent to Grants, Awards, and Medals Program Officer, GSA, P.O. Box 9140, Boulder, CO 80301-9140. For more detailed information about the nomination procedures, see www.geosociety.org. (Go to About Us, then to Medals and Awards.)

Book Reviews

Sedimentary Responses to Forced Regressions

Edited by D. Hunt and R.L. Gawthorpe, Geological Society (London) Special Publication No. 172, London, 2000, 383 p. $132; $78 for GSA members.

Sedimentary Responses to Forced Regressions is one of the best collections of papers on sequence stratigraphy produced in the past decade. Much of the strength of this work comes from its specific focus on a long-neglected and oversimplified aspect of sequence stratigraphy, namely, how sedimentary systems respond to a relative fall in sea level. Partly because deposits formed during such "forced regressions" tend to be thin or poorly preserved, they have previously received little attention. They have been treated by most as either a variation on late highstand or early lowstand deposition, when they clearly represent a transition between those two conditions, much like the transgressive systems tract. The 16 papers in this volume collectively make a powerful case for a fourth systems tract called the falling-stage systems tract or forced regressive wedge systems tract, which would lie above the highstand systems tract and below the lowstand systems tract. The editors have done a commendable job maintaining consistency and unity among the papers. Observations, interpretations, and arguments are clearly stated throughout the volume, making comparisons among the papers much easier. The volume also avoids the all-too-common split between siliciclastics and carbonates by including examples from both of these systems, as well as those from mixed systems. The individual studies draw from a wide range of data sets, including outcrops, cores, geophysical logs, seismic, and computer modeling. The first two papers treat concepts and models, with the remainder of the volume split between Paleozoic-Mesozoic case studies and Cenozoic case studies.

Although several of the volume's authors have previously published papers on similar topics, this volume brings together all of their arguments under a single cover; in addition, most of those who have previously published on forced regressions have expanded the scope of their work with their contributions to this volume. In short, this volume represents one of the most significant advances to the basic Exxon model of sequence stratigraphy. This collection will take its place beside previous sequence stratigraphic classics such as Society of Economic Paleontologists and Mineralogists Special Publication 42 and the American Association of Petroleum Geologists Methods in Exploration No. 7. More volumes like this are needed in sequence stratigraphy—ones that investigate well-defined research questions rather than ones that simply collect largely unrelated case studies.

Steven M. Holland
University of Georgia
Athens, GA 30602-2501

Beaches and Dunes of Developed Coasts

Karl F. Nordstrom, Cambridge University Press, Cambridge, 2000, 338 p., $74.95.

Many coastal regions have experienced unprecedented human development in the last 150 years. Much of this development has not been compatible with the dynamic nature of the shoreline and has led to significant controversy about how to best manage coastal resources. This debate has intensified in the face of recent concerns of possible increases in sea level and storm activity associated with the warming global climate.

This well-written book provides a comprehensive overview of current understanding of how coastal processes modify developed beaches. Although the book focuses on New Jersey, the author provides a global perspective on human alterations to beaches and subsequent management strategies. Chapters 1 and 2 include a historical review of the modes of human development of coastlines. In chapters 3 and 4 the author presents a possibly over-optimistic assessment of beach replenishment and hard structures as cost-effective, long-term means of erosion mitigation. Chapter 5 deals with contrasting the character of developed and "natural" landforms. The evolution of developed coasts with an emphasis on the effects of storms and changes in sea level and potential human responses is addressed in chapter 6. Chapters 7 and 8 deal with coastal-management programs and strategies for retaining natural-like features compatible with the dynamic coastal environment. The final chapter identifies some directions for future research on developed coasts.

Unfortunately, the author devotes only a few pages to potential effects on developed coasts of accelerated sea-level rise associated with the warming climate. Although Nordstrom points out significant uncertainties associated with predicting future climate and sea-level changes, these uncertainties should not prevent policy makers from striving to develop management strategies to deal with much more dynamic coastlines. While the book focuses on developed shorelines, an additional, useful chapter might have included strategies for avoiding the cycle of beach protection leading to increased property values requiring even more protection. How do we as a society prevent further unwise and dangerous development in the context of trying to preserve what remains of our coastal environment?

This book provides a great reference text and, with its focus on developed coasts, is a much-needed addition to the current literature. Nordstrom's text would be extremely useful to any student, planner, manager, or scientist interested in the interplay between geological processes and shoreline development. I can envision using this book as a classroom text for a coastal-zone management class or a supplement in a coastal processes course.

Jeffrey P. Donnelly
Woods Hole Oceanographic Institution
Woods Hole, MA 02543

NEW GSA MEMBERS

The following Members were elected by Council action during the period from March to October 2000.

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Sarah L. Taylor
Katherine L. Thelman
Dimitris A. Theocharis
Diana L. Thiel
David B. Thomas
Heather M. Thomas
Melanie L. Thomas
Steven A. Thomas
Timothy Tierney
Ron T. Tingook
Stephanie R.A. Tomusiak
Michael Toth
Stephanie L. Towle
Kim Tremaine
Ulrike Troitzsch
Hsin-Yi Tseng
Kunihiro Tsuchida
Martin G. Tuchscherer
Richard J. Twitchett
Amanda R. Tyson
TJ Ulrich
Jaime Urrutia Fucugauchi
James E. Van Alstine
Marije van Koolwijk
Caroline A. van Mourik
Jeremy R. Vaughan
Jo Anne Verhasselt
Brian Viggiano
Karen M. Viskupic
Steve Visocky
Susan J. Vogel
Olaf von der Cron
Iraj Vosoughi Niri
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Eckart Wallbrecher
Rachel I. Walker
Gregory Waltz
Yong Wang
Julie A. Ward
Mark Wardell
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Koichiro Watanabe
Charles Weiland
Noam Weisbrod
Robin L. Whatley
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Timothy M. White
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Thomas P. Whitson
Alan Whittington
James R. Whittington
Elisabeth Widom
Max Wilke
Bryan P. Williams
Deborah Wilson
James R. Wilson
Jeff Wilson
Boswell Wing
Amy Lynn Winkle
Francis D. Winslow III
Anne C. Witt
Chad E. Wolak
James T. Wood
Brad A. Woodard
Kerry Workman-Ford
Tianguang Xu
YaoYang Yan
Wan Yang
Wenbo Yang
Guo Ying
Chester Young
Christopher M. Young
Jeri J. Young
Michael Young
Colin Zelt
Marcos Zentilli
Michael Zieg
Mike Zimmer
Eric C. Zimmermann
John M. Zuleger

The following Members have transfered from Student Associate status.

Matthew Abahazi
Daniel Alessi
David Allen
Elizabeth Amrine
Paula Anderson
Russell Anderwald
Elizabeth Anker
Jennifer Aschoff
Richard Ashmore
Maryann Ashworth
Rebecca Atkinson
Dana Austin
Theresa Barber
Scott Barlow
Mary Barnes
Heather Barr
Alexander Bartholomew
Dayo Bayewu

NEW GSA MEMBERS

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Jarrad Berg
Jennings Berger
Robert Bergstrom
Heather Best
Eric Bilderback
Karen Blair
Barbara Boland
Melisa Borino
Aaron Borling
Rob Bosshart
Jeremy Boyce
Melissa Boysun
Matthew Brabeck
Bethany Bradley
Cassandra Brown
Samantha Budd
Malia Burrows
Katherine Callahan
John Canerdy
Leigh Cantey
Deirdra Cantrell
Tina Carrick
Riena Carroll
James Carter
Mark Chapa
Sean Chelius
Yvette Chovanec
Rebecca Choyce
Nicholas Chrobak
Jonathan Clark
Cathy Clegg-Scala
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Jason Collins
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Luis Damerell
Antje Danielson
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Bruce Davidson
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David Farris
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Ann Finocchio
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Erika Flemming
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Wesley Foll
Heather Folsom
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Zan Frederick
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Sarah Gaines
Alison Garich
Christine Garritano
Annalisa Ghezzi
Duncan Gibson
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Brian Guthrie
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Tomas Hernandez
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Letha Honea
Sarah Hood
K. Aubrey Hottell
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Leslie Hsu
Adrian Hughes V
Bretagne Hygelund
Dawn Ison
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Matthew Jackson
Catherine Jamet
Luke Jensen
Ernest Johnson
Susan Johnson
Priyanka Johri
Cyndi Jones
Matthew Justus
James Katz
David Keating
Bryan Kennedy
Karen King
Jeff Kirtley
Elliot Klein
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Kelly Knight
James Kocis
Matthew Kohlbecker
Amanda Kolker
Clifton Koontz
Patrick Kozak
Jonathan Kramer
Michael Kreitner
Brian Kristall
Seth Kruckenberg
Gabrielle Kurth
Angela Kurth
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Kathryn Lamb
Stacy Lambert
Alyssa Lanier
Joshua Lawson
Brad Lee
Serena Lee
M. Jeanetta Lee
Nathalie Legare
Erin Letrick
Rianda Levin
Kerrill Lewis
Thomas Lipka
Ashley Lucht
Stacy Maddox
Derek Main
Crystal Mann
Kasey McCall
Renee McCarter
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Sean McCuddy
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James McGuire
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Brian Meley
Laura Merrell
Nicholas Meyer
Joshua Miller
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Suzette Morman
Achim Mueller
Erich Mueller
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Heather Roy
Carolyn Ryder
Michael Rygel
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Cara Santelli
Zanna Satterwhite
Conrad Schaefer
M. Bernadette Scheller
David Schneider
Chad Schopp
Christian Schrader
Ann Schwarz Braden
Jessica Scott
Shane Seals
Jocelyn Sessa
Glenn Setkoski
Jeffery Shaner
Jason Shelton
Heath Shive
Sarah Shoemaker

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Sara Slater-Atwater
Lauren Smith
Chris Spitzer
Sara Spradlin
Jamie Stapleton
Mary Stecheson
Ryan Stepler
Wayne Stevenson
Jason Stine
Roger Stradal
Diana Strickland
Steven Suk
Biyai Suku-Ogbari
Brooke Swanson
Dustin Sweet
Eugene Szymanski
Tatia Taylor
Andrew Taylor
Peter B.Taylor
Michael Tennyson
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Katie Thornburg
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Kenzie Turner
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Sylvia White
Alan Willis
Brant Wilson
Mary Wimberly
Flavia Wood
Keith Woofter
Lynn Yarmey
Melissa Yenko
Matthew Young
Aimee Zipf
Vladimir Zivkovic

The following Student Associates joined between March and October 2000.

Jacob T. Abbott
Evrim Akyilmaz
Omar Ali
Thamer Alsaif
Elizabeth M. Amrine
Benjamin J. Andrews
Susan E. Asure
Michael S. August
Jaime S. Azain
Heather J. Bailey
Treasure L. Bailley
Ted Baker
Elizabeth A. Barnett
Jared A. Bartley
Bryant J. Bartschi
Neil A. Beaver
Walter H. Begay
Romana Begossi
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Peter J. Berquist
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Aaron D. Borling
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Matthew D. Brindle
Meredith L. Brislen
Chris R. Brown
Sarah R. Brown
Michael R. Bruemmer
Darren P. Burgett
Amy L. Burns
Matthew A. Busillo
Katherine D. Callahan
D. Phillip Cameron Jr.
Cameron D. Campbell
Tina Campbell
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Andrew K. Castor
Laura E. Clor
Trish Collins
Justin L. Conner
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Erica B. Cortez
Erin F. Craney
Rachel S. Culberson
Terri J. Daniel
Antje Danielson
Jason E. Davidson
Bilikisu B. Davies
K. Wesley Davis
Susan D. DeHart
Rochelle R. Destrampe
David S. Dickerson
Bridget A. Diefenbach
Darin A. Dolezal
Michelle M. Dooley
M. Kevin Doolin
Kimberly H. Doupe
Dominic C. Druke
Emily A. Duncan
Stacy D. Durden
Christa L. Edwards
Sandra J. Egan
Caroline S. Eikenberry
J. Fletcher England
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Annalisa Ghezzi
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Brianna C. Griffith
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Doreen J. Jessen
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Katherine A. Johnson
Susan P. Johnson
Susan S. Johnson
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David P. Keating
Linda J. Keefer
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Casmir N. Ketlhalefile
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Susan C. Lesko
Erin M. Letrick
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Christopher G. Linton
Shauna Little
Michael Livieratos
Sharon A. Longacre
Stacy A. Maddox
Evan T. Mankoff
Jennifer L. Martin
Theodore W. Mazzoli
Heather K. McCarren
Sean M. McCuddy
David C. McCoy
Amanda Michelle McGhee
Patricia A. McGrady
Alexander W. McKiernan
Myles McMonigle
Sarah L. Mersereau
Nicholas D. Mertes
Alisha R. Miller
Amy L. Miller
Christina M. Miller
Jennifer R. Millner
Stephanie Mrozek
Peter A. Murray
Alicia R. Musselman
Nicole R. Myers
Lynde Nanson
Alissa Naymark
Christopher R. Nelson
Jacinda L. Nettik
Rachel N. Nottingham
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Michael P. O'Ferrall
Christin Olinger
Anthony M. Oliverio
Richard J. O'Neil
Thomas A. Overocker
Omar L. Pacheco
Lewis H. Parker
Sandra L. Pashley
Sara L. Pearce
Jonathan W. Pennington
Gina Petruzzelli
Matthew R. Phillips
Marissa J. Pihl
Janna S. Pistiner
Jess C. Priest
Skylar L. Primm
Debra R. Prinkey
Kezia L. Procita
Christina M. Putney
Wayne N. Randall
Jessica Rasmussen
Timothy D. Raub
Jennifer L. Bristol Reitz
Amy L. Robertson
Nick E. Rohrbach
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Danielle E. Rose
Bernice R. Rosenzweig
Jeffrey B. Roth
Jessica C. Rowland
Roger L. Rushworth Jr.
Michael R. Ryman
Nils A. Sandin
Travis Sandland
Izabela B. Santos
Zanna A. Satterwhite
Conrad J. Schaefer
Kerry L. Schmidtbauer
Wolfgang Schmitt
Lori H. Schnick
Kyle A. Schuch
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Glenn Setkoski
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Nathan D. Stansell
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Marilynn Y. Stumfall
Joseph S. Sullivan
Sean M. Sullivan
William J. Sweeney III
Jennifer Swift
Kara A. Syvertsen
William J. Tackaberry Jr.
Carl H. Tape
Amie Joy Ten Brink
Melissa M. Thornton
Karen C. Tobin
Sara N. Tourscher
Emily S. Tremain
Melissa K. Trout
Holly B. Tulpin
Mark A. Tyra
Tim Unger
Kristen H. Van Kley
Greg A. VanderBeek
Sarah L. VanSkiver
David J. Velez
Karin J. Victorio
Kali E. Wallace
Richard H. Walzak
Lisa M. Wasiowich
Raina A. Waskiewicz
Beth A. Weinman
Bethany M. Weisberger
Robert Joe Wenger Jr.
Dru Wilbur
Robert D. Wilcox
Martha S. Williams
Nora E. Wilson
Charles Jennings Woods
Keith R. Woofter
Seth A. Young
Stephanie A. Zub

ANNOUNCEMENTS

MEETINGS CALENDAR

2001 MEETINGS

April 29–May 2	Minespace 2001, 103rd Annual Meeting of the Canadian Institute of Mining Metallurgy and Petroleum in Association with the Canadian Space Agency and the Association Professionnelle des Géologues et des Géophysiciens du Quebec (APGGQ), Quebec City, Quebec. Information: Serge Major, 1-800-667-1246, fax 514-939-2714, smajor@cim.org, www.minespace2001.org.
July 7–12	New Paradigms for the Prediction of Subsurface Conditions—EuroConference on the Characterisation of the Shallow Subsurface: Implications for Urban Infrastructure and Environmental Assessment, Spa, Belgium. Information: J. Hendekovic, European Science Foundation, 1 quai Lezay-Marnésia, 67080 Strasbourg Cedex, France, 33-388-76-71-35, fax 33-388-36-69-87, euresco@esf.org, www.esf.org/euresco. (Application deadline: April 2001.)
June 9–13	A Geo-Odyssey, Geo-Institute conference on foundations and ground improvement, Blacksburg, VA. Information: Professor J. Michael Duncan, CEE Department, 200 Patton Hall, Virginia Tech, Blacksburg, VA 24061-0105, (540) 231-5103, fax 540-231-7532, jmd@vt.edu, http://www.conted.vt.edu/geo2001.htm.
September 16–19	Combined Hydrogeology Specialty Conference and 54th Canadian Geotechnical Conference, Calgary, Alberta. Information: Dr. Cathy Ryan, (403) 220-2793, ryan@geo.ucalgary.ac, www.geo.ucalgary.ca/iah-cnc/.
September 23–26	The Society for Organic Petrology (TSOP) 18th Annual Meeting, Houston, Texas. Information: Dr. Coleman Robison, Texaco Group, Inc., E & P Technology Div., 3901 Briarpark Drive, Houston, Texas 77042 USA; (713) 432-6828, fax 713-838-4628, robiscr@texaco.com, www.tsop.org.

2002 MEETINGS

July 22–27	11th IAGOD Quadrennial Symposium in Association with GeoCongress 2002: Earth Systems and Metallogenesis, Windhoek, Namibia. Information: Ger Kegge, P.O. Box 90469, Klein Windhoek, Namibia, fax +00264-61-246128, kegge@iafrica.com.na; or Erik Hammerbeck, ehammerb@geoscience.org.za.
September	Sixth International Congress on Rudists, Pula, Croatia. Information: Alisa Martek, Institute of Geology, Sachsova 2, 10000 Zagreb, Croatia, 385-1-6160786, fax 385-1-6144718, amartek@igi.hr. (Preliminary registration deadline: May 31, 2001.)

Memorial Preprints Now Available

The following memorial preprints are now available, free of charge. To order, contact the GSA Member Service Center by e-mail at member@geosociety.org, by phone at 1-888-443-4472, or (303) 447-2020, ext. 774, by fax at 303-443-1510, or by mail to P.O. Box 9140, Boulder, CO 80301-9140, USA.

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The annual *Memorials* volume for 2000 (v. 31) will be available for purchase later this year.

In Memoriam

Ward H. Austin Jr.
Coahoma, Texas

David F. Davidson
Reston, Virginia
October 7, 2000

William H. Diment
Golden, Colorado
December 6, 2000

Samuel S. Goldich
Golden, Colorado
December 20, 2000

MacKenzie L. Keith
State College, Pennsylvania
November 6, 2000

Louis Riseman
Manhattan, Kansas

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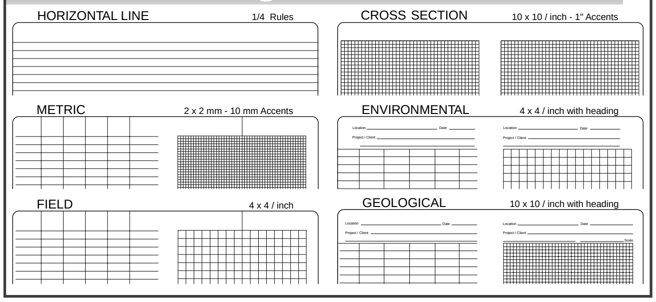

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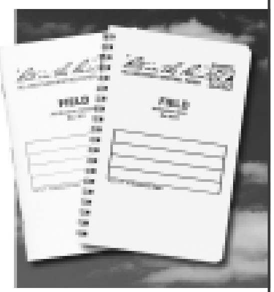

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RITR353-MX	$12.20	Field, Side Spiral (42 leaf, 8 1/2 x 11)
RITR135	$2.95	Shirt Pocket (Spiral, 50 lf, 3 x 5)
RITR146	$3.55	Hip Pocket (Spiral, 50 lf, 4 x 6)

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Field Forum

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GSA Field Forum: Bolide Impacts on Wet Targets

When: April 22–28, 2001

Where: Alamo, Nevada, and the adjacent ranges (five days); Moab, Utah, and nearby Canyonlands and Arches National Parks (two days). Lodging in Alamo will be at the new JFDI (Just Focus and Do It) Executive Retreat Ranch.

More information: See the October issue of *GSA Today* (also available at www.geosociety.org) or check the Alamo Breccia Research Page, http://talus.Mines.EDU/students/m/mmorgan/. Click on the GSA Field Forum link.

Cost: $925 ($600 for students), including guidebooks and handouts, meals, lodging (double occupancy), morning and afternoon refreshments, and transportation from starting point in Las Vegas to ending point at airports in Denver or Grand Junction, Colorado, or Salt Lake City, Utah. Optional extension in Moab is extra, with departure from Grand Junction or Denver.

Registration and information: Contact John E. Warme, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401, (303) 273-3816, fax 303-273-3859, jwarme@mines.edu.

Changing of the Guard for *GSA Bulletin*

John Geissman of the University of New Mexico completed a six-year term as science co-editor for *GSA Bulletin* at the end of 2000. The regular term for an editor is four years, but Geissman offered to stay on an extra two years so that the co-editorship terms could be staggered rather than both positions beginning at the same time, helping ease transition difficulties.

