GSA TODAY

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Experimental Stratigraphy

INSIDE

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science article

On the cover: Honeycomb floor of the eXperimental EarthScape basin at the St. Anthony Falls Laboratory, University of Minnesota. A 10-cell version of this basin was used for the experiment described in "Experimental Stratigraphy," Paola et al., p. 4–9. Photo by Jim Mullin.

Experimental Stratigraphy

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ABSTRACT

Stratigraphy has been a descriptive science for most of its history. Recently, thanks to the development of the mechanistic view of Earth embodied in plate tectonics and to improvements in our understanding of sediment dynamics, the stratigraphic community has developed a first generation of quantitative models for the filling of basins and the formation of stratigraphic patterns. How do we test such models? The field is the ultimate repository of information, but exposure is limited, and it is often difficult to constrain key governing variables independently. We have developed a novel experimental basin—nicknamed Jurassic Tank—that allows us to produce experimental stratigraphy under precisely controlled and monitored conditions of sediment supply, subsidence, base-level variation, and transport mechanics. The unique feature of the basin is a fully programmable subsiding floor. In the first application of the system, we looked for evidence of decoupling (out-of-phase behavior) between shoreline and base level, as has been predicted by some recent stratigraphic models. We found little support for this idea, but the results demonstrate the potential that experiments have for complementing field and theoretical studies of the filling of sedimentary basins.

Before you read this, try solving the problem posed in Figure 1.

INTRODUCTION

The central goal of sedimentary geology is to interpret the history of Earth's surface from sedimentary rocks. We develop competing hypotheses, debate, discuss, and compare, but unlike areas of science that deal in accessible time and space scales, in sedimentary geology it is often difficult to determine unambiguously who is right. The ultimate source of truth—the stratigraphic record itself—is like a fragmentary manuscript written in a long-forgotten language. Deposits are imperfectly exposed and hard to date, seismic images are highly filtered and expensive, and the precise sequence of events that produced real-world stratigraphy usually cannot be determined independently. Trying to understand the language of sediments using rocks alone would be like trying to understand Russian by opening *War and Peace* to the middle and staring at the pages.

Sedimentary geologists have long recognized this and sought Rosetta stones for the stratigraphic record through

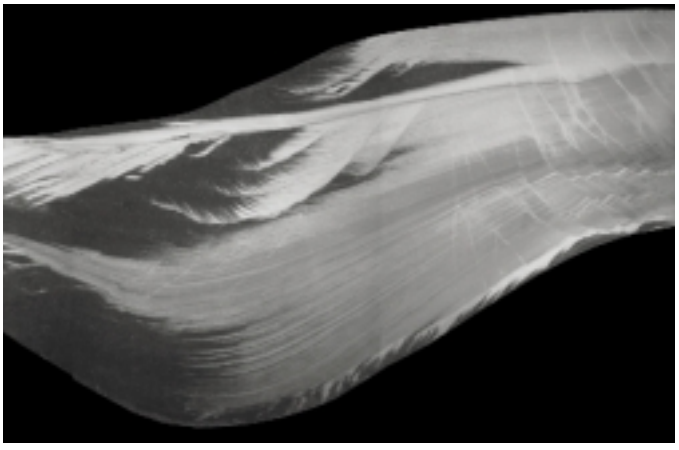

Figure 1. Can you interpret this panel? It shows a section of basin sediment taken parallel to transport (i.e., a dip section), with flow from right to left. Darker material is lighter and hence more mobile. Distal part of deposit was formed under water, and proximal part is fluvial. Break between light and dark material is a good indicator of shoreline position. The challenge: Deduce history of sediment supply, subsidence, and base level for this section using only information above and geometry of the preserved deposits. Answer is given in Figure 5.

studies of modern environments and processes. Most of our understanding of sedimentary lithofacies, for instance, comes from synthesis of the mainly horizontal information we have from modern depositional environments with the mainly vertical information provided by ancient deposits. A particularly fruitful line of research has clarified the origin of sedimentary structures (e.g., cross-stratification) in terms of bed forms and other relatively generic features of sediment-depositing flows (Allen, 1984; Middleton and Southard, 1984). This research, carried out in both field and laboratory, has taught us much about the alphabet of the language of sediments.

The paragraphs and chapters of the sedimentary narrative are written in the form of larger-scale sequences of sedimentary facies. A basic tenet in stratigraphy is that patterns in these sequences are controlled by three main independent variables: sea level, subsidence (rate and distribution), and sediment supply (e.g., Sloss, 1962). To this trinity we should add a fourth variable group that controls the efficacy of the transport system (e.g., water supply for rivers, wave climate or tidal range for the continental shelf). The first attempts to understand how changes in these independent variables are recorded stratigraphically were descriptive. However, the physical mechanisms that distribute sediment (not to mention biological and chemical processes) are complex enough that it is difficult to model stratigraphy using descriptive methods alone. Two major developments have allowed us to create a first generation of physically based, quantitative stratigraphic models (Cross, 1990; Harbaugh et al., 1999; Paola, 2000; Slingerland et al., 1994): (1) development of quantitative models of the mechanics of basin subsidence, an outgrowth of plate-tectonic theory; and (2) improvements in our understanding of how sediment-transport systems work. By coupling subsidence and transport, we produce theoretical models of stratigraphy. (Because of the complexity of the equation systems involved, quantitative stratigraphic models are nearly always numerical.) These models should allow us to read the sedimentary record with greater subtlety and precision. However, it is worth pausing before rushing off to apply our newly minted models to the stratigraphic record—after all, ancient basins are one setting where it is very hard to check our model results independently!

The Rationale for the eXperimental EarthScape Facility

In most sciences, carefully controlled experiments are the preferred means of testing theoretical models. For a variety of reasons, experimentation has not played much of a role in stratigraphic science, but the experimental approach is well developed in other areas of sediment dynamics, particularly in civil engineering and geomorphology. One of the main logistical hurdles to experimental stratigraphy is the necessity of including tectonic effects such as subsidence and uplift. We have addressed this by building a large experimental basin that incorporates a unique, flexible subsiding floor to simulate the development of sedimentary basins under a wide variety of subsidence conditions. This new experimental facility (the eXperimental EarthScape or XES basin) can be used to study the formation of stratigraphy under completely controlled conditions of base-level change, subsidence, sediment supply, and transport—the same influences that control natural basin stratigraphy. The experimental system includes the most fundamental physical processes associated with basin filling—river, wave, current, and mass-flow sediment transport—and it allows the boundaries between transport environments (e.g., the shoreline) to evolve on their own. The resulting data sets document spatial and temporal changes in sediment budgets, morphodynamics, and stratigraphic response.

The main advantages of experimental stratigraphy are that boundary conditions can be controlled, processes with natural analogs that occur over long time scales can be thoroughly documented, the resultant deposits can be dissected at high resolution and visualized in three dimensions, and transport processes can be directly related to depositional products. On the other hand, experimental systems leave some important things out (e.g., biogenic processes and Coriolis effects), and they distort others (e.g., topographic slopes tend to be exaggerated).

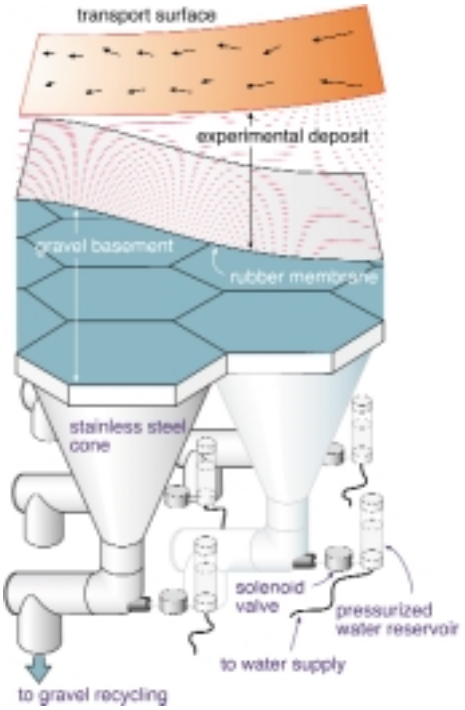

Figure 2. Schematic diagram of subsidence mechanism used in eXperimental EarthScape (XES) subsiding-floor experimental basin. Pulses of water shot through narrow tubes knock gravel out of pipe, causing subsidence of gravel surface.

Formally, we use theory to link experiments and field cases. Once a theory has had a good workout in a controlled system, we can be more confident about using it to scale the experimental results to the field, to evaluate effects that cannot be scaled down to experiments, and to model cases where we cannot check the answer independently. Stratigraphic experiments are especially well suited for testing formal "inversion" models for reconstructing variables like sea level and sediment supply directly from the stratigraphic record (Lessenger and Cross, 1996), and for evaluating how unique such reconstructions are (Heller et al., 1993).