Beginning his term as co-editor is Peter Copeland (University of Houston), who joins *Bulletin* co-editor, Allen Glazner (University of North Carolina at Chapel Hill) in handling the review process of the more than 200 manuscripts submitted to the journal each year.

Copeland is an associate professor in the Department of Geosciences at the University of Houston, where he has taught since 1990. He received his B.S. in geology from the University of Kansas in 1982, his M.S. in geology from the New Mexico Institute of Mining and Technology in 1986, and his Ph.D. in geology from State University of New York at Albany in 1990. A GSA member since 1984, Copeland also belongs to the American Geophysical Union and the American Association for the Advancement of Science. His research interests include thermochronology, tectonics of convergent margins, and geochemistry.

Copeland served on the editorial board of *Geology* from 1993 to 1995, and has served as an associate editor for *Bulletin* since 1997. He also has served on the advisory board of *Annual Editions: Geology* of Dushkin/McGraw Hill Publishers since 1997. Copeland is an enthusiastic supporter of the plans for electronic submission, review, and publication of *Bulletin* articles.

Peter Copeland

GSA Annual Meeting and Exposition

Morning, Noon, and Night

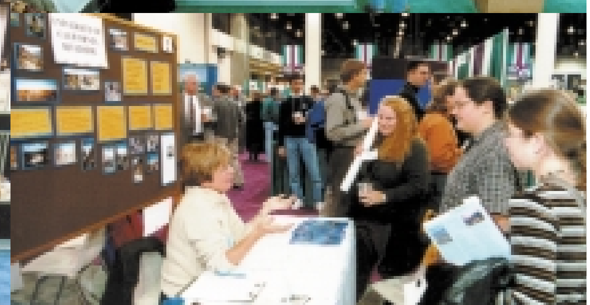
The days of Summit 2000 were filled from dawn to dusk with technical sessions, workshops, short courses, and field trips, and evening receptions, dinners, and alumni parties lasted well into the nights. GSA Division and Associated Society business meetings, award ceremonies, and luncheons filled out the week's activities for many.

Summit 2000 saw a record number of abstracts submitted, with most reaching GSA via an online submission system. The Joint Technical Program Committee had its work cut out for it, finding a place for 236 technical sessions in a convention center that was undergoing renovation.

A new GSA division, the Division of Geobiology and Geomicrobiology, was debated, discussed, and dubbed worthy. Proposed bylaws for the division, which will serve the interests of geomicrobiologists, microbiologists, geochemists, paleontologists, geoecologists, and astrobiologists, will be presented to GSA Council in May.

GSA Council welcomed a new president, Sharon Mosher, vice president, Anthony J. Naldrett, and four councilors (2001–2003 term), Steven M. Colman, Suzanne Mahlburg Kay, Peter W. Lipman, and Gerald M. Ross. Council also approved a new budget while committees mapped out activities for another year.

Along with 255 exhibit booths, the Exhibit Hall in the convention center housed poster sessions, the Welcoming Party, the Graduate Student Information Forum, the K–16 Educator's Share-a-thon, the GSA Bookstore, and areas for GSA Headquarters Services, the GSA Foundation, and GSA's Science and Outreach.



in Reno, Nevada

Summit 2000

Jill Schneiderman discusses her book *The Earth Around Us: Maintaining a Livable Planet* with Jill Whitman at Schneiderman 's Sunday evening book signing.

A perky group (clearly "morning people") heads out on one of the 22 field trips held in conjunction with the meeting.

Alumni events, such as this one for Middlebury College, give meeting goers a chance to see old friends.

The Internet Access Center let meeting goers keep in touch with their offices and families.

A presidential gathering: 2001 GSA President Sharon Mosher, GSA Past President (2000) Mary Lou Zoback, GSA Foundation Past President (1979) Leon Silver, and GSA Past President (1999) Gail Ashley.

Melody Brown Burkins, 1999–2000 GSA–U.S. Geological Survey Congressional Science Fellow, gives her report on happenings in Washington, D.C.

2000 Meeting Statistics

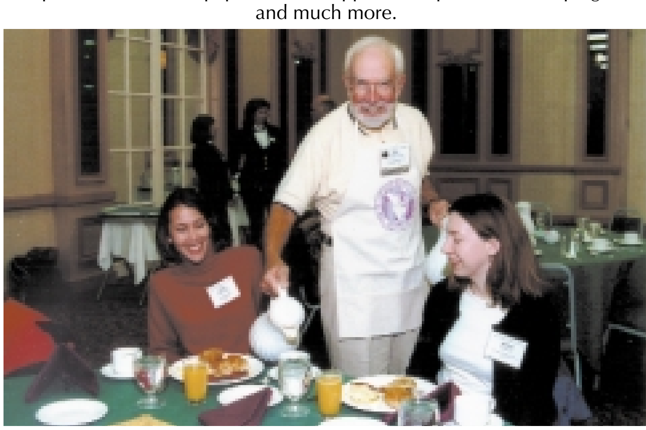
Abstracts submitted:	3,365
Total number of technical sessions (including posters):	236
Total attendance:	6,179
Short courses and field trips:	26
Number of exhibit booths:	255
Number of exhibiting companies:	160
Employment Service	
Number of interviews scheduled:	497
Number of applicants on-site:	170+
Number of employers using the on-site service:	52
Number of positions advertised:	60 academic 50+ consulting 7+ petroleum and federal government

Robert Larsen, 1999–2000 chair of the Engineering Geology Division, holds one of the gavels presented to winners of the division's awards.

The National Science Foundation's Herman Zimmerman, director of the Division of Earth Sciences, and Margaret Leinen, assistant director of the Directorate for Geosciences, attend a reception celebrating the NSF's 50th anniversary.

The Newsroom was the site of press briefings on the latest research being presented at the meeting. Here, a panel discusses geological studies surrounding the proposed Yucca Mountain Nuclear Waste Repository site.

At the student assistant check-in area…hey! Where is everybody? Working! Unsung heroes of the meeting, the 158 student assistants who worked at Summit 2000 distributed badges, ran slide projectors, helped ready both speakers and rooms, put up signs, took down signs, unpacked crates of equipment and supplies and packed them up again, and much more.



Ken Weaver serves coffee at the President's Student Breakfast, which was attended by 600 students.

The GSA Employment Service helped pave the way for countless career paths, bringing job seekers and employers together for on-site interviews.

Bob Diffendal may look as if he's bumming change from Elizabeth Anthony, but he's really trying to give away funds! Student travel grants such as those from GSA's North-Central Section help many students get to the Annual Meeting.

The Geology in Government Luncheon attracted 223 students, who heard speakers from the American Association of State Geologists, the Bureau of Land Management, the National Park Service, the U.S. Department of Agriculture Forest Service, and the U.S. Geological Survey.

Geological Society of America

and the GSA Foundation…

COMING OF AGE in the 21st CENTURY

"From the Earth's crust, we derive the resources that sustain humankind. An understanding of the Earth's processes affects where we live – riverbeds, shorelines, earthquakes, volcanoes, unstable ground. Without an understanding of geology, humankind is in peril."

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- **$25**
- **$50**
- **$100**
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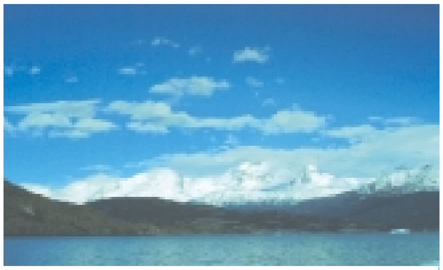
GSA FOUNDATION

2001 GeoVentures



Lago Argentino. Photo by J. Reynolds.

GeoTrip

New Year's at the End of the World: The Geology of Southern Patagonia, Including Tierra del Fuego
Dec. 26, 2001–Jan. 10, 2002
15 days, 14 nights
Scientific leaders: James Reynolds, Brevard College, Brevard, North Carolina; Dorothy L. Stout, Cypress College, Cypress, California.

Jim Reynolds has spent the past 15 years investigating the uplift history of the Andes. Using magnetostratigraphy, Jim and his colleagues are developing a relatively precise chronostratigraphy across the many tectonic provinces that we will visit. In addition to his work at Magstrat, LLC, and Brevard College, he holds an adjunct position at the University of Pittsburgh.

Since 1978, Dottie Stout has been leading geological expeditions around the world, including trips to China, South America, Africa, Europe, Indonesia, Australia, and Russia. Dottie is past president of the National Association of Geology Teachers and is temporarily on leave as a program director at the National Science Foundation.

Description

Our trip will start in Ushuaia, Argentina, the southernmost city in the world, at the base of the Cordillera Darwin on the Beagle Channel along the southern shore of Tierra del Fuego. The austral summer can be pleasant, but is seldom truly warm. We'll look at the glaciers, rocks, and the tectonic setting along the channel before we cross the mountains to the Patagonian steppes that comprise the northern part of the island. After crossing into Chile and taking the ferry across the Straits of Magellan to the South American mainland, we'll head eastward along the straits through the oil and gas fields to the penguin rookery near Punta Dungeness, Argentina. We'll observe the interplay between sea-level changes, glaciations, waves, currents, and extreme tidal ranges that shaped the coastline, while dodging the numerous rheas and guanacos on the plains. From there, we'll go to Río Gallegos and then to Glaciers National Park in the Patagonian Andes. We'll watch icebergs calve off of the Perito Moreno glacier into Lago Argentino, take a daylong boat trip on the lake, and slalom through the icebergs while Andean condors soar overhead. A low pass through the mountains will take us to Torres del Paine National Park in Chile to see the most spectacular mountains in the Andes. After a boat trip up the Ultima Esperanza fjord at Puerto Natales we'll head to Punta Arenas and our flight home.

Perito Moreno glacier. Photo by J. Reynolds.

Fees and Payment

$4,200 for GSA members, $4,300 for nonmembers. A $300 deposit is due with your reservation and is refundable through Sept. 1, less a $50 processing fee. Total balance is due Sept. 1. Minimum: 20; maximum: 30. Included: Guidebook; airfare from Atlanta to Ushuaia via Buenos Aires; ground transportation; lodging for 13 nights (double occupancy); and meals for 14 days. Not included: Airfare to and from Atlanta, Georgia; and alcoholic beverages.

GeoHostel

Impacts of Coastal Development on the Barrier Islands
Inlet Inn, Beaufort, North Carolina
April 21–26, 2001
5 days, 6 nights
Scientific leaders: David M. Bush, State University of West Georgia, Carrollton, Georgia; Robert S. Young, Western Carolina University, Cullowhee, North Carolina.

David Bush received his B.S. in geology from the State University of New York, College at Oneonta, and both his M.S. and Ph.D. in geology from Duke University. As a postdoctoral research associate with the Program for the Study of Developed Shorelines at Duke University, his research focused on coastal hazards, risk assessment mapping, and property damage mitigation. He has experience in areas including the U.S. Atlantic and Gulf of Mexico coasts, the Bahamas, the Caribbean, and others. He was part of the National Academy of Sciences post-disaster field study teams after hurricanes Gilbert and Hugo. He helped plan the U.S. Decade for Natural Hazard Reduction and is senior author of *Living with the Puerto Rico Shore, Living by the Rules of the Sea,* and *Living on the Edge of the Gulf: The West Florida and Alabama Coasts,* plus articles on coastal hazards, risk assessment, and property damage mitigation. David serves on the editorial board of *Environmental Geosciences.*

Robert Young received a B.S. in geology from the College of William and Mary and an M.S. in Quaternary studies from the University of Maine. He was a James B. Duke Doctoral Fellow at Duke University, where he received a Ph.D. in geology. Robert serves on the editorial boards of the *Journal of Coastal Research* and *Environmental Geosciences*. He is currently the technical program chair for GSA's 2001 Annual Meeting. Rob has been working in the area of coastal hazards, coastal storm processes, and coastal planning for the past 10 years, focussing on the U.S. east coast, the Caribbean, and Central America. He has conducted post-storm reconnaissance after the impact of nearly every major hurricane to strike the U.S. mainland and several in the Caribbean and has written numerous papers on coastal processes, numerical modeling, risk mapping, and property damage mitigation.

Above and below: Hurricane Floyd damage, North Carolina, September 1999. Photo by D. Bush.

Description

This GeoHostel will be interesting and challenging to the professional geologist, yet understandable and fascinating to others. We'll examine the dynamics of beach and barrier island processes with emphasis on the interaction of nearshore processes with human development. We'll discuss coastal hazards; assessment of risk for property damage from hurricanes and coastal storms; how development increases risks of living in the coastal zone; and coastal management issues of dealing with eroding shorelines, all illustrated during various field stops. Trips will begin and end in Beaufort, N.C. Hikes will not be strenuous. The weather is generally pleasant and sunny at this time of the year. Time will be available for visiting the North Carolina Aquarium, Mariners Museum, and Duke University Marine Laboratory.

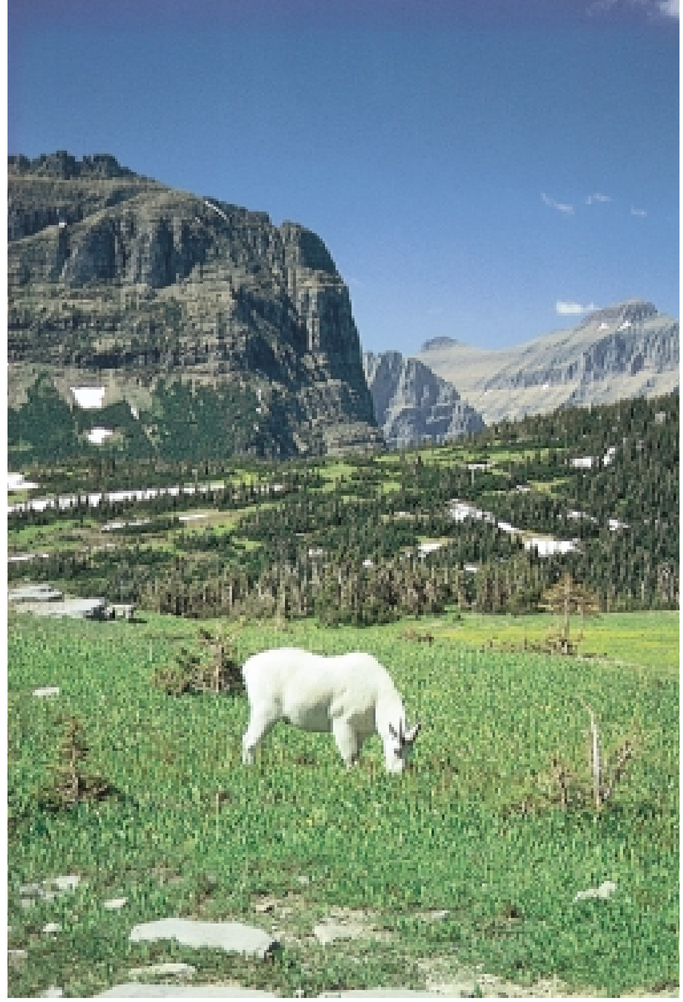
Fees and Payment

$1,000 for GSA members, $1,050 for nonmembers. A $100 deposit is due with your reservation and is refundable through March 1, less a $20 processing fee. Total balance is due March 1. Maximum: 32. Included: Classroom programs and materials; field trip transportation; lodging for six nights (single occupancy, or double for couples); breakfast and lunch daily; and welcoming and farewell events. Not included: Airfare to and from Beaufort, North Carolina; transportation during hours outside field trips; alcoholic beverages; and other expenses not specifically included.

GeoHostel

Geology of Glacier National Park, Montana
Glacier Park Super 8 Motel, Columbia Falls, Montana
July 14–19, 2001
5 days, 6 nights
Scientific Leaders: Rob Thomas and Sheila Roberts, Western Montana College, Dillon, Montana.

Rob Thomas is an associate professor of geology in the Department of Environmental Sciences at the Western Montana College of the University of Montana in Dillon, Montana. Rob developed an interest in the geology of Glacier National Park as a graduate student under the tutelage of Don Winston at the University of Montana—Missoula. He studied Cambrian mass extinctions for his doctoral work at the University of Washington and currently works on a diverse array of additional geologic problems, including Cenozoic extensional tectonism and sedimentation in southwestern Montana, applied fluvial geomorphology, and geoscience education. His passion is to make geology accessible to the public.



Along the "Going to the Sun" highway, Glacier National Park, Montana. Photo by Rob Thomas.

Sheila Roberts is an associate professor of geology and chemistry in the Department of Environmental Sciences at the Western Montana College of the University of Montana in Dillon, Montana. Sheila's understanding of the geology of the Glacier Park area includes numerous field trips and classes as a master's degree student at the University of Montana—Missoula and as a doctoral student at the University of Calgary. She teaches regional geology at Western and has edited publications about the geology of the Belt Supergroup and other regional geology, including the 2000 Rocky Mountain GSA guidebook. Sheila's current research on paleoclimates includes several projects on Pleistocene climate change in western Montana.

Description

The geology of the Glacier National Park region was first studied by Bailey Willis of the U.S. Geological Survey in 1902 as part of a reconnaissance study of the 49th parallel. Today, visitors marvel at the spectacular scenery and the multicolored rocks as they pass along the famous "Going to the Sun" highway. The rich geology of the Glacier National Park region includes beautifully exposed sedimentary rocks of the Proterozoic Belt Supergroup, Mesozoic compressional structures such as the Lewis Thrust, Cenozoic extensional topography, and a variety of Pleistocene alpine and continental glacial features. We'll focus on the geologic history of Glacier National Park and surrounding areas, with emphasis on the historic debate over the origin of the Belt Basin. We'll also examine the glacial geology and hydrogeology of the Flathead Valley and take a half-day rafting trip down the famous Middle Fork of the Flathead River. Trips are both full and half day, and plenty of leisure time will be available to enjoy the spectacular scenery of northwestern Montana!

GeoVentures 2001 for GSA Members and Friends

For complete details on GeoVentures or for full itineraries, contact Edna Collis, GeoVentures coordinator, 1-800-472-1988, ext. 134, fax 303-447-1133, ecollis@geosociety.org.

Participants must be 21 or older and in good health. Any physical condition requiring special attention, diet, or treatment must be reported in writing when reservations are made. We'll do our best to accommodate special needs, including dietary requirements and physical disabilities.

Deposits and payments are refundable, less a processing fee, up to the cutoff date. Termination by an individual during a trip in progress for any reason will not result in a refund, and no refund will be made for unused parts of trips. For details on accommodations and occupancies, see trip descriptions or contact Edna Collis.

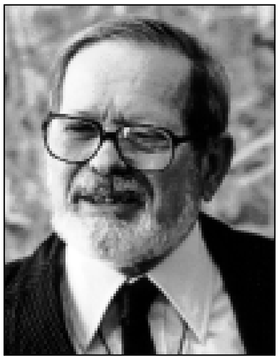
Fee and Payment

$1,050 for GSA members, $1,100 for nonmembers. A $100 deposit is due with your reservation and is refundable through June 1, less a $20 processing fee. Total balance is due June 1. Maximum: 32.

Included: Classroom programs and materials; field trip transportation; lodging for six nights (single occupancy; double for couples); breakfast and lunch daily; half-day raft trip; and welcoming and farewell events.

Not included: Airfare to and from Columbia Falls, Montana, transportation during hours outside field trips; alcoholic beverages, and other expenses not specifically included. ▲

MEDALS AND AWARDS FOR 2000



ROBERT L. FOLK

PENROSE MEDAL

PRESENTED TO ROBERT L. FOLK

Citation by Henry S. Chafetz

One is hard-pressed to find an aspect of sedimentary geology that has not been advanced by the far-reaching insights of this year's Penrose Medalist, Robert L. Folk (also known as Luigi during his Italian period). Bob's research interests have crisscrossed the terrain of sedimentary geology, from his seminal paper on limestone classification, which brought order to the somewhat haphazard description of carbonates, to papers on the petrography of avian urine. Folk's classification provided a framework within which limestones could be logically related to one another and is an example of the depth of understanding that he has given to our science; the classification's widespread use, some 40 years after its first publication, attests to the profound contribution it has made. In contrast, Bob's publications on such topics as avian urine, while not as far-reaching, provide insight into the inquiring nature of this original mind. No object has been too insignificant to attract his interest, and he has shown, time and again, that given an open and questioning mind, universal principles can be gleaned from seemingly mundane and geologically insignificant objects. In recent years, his interests have been focused on even finer scale objects, the realm of nannobacteria. Once again, Bob is showing us that looking with his ability to see what is there, rather than what we all previously knew was there, the eye and the mind can uncover new worlds (both earthly and martian) from nanoscale objects.

Bob's wide-ranging interests in geology are mirrored by his multifaceted interests in life. He has spent many an evening peering through his telescope, contributing to our knowledge of the heavens, or pouring over his voluminous stamp and coin collections, collections that have garnered awards. His musical tastes run the gamut from Vivaldi to Ernest Tubb (it's a toss-up which he likes better), and he has been known to converse on street corners around the globe in Spanish, Italian, Chinese, Hebrew, and Czech, among other languages.