At a more informal level, experiments help build intuition. There is nothing like watching a transport system evolve in front of you and then dissecting it to see how the depositional filter has rendered it in stratigraphy. We manipulate only boundary conditions. Within the basin, the transport systems organize themselves and do what they want rather than what we programmed them to do. Self-organization—the spontaneous emergence of patterns and structures—is a hallmark of sediment-transporting

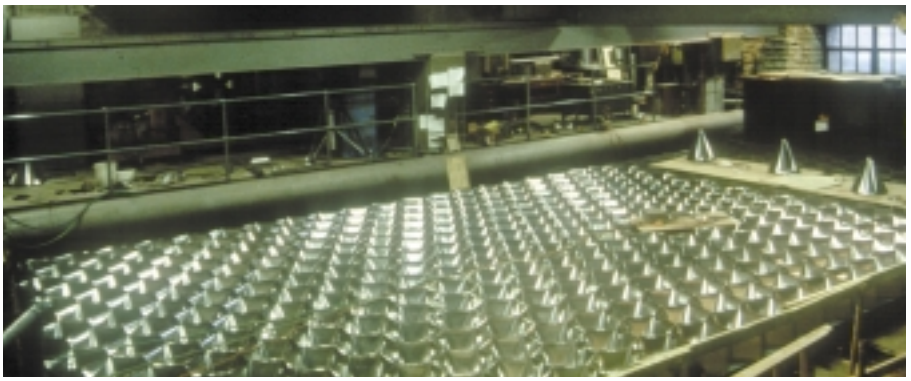

Figure 3. Honeycomb floor of full eXperimental EarthScape (XES) basin, with 432 subsidence cells. A 10-cell version was used for experiment described in this paper.

systems, and it gives even simple experiments the capacity to surprise us and trump our expectations. These surprises give us new ideas and things to look for in the field. As long as our intuition-building is tempered by a good understanding of the limitations and distortions of the experimental systems, it is one of the most valuable uses of stratigraphic experiments.

THE XES FACILITY

The XES facility is a large basin (13 m × 6.5 m) developed and built with funds from the National Science Foundation and the University of Minnesota that allows the accumulation of strata through the use of a flexible subsiding substrate (Fig. 2). The basin floor is a honeycomb of 432 independent subsidence cells (Fig. 3) through which a gravel basement is slowly extracted from below, providing space to accommodate deposition. An experiment starts with the basin filled with gravel. The top of the gravel is covered with a thin rubber membrane, which forms the base of the experimental deposit. Each subsidence cell is a hexagon forming the top of a cone that tapers down into a standard elbow pipe (Fig. 2), where the gravel sits at the angle of repose. Subsidence is induced by firing a pulse of high-pressure water into the gravel in the elbow, knocking a small volume into an exhaust line. Each subsidence cell has its own sealed pressure tube that drives the pulses via a computer-controlled solenoid valve. We have refined the pulsing so that each pulse produces ~0.12 mm of subsidence—the "earthquake slip" in the experiments. Hence, the subsidence is effectively smooth and continuous in time. The subsidence also is spatially continuous: The cells are separated only at floor level, so the gravel can flow laterally to accommodate differential subsidence with no imprinting of the hexagonal pattern onto the basement surface. The system provides ~1.3 m of usable accommodation space in the basin. Depending on loading of the gravel basement, lateral slopes of up to 60° can be produced between adjoining cells.

Premixed sediment and water can be fed from anywhere along the perimeter of the basin, and base level is independently set by a computer-controlled head tank mounted outside of the basin. More details of the design and mechanics of the basin are available on our Web site: www1.umn.edu/safl/research/research.html.

During an experiment, the surface-flow pattern is recorded using video and still cameras. In addition, a topographic scanning system, based on the design of Rice et al. (1988) and Wilson and Rice (1990), allows us to document the 3-dimensional evolution of the surface topography during the run for later comparison with the surface-flow images, the preserved deposits, and theoretical predictions.

Once an experiment is complete, the resultant deposits are cut in a series of precise parallel faces, beginning near one edge. Each face is photographed. About every 10 faces, a peel is taken of the cut face. This serial microtome process allows us to build a 3-dimensional image of the deposits by stacking the sequence of photographed slices. Additional equipment being added to the basin includes rainfall and wave generators, a high-resolution sonar system for recording underwater topography, and a system for rapid digital photography of sectioned deposits.

INITIAL EXPERIMENTAL RESULTS

The Experiment

Our first study (XES 96-1) involved a small prototype basin with 10 subsidence cells (Heller et al., 2001; Paola, 2000; Pratson and Gouveia, 2002). It was designed to study the effects of slow and rapid changes in base level on shoreline position and the resultant sequence stratigraphy. The experimental design was inspired by theoretical models proposed by Pitman (1978), Angevine (1989), and Jordan and Flemings (1991). This work suggested that for slow (long-period) base-level changes, shoreline would not track base

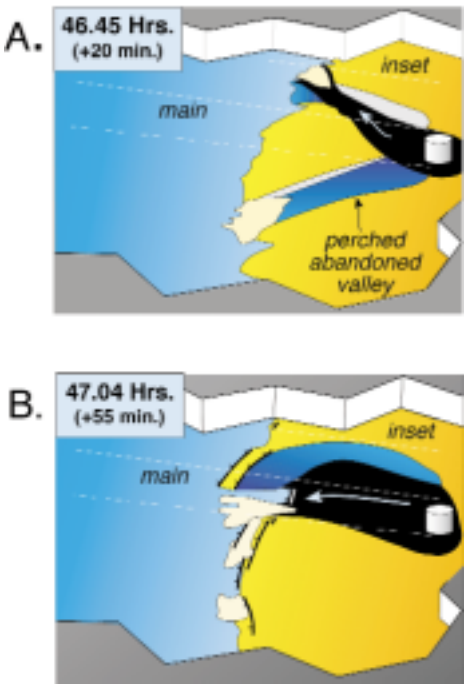

Figure 4. Drawings from photographs showing sediment surface at two times, 15 minutes apart, during the rapid base-level fall. Numbers in parentheses give time after start of the base-level cycle. Basin centerline is shown by dashed line; sediment-feed point is shown by small cylinder. Locations of two sections shown in Figure 5 are shown by white lines (main and inset panels). Zone of active flow is shown in black, and fault symbols show normal faults associated with exposure of delta front. Base-level history is given in Figure 5, with time for these images indicated by arrow.

level, as one would expect, but rather should track the *rate of change* of base level (i.e., shoreline would be 90° out of phase with base level). This idea is so strange—imagine that the high-water mark on your local beach occurred not at high tide but midway between low and high tide—that at first blush, it seems impossible. But over long time scales, the coastal plain is not a static surface on which sea-level rise and fall are passively imprinted. Rather, the surface morphology evolves along with changing sea level: Shelf transport produces different morphology from fluvial transport, and the boundary between the two regimes depends on where the shoreline is. If beaches could reshape themselves during a tidal cycle, our intuition about the relationship between shoreline and tidal height might be quite different.

Slow and rapid cycles are defined relative to a natural time constant for the basin (e.g., the "equilibrium time" defined in Paola et al. [1992]). Angevine's (1989) analysis of the Pitman model also suggested that the shoreline response to base-level change would be relatively weak for long-period base-level cycles. In contrast, rapid (short-period) base-level cycles were predicted to produce strong shoreline response directly in phase with base level, just as our intuition tells us. But it was the prediction that shoreline could get out of phase with base level that was most interesting, because it is so counterintuitive and because it has profound implications for inferring sea level stratigraphically. Unfortunately, Pitman's theory has proved difficult to test in the field (e.g., Miller et al., 1985, 1993). Could we find evidence for it experimentally?

We fed a mixture of water and sediment into one end of the basin (Fig. 4). The sediment was a 50:50 mixture (by volume) of quartz and coal sand, proxies for coarse and fine-grained clastics, respectively. Absolute base level was independently controlled from the opposite end of the basin. Subsidence was induced in a bowl-shaped pattern with a maximum in the center of the basin. Constant rates of water and sediment discharge and of subsidence were maintained throughout the run. The sediment discharge was set to balance the total

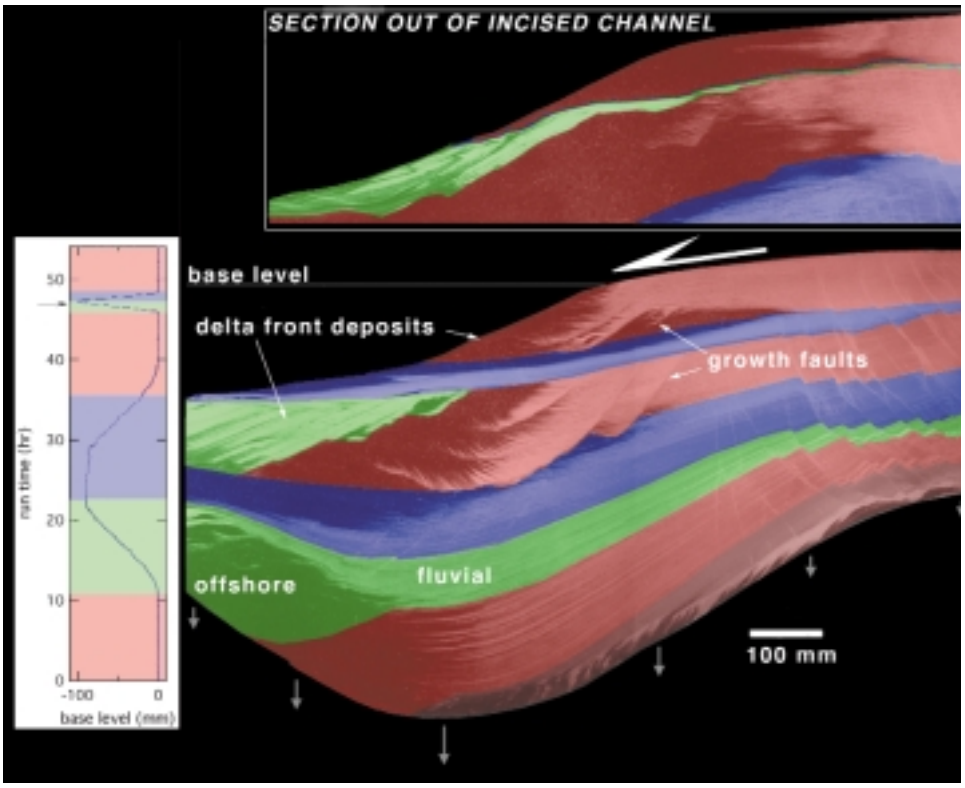

Figure 5. Flow-parallel (dip) panel of experimental deposit from base-level run. Color bands allow correlation of deposit with base-level curve to left. Arrow in base-level curve shows time of images in Figure 4. Spatial subsidence pattern is indicated by basement position at bottom of panel. Darker material is coal sand; lighter material is quartz sand. Inset shows upper part of stratigraphy from an area outside incised valley that formed during rapid base-level cycle. Locations of sections are shown in Figure 4.

rate of volumetric accommodation in the basin. We imposed two cycles of base-level change separated by periods of steady-state deposition (Fig. 5) to allow for relaxation of transient effects. The slow cycle had a total duration of 30 h, nearly 10 times the estimated equilibrium time of 3.4 h. The rapid cycle had a duration of 2 h.

What Happened?

Although some degree of incision occurred during both base-level falls, incision and valley formation were much

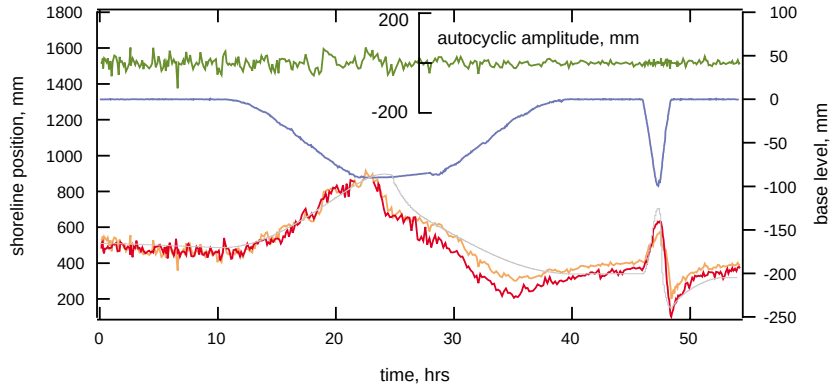

Figure 6. Shoreline position (red and orange) and base level (blue) during base-level run. Red shoreline curve was taken within incised valley, orange one just outside it. Gray curve is shoreline predicted with theoretical model of Swenson et al. (2000). Green curve at top shows high-frequency (autocyclic) variation in shoreline position. Classic "shazam" zigzag pattern that autocyclic variation produces in stratigraphy is clearly visible in Figures 1 and 5.

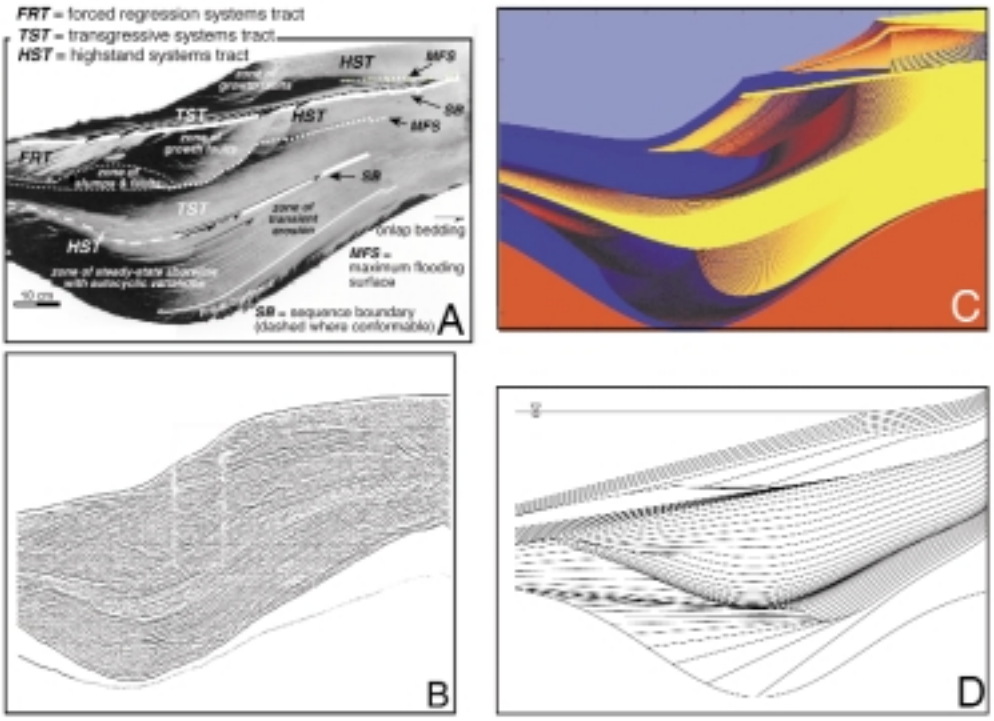

Figure 7. Various ways of using eXperimental EarthScape (XES) experimental deposits. **A.** Sequence-stratigraphic analysis (Heller et al., 2001). **B.** Synthetic seismic panel. **C.** Predicted stratigraphy (grain size, warmer colors are larger) using the SEDFLUX model (Syvitski and Hutton, 2001). **D.** Predicted stratigraphy (time lines) using model of Swenson et al. (2000).

stronger for the rapid base-level fall (Fig. 4). The rapid fall was characterized by initial exposure of the delta front and development of a narrow incised valley many times deeper than the pre-incision flow depth that extended headward along the length of the basin. The stratigraphic signature of the base-level cycle was quite different for sections inside and outside the incised valley (Fig. 5). Within the valley, the fall resulted in an unconformable sequence boundary that is easy to identify in stratigraphic cross sections. Significant valley filling, and resultant onlap, did not commence until the beginning of the subsequent base-level rise. During the rise, erosion of the valley walls significantly widened the incised valley. As a result, the cross-valley profile as recorded in the stratigraphy was substantially wider and more gently sloping than the actual valley at the end of the base-level fall. Although exaggerated because the sand in the experiment was relatively erodible, we believe this to be a general effect: Incised valley profiles will generally be composites that reflect both incision and widening by lateral erosion as the valley is filled. Areas outside the incised valley received no sediment and experienced the base-level cycle as a hiatus. In the field, these interfluve areas would show features such as soil development associated with a period of prolonged exposure and nondeposition.

In contrast, the slow base-level cycle produced a nearly symmetric regressive and transgressive stratigraphic record. Most of the base-level fall was accompanied by deposition and thus did not produce an unconformity that, in sequence stratigraphic parlance, would mark a sequence boundary. The basin fill developed during the slow cycle was also much more laterally continuous than for the rapid cycle. Overall, the rapid cycle had far greater impact on the distribution of sediment storage, the 3-dimensional geometry of fluvial and submarine transport systems, and the development of clearly segregated regressive and transgressive facies tracts.

Test of Theoretical Predictions

It had been predicted that shoreline response to the slow cycle would be attenuated and out of phase. First, it is clear from Figure 6 that in no sense was the slow-cycle response attenuated; the slow-cycle shoreline excursion was 417 mm, 2.1 times that for the rapid cycle. The shoreline remained closely locked to base level during the base-level fall, but deviated somewhat after that. Transgression began immediately upon stabilization of base level, and the point of maximum transgression occurred during the rise, as the rate of rise began to decrease (Fig. 6). There was also a noticeable overshoot in the transgression: the point of maximum transgression is landward by ~32% of the total shoreline excursion distance of the initial shoreline location. The same phenomenon occurred at the end of the rapid cycle, but the overshoot is proportionally much larger: 133% of the total excursion distance. Otherwise, the rapid-cycle–shoreline behavior closely tracked base level, as all existing theories would predict. On the whole, the experiment does not offer strong support for the idea that shoreline follows rate of change of base level rather than base level itself for long-period cycles. Theoretical analysis of the shoreline-response problem by Swenson et al. (2000) suggests that our failure to observe the predicted shoreline behavior cannot be explained by differences between the experimental geometry and the assumptions of Pitman (1978). Rather, it appears that Pitman's result is closely linked to his assumption of a constant sedimentation rate at the shoreline, a condition that is not satisfied in the experiments or, generally speaking, in nature.