Bob is the type example of a world-class scientist and extraordinary teacher. He brought his fire and enthusiasm for geology into the classroom as a distinguished faculty member at the University of Texas. Former student after former student gleefully relate tales (commonly known as Folk-lore) about his innovative, inspiring, and definitely demanding classes; many simply proclaim that Bob Folk was "just the best teacher I've ever had." As testament to this, Bob has already received the Distinguished Educator Award (American Association of Petroleum Geologists), Neil Miner Award (National Association of Geology Teachers), and the Knebel Distinguished Teaching Award twice (University of Texas).

Bob has also received many awards in recognition of his research contributions, including the Sorby Medal (International Association of Sedimentologists), Twenhofel Gold Medal (Society of Economic Paleontologists and Mineralogists), and several best paper awards. As a capstone, I can think of no one better deserving to receive this first Penrose Medal of the new century. Certainly Bob's ability to see new relationships, develop new interpretations, uncover new vistas, both large and nano in scale, is precisely the leadership the geosciences need as we enter the new century. It is therefore a distinct pleasure, as well as a great honor, to write this citation in recognition of Robert L. Folk.

Response by Robert L. Folk

I feel deeply honored by the award of the Penrose Medal, and I am especially grateful when reading the list of those geologists who have gotten it previously; most of those people were pretty much infallible in their geologic research. But occasional mistakes can be made, and this is certainly true in the year 2000; most of my own ideas have been judged to be crazy wrong.

Early on, under the enormous influence of the incomparable P.D. Krynine at Penn State, I became entranced by the classification of rocks. This is work that ought to be done only by fussy old maids with a stamp-collector mentality who worry over minutiae of boundary lines and like to invent strange words. Many geologists think that limestone classification is the only contribution I have ever made, and even that polyglot system was superseded after a few years by the Dunham classification, which was more practical for oil geologists.

For a long period, under the influence of J.C. Griffiths, I was mesmerized by the measurement of grain size and the quantification of particle shapes as evaluated by statistics. At one time, 40 years ago, that was considered to be THE WAY to identify paleoenvironments and find oil. This endeavor has all but disappeared, going the way of high button shoes.

In the 1950s, I was very much a proponent of an Appalachian source for the metamorphic-rich sands of the east Texas Eocene. Bill Fisher and nearly everyone else important thought it was ridiculous.

In August 1968, I gave a talk at the International Geological Congress on bimodal sands of the Australian desert and similar textures in ancient rocks. Fourteen hours later a horde of Russian tanks rolled across the Czech border and seized Prague, ending the congress in a tragic way.

Earle McBride and I worked on the radiolarian and spicule cherts of the west Texas Devonian and Italian Jurassic. Even over copious amounts of Italian wine I could not convince him that all the evidence converged on a shallow-water origin. And almost every living stratigrapher agrees with Earle; obviously he is the deeper thinker.

I hesitate to even mention *Rollers, Ripples, and Vortices.* Gary Kocurek believes this idea was absurd, and all five referees of *Sedimentology* thought likewise. A typical comment: "What is correct in the Folk manuscript is already well known; and what is new is complete rubbish." Of course, the reviewers were probably right; this paper sank out of sight like a stone, not even leaving any ripples or vortices behind it.

In 1978, they thought: "Ya decided to work on Roman travertines just because you like Italian food? What kind of a lifetime research plan is that?" When Hank Chafetz and I began to find bacteria doing the work of precipitation and asked for funding, one National Science Foundation reviewer, when asked about our reputation, responded, "Never heard of either one of them." And when in 1990, I began finding tiny little ovoids called nannobacteria in travertines and other rocks, my buddy Lynton S. Land thought this was a career-busting fiasco. We won't mention the microbiologist's response. In fact, in 1998, they convened in a meeting of top biologists in Washington, D.C., and once more proclaimed the lower limit of bacterial life to be about 0.2 microns, and they concluded that the bulk of my research for the past 10 years was deluded fantasy. (I just had another paper rejected on the grounds that "Everyone knows that your nannobacteria are too small to be alive.")

Well, despite this anathema of geological errors, most of my discoveries have been made not by brains but by dumb luck, idle curiosity, and lots of random reading. I must acknowledge my parents, who encouraged my collection of pretty pebbles from the glacial moraines around Cleveland, Ohio; my great teachers at Penn State, particularly Tom Bates, P.D. Krynine, and J.C. Griffiths; the Department Powers at the University of Texas, Sam Ellison and Ronald DeFord, who hired me as a walk-on and allowed me to do what I darn pleased and not waste my time writing futile grant proposals; my wife Margie Thomas, who has accompanied me in the field and puts up with my baseball games; my late friend Riccardo Assereto of the University of Milano who Italianized my life; my terrific colleagues at the University of Texas, in particular Earle McBride and Lynton Land; and of course, my many students, who gather data and help generate ideas. Thank you and grazie tanto.

ROBERT STEPHEN JOHN SPARKS

ARTHUR L. DAY MEDAL

PRESENTED TO ROBERT STEPHEN JOHN SPARKS

Citation by Steven Carey

During the past several decades, the field of volcanology has experienced a revolution in the fundamental understanding of volcanic processes. A significant part of that revolution can be directly attributed to the pioneering work of Steve Sparks.

Early in his career, Steve published a series of classic papers that elucidated the primary depositional mechanisms of pyroclastic flows and the factors that control their generation during explosive eruptions. An important result of that work was the establishment of an idealized stratigraphic sequence for ignimbrite deposits and the realization that fluidization is an important process in the transport of pyroclastic flows. Steve quickly recognized the great need for rigorous quantitative analysis of volcanic processes and began to develop numerical models for a variety of volcanological problems. An excellent example is his often-cited paper on the growth of bubbles in magmas. Drawing from previous work in industrial applications, he developed a numerical model for the formation of bubbles in magmas of different composition. Results of the model provided fundamental insights into the behavior of volcanic systems undergoing degassing and has remained a foundation for all subsequent work on the topic.

Another early work with Lionel Wilson and George Walker provided one of the first quantitative models for the dynamics of explosive eruptions and the factors that determine the growth and stability of eruption columns.

Together with colleagues such as Herbert Huppert and J.S. Turner, Steve championed the application of basic fluid dynamic principles to topics ranging from physical volcanology to igneous petrology. In particular, he expanded the use of simple analog laboratory experiments to investigate the behavior of complex geologic systems. Out of these studies grew significant new insights into topics such as the dynamics of large-scale plumes produced by explosive eruptions, the behavior of fractionating silicate melts within crustal magma chambers, the movement of lava flows, and the fragmentation of magma by volatile degassing. In particular, his experiments shed light on the importance of convective fractionation in magma chambers and challenged established ideas about crystal settling as a mechanism for magmatic evolution. In the area of volcanic plumes, Steve's application of fluid dynamic theory and experimental investigations led to a new appreciation for the structure and dynamics of these large convective systems and their interaction with Earth's atmosphere.

In recent years, Steve has worked hard to emphasize the societal relevance of volcanological research. He played a major role in the assessment and mitigation of volcanic hazards during the recent volcanic crisis on Montserrat in the West Indies. As the current president of the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI), he has made this topic a principal issue for the association.

Throughout his career, Steve has consistently recognized first-order problems in the fields of volcanology and igneous petrology and developed new and innovative approaches for their investigation. His productivity is legendary, having published more than 200 scientific articles and a book, and edited three books. He has an infectious enthusiasm for science that he willingly shares with others. His exceptional devotion to his work, combined with his generosity to both students and colleagues, has distinguished his contributions to the geosciences and provided an inspiration for a generation of volcanologists.

During his recent address to the IAVCEI assembly in Bali, Indonesia, Steve joked, in reference to his occasional absentmindedness, that if anyone found a stray geologic hammer on an outcrop it likely belonged to him. He may occasionally misplace his hammer but Steve is never at a loss for new and insightful idea about how Earth works. As a Fellow of Royal Society and recipient of the Wager Prize and Bigsby and Murchison Medals, it is now fitting that he receives the Arthur L. Day Medal.

Response by Robert Stephen John Sparks

I feel privileged to be awarded the Arthur Day Medal. As a citizen of another country, it is an added honor to be recognized by U.S. colleagues. I spent some of the formative years of my career in the United States as a NATO Fellow at the Graduate School of Oceanography, University of Rhode Island. I have many scientific colleagues and friends in the United States and greatly appreciate the colleagues who supported my nomination. I particularly appreciate the generous words of the citation written by my friend Steve Carey at the Graduate School of Oceanography.

As a schoolboy in the town of Chester near Liverpool, I was advised by Wally Pitcher that geology might be an interesting subject and that Imperial College was a good place to study it. There, I was taught by George Walker, who helped me and three friends organize an expedition to Iceland in 1969 in our first year as undergraduates. The wild and wonderful volcanic scenery of Iceland convinced me that volcanoes were rather interesting. Inevitably, the inspired teaching of George led to a Ph.D. under his supervision. George was at the height of his intellectual powers and was spearheading a revolution in field volcanology with his quantitative approach, remarkable observational skills in the field, and creative thinking. I joined a group of dedicated Walker disciples, including Geoff Wadge, Steve Self, and later, Colin Wilson, who were sometimes known as the tuffiosi.

My interests in trying to quantify and understand the dynamics of volcanic processes developed at that time because there seemed to be few explanations in the literature, and volcanology seemed largely a descriptive subject. I was lucky then and subsequently to collaborate with some outstanding colleagues, with backgrounds in mathematics and physics, who had the skills and ability to develop quantitative models and were also able to teach me some of the basics. In my first postdoc at Lancaster University, I was lucky to team up with Lionel Wilson. Together we developed some of the first dynamical models of explosive eruption columns. Lionel was a great mentor to bring me into the world of numerical models and physics.

At Cambridge in 1978, I started a long-term scientific partnership with Herbert Huppert in the Department of Applied Mathematics and Theoretical Physics. I managed to persuade Herbert that magmatic systems displayed an incredible richness and complexity from a fluid dynamical perspective, and we started to investigate magma chamber dynamics. I was privileged to work with such an able and innovative mathematician. At the start of our partnership, Herbert and I went to the Australian National University on sabbatical in 1980 to work with Stewart Turner. This was a particularly influential period, as I learned from Stewart and Herbert the power of simple laboratory experiments to help unravel nature's secrets. Since that time, a pattern of research emerged in which field observations have motivated the development of theory and design of analog experiments.

I have also been privileged to work with several other excellent scientists, including Haraldur Sigurdsson, Harry Pinkerton, Claude Jaupart, Andy Woods, Brad Sturtevant, and, most recently, Oleg Melnik from Moscow. I would like to make special mention of Brad Sturtevant, professor of aeronautical engineering at Caltech, who, sadly, passed away last month. Brad made great contributions to understanding complex explosive volcanic flows through his pioneering experiments and deep understanding of jet dynamics. He spent a year in Bristol helping to build a shock tube facility for the study of conduit flows. He will be greatly missed by the volcanological community, not least for his enthusiasm for natural science and volcanoes.

I have also learned a great deal from many gifted graduate students at Cambridge and Bristol. Working with young scientists who have new ideas and suspicion of the conventional wisdom, particularly that of their supervisor, is the best way of not going stale.

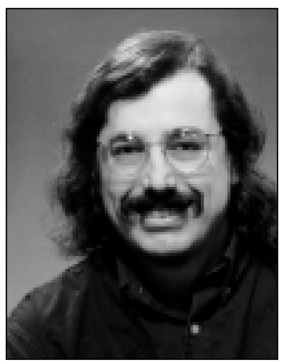
Since 1989, I have been based at Bristol University. The support of many colleagues has been wonderful, but I would like to make special mention of Bernie Wood. The first few years at Bristol focused on working with Bernie in building up what I believe is a great department.

My method of keeping sane while head of department was to disappear for a month each winter to the Andes in what has proved to be an excellent collaboration with the Geological Survey of Chile, who have volcanic field geologists to match the best. On Friday before this ceremony, I was on the crater rim of Taapaca volcano at 5400 m collecting geochron samples with Jorge Clavero, the latest gifted research student at Bristol. There is nothing more rewarding than working on a remote, unstudied volcano in a stunning landscape and trying to piece together the stratigraphy and past behaviors of the volcano from geology.

Since 1996, I have been involved in the practical side of volcanology on the island of Montserrat in the Caribbean, where an andesite lava dome has been growing at the Soufrière Hills volcano. The opportunity to help document a major eruption and to use my expertise in management of a volcanic crisis has perhaps been the most memorable and rewarding experience of all. Today gives me an opportunity, on behalf of British scientists, to thank U.S. colleagues who have helped the scientific work on Montserrat, notably Rick Hoblitt, Dan Miller and colleagues from the U.S. Geological Survey, and Barry Voight from Penn State.

Finally, I have been supported throughout by my family. My father, as a widower, bought my brother and me up in a bachelor household. He made sure of an excellent education and introduced me as a child to many good things in life, including watching Manchester United and Liverpool soccer teams, hearing great music such as Duke Ellington and Mahler, enjoying of the mountains of Wales and Scotland, and cooking a mean curry. As for my wife, Ann, I am sure that all field geologist will know that it takes a special person to be a partner for 30 years, living with a volcano fanatic. It has also been rewarding to have my two sons occasionally in the field. Last week, my 18-year-old Daniel and two of his friends spent the week measuring the dimensions of hummocks on a debris avalanche on the Chile-Bolivia border. I think they considered the surveying of tiny hills of rock as a bizarre and pointless occupation, but nevertheless enjoyable in the grandeur of the Andes landscape.

To finish, I once again thank GSA for the award of the Arthur Day Medal and the recognition it gives to volcanology as an important discipline of geology.



BASIL TIKOFF

YOUNG SCIENTIST AWARD (DONATH MEDAL)

PRESENTED TO BASIL TIKOFF

Citation by Peter J. Hudleston

It gives me great pleasure to provide the citation for Basil Tikoff, winner of this year's Donath Medal, or Young Scientist Award. Apart from the pleasure in seeing Basil's accomplishments recognized by the Society, there is the added pleasure that comes from knowing that both the recipient of the award, Basil, and the benefactors to GSA who made the award possible, Fred and Mavis Donath, have close ties to Minnesota and to my own department. Fred Donath took his first degree in Minnesota in the 1950s; Basil completed his Ph.D. there some 40 years later. It is all the more satisfying that Fred and Basil both chose to focus on rock deformation and structural geology. There is perhaps some completion of a circle—or maybe it should be an ellipse—in all this.

Basil is characterized by the eclecticism of his approach to solving geological problems, and by the range of topics that have attracted his attention, from the scale of the thin section to that of the lithosphere. Like several other recipients of the Donath Medal, a single label does not easily tag Basil. I believe he views himself as a field geologist tackling tectonic problems using whatever tools are necessary for the task. Certainly, nearly all his contributions to date have been seeded by field observations and the posing of questions arising from these. His work in the Sierra Nevada started with local questions of how to interpret fabric in terms of strain, and went on to address questions of pluton emplacement along an oblique convergent plate boundary. This work led in turn to considerations of strain and displacement partitioning along plate boundaries, providing the basis for a number of excellent papers. Jumping inward from the continental margin, he developed original ideas for the origin of the Laramide orogeny. There is a geographic trail that links many of his publications.

Basil has keen physical insight, and he has provided a new perspective on several problems that for some time have been a focus of attention in the structural geology and tectonics community. The theme that seems to run most persistently through his work is that of localization of deformation, by simple shear—with or without faulting—or by a process involving the more general phenomenon of transpression and/or transtension, with partitioning of displacement between slip on faults and continuous deformation. He has considered the ramifications of such behavior on the scale of individual shear zones and, more recently, on the scale of orogenic belts and tectonic plate boundaries. Transpression and/or transtension might now be considered the norm for plate boundary deformation, and this puts Basil in the center of the tectonic action, as it were.

One measure of Basil's scientific maturity is his degree of involvement—beyond presenting talks—in professional activities at national meetings and conferences. He has participated in several Penrose Conferences, helped organize and chair symposia and technical sessions at national GSA meetings, and helped present GSA Structural Geology and Tectonics Division short courses. There is a synergistic effect on the development of ideas in all this involvement and in his collaboration with many colleagues and students, and I believe such behavior characterizes both good education and good science.

In short, Basil Tikoff has made substantial and notable contributions to our science in a short period of time at an early stage of his career. He is thus a most worthy recipient of the Young Scientist Award.

Response by Basil Tikoff

It seems to me that while awards are often given to individuals, they rarely represent just an individual's effort. It is certainly the case with this award. I would like to take this opportunity to thank just some of the people with whom I share the honor of the Donath Medal.

Among my academic mentors, I would like to thank Steve Wojtal, Peter Hudleston, and especially Christian Teyssier. They have all provided role models for how to be an excellent advisor, scientist, and human being. I also wish to thank Hans Avé Lallemant, Allen Glazner, Rick Law, John Oldow, Othmar Tobisch, and Jean-Louis Vigneresse for helpful advice and support throughout my academic career.

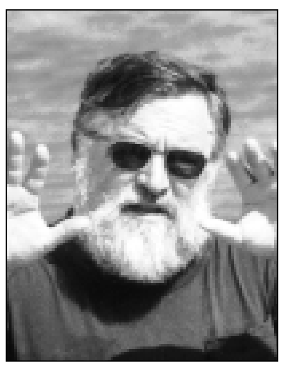
I also wish to include my friends and colleagues in this award, as their contributions made it possible. Chris Swezey and Brad Murray are personal friends who have taught me a lot about geology and the rest of life. The graduate students and post-doctoral fellows of the structural geology group at the University of Minnesota—too numerous to mention due to my long tenure there—taught me most of what I know about structural geology. Haakon Fossen, David Greene, Laurel Goodwin, Bernie Housen, Paul Kelso, Cathy Manduca, Michelle Markley, Julie Maxson, Bill McClelland, Sven Morgan, Steve Ralser, and Michel de St. Blanquat have all played double roles as scientific colleagues and personal friends. Students play a dual role as well, initially teaching me what I do not fully understand and, later, as colleagues. I greatly appreciate the students who have worked with me and acknowledge their contributions to this award. Thanks also to the Geology and Geophysics department at the University of Wisconsin for hiring me and facilitating my research.

I am fortunate in having a supportive family. My work would quite simply not be possible without Sara Hotchkiss, as anyone who knows us will attest. My immediate family and Sara's are the source of continual encouragement and entertainment, such as when my dad asks if I go out on "digs."

I would like to sincerely thank GSA for the honor of the Donath Medal. I find it particularly satisfying because I am not in a "hot" area of earth sciences, nor am I part of the increasing specialization that is occurring throughout the geosciences. I am a field scientist, which means that I am inherently a generalist. It is when I am staring at a confusing outcrop that I am most aware of my limitations. The strict subdivisions that we choose to accept in the geoscience community—for teaching classes, hiring, or any other purpose—tend to fade in this context. In the field, the strength of knowing something about geochemistry, geomorphology, geophysics, weathering, and all branches of traditional geology is paramount. I sometimes think that structural geology mistakenly tends toward engineering, rather than encouraging a more integrative approach toward studying Earth. In a rush for quantification, the geosciences have downplayed much of their strength. Geology is rich in a variety of data sets and has a virtual monopoly on the key element of time. These data sets are the ultimate test to which all models must answer, if the goal is to understand the history and processes recorded in the rocks. Modeling something and understanding something are often confused for the same thing, which they certainly are not. As stated succinctly by C. Box, "All models are wrong; some models are useful."

The generalist tradition is also the key to our future. The intellectual tradition of historical science pioneered in geology is not only being used in the biological sciences, but it is increasingly being incorporated into the social sciences and human history. The integration of physical, chemical, and biological processes, which is now occurring at the forefront of biomedical research, is just one example of the type of generalist investigation that the geoscience community has engaged in for the last century.

In a world of increasing specialization, the geoscience community offers a real contribution to both science and society in our ability to approach a problem from a variety of angles. Teaching this approach to students is critical for two reasons. First, because education and research are inseparable, and second, because the most important decisions of the future will be made with a variety of disparate, incomplete data sets, of the type geologists are accustomed to. I think that developing this academic tradition of generalism is where we can make the greatest contribution for the future. Thank you again for this honor.



ORRIN H. PILKEY

GSA PUBLIC SERVICE AWARD

PRESENTED TO ORRIN H. PILKEY

Citation by David M. Bush

It is my honor this afternoon to introduce to you Orrin H. Pilkey as he receives the GSA Public Service Award for 2000. Orrin has been deeply and personally involved with issues of coastal science and policy ever since his parents were visited by Hurricane Camille in 1969. Seeing this as a personal challenge, Orrin began the fight against the folly of unwise building at the coast and of trying to control the shoreline. He began with an early, short book *How to Live With an Island* about Bogue Banks, North Carolina. As a direct result of Orrin's efforts, the State of North Carolina was the first to enact regulations banning the use of hard shoreline stabilization as a response to shoreline erosion. North Carolina's Coastal Area Management Act has since served as a model for many other states.

Orrin has co-edited, with Bill Neal, the *Living With the Shore* book series, which now numbers more than 25 volumes. Each book contains basic information on coastal processes and coastal engineering, mile-by-mile descriptions of coastal hazards, recommendations for where and how to build, or to not build, and legal aspects about almost the entire length of our nation's shoreline.