Internally Generated Phenomena

These fell into two categories. Growth faults evolved before and during the rapid fall, trapping sediment at the fault breakaway zone (Fig. 5). The continuous increase of dip rotation with fault offset shows how steady the motion on the faults was. It is particularly striking that at no time prior to the rapid base-level cycle was there any surface manifestation of the presence of the faults. The only visible fault motion during the experiment was a collapse of the delta front during the rapid fall (Fig. 4B), with an offset of no more than 20 mm.

The second internally generated phenomenon was high-frequency fluctuation in shoreline position (Fig. 6) associated with shifting of the threads of maximum flow in the fluvial system. Such

autocyclic variation in shoreline position will not surprise anyone familiar with the stratigraphic record, but it is interesting that it is prominent in such a small-scale experiment. The amplitude of the autocyclic variation does not change significantly during the slow base-level cycle, but it diminishes measurably after that. Persistent removal of sediment by subsidence on localized growth faults may account for this during the steady-state interval before the rapid base-level fall. During the rapid fall, autocyclic variation is suppressed as incision focuses and trains the flow. While the fluvial system was less constrained during the rise, it was still sufficiently confined to inhibit fully developed lateral shifting.

TESTING OF STRATIGRAPHIC MODELS

The main goal of these experiments is to provide data to test and refine stratigraphic models and other interpretive tools. We are approaching this from several directions. A sequence-stratigraphic analysis of the section is shown in Figure 7A. For comparison of the experimental results with seismic-stratigraphic interpretation techniques, we use the model stratigraphy to produce synthetic seismic cross sections. The methods for doing this are explained in Pratson and Gouveia (2002); the results are shown in Figure 7B. In addition, the experimental results can be compared directly with existing theory. Apart from specific hypotheses like out-of-phase shoreline behavior, we can also compare the experimental results directly with theoretical stratigraphy, as illustrated in Figures 6, 7C, and 7D. In this case, the two models shown do a reasonable job, although there are problem areas, such as the modest shoreline overshoot at the end of the first cycle, that are not predicted well.

Of course, one of the best and simplest things to do with experimental stratigraphy is to deduce cause from stratigraphic pattern (Fig. 1). It's a very hard problem, and in our experience, the great temptation is to make the causes more complicated than necessary. And this was a relatively simple experiment! If nothing else, the difficulty of analyzing sections such as Figure 1 should remind us to treat the more difficult and underconstrained natural cases with respect, along with a generous supply of Ockham's famous razors.

COMMUNITY INVOLVEMENT IN XES

One of our main motivations in writing this article is to get the word out that the XES basin, and associated facilities at St. Anthony Falls Laboratory, are by no means a closed shop. Insofar as it is possible, we would like St. Anthony Falls Laboratory to be a resource for the earth sciences community. We are continuing to work on making the experimental results available via the Internet and/or CD-ROM. We also invite you to provide input and suggestions for future experiments. We are, of course, especially interested in input based on field experience and in case studies we can use for comparison with experimental results. Experiments on small space and time scales can never replace careful field study of real examples. On the other hand, interpreting natural stratigraphy is difficult enough so that we must take advantage of every opportunity for insight. Experimental stratigraphy is one more Rosetta stone that will help us decipher the language of sediments.

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DIALOGUE

Committee on Geology and Public Policy Plans Survey and List Server Launch

P. Geoffrey Feiss

P. Geoffrey Feiss, *Chair, Committee on Geology and Public Policy*

Ever wonder how to get information on political decisions that affect your work? Would you like to be more involved as a professional in public affairs? The results of the member survey for the GSA Strategic Plan indicate that the majority of you would answer one or both of these questions in the affirmative. The Committee on Geology and Public Policy, in the interests of assisting members in being more active in public policy, intends to conduct a voluntary membership survey.

The goal of this survey is to collect information that we can use to build a list server for interested members who will receive periodic electronic policy updates as well as time-sensitive notifications of political decisions that we believe are of interest to members.

How will this survey be conducted?

An online survey will be posted on the GSA Web site. It will query the public affairs interests of respondents. Examples might include environmental issues, natural hazards, resource policy, funding for the U.S. Geological Survey and National Science Foundation, or federal educational policy.

When will the survey take place and how will I know what to do?

A Web-based survey will be linked to the GSA homepage with a target date for posting of September 1, 2001. An e-mail will be sent to all GSA members at that time inviting participation. Notices with the survey URL will also be posted in *GSA Today*.

What will happen as a consequence of this survey?

The survey will ask if you are willing to be placed on an e-mail list managed by the Committee on Geology and Public Policy and GSA staff members. You will *not* be placed on this list without your explicit permission.

What kind of e-mail will I get?

No spam. The list server will be managed jointly by the Committee on Geology and Public Policy and GSA staff members. Mail will only be sent with their approval. All information will be nonpartisan, balanced, and germane to earth science professionals.

We encourage all members to become more active regarding public policy issues that affect the earth sciences, to participate in this survey, and to join the e-mail list.

AIBS and NCSE Set Up Evolution List Server Network

To support the teaching of evolution in schools and to ward off efforts to teach creationism in science classes, the American Institute of Biological Sciences (AIBS) and the National Center for Science Education (NCSE) have established a network of e-mail list servers for U.S. states, Canada, and other areas.

The servers allow scientists, teachers, and concerned citizens to communicate quickly regarding activities of school boards, state legislatures, and other organizations or governing bodies. This facilitates timely responses such as letter-writing efforts and testifying at hearings. To join the list for your state, visit the AIBS Web site, www.aibs.org, and follow the link to the AIBS/NCSE Evolution List Server Network. If your state is not listed and you would be willing to be the list manager, contact AIBS president Judith Weis, jweis@andromeda.rutgers.edu.

Attention Voting Members:
GSA Election is Just Around the Corner

In late July, you'll receive a postcard with instructions on how to access a secure Web site and your electronic ballot listing officer nominees for 2002 and councilor nominees for the term 2002–2004. Biographical information on each candidate and the 2000 Annual Report also will be available on the site.

Paper versions of ballots, candidate information, and the 2000 Annual Report will be readily available to those who do not have Internet access or choose not to vote online.

Watch for your ballot information and vote! The success of GSA depends on the work of the elected officers who serve on our Executive Committee and Council. Make your wishes for GSA known by voting.

Ballots must be submitted electronically or postmarked by Sept. 7, 2001.

2002 Officer and Councilor Nominees

GSA Council announces the following officer and councilor candidates. Biographical information on all candidates will be available August 9 at www.geosociety.org or by calling Members Services at (303) 447-2020 or 1-888-443-4472.

President (2002)

Tony Naldrett, Toronto, Ontario

Vice-President (2002)

B. Clark Burchfiel, Cambridge, Mass.

Treasurer

John E. Costa, Portland, Ore.

Councilor (2002–2004), Position 1

Roy J. Shlemon, Newport Beach, Calif.
Richard W. Galster, Edmonds, Wash.

Councilor (2002–2004), Position 2

Andrew H. Knoll, Cambridge, Mass.
Judith Totman Parrish, Tucson, Ariz.

Councilor (2002–2004), Position 3

Ronald M. Clowes, Vancouver, B.C.
G. Randy Keller, El Paso, Tex.

Councilor (2002–2004), Position 4

Grant Garven, Baltimore, Md.
(Second candidate to be announced.)

GSA Foundation Update

A Gathering for Planned Givers

Donna L. Russell, *Director of Operations*

Coterie (n): *a group of persons with a unifying common interest or purpose*

The Foundation's Pardee Coterie formed in 1995 to recognize those who had made planned gifts to the GSA Foundation in support of GSA and its programs. Members of the Pardee Coterie roster, along with their spouses and guests, meet once a year for a meal and a discussion or talk on a current topic of interest to scientists and supporters of geology. This is an informal group—there are no bylaws, no officers, and no committees.

The Joseph T. Pardee Memorial Fund originated through what is perhaps a classic example of planned giving—an estate bequest, a trust, and two charitable remainder unitrusts, transiting several lives. The resulting gift was GSA's second largest ever received, exceeded only by the R.A.F. Penrose Jr. bequest in 1931.

The very first Pardee Coterie was held in November 1995 during the GSA Annual Meeting in New Orleans. Participants enjoyed a breakfast at Brennan's restaurant and a discussion from Dan Sarewitz, who at that time was the program officer for the Institute for Environmental Education (now known as the Institute for Earth Science and the Environment), and who is also a former Congressional Science Fellow.

Last year, the coterie enjoyed breakfast at the White Orchid in Reno and a slide presentation from Gina Temple, an assistant professor in the Department of Geological Sciences at the University of Nevada.

Those who have made planned gifts to the Society or the Foundation, such as the Pooled Income Fund, bequests, or charitable remainder trusts or gift annuities, are automatically included in the Pardee Coterie. Others who have included GSA in their wills or who are contemplating planned gifts are asked to notify the Foundation by phone at (303) 447-2020, ext. 1154, by e-mail at gsaf@geosociety.org, or by mailing the coupon accompanying this article. Membership in the Pardee Coterie will follow promptly.