Orrin has given his time in an advisory capacity in several U.S. states as well as many countries, including Colombia, Portugal, the Marshall Islands, Morocco, Honduras, and several island nations in the West Indies. He is responsible for essentially beginning coastal studies in many of those countries.

He continues to tirelessly battle the Army Corps of Engineers in an attempt to save our shorelines from uncontrolled armoring and beach nourishment, projects promoted with bad science, faulty mathematical models of shoreline change, and skewed versions of natural coastal processes.

Orrin also has hit the lecture circuit over the years, bringing his message to audiences large and small. Seemingly incapable of saying "no" to any opportunity to spread the word, he once drove 100 miles each way one day to talk to what turned out to be three junior high school students. Most of his lectures were better attended, and he is personally responsible for changing the way of thinking of uncounted numbers of private citizens, community planners, elected officials, decision makers, and even a few engineers.

As an academician, Orrin has trained a generation of coastal scientists under the auspices of his Program for the Study of Developed Shorelines at Duke University.

Through writing for the public and the professional, field trips, lectures, letters to the editor, interviews on television, radio, and in print, Orrin arguably has had more influence on the way America thinks about the coast than any other individual. And he shows no signs of slowing yet.

I have known Orrin for more than 25 years and have been fortunate to have worked side by side with him in the field, the lab, and in the office. Needless to say, travels with Orrin are far from ordinary. It has been a pleasure working with him, traveling with him, and getting to know his family. He is my most unforgettable character. And he is richly deserving of this award.

Response by Orrin H. Pilkey

It has been my observation that controversial individuals in our profession are either ignored or they are given awards. I am deeply honored to be in the latter category. My absence at this ceremony belies the depth of appreciation that I have for the GSA Public Service Award. At this moment I am on the outer banks of North Carolina, leading a long-scheduled citizens' field trip, pointing out how beaches and buildings interact—the sort of thing that the award recognizes.

When I began my career, a young earth scientist involved in societal issues (as opposed to hard science) would have difficulty obtaining tenure. One would have to await the stage of full professor to sally forth into society, as I did. I am happy to note that earth science academia now recognizes and rewards research and participation in the public service arena.

The role of academic science in public service is a critical one. The tenure system was specifically designed to protect those who speak honestly on controversial issues in recognition of the fact that professors can speak to issues that scientists in government and industry cannot.

When I began speaking out, my first discovery was that many more people are interested in beaches than in abyssal plains, my former specialty. I found it very exciting to have an impact on society. I also found that principles that are patently obvious to us may be a complete mystery to the public and that the scientific truth doesn't always win out. At one point, a leading opponent to moving the Cape Hatteras lighthouse back from the shoreline noted that "Orrin Pilkey is living proof that Ph.D.s are not given out for common sense." True enough. But common sense and the scientific truth often don't coincide.

Controversy comes with the territory. The support of my university, despite an initial torrent of protest from wounded alumni and unhappy politicians, has been central to any success I have achieved. Nary a whisper of complaint, implicit or explicit, have I heard. Public universities, more closely en-twined with the political system than private universities, are sometimes less tolerant of controversial participation in societal debates by their faculty. As we speak, a geologist colleague in a major university is finding a lack of support from his administration; his sin being to have noted that seawalls destroy beaches even when the walls are in front of buildings owned by important politicians. One form of public service open to all of us is the education of our university administrators on the need for tolerance of their faculty, even if a political price must be paid.

I have always admired the much larger biology profession with its long tradition of tolerance and encouragement of scientific participation in critical societal issues. Our profession, grounded as it is in extraction of mineral resources, can claim no Rachel Carson in its history. But with the rise of environmental geology and accelerating public understanding of the need for geologic input in so many issues, we are a changing profession. Geology has so much to offer toward the solution of environmental problems. I believe our time has arrived.

SUZANNE M. KAY

GSA DISTINGUISHED SERVICE AWARD

PRESENTED TO SUZANNE M. KAY

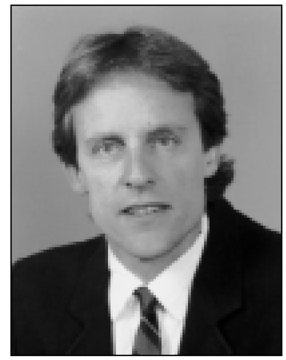
Citation by Faith Rogers

Suzanne Mahlburg Kay took on the work of *GSA Today* science editor (1996 through 1999) with characteristic energy and rigor—on her own for 1-1/2 years of her four-year term. As a science co-editor for GSA's monthly news publication, she solicited—and received—lead science articles on a wide variety of topics, from supercontinent reconstructions to recent climate change. When the reviewers had what she considered valid criticisms of a paper, Sue worked with the authors to improve that paper—in some cases, she helped them rewrite to make an article accessible to the broader geological community, including students. She sought papers that were scientifically rigorous but also thought-provoking, and she found them. This Cornell professor, with her record of achievement in working where logistics are challenging (the Aleutians and the Andes) accomplished the nearly impossible—getting authors with interesting stories to put those stories of their work into readable form, with eye-catching graphics, and submit them in time to be reviewed, revised, and edited for the next issue of *GSA Today*.

Sue Kay has the characteristics of a good *GSA Today* science co-editor, including a wide range of scientific interests, flexibility, and a willingness to take chances. We are fortunate that she accepted the challenge of fitting *GSA Today* editorial tasks into her already packed life.

Response by Suzanne M. Kay

I am very pleased to accept the GSA Distinguished Service Award and am sincerely grateful to GSA for the honor. I had help from quite a few people during my term as science editor of *GSA Today*. I have time here to mention only a few. The first is Eldridge Moores, who recruited me for the job when he assumed the GSA presidency. Eldridge initiated the lead science article and to me will always be Mr. GSA Today. He was a never-ending source of advice. Another vital person was Faith Rogers, who was the managing editor at GSA in Boulder. I can't imagine having been science editor without Faith's technical and moral support. She helped me in every situation that arose. Another key person was Molly Miller, who joined me as co-editor during my term and is still carrying on the job. I also want to thank the Cornell geology department lunch group, particularly Don Turcotte, Brian Isacks, and Larry Cathles, who were an endless source of ideas and friendly criticism. Last, and perhaps the most important is my family—particularly my husband, Robert Kay, who carried the ball when I was hiding out in the field in South America.



LEE R. KUMP

GSA DISTINGUISHED SERVICE AWARD

PRESENTED TO LEE R. KUMP

Citation by David M. Fountain and Jeanette Hammann

Ask any GSA journal science editor and the response will be the same: Accomplishing the minimum required is job enough in itself. Yet these volunteers consistently manage to bring more to the position.

Such is true of Lee Kump (*Geology* science co-editor, 1996–1999). While continuing his teaching and research at Penn State, he faced an unending stream of manuscripts, employing a rigorous schedule (beginning at 5 a.m. daily, it was rumored) without complaint.

Lee handled every task, from making difficult decisions on which papers to accept to responding to irate authors of rejected papers, with efficiency and an even hand. His sensible and thoughtful comments brought every debate back to the purpose of scientific publishing and of *Geology*. Lee helped teach not one, not two, but three science co-editors the ropes as they began their terms, and he took on extra work through each transition.

Lee also instituted a monthly news release system to promote *Geology*. Nontechnical summaries of articles are sent to science writers nationwide and in the United Kingdom. *Geology* now receives inquiries from internationally known journals, such as *Science* and *New Scientist*, and regional newspapers, such as *The Dallas Morning News* and the *San Jose Mercury News*.

Lee Kump set a high standard for *Geology* and promoted its visibility, and therefore its influence, in scientific communication. His service to GSA and to the geoscience community has been invaluable.

Response by Lee R. Kump

Serving as a co-editor of *Geology* was an honor, an education, and a great way to stay out of trouble. Michelle, my editorial assistant and wife, and I worked out of a home office that Don Davidson was kind enough to equip with computer, copy machine, and fax. We filled in all of our idle moments and then some with *Geology*, a situation tolerated by our children, the professional staff at GSA headquarters, and the authors and reviewers of *Geology*. Life could have been much more difficult, though, had it not been for the tutelage of Hank Mullins, David Fountain, and Faith Rogers, the expert office and editorial work of Sonia Smith, Jeanette Hammann, Marlene Mayer, Vanessa Carney, and Anika Burkard in Boulder, hard-working co-editors David Fountain, Carol Simpson, and Ben van der Pluijm, and a terrific group of editorial board members.

The great surprise of my tenure as editor was the receptiveness with which the press received news of the exciting developments in earth science being presented in *Geology*. The idea was originally Michelle's, in response to my question of how we could possibly improve a journal that was already in such good shape. Early discussions with Bill Broad (*The New York Times*) and Carl Zimmer (formerly of *Discover Magazine*) indicated that a monthly notice of papers appearing in *Geology* would focus media interest on the journal. We now see that they were right; *Geology* articles have been picked up by major wire services, nightly television news, and a host of popular science magazines. The public is hungry for information concerning Earth, its history and dynamics. Their curiosity is easy to feed, once we make the small extra effort to prepare the meal properly.

BRUCE MOLNIA

GSA DISTINGUISHED SERVICE AWARD

PRESENTED TO BRUCE MOLNIA

Bruce Molnia took on the task of reporting on the political aspects of geoscience, from the vantage point of Washington, D.C., for *GSA Today* readers in 1991, and he proceeded to enhance our awareness of the issues for the next 8 years.

Working from his U.S. Geological Survey office in Reston, Bruce was diligent in finding information from a variety of sources and putting it into readable form for us. In his Washington Report columns, he unraveled the complicated issues. For the Forum series, he persuaded an assortment of writers to present different takes on subjects ranging from mineral resources in Antarctica to ethnic minorities in the geosciences. His exhaustive list of acronyms used in government and in the geosciences became a useful reference for readers and editors. (An update of the list was published on the GSA Web site in 1999.) He reported frequently on the effects of federal budget cuts on geoscience personnel and initiatives, and he interviewed USGS directors, to give GSA members an idea of where the Survey was headed. His reports covered the spectrum from resources to climate change.

Bruce is one of the volunteers who added zip to the reformatted Society news publication. We appreciate his conscientious dedication to broadening the scope of our understanding of how government and science interact.

Response by Bruce Molnia

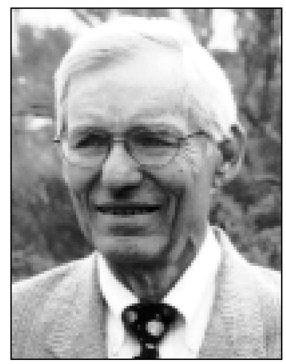
I am pleased and honored to receive the ultimate service award that GSA bestows. Specifically, the Society is honoring me for an involvement that spanned more than a decade. This involvement evolved from an ongoing dialogue with GSA's executive director at that time, Mike Wahl, about a proactive GSA. After Mike's retirement, this discussion was continued with Don Davidson.

In 1985, I moved to Washington, D.C., to fill a public policy position with the National Research Council. Thereafter, when I saw Mike at Society Meetings, we would discuss "societal relevance and GSA's involvement." By 1988, the discussion evolved from "what ifs" to action. Mike asked me and others for ideas to improve GSA's monthly publication, *News and Information*. Two years later, the result, *GSA Today*, was launched.

Through last December, I served as Forum editor. Initially, I would write the Washington Report and organize, write an introduction for, and edit the Forum every month. In 1991, I prepared 21 separate articles totaling more than 40,000 words. In 1992, as the competition for space in the successful *GSA Today* increased, the Society asked if I would be willing to reduce my output to either a Forum or Washington Report each month.

Feigning reluctance, I quickly agreed. After nine years, the result was 110 articles in 99 issues, totaling more than 250,000 words. Topics spanned the globe, ranging from the environmental voting record of Congress to the teaching of creationism.

Mike Wahl, Don Davidson, Faith Rogers, Jim Clark, Joan Manly—this could not have happened without your dedicated involvement. GSA, thank you very much!



RICHARD L. HAY

RIP RAPP ARCHAEOLOGICAL GEOLOGY AWARD

PRESENTED TO RICHARD L. HAY

Citation by Gail Ashley

Richard Hay has a long and distinguished career in archaeological geology, providing the geological context of two of the most important hominid-bearing sites known in East Africa: Olduvai Gorge and Laetoli. Hay's monograph, *Geology of the Olduvai Gorge* (1976), was based on more than 12 years of fieldwork and stands as a model for archaeological geology research.

Working along side Mary and Louis Leakey, Hay produced a basin-wide integrated study of stratigraphy, geochronology, paleontology, sedimentology, mineralogy, isotope geochemistry, and archaeology. He used his geological perspective to help the Leakeys sort out human activities involved in selecting and transporting lithic materials used for stone tools. Having only rudimentary geologic and topographic maps and low resolution air photos, Hay worked under very difficult field conditions to produce this seminal study that won the 1978 Kirk Bryan Award from the Quaternary Geology and Geomorphology Division of GSA. One well-kept secret is that he introduced Mary Leakey to little Dutch cigarattes. This could be why he was one of the few scientists that was always welcome at the Leakey Olduvai camp.

At Laetoli, he documented the nature of syndepositional volcanism and processes of the unique record of early hominid footprints. He was also a pioneer in the field-based investigations of sedimentology's most mind-boggling creations: zeolites and authigenic clay minerals.

As teacher and supervisor, he has influenced a long list of leading figures in East African geology. He is a geologist-geochemist extraordinaire, and with graduate students from Berkeley and the University of Illinois, he spent much of his professional life deciphering the mineralogic, geologic, and paleoclimatic record of arid environments. He is a modest, unassuming man who is open to discussion and generous with his time and ideas. Dick Hay has left his own unique imprint on the field—a superb mineralogist, a top notch field geoarch-aeologist and a wizard with the hand lens.

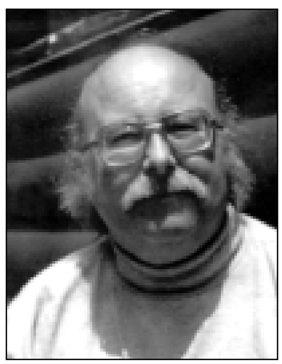
Response by Richard L. Hay

It is a great pleasure to receive the Rip Rapp Award for my work at Olduvai Gorge and Laetoli. I thank Gail for her over-generous comments on my abilities and achievements. My Olduvai adventure resulted from the dating of early hominids in Bed I by two of my former colleagues at Berkeley, Garniss Curtis and Jack Evernden. Their dates of about 1.8 Ma for hominids and tools of Bed I, published in 1961, were controversial because of their unexpectedly great age. One objection to accepting the dates was the lack of stratigraphic control. Thanks to my colleagues and Louis Leakey, I was invited to work out the stratigraphy of Bed I, in what was expected to be a single field season. This grew into many more, as Mary Leakey needed geologic work for her many archaeological sites. For 12 years, I worked on the stratigraphy, the record of tectonism and climatic change, and paleoenvironmental reconstructions.

Working in the gorge is a remarkable experience, as many have found. The litter of stone tools in the gorge continually reminds one of the former occupants of the area, and the strata offer the opportunity to determine their age and paleoenvironments. Hominid discoveries at Laetoli, 30 km from Olduvai, led to fieldwork on quite a different set of deposits over the next seven years. The most exciting find was the Footprint Tuff, which contains a remarkable variety and number of footprints, including those of early hominids that record the faunal change with the onset of the rainy season.

In 1989, I assisted Robert Blumenschine of Rutgers University and Fidelis Masao of the University of Dar es Salaam in a landscape archaeology experiment. It was successful, and in 1994, a major landscape archaeology project was begun, with Gail Ashley as geologist. My earlier stratigraphy proved inadequate in several places, and I thank Gail for inviting me to work with her to improve the stratigraphic control. This provided an opportunity to get involved in new problems and wrestle with old ones.

Many scientists, of varied disciplines, have contributed to the archaeological geology of Olduvai Gorge. Dating has involved varied methods: K-Ar, $^{40}Ar/^{39}Ar$, ^{14}C, fission track, amino acid racemization, paleomagnetism, and electron spin resonance. Some contradictory results have emerged, and more dating is needed. Paleoenvironmental reconstructions for Beds I and II owe much to specialized studies of bovids, small mammals, birds, and fish. Much has also been learned from mineralogy and stable isotopes, and of particular importance was Thure Cerling's documenting a drift to aridity over the past 2 m.y. from the isotopic composition of pedogenic carbonates. Of current interest is the nature and timing of millennial-scale climatic fluctuations, and Gail has made an important step forward by linking paleoclimatic fluctuations at Olduvai with global fluctuations.



JAMES P. MCCALPIN

E.B. BURWELL, JR., AWARD

PRESENTED TO JAMES P. MCCALPIN

Citation by Scott F. Burns

Each year, the Engineering Geology Division of GSA awards the E.B. Burwell, Jr., Award to authors or editors whose papers or books have significantly advanced our understanding of the principles and practice of engineering geology. It is my honor to recognize Jim McCalpin, editor of *Paleoseismology*, as the recipient of this year's award. This book has become the standard reference text for anyone working in the young field of paleoseismology. Interpretation of earthquake history is an important role for engineering geologists all over the world today. In this one book, one can now find the state-of-the-art presentations on field techniques and data interpretation in paleoseismology. It is well organized and includes diagrams from the many case histories discussed. The extensive list of references is very helpful to anyone doing research in the field.

Jim is more than an editor of the book, for he is either the author or co-author on six of the nine chapters. The book has a strong field component, which is so important in this field, and covers paleoseismology in different environments (volcanic, extensional, compressional, and strike-slip). Two chapters discuss the application of landslides and liquefaction deposits for paleoseismic analysis. The last chapter shows how to apply paleoseismic data to seismic assessment. Jim's selection of co-authors for the different chapters reads like a book of who's who in the field. All other authors are active field researchers in paleoseismology.

Jim's interest in geology began when he was challenged as an undergraduate student at the University of Texas in the class of this year's Penrose Medal Award winner, Robert Folk. After receiving his B.S. degree with honors there in 1972, he moved to the University of Colorado for his M.S. in geology in 1975. He migrated only a few miles away to complete the Ph.D. at the Colorado School of Mines in 1981. After a brief stint as county geologist for Jefferson County, Colorado, he became a professor at Utah State University for nine years. For the past nine years, he has been president of GEO-HAZ Consulting, Inc., in Estes Park, Colorado. He has completed more than 50 projects in paleoseismology for universities, governmental agencies, and the top consulting firms in geology and engineering from coast to coast. During this past year, he has embarked on a new endeavor in addition to consulting: developing the Crestone Science Center in Crestone, Colorado. It will become a science school that will emphasize the earth sciences.

Jim remains an active researcher while being a consultant. He has more than 73 citations to his name for his past 27 years as a scientist. More remarkable is the fact that he has 29 refereed publications since turning into a consultant nine years ago.

Response by James McCalpin

I am honored to receive this award, and I must acknowledge the efforts of other contributors to the book, including Alan Nelson, Bill Hackett, Dick Smith, Suzette Jackson, Gary Carver, Ray Weldon, Tom Rockwell, Steve Obermeier, and Randy Jibson. Not everyone has the opportunity to write the first reference book in a newly evolved field. The field of paleoseismology did not even exist when I took my first geology course in 1970. In such an endeavor, the temptation toward plagiarism is great, and as Mae West once remarked, "I can resist anything except temptation." I have tried to plagiarize everyone in the field on an equal-opportunity basis, but if I accidentally overlooked anyone, please contact me.

Isaac Newton, a great scientist and all-around modest fellow, once said, "If I see farther than other men, it is because I stand on the shoulders of giants." Well, I am neither as great nor as modest as Sir Isaac, but I must acknowledge several giants, whose backs I scrambled up and on whose heads I am still standing, to explain why I am standing before you today.

The first of these taught my first geology course in 1970 at the University of Texas at Austin. He was already a world-famous researcher, but he did not feel that teaching Geology 101 was beneath his dignity. He divided the class into groups that competed to correctly answer questions. Wrong answers were awarded with a thrown blackboard eraser, which invariably missed its target and exploded on impact, showering the innocent with chalk dust. I learned two things from the gentleman. First, just because you are a great geologist doesn't mean you have a great throwing arm. Second, the great discoveries in science were made by looking at ordinary, everyday things that many people had looked at before, and asking those questions that nobody had thought to ask before. The gentleman is this year's Penrose Medalist, Robert L. Folk.

After my period of indentured servitude (1970–1971) with Dr. Folk, I applied to be student assistant to the brand-new geomorphology professor. This fellow was an unknown quantity, but arrived with high recommendations from the University of Colorado. He turned out to be one of the new breed of quantitative geomorphologists, and he taught me two critical things. First, how to use a Leroy lettering machine and to clean out a Rapidograph. Second, by application of modern quantitative methods, such as fluid dynamics, that the old descriptive body of geomorphologic knowledge could be reassessed quantitatively, often with surprising results. This fellow, Victor R. Baker, later achieved some renown as a geomorphologist and as a president of GSA. Dr. Baker's third great accomplishment was as an author of fiction, in particular the letter of recommendation he wrote for me to the University of Colorado. This fictional essay was so successful that I was admitted to graduate school under Giant #3 of this tale, a tall guy who liked to dig soil pits.