Focus on a Foundation Fund

The John T. Dillon Alaska Research Award Fund

The John T. Dillon fund was established at the Foundation in October 1988 and supports scientific research in Alaska. Income from the fund is used for annual student research grants for field studies on structure and tectonics, geochronology of significant rock units, or other earth science projects in that state.

Dillon received his Ph.D. from the University of California at Santa Barbara in 1975. He worked briefly for the U.S. Geological Survey in southern California and then joined the Alaska Department of Natural Resources. His 11-year employment with the Alaska Survey focused on the tectonics of northern Alaska. Dillon was particularly noted for his radiometric age–dating work in the Brooks Range, the results of which have had a major impact on the geologic understanding of this mountain range.

John Dillon died in the field in a plane crash the summer of 1987. His father was also killed in that crash. Both were returning from the Arctic National Wildlife Refuge after completing the season's work.

The April 2001 net assets of the Dillon fund were $57,750. The Committee on Research Grants awarded the 2001 award to David F. Sunderlin from the University of Chicago for his project, "Permian tectonics and paleobotany of the Farewell terrane in Denali National Park, Alaska."

Most memorable early geologic experience

Driving my old 1937 Ford through snow and ice to Ottawa's Chateau Laurier for the 1947 GSA meeting, made unforgettable by the presence of many outstanding "old-timers," including Andy Lawson, Alfred Lane, and Herbert Hobbs.

—Helen L. Foster

Thomas D. Fouch

Thomas D. Fouch Named GSA Foundation President

Morris W. Leighton, Chair of the GSA Foundation Board of Trustees, announced that Thomas D. Fouch was selected as president of the Foundation. Fouch will join the Foundation in January 2002, shortly after his retirement from the U.S. Geological Survey (USGS) at the end of this year.

Currently a regional geologist, Fouch has served the USGS for 27 years. Previously, he spent one year with J.M. Huber and five years with Shell Oil. He received his B.S. degree in earth science in 1966 from Portland State University in Oregon and his M.S. degree in geology in 1968 from the University of Oregon.

"I look forward to serving the Foundation and the Society and its members," Fouch said. "I will take great pride in promoting the growth and use of quality geoscience knowledge and information through the Society and the people that it serves."

Fouch has extensive experience as a leader, a manager, a strategic planner, and an implementer, and he brings with him to GSA a broad background in program development, program evaluation, and resource planning, and in representing his organization with outside groups or agencies.

"He has a reputation as a trusted, credible, and respected team player with a warm personality and remarkable people skills," Leighton said in his welcome to Fouch. "His work ethic, long history of performance, and intellectual capacity are all exceptional. He is a quick learner, has a strong interest in the job, and a desire to see the Foundation successful in its efforts to seek funds in support of GSA programs and activities."

Boston 2001: November 1–10, 2001

A GEO-ODYSSEY

GSA Short Courses Offered at GSA Annual Meeting

The height of knowledge and understanding begins with a great short course at the GSA Annual Meeting in Boston! For complete course and faculty descriptions, registration information, and details on student scholarships, see the June issue of *GSA Today* or visit www.geosociety.org. Questions? Contact Edna Collis, ecollis@geosociety.org, (303) 447-2020, ext. 1134.

Preregistration deadline: September 28
Cancellation deadline: October 5

1. Application of Thermochronometry to Tectonics

Sat. and Sun., Nov. 3–4, 8 a.m.–5 p.m. both days. Hynes Convention Center. Cosponsored by *GSA Structural Geology and Tectonics Division.* Limit: 30. Fee: $435, students $415; includes course manual. CEUs: 1.6.

Since most tectonic processes alter the distribution of heat in the crust, the thermal record preserved as isotopic variations in minerals can provide valuable insights regarding timing and rates of deformation processes. This course provides a contemporary treatment of thermochronology and its application to studies of crustal deformation and presents relevant isotopic systems and means of interpretation, together with a hands-on introduction to computer-based interpretive models.

Faculty: T. Mark Harrison, Dept. of Earth and Space Sciences and Institute of Geophysics and Planetary Physics, University of California, Los Angeles; Marty Grove and Oscar M. Lovera, Dept. of Earth and Space Sciences, University of California, Los Angeles; Peter K. Zeitler, Dept. of Earth and Environmental Sciences, Lehigh University.

2. Micromorphology of Glacigenic Sediments

Sat. and Sun., Nov. 3–4, 8 a.m.–5 p.m. both days. Boston College. Cosponsored by *GSA Quaternary Geology and Geomorphology Division.* Limit: 30. Fee: $420, students $400; includes course manual, lunches. CEUs: 1.6.

Learn concepts and practices of techniques associated with micromorphological examination of sediments through investigation of terrestrial and marine glacial sediments. Discussion includes field-sampling techniques and strategies and the various methods of laboratory impregnation of soft sediments, thin-section description and analyses, terminology and classification methods of micromorphological analyses (illustrated with a variety of thin sections), and the research value and applied uses of micromorphological analyses. Participants will describe, interpret, and present findings on their samples.

Faculty: John Menzies, Dept. of Earth Sciences, Brock University; Jaap J.M. van der Meer, Dept. of Geography, Queen Mary College, University of London; James Rose, Dept. of Geography, Royal Holloway, University of London.

3. Applications of Environmental Isotopes to Watershed Hydrology and Biogeochemistry

Sun., Nov. 4, 8 a.m.–5 p.m. Hynes Convention Center. Cosponsored by *GSA Hydrogeology Division.* Limit: 30. Fee: $340, students $320; includes course manual, lunch. CEUs: 0.8.

This course will focus on practical applications of water, solute, and biomass isotopes for gaining a better understanding of the hydrology and biogeochemistry of watersheds and small basins. The wide range of discussion topics will include tracing water sources and pollutants, flowpath determination, biogeochemical reaction mechanisms, and food-web reconstruction.

Faculty: Carol Kendall and Thomas Bullen, Water Resources Division, U.S. Geological Survey, Menlo Park, Calif.

4. Estimating Rates of Groundwater Recharge

Sun., Nov. 4, 8 a.m.–5 p.m. Hynes Convention Center. Cosponsored by *GSA Hydrogeology Division.* Limit: 30. Fee: $250, students $230; includes course manual, lunch. CEUs: 0.8.

Good estimates of groundwater recharge are required to accurately assess water resources and evaluate aquifer vulnerability to contamination. We'll review theory, assumptions, uncertainties, advantages, and limitations of different approaches for estimating recharge rates. We'll also discuss physical, tracer, and numerical modeling techniques based on surface water, unsaturated zone, and saturated zone data. Course content is aimed at practicing hydrologists and advanced hydrology students.

Faculty: Richard W. Healy, U.S. Geological Survey, Denver, Colo.; Bridget R. Scanlon, Bureau of Economic Geology, University of Texas, Austin.

5. Management and Leadership Skills for Geoscience Department Chairs and Institute Directors

Sun., Nov. 4, 8 a.m.–5 p.m. Hynes Convention Center. Cosponsored by *National Association of Geoscience Teachers.* Limit: 30. Fee: $260, students $240; includes course manual, lunch. CEUs: 0.8.

An introduction to the interpersonal tools and skills needed to effectively and efficiently manage and lead in an academic setting, this course is for faculty and research scientists who are new to academic administration or wish to prepare for a transition to administration. Experienced department chairs and institute directors wanting to improve their administrative skills and network with peers sharing similar responsibilities and challenges will also benefit from this fresh approach that combines dynamic, nuts-and-bolts management training of the business world with the experience and leadership of one of academia's own.

Faculty: Lee J. Suttner, Dept. of Geological Sciences, Indiana University, Bloomington; Sheila Moore, Training Concepts, Chattanooga, Tenn.

6. Mobilization of Metals from Fossil Fuels: Impacts to the Environment and Human Health

Sun., Nov. 4, 1–5 p.m. Hynes Convention Center. Cosponsored by *GSA Coal Geology Division.* Limit: 40. Fee: $190, students $170; includes course manual, refreshments. CEUs: 0.4.

Appropriate for those with little or no prior experience in energy geology, this course will

GSA Names 2001 Medal and Award Recipients

Society awards for 2001 will be presented to the following people at the GSA Annual Meeting in Boston.

Penrose Medal
Kenneth J. Hsu
Zurich, Switzerland

Arthur L. Day Medal
Richard O'Connell
Harvard University

Young Scientist (Donath) Medal
A. Hope Jahren
Johns Hopkins University

Honorary Fellows
Erik Flügel
Universität Erlangen, Germany

Alberto Carlos Riccardi
Facultad de Ciencias Naturales y Museo, Argentina

K.S. Valdiya
Jawaharlal Nehru Centre for Advanced Scientific Research, India

GSA Distinguished Service Award
Craig H. Jones
University of Colorado

GSA Public Service Award
Eugenia Scott
National Center for Science Education

G. Brent Dalrymple
Oregon State University

AGI Medal in Memory of Ian Campbell
Kenneth N. Weaver
Maryland Geological Survey (Emeritus)

John C. Frye Environment Award
Julie A. LeFever
John P. Bluemle
Ryan P. Waldkirch
North Dakota Geological Survey
Educational Series No. 25, Flooding in the Grand Forks—East Grand Forks North Dakota and Minnesota Area

Michel T. Halbouty Distinguished Lecturer
John D. Bredehoeft
U.S. Geological Survey (Emeritus)

Rip Rapp Archaeological Geology Award
Bruce Gladfelter
University of Illinois, Chicago (Emeritus)

Gilbert H. Cady Award (Coal Geology Division)
John C. Crelling
Southern Illinois University

E.B. Burwell, Jr., Award (Engineering Geology Division)
David Noe
Colorado Geological Survey

William P. Rodgers
Colorado Geological Survey (Emeritus)

Candace Jochim
Lake Oswego, Ore.

George P. Woollard Award (Geophysics Division)
Bradford Hager
Massachusetts Institute of Technology

History of Geology Award
Walter O. Kupsch
University of Saskatchewan

O.E. Meinzer Award (Hydrogeology Division)
Fred Phillips
New Mexico Tech

G.K. Gilbert Award (Planetary Geology Division)
H. Jay Melosh
University of Arizona

Kirk Bryan Award for Research Excellence (Quaternary Geology and Geomorphology Division)
Richard M. Iverson
U.S. Geological Survey, Vancouver, Wash.

Laurence L. Sloss Award (Sedimentary Geology Division)
Robert H. Dott Jr.
University of Wisconsin

Structural Geology and Tectonics Division Career Contribution Award
Donald U. Wise
Franklin & Marshall College

examine the sources of metals in fossil fuels and their combustion products, and related environmental and health effects. Issues include toxic elements such as mercury and arsenic, particulate matter ($PM_{2.5}$), and regulatory aspects. Case studies of health impacts in the U.S. and abroad will be presented.

Faculty: Robert B. Finkelman, Allan Kolker, and Leslie Ruppert, U.S. Geological Survey, Reston, Va.

7. Practical Geoscience Ethics: Elements, Examples, and Education

Sun., Nov. 4, 1–5 p.m. Hynes Convention Center. Cosponsored by *American Institute of Professional Geologists* and *GSA Engineering Geology Division.* Limit: 30. Fee: $200, students $180; includes course manual, refreshments. CEUs: 0.4.

The elements of geoscience professional ethics will be examined using case histories to illustrate the issues presented including the distinction between ethical rules and ethical ideals. The course will provide a better foundation in professional ethics for practicing professionals and students and will provide faculty with ideas on how to effectively teach professional ethics in an already overcrowded curriculum.

Faculty: David M. Abbott Jr., AIPG Ethics Committee Chairman, Denver; John W. Williams, San Jose State University.

8. Tectonics and Topography: Crustal Deformation, Surficial Processes, and Landforms

Sun., Nov. 4, 8 a.m.–5 p.m. Hynes Convention Center. Cosponsored by *GSA Structural Geology and Tectonics Division.* Limit: 30. Fee: $385, students $365; includes course manual, lunch. CEUs: 0.8.

This course is intended for geologists with backgrounds in any subdiscipline who wish to learn more about interactions between crustal (tectonic) and surficial (climatic and erosional) processes and about landforms that result from those interactions. Participants will have an opportunity to use simple 2-D computer models (MatLab software) that illustrate feedback between crustal and surficial processes.

Faculty: Dorothy Merritts, Franklin and Marshall College; Roland Burgmann, University of California, Berkeley.

Register online: www.geosociety.org.

ROCK STARS

W.H. Twenhofel: Patriarch of Sedimentary Geology

R.H. Dott Jr., *University of Wisconsin, Madison, WI 53706, USA*

William H. Twenhofel (1875–1957) as he appeared during his 29-year career at the University of Wisconsin.

Boyhood on a small Kentucky farm was an inauspicious beginning for "The foremost authority in the world of sedimentation," as a newspaper reporter described William H. Twenhofel when he retired from the University of Wisconsin in 1945. Twenhofel was among a handful of founders of the specialty now called sedimentology, and his university was one of a few centers of research and teaching in that specialty before 1950.

Twen, or Twennie, as he was known to students and colleagues, was born in 1875 to German immigrant parents near Covington, Kentucky, just across the Ohio River from Cincinnati. He attended public country primary schools, but had to attend a private school to gain a secondary education. Because of his family's modest economic means, Twenhofel began earning his own living when he was a teenager. This infused him with frugality, self discipline, and great capacity for work—qualities that served him well throughout his career. From 1896 to 1904, he taught in local schools during the winter and took other jobs—for example, as a conductor with the Covington Street Railway Company—in the summer. In 1899, he married his childhood sweetheart, Virgie M. Stephens.

During the summers of 1902–1904, Twenhofel studied at the National Normal School in Lebanon, Ohio. After receiving the B.A. in 1904, he taught at the East Texas Normal College in Commerce, Texas.

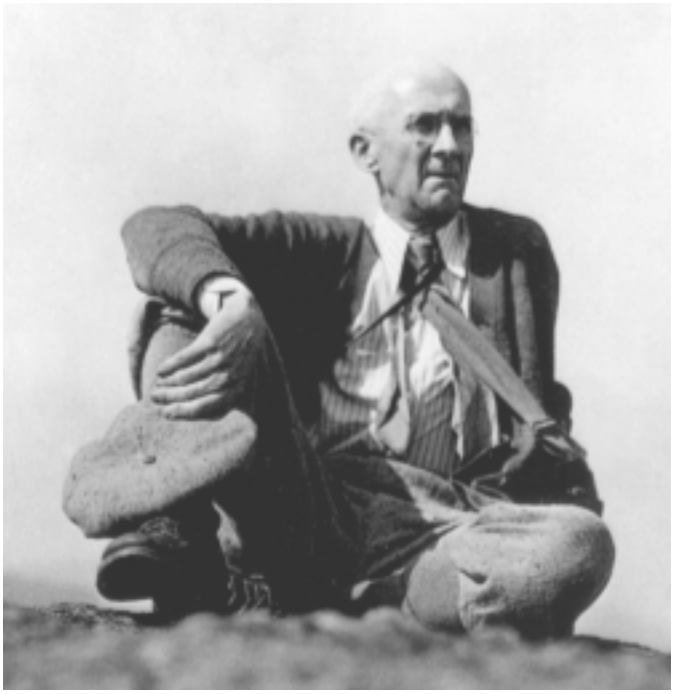
The rich Ordovician fossils of the Cincinnati area had nurtured the careers of several outstanding American paleontologists, but for Twenhofel it was a delayed reaction. He first taught mathematics and intended to pursue that for postgraduate studies. But in his last year at East Texas, he had to take over the duties of a recalcitrant geology instructor, and that was a turning point. As he told the reporter in 1945, he had become interested in geology by accident. "I've always been a collector. As far back as I can remember, I picked up arrowheads and fossils and saved them."

By 1907, at the age of 32, Twenhofel had saved enough money to enter Yale University. He quickly earned another A.B. (1908), the M.A. (1910), and the Ph.D. (1912). At Yale, Twenhofel was influenced by Joseph Barrell and Charles Schuchert, the latter of whom was one of those outstanding Cincinnati-born paleontologists. Schuchert suggested a dissertation in maritime Canada to study fossils along the Ordovician-Silurian boundary. Twenhofel recalled that the area where he worked from 1908 to 1910 was remote and wild, requiring an "expedition which entails hardship. You spend half of your time getting to your destination and half of the remaining time waiting for the rain to quit." He walked 700 miles around Anticosti Island while his supplies followed by dories rowed just offshore. It was worth it, because "Anticosti is ramjammed full of beautiful fossils." He once stayed with a local, "Old Man Hollister, who took care of us the best way he could—dried salmon and bread; no butter, no plates, and only a little molasses in our tea."

Twenhofel's early Canadian research brought him back to the maritime region for many years. Although the first half of his career was primarily in paleontology and stratigraphy, his presidential address to the Paleontological Society in 1931 foreshadowed a new sedimentation career by emphasizing the importance of sedimentary environments to paleoecology.

Joseph Barrell had interested Twenhofel in how weathering, erosion, depositional environments, and subsidence affect sedimentation. This gave the impetus for Twenhofel's second career. His first contribution came when he joined a 1914 Harvard expedition to the Baltic Sea to compare the lower Paleozoic paleontology and stratigraphy with that of maritime Canada. Once, Twenhofel's small boat grounded in a bay, and when he jumped out, he sank up to his waist in black, stinking mud. This prompted a short article on black shale in the making. Together with dolomite and banded iron formation, the origin of black shale was for years an intractable problem (the origins of these three are still debated). World War I began while Twenhofel was investigating Silurian rocks on the Baltic island of Gotland. He was arrested because he was foreign, but the officer had once been "a Boston cop so I talked my way out of it."

In 1910, Twenhofel began teaching at the University of Kansas, and in 1915, he became state geologist. In 1916, he moved to the University of Wisconsin. His sedimentation career blossomed with an appointment in 1919 to the National Research Council (NRC) Committee on Sedimentation. This body assembled investigators to survey the newly emerging specialty. Twenhofel remained on the committee until 1949, and he chaired it from 1923 to 1931. He wrote most of *A Treatise of Sedimentation*, published by the committee in 1926. The appearance of this seminal volume and the creation of the Society of Economic Paleontologists and Mineralogists in the same year marked the beginning of modern sedimentology. Twenhofel was a key player in both events, and in 1930 co-founded the *Journal of Sedimentary Petrology*, the first journal in the field. From 1933 to 1946, he was its editor.