Dr. Soil Pit was responsible for my first (and probably last) epiphany out in the field, when a whole bunch of disconnected geologic information all fell into place in a few seconds. As usual, I had my nose stuck up against a soil profile in a roadcut, but was progressively becoming more confused, since it looked like properties of one horizon were mixing with those of another. When I confessed my mounting confusion to Dr. Soil Pit, he bellowed, "Well McCalpin, you boob, look over the top of the roadcut." When I did, I saw the geomorphic elements of the landscape coming right down into the roadcut, and all at once a light bulb switched on. Oh, I thought, the soils, the landscape, the deposits—they are all interconnected. Dr. Soil Pit must have taught a few other folks similar lessons, because when he was awarded the Distinguished Career Award this year by GSA's Quaternary Geology and Geomorphology Division, he was surrounded by his ex-students and their students who numbered at least 100. He is Peter W. Birkeland.

Despite the tutelage of these giants, when I started teaching in 1982 at Utah State University, I had a few difficulties, one of which was the lack of a textbook in paleoseismology or neotectonics, which was the thesis topic of most of my graduate students. To fill this gap, I started compiling a manual by trolling through the published literature in geomorphology and tectonics, snagging the best pieces of geologic flotsam and jetsam that compromises this hybrid field. Although the book *Paleoseismology* was begun at Utah State, the bulk of the writing was done between 1991 and 1994, when I was sitting in my new consulting office in Colorado, waiting for clients to beat down my door. Rather than sit there staring at the phone, I started to polish up the old manual for my grad students. Fortunately, I picked a very good team of contributors to fill in those parts of the book where I had no personal field experience. Evidently, I made a good choice, as indicated by this award and the honor it bestows on myself and the other nine contributors. Once again, thank you.

DONALD FORSYTH

GEORGE P. WOOLLARD AWARD

PRESENTED TO DONALD FORSYTH

Citation by Gene Humphreys

The Woollard award is special in that it acknowledges a geophysicist who has made broad contributions to earth science—one who has, in particular, had important influence on the geological community.

Don Forsyth, I think, has done this by being unaware of the boundaries between geology and geophysics. Or maybe more correctly, it's just that he is so enthusiastic about what Earth is doing and what we can do to understand it, that we lose track of the distinctions. It seems that he is delighted merely in the fact that we can understand Earth and its behavior.

If pressed, Don probably would call himself a seismologist who works on oceanic problems. This does represent the greater fraction of his 100 or so publications, and many of these papers are important and widely cited. But included in these publications are many nonoceanic papers notable for their subject and importance, such as a paper with Frank Press dealing with petrological models of spreading lithosphere; the well-known Forsyth and Uyeda paper on the relative importance of the driving forces of plate tectonics; papers on continental earthquakes; thermal conduction problems; plate bending; continental uplift, isostasy gravity and flexural support of topography; the mechanics of low-angle normal faulting; asthenospheric flow beneath plate boundaries; development of the method commonly used to infer regional stress from earthquake data, and even heterogeneity of the core-mantle boundary.

Furthermore, because he has had so much person-to-person contact in what really is a small community, his influence goes well beyond the direct impact of his papers. He has more than 50 co-authors (counting only papers with one to two co-authors). He has served on committees that have created or guided the RIDGE Program, Incorporated Research Institutions for Seismology (IRIS), the National Science Foundation, and departments around the country. And in his various professional functions, I'm always impressed with his perception, honesty, dignity, and the positive, thoughtful manner he brings to the task at hand.

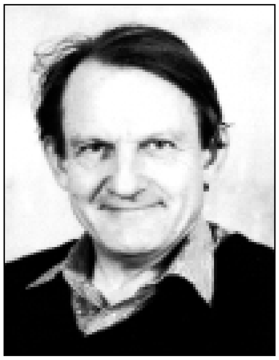
So it is fitting and proper that we recognize Don's contributions. This is our chance to say thanks for bringing the sense of quality to your work and your colleagues. Thank you.

Response by Donald Forsyth

Thank you, Gene, for that generous citation. I have had a lot of fun trying to solve Earth's puzzles with geophysics. Anyone who is able to do what they love and be paid for it, and then even be told once in a while that their work is appreciated, is very fortunate indeed. I have always felt very lucky to live in an era when there is exciting science to be done and support available to do it.

It is traditional at times like this to acknowledge the support of individuals, but I think the work of many to provide the infrastructure of science is equally important. Without ships to go to sea in, the equipment aboard, ocean-bottom seismometers built by several different groups, IRIS, and the Global Seismic Network and its predecessor, the Worldwide Standardized Seismograph Network, and compilations of gravity and topography data, most of what my students and I have accomplished wouldn't have been possible. Early in your career, you are thankful for your mentors, but at this stage, it is your students who keep you alive and productive, and I very much appreciate their hard work and new ideas. I do want to thank particularly three current colleagues at Brown, Marc Parmentier, Dan Scheirer, and Karen Fischer, who make the day-to-day practice of science so enjoyable and stimulating.

Finally, I will take advantage of this opportunity to give three pieces of advice. First, be willing to try new things; be a generalist as much as possible in this age of specialization. So what if you don't know what you are doing when you start—you are likely to stumble into something interesting as you find your way. Second, when you wake up in the middle of the night with a good idea, write it down. Third, and this I have learned from repeated experience, if you follow my second piece of advice, turn the light on.



HUGH S. TORRENS

HISTORY OF GEOLOGY DIVISION AWARD

PRESENTED TO HUGH S. TORRENS

Citation by William Brice

With this award, we honor Hugh S. Torrens for his long and outstanding contribution to the field of history of geology. Somehow it seems natural that paleontology should have been his first professional love, as it is such a historical science. He especially loved working with those beautiful, coiled ammonites of the Mesozoic. The fact that he is the generic and specific dedicatee of several ammonites speaks to his prominence in that field. But it is for his dedication to and passion for the history of geology that we honor him now.

Hugh completed his B.A. at Oxford and his Ph.D. at the University of Leicester. Since October 1967, he has been a member of the faculty at Keele University, where he attained his professorship in May 1998. He also served as a visiting professor at the University of California, Santa Cruz (1996); Eotvos Lorand University, Budapest, Hungary (1997); and the University of Saskatchewan, Saskatoon, Canada (1998). In September 2000, Hugh obtained a goal that many of us in this room are seeking, whether we know it or not, for he retired and became professor emeritus.

Hugh has produced more than 200 books, papers, and articles on a broad range of subjects. He has held various offices in such historically oriented organizations as: the Geological Curators' Group (Geological Society of London); the British Society for the History of Science; the International Commission on the History of Geological Sciences; the History of Earth Sciences Society; and the Comite Francais d'Histoire de la Geologie; just to mention a few.

One area of his research that deserves special mention is his work on the life of Mary Anning. All of us have thought we know the story of Mary Anning; telling our classes that she collected fossils and that she was the subject of the old rhyme, "She sells sea shells down by the sea shore.…" But generally, there it would end, and a giant in the field of paleontology would be reduced to the subject of a tongue-twisting rhyme. With the tenacity of a bloodhound and a marvelous instinct for the historical trail, Hugh reconstructed the life of this extraordinary woman, who was a major figure in early paleontology, especially of Ichthyosaurs and Plesiosaurs. She was one of the few people of her age, other than perhaps William Smith, also one of Hugh's subjects, who actually made her living with her geology.

A few years ago, my wife, Heather, and I went to the small town of Lyme Regis, the home of Mary Anning, with Hugh as our guide. We visited the site of her fossil shop, now, thanks to Hugh's involvement, a museum to her work. Hugh told the story of her death at age 47 in 1847 and of the many inaccurate historical accounts of the last few years of her life. There are reports that she became a drunk and spent many of her last years "in her cups." However, Hugh discovered that Anning suffered from a form of very painful breast cancer, and the only release from the pain was laudanum, a narcotic containing opium. No wonder she gave the impression of being "in her cups." Hugh made the story of her death so real that we had tears in our eyes. We stood silently before her grave, each of us feeling as though we had lost a friend, for Hugh's insightful scholarship had made her live again in our minds and hearts. The full irony of her life struck us as we gazed at the beautiful stained glass window presented to the Lyme Regis church by the Geological Society and dedicated to her memory. It has a wonderful inscription across the bottom filled with laudatory words about her contribution to the betterment of society and her concern for the poor, but not one word about her contribution to geology and paleontology. Thanks to Hugh's work, we now know how much she contributed to our science.

One need look no further than Hugh's own family to see the inspiration for his exploration into the contributions of women, for with him all these years has been his wife, Shirley, who has made her own special contribution to the Red Cross of Great Britain. We very much appreciate her understanding and acceptance of the fact that many times he was preoccupied with other women, even though they had been dead for many years.

In recognition of his many contributions to the history of geology, it is with great personal honor and pride that I present my friend and colleague, Hugh Torrens, the winner of the History of Geology Division Award for the year 2000.

Response by Hugh S. Torrens

I heard the glad tidings of my receiving this award while listening to Elgar's rarely performed First World War cantata "For the Fallen," on the BBC. I remembered his wife had been assistant to the geologist W. S. Symonds and how very vital wives are, particularly mine! Then I recalled Benjamin Britten's opinion of this music; tender, grieving, agonized, splendid. My presence at the first performance of Britten's "War Requiem" will remain, like today, never-to-be-forgotten. Britten also owed much to Americans. One, in a 1941 Californian bookstore, sold him the book through which he rediscovered his roots; George Crabbe's *Poems*. These inspired his return to England (and *Peter Grimes*). Crabbe, too, had deep interests in geology. But why discuss music? Because music needs to be composed (or sometimes elaborated like Anthony Payne's reconstruction of Elgar's "Third Symphony") and, like history, published. But music also must be performed. Rutland Boughton only heard his fine, still unpublished, "Third Symphony" (1937) once (privately!). Its only recording drew the comment, "For a symphony as beautiful as this to be unknown, doesn't say much for promoters of music." We historians of geology might ponder how we better promote what we do.

Because there is a paradox. Academic interest in the history of geology is minimal back home (as no sane person plays cricket in Reno?). The all-pervading bureaucracy in our universities demands only "Impact Factors" (to three decimal places!) and "Research Quality Assessment" of "Groups." "One Person Groups" are as undesirable as attempts to be both scientist and historian, supposedly diminishing both. Those who try, become marginal, moving in more than one world, but not at home in, or of interest to, either. I hoped for better at my former university, set up in 1949 to encourage breadth in education, through its Joint Honours Degree programs (why aren't joint honours graduates equally diminished?) and—abandoned—Foundation Year. But that university demonstrated its indifference to the history of science by the secret sale of its precious Turner Collection of rare books in 1998 (*Physics Today*, April 1999, p. 64).

My greatest feeling is of gratitude, both for this award from friends, and the help I received to get here. To receive it in 2000 was a particular delight, as this year has slightly involved me in three fine new books; Simon Knell's *Culture of English Geology*, Cherry Lewis' *The Dating Game: One Man's Search for the Age of the Earth*, and Debbie Cadbury's *Dinosaur Hunters*. We might see that these are now read, used and quoted (i.e., performed). It is only through such scholarship that we can render justice to those who preceded us in studying our unique planet. Henry Ford was right about the importance of such history. But how we urge it, and its fascination, more, whether in the academy or on geologists (who should be the most historical of scientists), remain intractable problems. Peter Medawar was equally right to assert that "The history of science bores most scientists stiff." But here is another paradox. According to a 1995 Roper poll for the American History Channel, "The item of greatest interest to the public is the History of Science and Technology." What are we to make of these different perceptions?

FRANCNIS H. CHAPELLE

O.E. MEINZER AWARD

PRESENTED TO FRANCIS H. CHAPELLE

Citation by Don Vroblesky

It is my pleasure and great honor to present the O.E. Meinzer Award to Frank Chapelle. The Meinzer Award is presented to authors whose papers or series of papers represent pivotal advances in the science of hydrogeology or some related field. In Frank's case, the award is for a body of literature that has greatly advanced our understanding of groundwater microbiology.

Frank and I first met as undergraduates at the University of Maryland. We both took jobs with the U.S. Geological Survey in Towson, Maryland, and began attending graduate school. Today we work in the same USGS office in Columbia, South Carolina. Over the years, I have had the great privilege of watching the development of the ideas for which he is being honored today.

In graduate school, we explored rock outcrops on Roy Lindholm's field trips and puzzle over features such as red and green colored sedimentary rock. Frank hypothesized that these and other geologic patterns were the footprints of ancient redox reactions and that the microbial processes were likely involved. These thought processes were a foreshadowing of the path that he would take with his career. Starting in the 1980s, his work demonstrated the enormous impact of microbial processes on the water chemistry of regional flow systems. The source of carbon dioxide in regional groundwater systems had long been a subject of intense speculation. Frank's isolation and examination of microbial populations from these sediments and comparison of stable carbon isotopes demonstrated that the carbon dioxide was derived from microbially mediated reactions.

Although it was becoming increasingly evident that microbial processes in groundwater were extremely important controls in the chemistry of both pristine and contaminated aquifers, microbial investigations were problematic because of the difficulty in aseptically sampling deep subsurface sediments and the fact that microbial processes in laboratory incubations often do not reflect in situ processes. In response, Frank and Derek Lovley developed nonmicrobiological approaches microbial processes, including measurements of dissolved hydrogen gas, which can be used in conjunction with other water-chemistry data, to predict the predominant microbially catalyzed redox reactions. This work constitutes one of the four papers for which he is being honored (Chapelle, McMahon, Dubrovsky, Fuiji, Oaksford, and Vroblesky,1995, Deducing the distribution of terminal electron-accepting processes in hydrologically diverse groundwater systems: Water Resources Research, v. 31, p. 359–371).

Frank put this approach to great use in explaining chemical distributions that had been poorly understood. His work showed that microbial competition for organic substrate was a major factor controlling the distribution of hydrochemical facies and zones of high dissolved iron in the South Carolina Coastal Plain. Even the source of such organic substrate was not understood until Frank and Pete McMahon showed that organic matter was diffusing from confining beds into the adjacent aquifers to support microbial growth. They found that sulfate was diffusing out of the confining beds in sufficient concentrations to maintain sulfate reduction and explain the perplexing lack of sulfate depletion reported previously by others. These and other findings are summarized in the second publication for which he is being honored (Lovley and Chapelle, 1995, Deep subsurface microbial processes: Reviews of Geophysics, v. 33, p. 691–698).

By combining laboratory and field methods, Frank measured biodegradation rates of groundwater contaminants. Such rate estimates are of great importance to investigators attempting to determine the time required for microbial remediation of aquifers. This work constitutes the third paper for which he is being honored (Chapelle, Bradley, Lovley, and Vroblesky, 1996, Measuring rates of biodegradation in a contaminated aquifer using field and laboratory methods: Ground Water, v. 34, p. 691–698).

Perhaps Frank's most important contribution to today's issues has been in the field of contaminant hydrology. Together with his long-time friend and co-author Paul Bradley, he has been in the forefront of elucidating pathways and environments of contaminant degradation, and he is being honored for one of his numerous papers in this field (Bradley, Chapelle, and Wilson, 1998, Field and laboratory evidence for intrinsic biodegradation of vinyl chloride contamination in a Fe(III)-reducing aquifer: Journal of Contaminant Hydrology, v. 31, p. 111–127). Prior to this paper, mainstream thinking was that vinyl chloride degradation was extremely limited under anaerobic conditions. This paper showed that under anaerobic iron-reducing conditions, microbial degradation can be an important depletion mechanism for vinyl chloride.

Frank continues to be a leading researcher in the combined fields of groundwater microbiology and geochemistry. His widely used textbook, *Ground-Water Microbiology and Geochemistry*, now in its second edition, is the first and most comprehensive examination of the contribution of microbial processes to subsurface geochemistry. His most recent book, *The Hidden Sea*, gives a nontechnical overview of groundwater systems and the aura of mystery that often surrounds them.

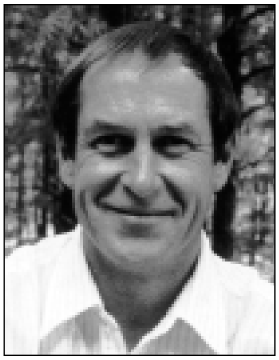
Response by Francis H. Chapelle

I'd like to thank the Society and its members for considering me for this award. The award has special significance for me because of the deep regard I hold for the work of O.E. Meinzer. He combined the characteristics of a careful, insightful scientist with an ability to make his findings available not only to his colleagues, but to nontechnical laypeople as well. His example is one I have always tried to emulate.

Understanding the importance of microbial processes in groundwater geochemistry has been an important field of endeavor in the last 20 or so years. As is always the case, my own work in this area has benefited greatly from interaction with many teachers, colleagues, and friends. If I hadn't had the privilege of studying with William Back at The George Washington University, I would never have developed an interest in groundwater geochemistry and microbiology. Bill was not a microbiologist. But he had the knack, characteristic of all great teachers, of fostering interests that lay outside his immediate sphere of expertise.

Early on in my career with the U.S. Geological Survey, I was fortunate enough to have the help and support of some truly great scientists, including Mary Jo Baedecker, L. Neil Plummer, and Don Thorstenson. While we didn't always agree on everything (scientists never do), their help and inspiration was more important than perhaps they know. Finally, I have been downright lucky in the friends and colleagues I have had. Don Vroblesky, with whom I went to college and graduate school, is one of the most observant and imaginative people I've ever known. Peter B. McMahon, Paul M. Bradley, and James E. Landmeyer, in addition to being great scientists, have been solid and constant friends. I can't thank them enough.

The field of groundwater microbiology is really in its infancy. The new tools of molecular ecology are presently, and will continue to be in the future, revolutionizing the study of microbial processes in groundwater systems. Even now, most of the microorganisms found in subsurface environments using these tools are entirely new to science, with rRNA sequences unlike any presently in our large (but obviously incomplete) databases. The coming years will demonstrate that much of the microbial diversity present on Earth is sequestered in subsurface environments. Furthermore, it's entirely possible that subsurface environments will prove to have been the cradle of life on Earth, as well as possibly harboring life on other planets or asteroids in our solar system. The next few years are going to be interesting.



LAURENCE A. SODERBLOM

G.K. GILBERT AWARD

PRESENTED TO LAURENCE A. SODERBLOM

Citation by Don E. Wilhelms

Larry Soderblom has long deserved the G.K. Gilbert award because he has done so much in so many ways to better solar system exploration. Two of his many interests and skills were already evident in high school in Las Vegas—New Mexico, that is—where he was an avid amateur astronomer and built a working stellar spectrograph. Two more showed up at New Mexico Tech, where he obtained B.S. degrees in geology and physics. In 1966 came a graduate geophysics major at Caltech, and the influence of Bruce Murray and Gene Shoemaker. Murray encouraged Larry's interest in the Caltech–Jet Propulsion Lab specialty of lunar reflectance spectra, and Shoemaker pointed to the impact erosion of small lunar craters as a problem suited to Larry's dual talents in mathematics and geology. Larry obtained the reflectance data himself with a photoelectric photometer at Mount Wilson. The result was a Ph.D. thesis dated 1970, entitled "The Distribution and Ages of Regional Lithologies in the Lunar Maria."

In August 1970, while still a Caltech postdoc, Soderblom joined the U.S. Geological Survey Branch of Astrogeologic Studies in Flagstaff with the title of geophysicist. The branch and science of astrogeology haven't been the same since.

Larry showed a mind-boggling mastery of computer science and soon set about designing, developing, and managing a computerized image-processing system that has led to revolutions in image processing and digital cartography. He served on or chaired more than half a dozen key NASA boards, and when Mars Observer went silent in August 1993, he was on the planning teams that defined its successors. In the 1990s, he helped define the first New Millennium missions, successfully hounded NASA and JPL to get solar electric propulsion on Deep Space 1, helped design its instrument package (MICAS), and is leader of the MICAS flight team

Larry's involvement with flight teams has been intense, effective, and beneficial to all of us. He started with the Mariners, segued to Viking Orbiter, and later to Mars Pathfinder and the orbital-camera teams for Mars Observer and Mars Global Surveyor. He was an original member of the Voyager Imaging Science Experiment in 1971 and became deputy team leader. As a geoscientist he had responsibility for satellites, and he led the team's effort in image processing. NASA recognized his crucial role with medals for exceptional scientific achievement in 1981 and 1986. After Voyager, he went on to Galileo and Cassini, leading in the proposal and development of a new class of imaging spectrometers, and serving on the flight experiment teams. He was interdisciplinary scientist for Mars Observer and still is for Mars Global Surveyor and Cassini.