Twenhofel relaxing for a contemplative moment in the field.

Twenhofel had an unusual talent for directing committee efforts. He could get colleagues to work hard and achieve timely completions, which many today would regard as a near miracle. After chairing the Sedimentation Committee, he directed the NRC's Division of Geology and Geophysics (1931–1934) and helped organize the Committee on Stratigraphy. Next he chaired the NRC Committee on Paleoecology (1934–1937).

Twenhofel made many additional contributions. In 1935, he co-authored a popular textbook of invertebrate paleontology, and in 1939, he published *Principles of Sedimentation*, the first North American textbook on that subject. In 1941, he co-authored *Methods of Study of Sediments* with Stanley A. Tyler. Studies of the mineralogy of sediments began in Europe around 1900, and accelerated in the 1920s and 1930s as the petroleum industry sought criteria derivable from small drill cuttings for correlation between wells. Variations among accessory minerals in sandstones seemed promising; it was this study of sedimentary mineralogy that had prompted the creation of the *Journal of Sedimentary Petrology*.

With a strong tradition in mineralogy and petrology, the University of Wisconsin was a natural venue for accessory mineral studies, and Twenhofel directed student research on the heavy minerals of several Paleozoic and Precambrian formations. In the long run, however, microfossils proved more valuable for industry, so the heavy mineral era yielded to other themes in sedimentology.

During the 1930s and 1940s, Twenhofel began investigating lake sediments, which complemented pioneering research by University of Wisconsin limnologists. He co-authored papers on lakes with 10 students, including Vincent E. McElvey, who later became the ninth director of the U.S. Geological Survey (1971–1978). Twenhofel also wrote about such topics as Cambrian glauconitic greensands and their potential as a source of potash fertilizer, marine conglomerates and unconformities, deep-sea sediments, and corals and other reefs, but he is remembered especially for emphasizing sedimentary environments. Having "been born with the outdoors in his blood," he observed all of nature, especially plants and soils. Reflecting his farming roots, Twenhofel wrote and lectured about the geologic origin of soils and how vital they are to humankind, and he warned of the dangers of soil erosion.

Among the many honors bestowed upon Twenhofel, the greatest was the creation of the Twenhofel Medal, the Society of Economic Paleontologists and Mineralogists' highest award. Multitudes of students remembered W.H. Twenhofel as an inspiring teacher whose lectures were laced with humor and memorable anecdotes. Annual dances for students in the Twenhofels' attic were legendary, and he was reknowned for public outreach. The affection for "Twen" was exemplified by a present from his introductory geology class in May 1944. The accompanying card stated, "Our thanks to you for being the friend of students and youth, as well as the true scholar that you are."

According to Robert R. Shrock, Twenhofel held the philosophy that an investigator's "every faculty should be used—the *feet* to carry [one] across the strand, along the cliff, and over the rocky wastes; the *eyes* to search out the endless detail of the geological record; and the *mind* to analyze the significance of those details." The energetic and alert W.H. Twenhofel always practiced what he preached.

The Rock Stars series is produced by the GSA History of Geology Division. This profile was edited by Robert N. Ginsburg, rginsburg@rsmas.miami.edu.

Further Reading

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Shrock, Robert R., 1947, William Henry Twenhofel—Honorary Member: American Association of Petroleum Geologists Bulletin, v. 31, p. 835–840.

W.H. Twenhofel (right of speaker) dressed in 1940s' field style on an excursion in central Wisconsin. "The rugged little professor" could outwalk students less than half his age.

ANNOUNCEMENTS

MEETINGS CALENDAR

2001

September 24–26	Coal Quality: Global Priorities, Reston, Va. Information: Kris Dennen, kdennen@usgs.gov, (703) 648-6487, fax 703-648-6419, http://energy.er.usgs.gov/wocqi.

2002

March 4–7	GeoProc2002—Geochemical Processes, Bremen, Germany. Information: Horst D. Schulz, +49(0)421-218-3393, fax +49(0)421-218-4321, hdschulz@uni-bremen.de; Astrid Hadeler, +49(0)421-218-3950, fax +49(0)421-218-4321, ahadeler@uni-bremen.de, www.geochemie.uni-bremen.de. Abstract deadlines: August 15, 2001 (hard copy); August 31, 2001 (electronic).
May 20–23	Third International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California. Information: The Conference Group, 1989 W. Fifth Avenue, Ste. 5, Columbus, OH 43212-1912, USA, 1-800-783-6338 (U.S. and Canada), (614) 424-5461, fax 614-488-5747, conferencegroup@compuserve.com, www.battelle.org/chlorcon.
July 14–August 2	9th International Platinum Symposium and Field Conference, Bozeman, Montana. Organizers: IGCP (International Geological Correlation Programme) 427, Society for Geology Applied to Mineral Deposits. Information: Roger Cooper, Cooperrw@hal.lamar.edu, (409) 880-8239, fax 409-880-8246, www.platinumsymposium.org.
August 25–30	Gondwana 11: Correlations and Connections, Gateway Antarctica, University of Canterbury, Christchurch, New Zealand. Information: +64-3-364 2136, fax +64-3-364 2197, s.hawtin@anta.canterbury.ac.nz, www.anta.canterbury.ac.nz

2003

August 18–21	9th International Symposium on the Ordovician System and 7th International Graptolite Conference, San Juan City, Argentina. Information: Guillermo L. Albanesi, galbanesi@arnet.com.ar, Matilde S. Beresi, mberesi@lab.cricyt.edu.ar, http://ceor.seos.uvic.ca/ordovician, http://iago.stfx.ca/people/mmelchin/silurian9.htm.
September 10–12	Third International Conference on Debris-Flow Hazards Mitigation: Mechanics, Prediction, and Assessment, Davos, Switzerland. Information: Dieter Rickenmann, Swiss Federal Research Institute WSL, Zürcherstrasse 11, CH-8903 Birmensdorf, Switzerland, +41-1-739-24-42, fax +41-1-739-24-88, rickenmann@wsl.ch, DFC3_Inf@wsl.ch, www.wsl.ch/3rdDFHM.

2002 Ludo Frevel Crystallography Scholarship Award

If you are a graduate student seeking a degree with a major interest in crystallography, you may be eligible to apply for the Ludo Frevel Crystallography Scholarship. For information on applicant qualifications, scholarship restrictions, and how to apply, contact the International Centre for Diffraction Data (ICDD), Scholarship Awards Committee, c/o Corporate Secretary, International Centre for Diffraction Data, 12 Campus Boulevard, Newtown Square, PA 19073-3273, USA. **Applications for the 2002 awards must be received by the ICDD no later than October 31, 2001.**

The ICDD established the Ludo Frevel Crystallography Scholarship Fund to encourage promising graduate students to pursue crystallographically oriented research. The ICDD has awarded 39 scholarships totaling more than $80,000 since the scholarship's inception in 1991.

AGI Compensation Report Available at a Discount

The American Geological Institute (AGI) has released its salary report, *Compensation for Geoscientists—2001*. The report shows results of a survey, conducted by Abbott, Langer & Associates, which was sent to a sample of members of participating AGI member societies.The 370-page report, sponsored by AGI and other geoscience societies, provides information on base salaries; fees, bonuses, and commissions; and total cash compensation of professional geoscientists.

GSA members can purchase *Compensation of Geoscientists—2001* at a 50% discount off the list price of $275.00. To order a copy, write to Abbott, Langer & Associates, Inc., Dept. GSA, 548 First Street, Crete, IL 60417, call (708) 672-4200, or fax 708-672-4674. Be sure to mention your GSA membership to take advantage of the discount. For more information about the report or about Abbott, Langer & Associates, visit www.abbott-langer.com.

In Memoriam

Steven H. Harris
Bismarck, North Dakota
March 11, 2001

William B. Joyner
San Mateo, California
March 2001

Frank E. Kottlowski
Socorro, New Mexico
April 18, 2001

Norman R. Lutz
Anchorage, Alaska
March 2001

Horace P. Miller
Tucson, Arizona

Gerald M. Richmond
Denver, Colorado
February 4, 2001

GSA EMPLOYMENT SERVICE

Job Seekers: Receive national exposure

Are you seeking a new position in the geosciences? Use the GSA Employment Service to let employers know what you can offer them. Your name and résumé will be provided to participating employers who seek an individual with your qualifications. You may register at any time. Complete the application form on page 20, prepare a one- to two-page résumé, and mail both with your payment to GSA headquarters. A one-year listing for GSA Members and Associates in good standing is $35; for nonmembers the cost is $65. Let GSA help you find the right job!

Employers: Find the perfect match

You can save time and resources in your search for qualified employees by using GSA's database of job-seeking geoscientists. Complete the Employer's Request for Earth Science Applicants form on page 21. Specify educational and professional experience requirements as well as the area or areas of expertise your applicant should have. GSA will take it from there. You'll receive a list of matching applicants that includes names, addresses, phone numbers, areas of specialty, type of employment desired, degrees held, years of professional experience, and current employment status. Applicants' résumés are sent with each list. The cost of an applicant list in one or two geoscience fields is $175. Each additional field is $50. A list of the entire applicant database is available for $350. It is solely the employer's decision to contact applicants who interest them; we do not notify applicants of matches. Employers using the matching service are invited, at no additional cost, to have their position announcement posted for three months on the GSA Web site.