As for his own scientific studies, he first studied the Moon for his Ph.D. thesis, and again as Galileo flew by. Then came Mars, first its surficial processes and polar deposits, but later any geologic matter that orbiting or surface cameras revealed. Of the Jovian satellites, he said, "There is no such thing as an uninteresting Galilean satellite," and showed us why, especially in his studies of Io and Europa with Al McEwen and Baerbel Lucchitta. Next, Saturn's zoo of small satellites, and the even weirder zoo of Uranus—think Miranda (which might have remained unknown if Soderblom and other convincing people hadn't lobbied for keeping Voyager alive). Last but not least, Neptune's Triton; Larry calculated the "uncomfortably long" exposure time needed while Voyager 2 flew past in dim light and stretched our imaginations on August 25, 1989; and, studying stereo images, he discovered and explained the geysers above Triton's surface.

Larry has been deeply and effectively immersed in every stage of the scientific investigatory process from proposing space flights to archiving the data. His competence and visionary overview of planetary exploration, combined with rare personal qualities, have made him a charismatic leader of people and missions. Larry Soderblom is not only a scientific and technical genius but also a genial gentleman, and certainly one of the very most deserving holders of the G.K. Gilbert Award.

Response by Laurence A. Soderblom

Receiving the Gilbert Award has deep personal meaning to me as for anyone who subscribes to Gilbert's basic approach to science, neatly captured by Gilbert's biographer, Stephen Pyne, in the description, "to convert a problem of geography and history into one of geometry and physics." Gilbert's mode of science has become the underpinning of modern geology. In striving to follow this principle, I had important guidance from Eugene M. Shoemaker and Bruce C. Murray, both Gilbert-like: generalists and geologists first but solidly planted in the physics and mathematics. To them both I am grateful and indebted.

During the last 50 years, through the nation's planetary exploration program, the field has exploded from Gilbert's early studies and insights on impacts on the Moon and on Earth to the entire solar system. Mars now grows closer and closer in familiarity. A textbook on the geology of Mars of reads like that of a terrestrial geomorphology—the words glacial, volcanic, fluvial, eolian, and lacustral fill its volume. But the closer we look at the Red Planet, the more enigmatic it becomes, and the less certain are we of its nature and history. The elucidation of Mars' fundamental geologic history and nature still lies in the future.

When it became clear that an Apollo Program continuation to Mars was not viable, a new timetable was set in the 1970s for sample return and human exploration of Mars: sample return ca. 2005 and mankind to Mars ca. 2015. The pair of 2003 Mars Exploration Rover Missions is resilient and redundant. If both succeed, scientific return from the two sites will be rich indeed!

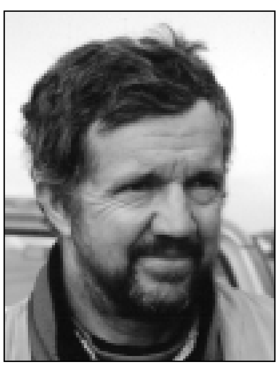
The space exploration program has irreversibly altered our sense of home. I recall Apollo astronauts using phrases like, "We're home now," first in transit back to Earth and later when climbing aboard the lunar ascent module. They were rapidly extending our definition of home. The Voyagers moved the boundaries of our home to the edge of our solar system. Through such spacecraft, our sense of sight is transferred directly across the solar system. Our spacecraft have made us at home, comfortable anywhere in our solar system from the surface of Mars to the environs of Mercury and Triton.

A direct lesson from Voyager was that our traditional scientific conservatism caused us to vastly underanticipate what we would find. For the Galilean satellites of Jupiter, most of us expected heavily cratered, dead objects—planetary objects that perhaps only Bob Strom, that paragon of planetary cratering, could love. Io was to be a yellow-orange version of the Moon. I don't believe even Peale, Cassen, and Reynolds, who predicted Io's volcanism due to tidal heating (published only weeks before Voyager 1's arrival), had any notion of the tremendous plethora of active volcanic variety that Voyager and Galileo would witness. Craters of the impact form are, so far, totally absent on its hellish plains. The paucity of craters on nearby Europa caused Shoemaker to estimate an age for its surface as low as 100 Ma. Many scientists believe now that parts of the surface are even much younger and that Europa may harbor a subsurface ocean, liquid to this day. Europa is today's center of attention for the next step in outer solar system exploration. Our model for the icy moon Triton continually shrank and grew colder as we approached environs of

Neptune, finally stabilizing into a small bright moon with a surface at 37 degrees above absolute zero! Triton too turned out to have active processes at its surface.

Why all this geologic activity on such cold, remote objects? And I would bet we find so for Pluto as well, if we were ever to mount the courage to go there. There are two reasons: geological lubricants and energy sources. No matter how far we go from our central star, no matter how cold it becomes, we will find commonplace planetary materials—carbon monoxide, nitrogen, methane, sulfur dioxide, carbon dioxide, and under special circumstances, in the cases of Mars and Europa, water—that will be mobile, serving as the lubricants for geologic activity. Second, we find a broad variety of energy sources operative to drive geologic processes. Wherever we look in our solar system, unusual forms of energy pop up to drive geologic engines. Our expectations need to be set high—we need to expect as commonplace the complex, the exotic, the bizarre, and, for sure, active processes! We have learned some lessons for the next star.

Let me close with the subject of ion propulsion. Deep Space 1 is a tiny NASA spacecraft that sports the first deep space ion propulsion engine. Its thrust is only about the weight of a sheet of paper. It is our Model A, but it will chase down Comet Borrelly late next year. One night I saw the DS1 engine being tested at the Jet Propulsion Laboratory—this was for me, pure Star Trek. The iridescent blue beam of ionized xenon jetting out of its orifice at 30 km/s is real. I realized that night that we now sit at the edge of the technological breakthroughs that will soon enable us to take Voyager's lessons to that next star.



BRIAN F. ATWATER

KIRK BRYAN AWARD

PRESENTED TO BRIAN F. ATWATER AND EILEEN HEMPHILL-HALEY

Citation by John J. Clague

The Kirk Bryan Award recognizes an outstanding contribution in the field of Quaternary geology and geomorphology. It is my distinct pleasure, on behalf of GSA's Quaternary Geology and Geomorphology Division, to present the award this year to Brian Atwater and Eileen Hemphill-Haley for their splendid monograph *Recurrence intervals for great earthquakes of the past 3,500 years at northeastern Willapa Bay, Washington* (U.S. Geological Survey Professional Paper 1576, published in 1997).

EILEEN HEMPHILL-HALEY

I can think of no more important and influential publication in Quaternary science in recent years than USGS Professional Paper 1576. It is a summary of a decade of careful, innovative research by Atwater and Hemphill-Haley on the geologic record of great earthquakes in southwestern Washington. If you wish to show students how science should be done, have them read USGS Professional Paper 1576.

I remember Brian commenting to me in 1985 or 1986, after one of his first forays into the muddy tidal marshes at Willapa Bay, that he thought he had found evidence for repeated sudden coseismic subsidence of the land, but that he wasn't sure he believed the implications of what he had seen. Brian is not a scientist who jumps to conclusions or cuts corners testing a hypothesis. He spent summer after summer in the late 1980s and 1990s documenting in extraordinary detail physical evidence of recent, very large earthquakes. To do this, he enlisted the help of Eileen Hemphill-Haley, a diatom paleoecologist. At first blush, Brian and Eileen would appear to be an odd couple, scientifically speaking, yet their collaboration proved to be critical to demonstrating that the region had experienced repeated large earthquakes. Eileen showed, through analysis of fossil diatoms and comparison of fossil and modern diatom assemblages, that the buried marsh and forest soils that Brian mapped in tidal channels at Willapa Bay had subsided abruptly 1–2 m during earthquakes. She also showed that the sand layers that directly overlie some of the soils contain marine diatoms, indicating landward transport and deposition of coarse sediment. This proved to be a critical piece of evidence for a tsunami origin for the sand layers.

USGS Professional Paper 1576 is a comprehensive document, far exceeding in scope what can be presented in a journal paper. To their credit, Brian and Eileen took the time to present the wealth of their findings in a single publication rather than slicing it up, salami-style, in a series of shorter, less complete journal papers. The monograph is, however, more than thorough, well argued science; it's a great read—the writing is elegant and illustrative material is beautiful.

I can't overemphasize the impact that Brian's and Eileen's research has had on our understanding of earthquakes in the Pacific Northwest. Improved public awareness of earthquake hazards in the region is rooted, in part, in their work. Brian was one of only a few geologists working on earthquakes in the Pacific Northwest when the USGS transferred him to Seattle in 1985. Today, scores of government and university researchers, private-sector geologists, and students are working on Cascadia earthquakes, and most of them have been encouraged and supported by Brian.

USGS Professional Paper 1576 exemplifies how seamless basic and applied geoscience can be and, further, how important Quaternary geoscience is to society. The contribution that Brian and Eileen have made to our understanding of Cascadia earthquake hazards has proved to be vital.

Let me close with a few anecdotes of a more personal nature. Brian is a well-known figure in the communities around Willapa Bay. Most local residents remember the man with the white hat paddling his canoe up and down every tidal channel around the bay. This man went out of his way to tell people what he was doing and why, and he explained to them how all those tree stumps rooted in tidal muds in the bay came to be. Anyone who has ever done field work with Brian learns very quickly to either stand back as he cleans off an outcrop or be hit by flying mud—he's a human backhoe. Also, if you stay in Brian's field camp, you will at some time be included in the bread-baking detail. Brian turns up his nose at the store-bought stuff, and late in the evenings somebody, often Brian, bakes fresh bread for sandwiches the next day. Finally, Brian always has chocolate on hand to make cocoa on cold mornings. God help you if you get between Brian and his chocolate!

Eileen met Brian at the first special session on Cascadia earthquake research at the American Geophysical Union meeting in San Francisco in 1987. At that time, she was a graduate student at the University of California at Santa Cruz and was employed by the USGS. Up until then, all her research experience had been in Quaternary paleoclimatology working with the Marine Branch of the USGS. Her original plans for Ph.D. research weren't working out, and she was shopping for another project. She introduced herself to this forceful scientist with what many people at the AGU session considered outlandish ideas. Brian suggested that perhaps Eileen would like to look at a few samples from Willapa Bay, and the rest, as they say, is history. Eileen liked the idea of applying paleontology to paleoseismology, so she began working full time on the project the following summer. Eileen no longer works for the USGS, although she continues her collaboration with Brian to this day. After leaving the government, Eileen has pursued a career in music and is an accomplished singer and songwriter. Her songs are unusual and beautiful. Check them out on one of her CDs or her Web site, www.h2tunes.com.

With *Recurrence intervals for great earthquakes of the past 3,500 years at northeastern Willapa Bay, Washington*, Brian and Eileen have shown what Quaternary scientists can contribute to both science and society. I present to you the 2000 recipients of the Kirk Bryan Award, Brian Atwater and Eileen Hemphill-Haley.

Response by Eileen Hemphill-Haley

It is my great honor, along with Brian Atwater, to receive the 2000 Kirk Bryan Award. My sincerest thanks to the Quaternary Geology and Geomorphology Division of GSA for this recognition.

As wonderful as it is to receive this award, the greatest joy for me has been the opportunity to participate in about a decade's worth of research on problems I have found engaging, and with people I admire. My work with Brian along Willapa Bay represents our initial attempts to apply micropaleontology to aspects of Quaternary paleoseismology, and helped to lay the groundwork for a series of additional studies focusing on earthquakes and tsunamis along the Cascadia margin. I have nothing but the highest regard for Brian, and won't embarrass him by expounding about it too much. But it is significant that, at his request, I have slogged through knee-deep mud in search of the perfect sample, and have on many occasions gotten up before God to beat the tides. Believe me, these are not things that I would do for many people. But I'm happy for the work we've done together in the past, and have no doubt that we will continue to figure out ways to work together in the future.

Looking back over the past years, there are a number of people who helped me along the way, and for whose support I am grateful. I had several mentors at the USGS, including James V. Gardner, Michael Field, and John Barron. Denise Armstrong and Carter Borden made important contributions to the project. But of the many people with whom I have worked or conferred, there are two I especially want to acknowledge for their help and friendship. The first worked with me through a student appointment at the USGS, and the second was a volunteer in the diatom department at the California Academy of Sciences.

Roger Lewis came to work for me on a student appointment at the USGS in 1992, and soon became my right-hand man in both the lab and field. During his years in the USGS micropaleontology lab in Menlo Park, he greatly refined our diatom sample-processing techniques, and always maintained a good attitude, although the work could be very tedious at times. His skills in the lab were surpassed only by his abilities in the field, where he maintained the same dependable, upbeat attitude, and clear excitement for the science. Roger has since moved on to pursue graduate studies in marine geochemistry, but I am happy to thank him here for all his past contributions to paleoseismology and paleoecology in the Pacific Northwest.

Mr. Albert Dell Mahood is a former high school biology teacher, who in his retirement worked as a volunteer in the diatom department at the California Academy of Sciences in San Francisco. I spent many afternoons researching diatom taxonomy and ecology with Dell and depended greatly on his help—and humor—during this research. As a volunteer for science, he shared knowledge and experience that helped us to better understand the results of our diatom analyses, and I'm pleased to have the opportunity to formally thank him at this time.

My thanks once again to GSA for the Kirk Bryan Award, and my deepest gratitude to the friends and colleagues who helped Brian Atwater and me to achieve this honor.

Response by Brian Atwater

In Cascadia paleoseismology, Eileen Hemphill-Haley is known for careful and productive work with fossil diatoms. I hope the Kirk Bryan Award brings this work the wider recognition it deserves.

I join Eileen in thanking our co-workers. Many of them were volunteers or low-paid assistants. Others provided tough reviews of a long manuscript—or of three versions of that manuscript, in the case of an outstanding reviewer. Still others worked as administrators, accountants, and editors.

In the few moments remaining, let me mention some of the additional work that contributed to our report.

Much in Cascadia paleoseismology depends on analogies with great earthquakes at other subduction zones—1944 and 1946 in Japan, 1960 in Chile, 1964 in Alaska. These examples provide a basis for recognizing earthquakes from geologic signs of their land-level changes and tsunamis.

Geophysicists were probably the first to think about great earthquakes at Cascadia. Some of them did so as regulators of nuclear power plants in the early 1980s.

By the early 1990s, "marsh jerks" had identified geologic signs of subsidence and tsunamis at bays and river mouths in British Columbia, Washington, Oregon, and California. Later in the 1990s came exact dating of Cascadia's most recent great earthquake—to January 26, 1700. This dating, like so much else in Quaternary geology, is founded on the radiocarbon time scale. Also essential were ring-width pattern matching at Cascadia and historical scholarship in Japan.

These efforts, among others, built the giant on whose shoulders Eileen and I stand.

RUSSELL R. DUTCHER

GILBERT H. CADY AWARD

PRESENTED TO RUSSELL R. DUTCHER

Citation by Alex R. Cameron, James R. Staub, and John C. Crelling

The Gilbert H. Cady Award is presented this year to Russell R. Dutcher to acknowledge his outstanding contributions to the field of coal geology. In a career spanning four decades he has made significant contributions as a professor and researcher, as a university administrator, and as an editor.

As a professor, he has been a gifted and inspiring teacher who demanded the best from his students. Under his guidance, 17 students completed their M.S. degrees and three completed their Ph.D. degrees in coal geology and coal petrology. As a researcher, he has made many contributions in the areas of applied coal petrology, coal metamorphism, and coal bed methane. He has published nearly 40 papers and edited four books, including a GSA Special Paper and an ASTM Special Technical Publication.

As a university administrator, he helped lead the legendary Coal Research Section at the Pennsylvania State University. At Southern Illinois University, he developed the very successful and widely recognized coal research program in the Department of Geology, and he also established and initially led the multidisciplinary Coal Research Center. He has been a great advocate of coal research and has been instrumental in obtaining millions of dollars of research funding.

As an editor, he took over the *International Journal of Coal Geology* after the retirement of William Spackman, the founder of the journal. He was editor in chief of 29 volumes (64 issues) of the journal, including 14 special issues covering a wide variety of topics in coal geology. He added a number of talented editors and reviewers, encouraged industrial contributions, and maintained the international nature of the journal. By virtue of his many accomplishments and his lifelong commitment to the field of coal geology, he is a deserving recipient of the Gilbert H. Cady Award.

Response by Russell R. Dutcher

It is a distinct pleasure to acknowledge the kind words of the Cady Award citationists this year. My thanks are graciously offered to this year's Cady Award committee and to its capable chair, James Staub.

Receipt of this recognition came as a total surprise to me. I was, in fact, nominating another person for this honor and had no inclination of what was in the offering. Jim Staub would, I'm sure, recount my stunned reaction when it became necessary to let me in on the results of the Cady Award deliberations. I am still in some sort of shock.

Those of us in our profession who actually knew Dr. Cady are dwindling in numbers. To those of you who did not know "Doc," you missed, through no fault of your own, a great man. He was a person totally dedicated to his profession, one with sometimes an apparently gruff exterior, which thinly masked a kind, helpful, and caring individual. There are many stories. I will relate only one.

While at Penn State, the coal group was physically separated from the Geology Department for several years—housed in a house on campus that was converted to a laboratory and office building. Doc was working with Bill Spackmam, guiding the progress on two research grants that we had as the result of a large state initiative on coal. One morning I came to work at a few minutes after 8 a.m. and found Doc Cady sitting on the top step of the porch, and I was greeted with the question, "What time do you people get to work here?" We had earned that question—Doc could not get into the building.

To be selected for this award is a humbling experience—to join the list of recipients is an emotional shock. Many of these people are ones who helped me a great deal when I was Bill Spackman's graduate student. Some were fellow graduate students in the Penn State coal group. Others were at laboratories that I was fortunate enough to visit. There have been many flashbacks in the last few months—memories of exciting times and superb cooperation.

Someone once said something to the effect that accomplishments are made by standing on the shoulders of others—we build on what others have done or done for us. I would like to mention just a few names: John Lucke, L.R. Wilson, Burke Maxey, and Mitch Light got me through the B.A. and M.S. Degrees. Bill Spackman has to have the broadest and toughest shoulders of anyone I can imagine. He has my gratitude for all he has done for me and my career. Others would back me on this statement as he helped many.

It is appropriate for me to acknowledge my parents as I found out later they made considerable sacrifices, first so that I could attend a specific high school in my hometown. After that they were able to help with college expenses. I am old enough to remember the depth of the Depression and there not being a nickel left in some weeks for an ice cream cone. I remember my father losing his job in New York City after 33 years with the same company—no retirement, no pension. These memories kept me working. Dale F. "Dusty" Ritter was an invaluable friend and confidant as I moved to administrative roles. I needed someone who would give me straight answers regarding ideas and possible actions. Dusty is no "yes man" and was happy to say, when necessary, "that's a lousy idea." I thank him.

Alex Cameron, a recent recipient of the Cady Award, was a close friend over many years. We were office mates in graduate school in the times when graduate students worked nights. He nominated me for this honor.

We were fortunate to have spent time with Alex and Cathy in early August of this year—some of that time was in the field! As you know, Alex passed away in September. He is missed by us all, perhaps most by those who knew him as a great geologist and a fine human being. Thank you all very much.

S. WARREN CAREY

STRUCTURAL GEOLOGY AND TECTONICS DIVISION CAREER CONTRIBUTION AWARD

PRESENTED TO S. WARREN CAREY

Citation by B. Clark Burchfiel and Christopher Powell

It is with great pleasure that we present to you Samuel Warren Carey as this year's recipient of the Career Contribution Award of the Structural Geology and Tectonics Division of the GSA.

Professor Carey has a long and distinguished career spanning more than 60 years as a professional scientist, and one can truly say he is an individual who has lived life to the fullest. He graduated with a B.Sc. (1st class honours) from The University of Sydney, Australia, in 1933, and a year later he was awarded his M.Sc. From 1934 to 1938 he worked as a petroleum geologist for Oil Search Ltd. in New Guinea, during which he completed his D.Sc. on *Tectonic Evolution of New Guinea and Melanesia*. Those were the days when there were no roads in New Guinea outside the major towns; Carey and his exploration team took to the jungle on foot.

During World War II, Carey was a captain in a Special Unit of the A.I.F. (Australian Imperial Forces) behind Japanese lines. He served his country with distinction, showing incisive intellect and bravery in the face of appalling conditions. His will to succeed at all costs is a distinctive mark of his public life, in academic, military, and civilian spheres.

As an undergraduate student (1930s), Carey became convinced of Wegener's concept of the gross dispersion of the continents of Earth through time, and later developed continental drift concepts by extending Wegener's ideas to mountain belts, which he analyzed in detail and with precision. The rheid concept in 1954 was a major contribution to tectonic thought as Carey introduced time as an essential component of our mechanical view of geological materials. Carey's ideas of folded mountain belts was published in the Proceedings of the Royal Society of Tasmania in 1955, but was not widely known to the world until the 1958 publication of *Continental Drift: A symposium*. A steady stream of papers in the mid-1950s and early 1960s introduced concepts such as the strength of Earth's crust, the necessity for décollement below concentric folds, the asymmetry of Earth and the scale of geotectonic phenomena. In rebutting Sir Harold Jeffrey's assertion (1929) of a 15° misfit between South America and Africa, he published (1955) a precise continental reconstruction which has become known as the Bullard (1962) fit.

Carey's main international reputation came from the Continental Drift Symposium held in Hobart, Tasmania, in 1958. Chester Longwell, who wrote the introduction to this symposium, was so impressed by Carey's work that he suggested Carey come to Yale University as a one-year replacement for John Rodgers, who was scheduled to go on sabbatical leave (1959–1960). This was a crucial period in the development of geological thought, because the first puzzling pieces of information from the ocean were beginning to trouble the minds of people like Hess and Dietz. Carey's oratory was arguably a catalyst that sparked the widely accepted theory of plate tectonics. His influence on scientists such as Harry Hess, J. Tuzo Wilson, and numerous others was significant in the development of their then revolutionary ideas on plate tectonics. In John Rodgers' own words when he accepted this award eleven years ago,"…North American geology has never been the same since."

As students of Carey, we must comment on his commitment to teaching and to students. Within and outside of class he promoted totally free-ranging academic thought. He challenged every student to think and followed this up with copious handwritten notes on any piece of work handed to him. Ideas and concepts were thoroughly debated, and one had to defend his position competently. No Carey graduate student has ever forgotten the essential survival skills that Carey taught.

In the 1958 Continental Drift Symposium there is one diagram (Fig. 39d, p. 280) which differs from all others in that it is only drawn in outline. Here, Carey tried to fit Pangea onto a globe of present-day size, but could not close India in Gondwanaland back to Asia or North and South America in to their Pangean fit against Africa without forming a major gap. The diagram marks the time when Carey first concluded that Earth had expanded. His work on the expanding Earth since then was published in a long essay (1975) and a book (1976). This was followed by investigation of the implications for Earth and the universe in 1988 and, more recently, in 1996, of Earth, the universe and the cosmos.

Samuel Warren Carey is a truly remarkable man, perhaps the most mobilist tectonician of his time, who has made more impact on our science and scientists than almost any other person of his era. He is a man of courage, clarity of thought, and above all, a man who pursued every idea to its logical conclusion. We can think of no worthier candidate for the Career Contribution Award of the Structural Geology and Tectonics Division of GSA.

Response by David Groves, on behalf of S. Warren Carey

I am delighted to accept the Structural Geology and Tectonics Division Career Contribution Award on behalf of Professor S. Warren Carey. I had the great fortune to be an undergraduate and postgraduate student at the University of Tasmania at the height of Professor Carey's career. His flamboyant lecture style, innovation, lateral thinking, and global perspective made him a giant of his time. His classes were always full, and audiences sat on stairs or crushed into doorways and available spaces in packed lecture theatres to hear his inspirational, and often theatrical, public lectures. His students gained an unparalleled breadth of knowledge on structure and tectonics, headily inhaling new concepts of rheidity, sphenochasms, and oroclines on a dynamic Earth. In the postwar era, he was one of the few lateral thinkers who paved the way for many of the global tectonic concepts that were to revolutionize the earth sciences in the last three decades of the twentieth century. Not only did he leave his indelible mark in the structural and tectonic literature, but he inspired those around him. Tasmania is a small island of about half a million people, but the reputation of its geologists, in terms of high positions in academia and industry, is out of all proportion to this population. Such is the legacy of a great man and an outstanding geoscientist.

GEORGE D. KLEIN

LAURENCE L. SLOSS AWARD

PRESENTED TO GEORGE D. KLEIN

Citation by Kathleen M. Marsaglia

The Laurence L. Sloss award for Sedimentary Geology was established to celebrate those who emulate the outstanding achievements of Laurence Sloss in the field of sedimentary geology and in exemplary service to GSA. George D. Klein, the 2000 recipient of this award, has had a distinguished career in academia and in serving as president of the New Jersey Marine Sciences Consortium and director of the New Jersey Sea Grant College program. He is currently an emeritus professor at the University of Illinois and an independent consultant in the petroleum industry.

Throughout their careers, Sloss and Klein provided unique sedimentological views from the craton, complementary in some instances and countervailing in others. Both worked steadfastly to promote the field of sedimentary geology and GSA. George's efforts include serving as the founding chair and past chairman of the GSA Sedimentary Geology Division. During his service as chairman, membership jumped from five to 1,500, making this newborn division the fourth largest within GSA and a force on the GSA Technical Program Committee.

As a very visible and vocal member of the society, George attended and presented papers at approximately 30 GSA annual meetings. His impressive list of publications includes editorships of two GSA special papers, nine articles in the *GSA Bulletin*, and eight articles in *Geology*. George served as one of the original editorial advisors for *Geology*, as well as an associate editor for the *Bulletin*.

George is perhaps best known and most widely cited for his insightful and thorough work in tidal processes and facies, publishing two books and more than 30 journal articles on tidal processes and modern and ancient tidalites, a term he coined. His paper on the application of flow regime and ocean-circulation models to tidal-flat and tidal sand-body environments and the significance of time-velocity asymmetry of tidal currents in controlling tidal sand-bar processes and patterns received the 1970 SEPM (Society for Sedimentary Geology) Best Paper Award. More recently, he has made significant contributions to the literature on the origin of cyclothems and the tectonics of sedimentary basins.

George has routinely consulted and taught short courses in the petroleum industry, using his text *Sandstone Depositional Models for Exploration for Fossil Fuels*. George was also active in deep-sea exploration. He served on a number of Deep Sea Drilling Project panels and sailed as a co-chief on Leg 58 in the Philippine Sea.

George fostered graduate research and challenged students to think critically and reach their highest potential, supervising student research on tidal, fluvial, and glacial sedimentation processes; backarc sedimentation and tectonics; basin subsidence mechanisms; the carbonate-to-clastic transition; and my special project work on the paleogeography of storms, among others.

The George Klein I have known for 20 years as a teacher, co-author, colleague, and mentor is a committed, consummate professional and gentlemanly geoscientist with insatiable scientific curiosity and a strong devotion to the understanding of sedimentary rocks. It is an honor to present him as the 2000 recipient of the Laurence L. Sloss Award for Sedimentology.

Response by George D. Klein

It is extremely thoughtful of Kathie Marsaglia to both nominate and cite me for the Laurence L. Sloss Award. Kathie completed and published research with me while at Illinois. Her master's was supervised by another colleague. Hence, her nomination is special.

Kathie is not alone in helping me. I was truly blessed through help from my parents, professors at all levels, fellow graduate students, colleagues at large, former students, and fellow consultants. Collectively I thank them all.

Larry Sloss and I first met at the GSA meeting in 1960. He was magnanimous, reasonable, helpful, and indirectly, an exemplary mentor. When receiving the Twenhofel Medal he said, "Lack of virtue does not necessarily mean lack of rewards." That's true for me!

In conversations, Larry periodically asked, "What's the future of sedimentary geology?" Let me comment: Ten years ago, nearly 30 university departments in America were centers of excellence in sedimentary geology. Today, it is almost half. Yet we need sedimentary geology more than ever to solve incredible resource shortages and environmental problems.

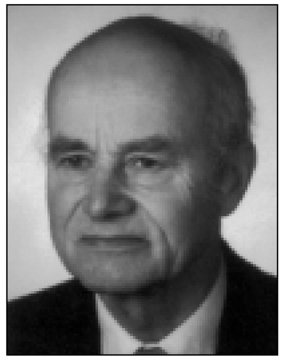
How do we effect a change? We do it by adopting the National Research Council Select Committee's proposed community-based approach.To reach the next level, sedimentary geologists must reexamine our mindset, work, and direction. We live in a digital world. As a petroleum consultant, I see digital displays of subsurface depositional systems with incredible resolution. Consider the following:

- Barbara Radovich, in a forthcoming paper, describes "3-D seismic as outcrop."
- Ian Bryant at Schlumberger is developing geographic information system digital outcrop mapping systems that bridge outcrops to the subsurface.
- Multidisciplinary modeling by Chris Paola provides understanding sedimentary basin evolution in a new dimension.
- Astronomical forcing factors intermediate between tidal cycles and Milancovich frequencies, according to Mike Rampino, influence climate and sediment deposition.
- Tidalite research now focuses on interdisciplinary findings from biologists, physical oceanographers, organic chemists, and sedimentologists. Erosion and deposition are influenced perhaps more by biochemical reactions within sediments rather than physical currents alone.

All these data and digital formats are accessible through a community-based approach.

A successful community-based approach requires building alliances beyond traditional multi-institutional projects. Academic sedimentary geologists must broaden such alliances to include as full partners their colleagues in industry, consulting firms, state and federal agencies in the United States and overseas, fully sharing common research agendas. Such alliances will make the community-based approach a successful reality if we take advantage of the opportunities before us. It's time to develop such broader alliances to reassert sedimentary geology as the premier field of geology by taking it to the next level.

In closing, I wish to acknowledge my wife, SuYon Chong, whom I met after leaving Illinois in 1993. We were married a year later, and she has done so much for me. SuYon never saw my career develop. By awarding me the Laurence L. Sloss Award, you provided her with an opportunity to meet you, my colleagues. For this added bonus, I am extremely grateful to the GSA Division on Sedimentary Geology for bestowing on me the Laurence L. Sloss Award.



GERHARD EINSELE

2000 HONORARY FELLOW

GERHARD EINSELE

Gerhard Einsele, Professor Emeritus, Department of Earth Sciences, Geologisch-Paläontologisches Institut der Universität, Tübingen, was honored at the GSA Annual Meeting in Reno, Nevada, November 9–18, 2000, as the 2000 GSA Honorary Fellow.

At a time when the earth sciences, following the general trend in science, became fragmented into ever smaller subdisciplines, Einsele swam against the current, effectively bridging the fields of sedimentology, hydrogeology, and environmental geology. He made significant contributions to modern and ancient deep-water sedimentation in the Gulf of California and the Rhenish Slate Belt in Germany. In his dealings with the problems of compaction, sediment physical properties, and denudation-sedimentation balances, he achieved fundamental progress through the application of quantitative techniques.

Born in Germany in 1925, Einsele began his studies in 1948 after return from war imprisonment in Egypt. He obtained his doctorate in mineralogy in 1954 and the habilitation (D.Sc.) in 1961 from the University of Tübingen. University appointments included the chairs for applied geology at Kiel University and for exogenic dynamics at Tübingen.

Einsele is best known for his book *Sedimentary Basins: Evolution, Facies, and Sediment Budget*, a standard reference book for any course on basin analysis and sedimentation and tectonics. He was co-editor of the landmark publication *Cyclic and Event Stratification* and editor of the book about a major ecological-environmental research project, *Nature Park Schönbuch*. He received the Hans-Stille medal of the German Geological Society, whose hydrology subdivision he chaired for many years. In 1997, he toured Europe and North America as an International Association of Sedimentologists distinguished lecturer. ▲

GSA Fellows elected by Council on November 13, 2000

Geoffrey A. Abers

Warren D. Allmon

Götz Bokelmann

William S. Cordua

Peter H. Hennings

Maria Florencia Márquez – Zavalía

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Positions Open

ENVIRONMENTAL GEOLOGIST NORTHERN KENTUCKY UNIVERSITY

The Department of Physics and Geology invites applications for a tenure-track position in environmental geology beginning in August 2001. Undergraduate teaching experience and a Ph.D. in geology with experience in environmental geology are required. Teaching responsibilities will include upper division undergraduate courses in the candidate's area of specialization as well as introductory geology courses with labs. Preference will be given to individuals with strong backgrounds in hydrogeology and environmental studies of groundwater quality. Candidates will be expected to develop a modest research program that will include undergraduate geology and environmental science majors. The candidate will also be expected to contribute to the department's educational outreach programs to P–12 and non-traditional science students. Collaboration with NKU's emerging Environmental Science program, Environmental Resource Management Center and/or the Center for Integrative Natural Science and Mathematics offer the successful candidate additional professional opportunities. Rank and salary commensurate with qualifications. Send letter of application, curriculum vitae, separate statements of teaching philosophy and research interests, and the names, addresses, phone numbers, and e-mail addresses of three references to: Geology Search Committee, Department of Physics and Geology, Northern Kentucky University, Highland Heights, KY 41099-1900. Candidates may be required to submit additional documentation. Screening will begin Mar. 15, 2001 and continue until the position is filled. For additional information on Northern Kentucky University visit http://www.nku.edu. Northern Kentucky University is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF IDAHO DISTINGUISHED PROFESSOR IN SUBSURFACE SCIENCE

The Department of Biological and Agricultural Engineering invites nominations and applications for the position of Distinguished Professor in Subsurface Science. This is a tenured, full time, 12-month/year position at Idaho Falls. The campus is ideally located adjacent to the Idaho National Engineering and Environmental Laboratory (INEEL) and near Yellowstone and Teton National Parks. The research and teaching effort will focus on strengthening the strategic alliance of the University of Idaho and INEEL in the area of vadose zone hydrology and contaminant transport. **Research Duties:** Develop a nationally recognized research program in vadose zone hydrology and contaminant transport. The research will focus on arid and semi arid environments characterized by a thick and fractured vadose zone. **Teaching Duties:** Develop and teach courses focused on analysis of flow and transport in the vadose zone and support hydrology courses at the graduate level, and provide academic and research advice to undergraduate and graduate students. **Required Qualifications:** Excellence in research in the vadose zone; demonstrated ability to participate in and lead interdisciplinary research teams; Ph.D. in agricultural, biological, civil, environmental engineering or related discipline. **Desired Qualifications:** Demonstrated ability in teaching courses at the undergraduate and graduate level. Demonstrated ability in advising and directing graduate students. Registered Professional Engineer or eligible to take the P.E. exam for the State of Idaho. Contact/Application Procedure: Submit application letter including a statement of interests and goals, curriculum vitae, most recent peer reviewed publication, and the names, addresses, telephone numbers, and e-mail addresses of three references to: Dr. James A. DeShazer, Head, Department of Biological & Agricultural Engineering, University of Idaho, P.O. Box 440904, EP 419, Moscow, Idaho 83844-0904. Telephone: (208) 885-6182. FAX: (208) 885-7908, E-mail: baengr@uidaho.edu. **Closing Date for Applications:** Will close when a sufficient number of qualified candidates have been identified, but not earlier than March 15, 2001. Information on the University of Idaho, the UI Department of Biological and Agricultural Engineering, Idaho Water Resources Research Institute and the Idaho National Engineering and Environmental Laboratory can be obtained from: www.if.uidaho.edu, www.uidaho.edu, www.uidaho.edu/bae, www.uidaho.edu/rsrch/iwrri, and www.inel.gov. A complete description can be obtained from www.uidaho.edu/bae. To enrich education through diversity, the University of Idaho is an equal opportunity/affirmative action employer.

ASSISTANT PROFESSOR OF RESEARCH, PHYSICS AND CHEMISTRY OF MAGMATIC PROCESSES OR MINERAL INTERFACES AT HIGH TEMPERATURES

The Department of Geological Sciences at Brown University is planning future research directions as part of a long-term strategic plan. We invite applications for an assistant professor of research position with expertise in the physics and chemistry of magmatic processes, including high-temperature solid-state processes. Such processes might include, but are not limited to, partial melting, magma generation, petrogenesis, melt migration, magma chamber processes and volcanic eruption, crystal and bubble nucleation and growth, transport and/or reaction at grain boundaries or crystal-melt interfaces. Candidates with research interests in both Earth and planetary problems are encouraged to apply.

Preference will be given to candidates whose strengths complement existing departmental research programs (see http://www.geo.brown.edu). A Ph.D. degree or equivalent is required.

This will be a 3-year appointment, non-tenured, with the possibility of renewal. The position will be funded by a combination of university and external sources. Opportunities exist for teaching in our high-caliber undergraduate and graduate programs and for supervising graduate-level research.

Applicants should forward a curriculum vita, descriptions of research and teaching interests, and a list of at least three potential references to Timothy Herbert, Chair, Search Committee, Department of Geological Sciences, Brown University, Providence, RI 02912-1846.

We will begin to review applications on February 15, 2001. The anticipated start date of the position is July 1, 2001.

Brown University is an equal opportunity/affirmative action employer. We particularly welcome applications from minority or female candidates.

LECTURER, HYDROGEOLOGY SUNY ONEONTA

The Department of Earth Sciences at the State University of New York, College at Oneonta, invites applications for a one-year, lecturer position beginning Fall 2001. This is a full-time, sabbatical replacement in hydrogeology. Emphasis is on groundwater hydrology and watershed management, preferably incorporating field applications, environmental geophysics, and aqueous geochemistry. Master's degree required, Ph.D. preferred. The applicant will be expected to teach undergraduate courses in hydrogeology, watershed management and physical geology, with additional offerings at the undergraduate or master's level in groundwater modeling, aqueous geochemistry, or environmental geophysics. Courses will serve departmental programs in water resources, geology, meteorology, and environmental science. Please see our Web page at www.oneonta.edu. To apply: Send letter of application, resume, academic transcripts, and three letters of recommendation to: Dr. Peter Muller, Chair, Department of Earth Sciences, Box B, SUNY, Oneonta, NY, 13820-4015, (607) 436-3707, mullerpd@oneonta.edu. Review of applications will begin March 1, 2001, and continue until position is filled. SUNY Oneonta is an EEO/AA/ADA employer. Women, minorities, veterans, and persons with disabilities are encouraged to apply.

EASTERN KENTUCKY UNIVERSITY

The Department of Earth Sciences (www.earthscience.eku.edu) invites applications for two full-time positions, both to begin August 15, 2001.

Surficial Geologist/Geoscientist (Assistant Professor, tenure-track). We seek a colleague with academic training and practical experience in surface active geological processes and their consequences, who will complement the department's existing strengths in hydrogeology and environmental science. Candidates must exhibit a commitment to excellence in teaching, will be responsible for general education science courses, courses for undergraduate and graduate geology majors, and will supervise master's degree candidates. We expect the incumbent to involve students in his/her research. Ph.D. preferred; ABD required.

Earth Scientist (Visiting Assistant Professor, renewable to a maximum of three years). We wish to add to our faculty a broadly educated earth scientist capable of teaching interdisciplinary science, as well as geology courses for non-majors and majors. Candidates must be interested in offering courses to pre- and in-service teachers, and be willing to teach a course at one of EKU's extended campus centers. Ph.D. preferred; ABD required.

Eastern Kentucky University is a large, comprehensive, regional university located in the Bluegrass region of Kentucky, 25 miles south of Lexington. Candidates should submit a letter of application, clearly identifying the position(s) being applied for; curriculum vitae; statement of teaching and research interests; and contact information, including name, address, e-mail address and telephone numbers, of three references to Dr. Malcolm P. Frisbie, Acting Chair, Department of Earth Sciences, Eastern Kentucky University, Richmond, KY 40475-3102. Review of applications will begin March 1, 2001; positions will remain open until filled. Address questions to natfrisbie@acs.eku.edu. Eastern Kentucky University is an equal opportunity/affirmative action employer and encourages applications from minority and female candidates.

NORTH CAROLINA STATE UNIVERSITY

The Department of Marine, Earth and Atmospheric Sciences (MEAS) at North Carolina State University in Raleigh invites applications and nominations for the position of professor and head of the department. MEAS is one of the largest interdisciplinary earth science departments in the nation and has 32 full-time faculty and numerous visiting, adjunct, and associate faculty. The new head must have an earned Ph.D., a strong record of scholarly activity, possess the vision and ability to take a leadership role in new directions for the department, and have a balanced appreciation for all areas in a multidisciplinary department. He or she is expected to establish high standards for the teaching, research and outreach programs of the department and to maintain a vigorous program of scholarship and professional activity. The salary and initial package for the successful applicant will be competitive and commensurate with qualifications. Applicants should send a letter of interest, a curriculum vita, and names of at least three references to Dr. R.H. Martin, Chair, MEAS Head Search Committee, College of Physical and Mathematical Sciences, Box 8201, North Carolina State University, Raleigh, NC 27695-8201. The department and its activities are described more fully on its Web site, http://www.meas.ncsu.edu. Questions may be directed to rhmartin@math.ncsu.edu. Review of applications will begin Feb. 1, 2001, and will continue until the position is filled. Proper documentation of identity and employability will be required. N.C. State is an equal opportunity, affirmative action employer and especially solicits applications from women, underrepresented minorities, and persons with disabilities.

DEPARTMENT OF OCEANOGRAPHY DALHOUSIE UNIVERSITY AND CANADIAN INSTITUTE FOR ADVANCED RESEARCH

Applications are invited for a probationary tenure track assistant professor position in GEOCHEMISTRY OF ANCIENT AND MODERN OCEANS. The successful candidate will be expected to develop a vigorous, externally funded research program, supervise M.Sc. and Ph.D. students, and teach graduate and undergraduate classes. S/he will also be appointed a scholar in the Earth System Evolution Programme (ESEP) of the Canadian Institute for Advanced Research (CIAR). Candidates should have an interest in quantitative interdisciplinary research into the role of ocean chemistry in regulating and recording the evolution of Earth's biogeochemical cycles.

The successful candidate will have a record of research achievement, contribution to the discipline, and assessed potential necessary to be appointed by CIAR. As a member of ESEP, the incumbent initially will be supported partly by CIAR and during this time will benefit from reduced teaching responsibilities and from association with an international network of researchers in earth system sciences. A Ph.D. is required, and postdoctoral experience is normally expected.

Applicants should submit a c.v., a statement of research/teaching objectives, and the name, address, phone, and e-mail of four referees. Applications will be considered as soon as they are complete, and they will be accepted until the position is filled. Applications should be sent to: Chair, Geochemistry of Ancient and Modern Oceans Search Committee, Department of Oceanography Dalhousie University, Halifax, NS, Canada, B3J 4H1, phone (902) 494-3557, fax (902) 494-3877, oceanography@dal.ca. For more specific information, access our Web sites: www.phys.ocean.dal.ca/docs/jobsatdal.html; www.ciar.ca; adder.ocean.dal.ca/esep.

DALHOUSIE UNIVERSITY is an Employment Equity/Affirmative Action Employer. The University encourages applications from qualified women, Aboriginal peoples, racially visible people, and persons with a disability. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

MICROPALEONTOLOGIST
SEA-ICE RECONSTRUCTIONS
LAMONT-DOHERTY EARTH OBSERVATORY

Lamont-Doherty Earth Observatory of Columbia University invites applications from individuals with demonstrated expertise in reconstructing past sea-ice distributions using microfossils preserved in marine sediments. The position will be filled either at the level of postdoctoral research scientist or at the level of associate research scientist, depending on the qualifications and experience of the successful candidate. Salary will be commensurate with the position.

The successful candidate will have a Ph.D. and demonstrated experience in micropaleontological techniques as well as in the development and application of transfer functions used to reconstruct past changes in sea ice distributions. Prior experience in processing sediment trap samples, as well as sediments, is highly desirable, as is experience using transfer functions to reconstruct sea surface temperature. The successful candidate will also be expected to have a demonstrated knowledge of the literature of late Quaternary paleoceanography of the Southern Ocean.

Funding is available initially for one year, with anticipation of a second year contingent on the availability of incremental funds and the successful review of first-year activities. The opportunity exists for the successful candidate to develop an independent externally funded program of research, and apply for appointment to the permanent research staff at LDEO beyond the completion of this project.

Candidates are requested to send a vita, including an e-mail address, together with a brief description of prior research experience to Dr. Robert F. Anderson, Lamont-Doherty Earth Observatory of Columbia University, 61 Route 9W, Palisades, NY 10964, USA. Inquiries may also be sent to boba@ldeo.columbia.edu. Candidates should arrange to have three letters of recommendation sent directly to the address above.

It is anticipated that the position will be filled in spring 2001. Consideration of applications will begin on March 1, 2001, and will continue until the position is filled. Minorities and women are encouraged to apply. Columbia University is an equal opportunity/affirmative action employer.

UWM GEOSCIENCES ASSOCIATE INFORMATION PROCESSING CONSULTANT

The Department of Geosciences at the University of Wisconsin—Milwaukee seeks to hire an academic staff member into the position of associate information processing consultant. Applicants must hold a bachelor's degree in geosciences or computer science. A master's degree or post-baccalaureate experience is desirable. The successful candidate will act as a resource for information technology and computer applications related to teaching and research, operate and manage data from UWM's seismograph systems, and support departmental outreach/educational activities. A more complete description of the position and information regarding the department is available online at: http://www.uwm.edu/Dept/Geosciences/.

Candidates must mail a resume, a statement of application, and the names of three references to Mark Harris, Chair, Department of Geosciences, University of Wisconsin—Milwaukee, P.O. Box 413, Milwaukee, WI 53201 (fax: 414-229-5452; e-mail: mtharris@uwm.edu), and postmarked by March 1, 2001. The University of Wisconsin—Milwaukee is an Equal Opportunity/Affirmative Action Employer.

SEDIMENTOLOGY/STRATIGRAPHY
INDIANA UNIVERSITY—BLOOMINGTON

The Department of Geological Sciences at Indiana University, Bloomington, invites applications for a tenure-track position at the assistant or associate professor level or a tenured position at the associate professor level in the general area of sedimentology/stratigraphy. Candidates applying at the assistant professor level should have postdoctoral experience.

Applications should include a personal statement of teaching and research interests, a detailed curriculum vitae, and names and addresses (including e-mail) of five referees. Appointment could begin as early as August, 2001. Applications should be submitted by March 15, 2001, to Chair, Sed/Strat Search Committee, Department of Geological Sciences, Indiana University, 1001 E. 10th St., Bloomington, IN 47405. Information about the Indiana University Department of Geological Sciences can be found at http://www.indiana.edu/~geosci.

Indiana University, as an Equal Opportunity/Affirmative Action Employer, encourages the candidacies of women and minorities.

LABORATORY COORDINATOR
DEPARTMENT OF GEOLOGY AND ENVIRONMENTAL GEOSCIENCES

The Department of Geology and Environmental Geosciences at Lafayette College, Easton, PA, is accepting applications for a full-time, nontenure-track position for a laboratory coordinator. Applicants must have at least an M.S. in geology. Responsibilities will include teaching introductory geology laboratories, assisting with upper-level geology courses, laboratory preparation and set up, and on occasion, teaching introductory geology lectures. The lab coordinator will also curate the rock and mineral and map collections used for teaching and provide field and electronic support. A strong computer background including proficiency using both Macintosh and Windows-based PCs and associated hardware/software such as a slide maker, scanner, digitizer, etc., is essential. The position begins summer/fall 2001. Please include a resume, a description of experience and capabilities, graduate and undergraduate transcripts, and reference letters from at least three references to: Dr. Dru Germanoski, Head, Department of Geology and Environmental Geosciences, Lafayette College, Easton, PA 18042; e-mail germanod@Lafayette.edu. Lafayette College is committed to equal opportunity. Women and minorities are encouraged to apply. We will begin reviewing applications March 1, 2001, and applications will be accepted until the position is filled.

WITTENBERG UNIVERSITY
ASSISTANT PROFESSOR OF GEOLOGY

The Department of Geology invites applications for a tenure-track appointment at the assistant professor rank beginning August 20, 2001. Applicants should be broadly trained in the geosciences with expertise in sedimentary processes and environments and stratigraphy. The primary teaching responsibilities include introductory geology and undergraduate courses in the general areas of sedimentary geology, stratigraphy, and earth history. An integral field component in both teaching and research is essential. The ability to incorporate fundamentals of invertebrate paleontology in appropriate courses would be an advantage. The successful candidate will be expected to demonstrate excellence in teaching and maintain an active research program that involves students in at least one of the areas of teaching responsibility. Current faculty expertise in the department includes mineralogy, igneous & metamorphic petrology, process geomorphology, environmental geology, and economic geology. Geology faculty members are encouraged to contribute to interdepartmental programs in environmental studies and field studies, and the college's first-year interdisciplinary course.

Wittenberg University is a small, private, residential undergraduate institution firmly committed to the liberal arts and sciences. Interested applicants are encouraged to visit our Web site (www.wittenberg.edu) for details about the college and department. Wittenberg participates in AA/EOE/ADA. We encourage women and minority applicants to apply as we are committed to creating an ethnically and culturally diverse community. Review of applications will begin February 1, 2001, and continue until the position is filled.

Applications should include a curriculum vita, a brief statement about teaching in a liberal arts and sciences setting, and your thoughts on involving research and field experience in your teaching. Send these materials and a list of at least three references (with phone numbers and e-mail addresses) to Dr. Kenneth W. Bladh, Professor and Chair, Geology Department, Wittenberg University, Springfield, Ohio, 45501-0720, kbladh@wittenberg.edu.

SURFICIAL PROCESSES
UNIVERSITY OF MINNESOTA

The Department of Geology and Geophysics at the University of Minnesota invites applications for a tenure-track assistant professorship in surficial processes, broadly interpreted. Appointment at a more senior rank is possible under exceptional circumstances. Applicants must have a doctoral degree or equivalent at the time of appointment and demonstrate strong potential for creative research and excellent teaching at both the undergraduate and graduate levels. The Department of Geology and Geophysics has 24 faculty members, 25 research associates and postdoctoral fellows, and about 60 graduate students encompassing a broad range of geoscience research. Existing strengths in the School of Earth Sciences include the Minnesota Geological Survey, the Limnological Research Center, and the Institute for Rock Magnetism, along with energetic research programs in isotope and low-temperature geochemistry, geodynamics, tectonics, hydrogeology, paleoclimatology, and sedimentary geology. We maintain a wide array of modern analytical, experimental, and computational facilities, and have strong ties with the St. Anthony Falls Laboratory (environmental fluid mechanics) and the Large Lakes Observatory (UM—Duluth). Interested applicants are invited to visit our Web site (http://www.geo.umn.edu/) to learn more about the School of Earth Sciences.

Applicants should send a resume, a bibliography, and a statement of teaching and research interests, as well as the names and addresses of at least three referees to Search Committee (Surficial Processes), Department of Geology and Geophysics, University of Minnesota, Minneapolis, MN 55455, USA; phone: (612) 624-1333; fax: (612) 625-3819.

Review of files began on December 1, 2000. Applications will be accepted until the position is filled.

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

WATER SCIENCE
UNIVERSITY OF NEBRASKA—LINCOLN

The University of Nebraska—Lincoln invites applications for a faculty position in water science in the Department of Geosciences. This position will be filled at the rank of associate or full professor. Ph.D. is required. The successful candidate will have a substantial record of research, a history of external funding, and the potential to become a leader in the hydrological sciences. Our department emphasizes hydrogeology, meteorology/climatology, sedimentary geology, and surficial processes. Preference will be given to water scientists with research specialties that will promote interactions with one or more of these fields. We especially seek applicants with expertise in geochemistry or surface hydrology. Examples of research areas that would be of interest include (but are not limited to) physical and chemical interactions between surface and groundwater, low-temperature water-rock interactions, numerical modeling of hydrological systems, atmosphere-hydrosphere interactions, and watershed hydrology and geochemistry.

The University of Nebraska—Lincoln is the principal research institution in the four-campus University of Nebraska system. The Department of Geosciences resides within the College of Arts and Sciences, the oldest, largest, and most diverse college in the University and state. The department has grown from 13 faculty members (9.6 FTE) in 1996 to 22 faculty members (16.1 FTE) today, some of whom share appointments with the University of Nebraska State Museum, the Conservation and Survey Division, or the School of Natural Resource Sciences. The department offers B.A., B.S., M.S., and Ph.D. degrees, with graduate specializations in geology, meteorology/climatology, and hydrogeology. Additional information on the department and two other faculty searches now in progress is available at www.unl.edu/geology/geohome/html. Applicants should submit a letter of interest, current resume, and contact information for five references to: Dr. Vitaly Zlotnik, Chair, Water Science Search Committee, University of Nebraska—Lincoln, Department of Geosciences, 214 Bessey Hall, Lincoln NE 68588-0340. Further information can be obtained by phone, (402) 472-2663, fax, 402-472-4917, or e-mail, vzlotnik1@unl.edu.

Review of applications will begin February 28, 2001, and continue until the position is filled. The University of Nebraska—Lincoln is committed to a pluralistic campus community through Affirmative Action and Equal Opportunity, and is responsive to the needs of dual career couples. We assure reasonable accommodation under the Americans with Disabilities Act; contact Vitaly Zlotnik at (402) 472-2663 for further information.

GEOLOGICAL ENGINEERING FACULTY
DEPARTMENT OF MINING AND GEOLOGICAL ENGINEERING
UNIVERSITY OF ALASKA FAIRBANKS

Position # 203845. The Department of Mining and Geological Engineering at the University of Alaska Fairbanks invites application for a tenure-track assistant professor in geological engineering. The position requires a strong commitment to outstanding teaching, sponsored research, and publications in archival journals. The position is available beginning fall 2001. Candidates are required to have a bachelor's degree in engineering or geological sciences and an earned Ph.D. degree in engineering by the time of appointment. At least one of the earned degrees must be in geological engineering. Industrial experience is desirable, and professional registration or eligibility for immediate registration as a professional engineer in the State of Alaska will be given preference. Further, the successful candidate must demonstrate or show potential for scholarly accomplishments and the ability to attract research funding. Salary will be commensurate with education and experience.

The candidate will be expected to assist in teaching one or more of the following areas: geo-materials engineering, geologic hazards, engineering design, and engineering sciences (computer techniques, mechanics, and mechanics of materials), and developing graduate courses in geological engineering.

The application deadline is March 1, 2001. The review of applications will begin on March 15, 2001.

Applicant should send curriculum vitae, a statement of current and future research interests, and the names of three professional references to: Chairman, Geological Engineering Faculty Search Committee, Department of Mining & Geological Engineering, University of Alaska Fairbanks, P.O. Box 755800, Fairbanks, Alaska 99775-5800, (907) 474-7388, fax 907-474-6635.

GEOLOGICAL ENGINEERING FACULTY
DEPARTMENT OF MINING
AND GEOLOGICAL ENGINEERING
UNIVERSITY OF ALASKA FAIRBANKS

Position # 203895. The Department of Mining and Geological Engineering at the University of Alaska Fairbanks invites application for a tenure-track assistant professor in geological engineering. The position requires a strong commitment to outstanding teaching, sponsored research, and publications in archival journals. The position is available beginning fall 2001. Candidates are required to have a bachelor's degree in engineering or geological sciences and an earned Ph.D. degree in engineering or geological sciences by the time of appointment. At least one of the earned degrees must be in geological engineering. Industrial experience is desirable, and professional registration or eligibility for immediate registration as a professional engineer in the State of Alaska will be given preference. Further, the successful candidate must demonstrate or show potential for scholarly accomplishments and the ability to attract research funding. Salary will be commensurate with education and experience.

The candidate will be expected to assist in teaching one or more of the following areas: remote sensing, Geographical Information Systems, subsurface hydrology, engineering design, and engineering sciences (computer techniques, mechanics, and mechanics of materials), and developing graduate courses in geological engineering.

The application deadline is March 1, 2001. The review of applications will begin on March 15, 2001.

Applicant should send curriculum vitae, a statement of current and future research interest and the names of three professional references to: Chairman, Geological Engineering Faculty Search Committee, Department of Mining & Geological Engineering, University of Alaska Fairbanks, P.O. Box 755800, Fairbanks, Alaska 99775-5800, (907) 474-7388, fax 907-474-6635.

ASSISTANT PROFESSOR IN EARTH SCIENCES
WHITTIER COLLEGE

The Environmental Science Program at Whittier College invites applications for a tenure-track position at the assistant professor level in the Department of Earth Sciences. A Ph.D. in geology or a closely related field is required. Candidates with specialties in earth surface or near surface processes, or those working on geosphere-hydrosphere-atmosphere interactions will be given preference. Excellent teaching at all undergraduate levels in earth sciences and the interdisciplinary environmental sciences program is expected, as is participation in Whittier's innovative interdisciplinary liberal education and writing programs. The successful candidate will develop a research program involving Whittier undergraduates. For more detailed information see www.earthsciences.whittier.edu or contact Cheryl Swift at (562) 907-4273. Applications will be accepted until the position is filled; review of applications began in January. Whittier College is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply.

Whittier is a small, independent, selective liberal arts college in southeast Los Angeles County.

ENVIRONMENTAL GEOLOGIST
LANDER UNIVERSITY

Environmental Geologist: Assistant Professor, Tenure-Track: Begins August 2001. Required: Ph.D. in geology; teach physical and environmental geology, environmental science, and hydrogeology; coordinate E.S. degree program; and direct undergraduate research. Screening of applicants began Jan. 1, 2001. Application information and complete job description may be obtained at http://www.science.lander.edu/jobs.html AA/EOE.

Services and Supplies

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

Opportunities for Students

Graduate Student Opportunities, Department of Geological and Petroleum Engineering, University of Missouri—Rolla. We are pleased to announce the availability of a graduate research assistantship to develop and test a computer program to simulate subsurface investigations for environmental and geotechnical sites. The project is funded through the NSF Division of Undergraduate Education. Applicants should have an interest in stratigraphy, groundwater, engineering geology, and GIS. No computer programming skills are required. More information on the project may be found at www.umr.edu/~psanti/simulator/ and by e-mail to psanti@umr.edu.

The department offers a wide range of graduate specialties, including emphasis areas in environmental protection and hazardous waste management, groundwater hydrology and contaminant transport, engineering geology and geotechnics, and natural resources, minerals, and energy. Teaching assistantships are also available for M.S. and Ph.D. candidates starting in the fall 2001 and winter 2002 semesters. More information may be found on the department's home page at www.umr.edu/~gee or write to: Graduate Advisor, Dept. of Geological and Petroleum Engineering, 129 McNutt Hall, University of Missouri—Rolla, Rolla, MO 65409.

Undergraduate Research Opportunity. The Minority Undergraduate Scholarship and Training (M.U.S.T.) program in biogeochemistry at Old Dominion University invites applications for the summer 2001 session. This program invites 10 undergraduate scholars majoring in the natural sciences from U.S. institutions to the Old Dominion University campus in Norfolk, VA, for a 10-week research program (June 4 through August 18). Students work with faculty mentors specializing in the field of biogeochemistry.

Research opportunities exist for the study of metal cycling in ocean/estuarine environments, water mass tracing, habitat reconstruction via trace metal composition of biological material and much more. For information about the program please visit us online at http://web.odu.edu or contact Dr. Robyn Hannigan, (870) 972-3086, hannigan@avajo.astate.edu. Applications are due March 20, 2001.

Arkansas State University: Environmental Sciences Ph.D. Program, Graduate Research Assistantship. The Environmental Sciences Ph.D. Program at Arkansas State University seeks a Ph.D. student to conduct research in hydrochemistry/aquatic ecology. The USGS-AWRC funded project is focused on investigating the linkages between habitat contraction and basin hydrology. Our goal is to conduct field, laboratory, and numerical studies to examine the contraction of endemic species habitat and changes in basin hydrology. We seek a motivated student with a degree in either geology or biology and a strong background in the other science. Interested students are encouraged to apply for fall 2001 admission.

For information about the Environmental Sciences Ph.D. Program, see our Web site (http://www.cas.astate.edu/evs) or contact Dr. Robyn Hannigan, Department of Chemistry, Arkansas State University, State University, AR, 72467, (870) 972-3086, hannigan@navajo.astate.edu.

Graduate Assistantships. The Geology Department and Center for Remote Sensing and Energy Research has assistantships available for M.S. students for the spring and fall semesters. Financial aid includes a nine-month stipend for two years, full tuition waiver, and funds to support thesis research. Areas of department expertise include hydrology, remote sensing, environmental geology and geochemistry, carbonate and clastic sedimentology, petroleum geology, paleovolcanology, structure and tectonics, Precambrian geology, and computer applications in geology. Field research is carried out in Scotland, the Sierra Nevada in California, and Africa, as well as in Texas and Oklahoma. Contact Dr. R. Hanson at (817) 257-7996; hanson@gamma.is.tcu.edu. Additional information about the department can be found on our Web site at http://geowww.geo.tcu.edu.

Graduate Assistantships at California State University, Fullerton. The Department of Geological Sciences has at least two full calendar-year graduate assistantships (including a summer stipend) available beginning fall 2001. These two-year, combined teaching/research assistantships are available to exceptionally qualified students entering our M.S. program in fall 2001. The area of study is unrestricted. Our department has research strengths in applied geology (including engineering geology and hydrogeology), stratigraphy, Quaternary geology and neotectonics, petrology and geochemistry, geophysics, and tectonics.

For more information and applications, visit http://geology.fullerton.edu or contact Brady Rhodes, Graduate Advisor, Department of Geological Sciences, California State University, Fullerton, Fullerton, CA 92834 or brhodes@fullerton.edu. Applications must be received by March 1, 2001, in order to be considered for these assistantships.

Department of Geosciences, University of Arizona, announces the availability of Sloan Scholarships for minority graduate students in the geosciences. The Alfred P. Sloan Foundation and the Department of Geosciences are committed to increasing the number of African Americans, Hispanic Americans, and Native Americans receiving Ph.D.s in the geosciences. Sloan scholars receive up to $30,000 for stipends, tuition, fees, and research expenses, plus peer and faculty mentoring. Additional support through other fellowships, and teaching or research assistantships is also available. Master's (intending to complete a Ph.D.) and Ph.D. candidates will be considered. Inquiries and requests for applications to: Graduate Program, Department of Geosciences, The University of Arizona, Tucson, AZ 85721. Or, gradapps@geo.arizona.edu and http://geo.arizona.edu.

Applied Geohydrology Summer Research Assistantships: Kansas Geological Survey, Lawrence, KS. These are 12-week summer positions open to students at any university. The individual will participate in a variety of field activities in support of KGS research programs. The themes of the activities in the summer of 2001 will be hydraulic test methods, direct push technology, and steam-aquifer interactions. Start approx. 5-14-01. Salary $5,500 for 12-week appointment. Required: Relevant coursework in earth sciences or engineering; interest in hydrogeology; and ability and willingness to participate in moderate physical activity in mid-summer temperatures in Kansas. Applications postmarked by 3-1-01, first review. See #66146 at <http://www.kgs.ukans.edu/General/jobs.html> or call (785) 864-2152. The Univ. of Kansas is an EO/AA employer.