Take part in the Employment Interview Service at the Annual Meeting

A great opportunity awaits you at GSA's Employment Interview Service, conducted each fall in conjunction with the Society's Annual Meeting. At the 2000 Annual Meeting in Reno, the service brought 52 employers and more than 170 applicants together for face-to-face interviews.

Mark your calendar: 2001 GSA Annual Meeting, November 4–7 in Boston

Applicants: If we receive your materials by September 15, your file will be included in the information employers receive *prior* to the meeting. Indicate on your application form that you would like to interview in Boston. If you sign up for the service after September 15 or at the meeting, employers will have on-site access to your information and résumé.

Employers: When you rent interview space at GSA's Annual Meeting, our staff will schedule all interviews for you. Plus, you'll have access to the entire applicant list and résumés, a message center, ongoing posting of job openings, on-site applicant registration and résumé updating, and photocopying services. Space is rented in half-day increments. Or you can forego the interview booth, but use all the other services with the Message Center Only option. We offer flexibility and service—it's your choice!

More information and forms are posted in the Professional Development section of the GSA Web site at www.geosociety.org. Or, contact Nancy Williams, Director of Member Services, GSA, P.O. Box 9140, Boulder, CO 80301-9140, (303) 447-2020, ext. 1117, nwilliams@geosociety.org.

NEW for Boston: Technical Session Rooms Get Upgrade

In addition to the standard technical equipment—two 35 mm slide projectors, two screens, and one overhead projector—GSA will also provide one LCD projector and one laptop computer loaded with the Windows operating system for anyone interested in giving a PowerPoint presentation at the Annual Meeting in Boston. This will be standard equipment in each of the oral technical session rooms. You will have the flexibility of using PowerPoint alone or in addition to slides or overheads. If you intend to give a PowerPoint presentation, please save your presentation on a 100MB IBM-formatted Zip disk. The resolution of PowerPoint presentations using the provided equipment is 1024 × 768, VGA output.

The Speaker Ready Room, located in room 204 in the Hynes Convention Center, will be outfitted with the same equipment found in each of the technical session rooms. This room is available to all presenters at the Boston meeting, giving them the opportunity to review their slides, PowerPoint presentation, and overhead transparencies. When you arrive at the convention center, please take advantage of the Speaker Ready Room to test your presentation. More information will be provided in the Speaker's Guide posted on our Web site in mid-August.

The Geological Society of America

3300 Penrose Place • P.O. Box 9140 • Boulder, CO 80301-9140
(303) 447-2020 • Fax: 303-443-1510 • E-mail: member@geosociety.org

FOR ACCOUNTING USE ONLY

Current? _____ $35 $65

Ck # _____

ID No. _____

APPLICATION FOR EMPLOYMENT MATCHING SERVICE

(*Please complete **ALL** information below.*)

TITLE: ☐ Dr. ☐ Mr. ☐ Ms. ☐ Mrs. ☐ Miss

NAME _____ **DATE** _____
Family / Last Name First

MAILING ADDRESS _____

CITY _____ **STATE** _____ **ZIP CODE** _____

DATE AVAILABLE _____ **E-MAIL** _____

CONTACT TELEPHONE ( ) _____ **or** ( ) _____
area code Business area code Home

PRESENT SPECIALTY
Choose **ONE** from codes listed below **1.** _____ **YEARS EXPERIENCE IN THIS SPECIALTY** _____

OTHER EXPERIENCE Must use specialty codes listed below.
Choose **THREE** that best describe your expertise in order of importance. **2.** _____ **3.** _____ **4.** _____
Note: The more specialty codes you use (total of four) the greater the chance for an employer match.

TYPE OF POSITION DESIRED (Check as many boxes as apply.)
Interested in: ☐ Academic ☐ Government ☐ Industry ☐ Other
Specific interest: ☐ Administration ☐ Exploration/Production ☐ Field ☐ Research ☐ Teaching

GIVE NUMBER OF YEARS EXPERIENCE FOR ANY OF THE FOLLOWING THAT ARE APPLICABLE
Administrative_____ Exploration/Production_____ Field_____ Research_____ Teaching_____ Total geological experience_____

ACADEMIC TRAINING

College or University	Degree (rec'd or expected)	Year	Major

PRESENT EMPLOYER _____

SPECIALTY CODES Select those that best describe your ability. Use codes in bold face only when other breakdowns are inadequate.

100 Economic Geology
101 coal geology
102 geothermal, etc.
103 metallic deposits
104 nonmetallic deposits
105 mining geology
120 Engineering Geology
150 Environmental Geology
160 Public Education & Communication
200 General Geology
220 Geochemistry
221 organic
222 high temperature
223 low temperature
224 stable isotopes
225 geochronology
250 Geomorphology
300 Geophysics
301 seismic
302 gravity/magnetics
303 seismicity
304 paleomagnetism
320 Hydrogeology
321 hydrochemistry
322 ground water
323 surface water
330 Library
350 Mathematical Geology
351 computer science
352 statistical geology
400 Mineralogy
401 crystallography
402 clay mineralogy
410 Museum (curator)
420 Oceanography
421 marine geology
422 coastal geology
450 Paleontology
451 invertebrate
452 vertebrate
453 micropaleontology
454 paleobotany
455 paleoecology
500 Petroleum Geology
501 exploration
502 subsurface strat.
520 Petrology
521 igneous
522 metamorphic
523 sedimentary (clastic)
524 sedimentary (carb.)
525 experimental
550 Planetology
575 Quaternary Geology
600 Regional Geology
620 Remote Sensing
621 photogeology
622 photogrammetry
630 Science Editing
650 Sedimentology
651 sed. processes
652 sed. environments
720 Stratigraphy
750 Structural Geology
751 tectonics
752 tectonophysics
753 rock mechanics
800 Volcanology

Résumé must accompany this form or be e-mailed to nwilliams@geosociety.org, and it must be ***limited to two pages*** of text. Include your name, address, and phone number; concise details of work experience; and majors/minors on degrees.

Fee: $35 if you are a Member or Student Associate of GSA in good standing (Member #_____), $65 if you are not a member of GSA. Payment in U.S. funds (check, money order, or charge information ***must accompany form).***

Make check payable to the Geological Society of America. This application will be active for 1 year.

☐ Check / Money Order ☐ MasterCard ☐ VISA ☐ Discover ☐ American Express or Optima

Card Expires (Mo/Yr) Card Number

Signature _____
Required for credit card payment Date

I agree to release GSA or their representatives from responsibility for errors that may occur in processing or distributing this data. I understand that GSA makes ***no guarantee*** of contact by an employer in this service. I agree to notify GSA Employment Service immediately of change of address or acceptance of a position.

Signature ***(required)*** _____ I will will not attend the 2001 GSA Annual Meeting in Boston.

The Geological Society of America

3300 Penrose Place • P.O. Box 9140 • Boulder, Colorado 80301-9140 • (303) 447-2020 • Fax: 303-443-1510 • E-mail: member@geosociety.org

EMPLOYER'S REQUEST FOR EARTH SCIENCE APPLICANTS

(Please type or print legibly)

NAME _____ **DATE** _____

ORGANIZATION _____

MAILING ADDRESS _____

CITY _____ **STATE** _____ **ZIP CODE** _____ **TELEPHONE (** **)** _____
area code Number

E-MAIL _____ **FAX (** **)** _____

SPECIALTY CODES (see list below) Cost for report is $175 for 1–2 codes. A list of 1–2 codes is provided at no additional cost with all booth rentals. Additional codes, $50 each; entire list, $350.

List the specialty code numbers that you wish to order, or ☐ check here if you want the entire file of applicants in *ALL* specialties.

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____

POSITION DATA: What position(s) do you expect to fill? _____

In what area(s)? _____

Degree requirements _____ Number of positions available _____

SPECIALTY CODES

100 Economic Geology
101 coal geology
102 geothermal, etc.
103 metallic deposits
104 nonmetallic deposits
105 mining geology
120 Engineering Geology
150 Environmental Geology
160 Public Education & Communication
200 General Geology
220 Geochemistry
221 organic
222 high temperature
223 low temperature
224 stable isotopes
225 geochronology
250 Geomorphology
300 Geophysics
301 seismic
302 gravity/magnetics
303 seismicity
304 paleomagnetism
320 Hydrogeology
321 hydrochemistry
322 ground water
323 surface water
330 Library
350 Mathematical Geology
351 computer science
352 statistical geology
400 Mineralogy
401 crystallography
402 clay mineralogy
410 Museum (curator)
420 Oceanography
421 marine geology
422 coastal geology
450 Paleontology
451 invertebrate
452 vertebrate
453 micropaleontology
454 paleobotany
455 paleoecology
500 Petroleum Geology
501 exploration
502 subsurface strat.
520 Petrology
521 igneous
522 metamorphic
523 sedimentary (clastic)
524 sedimentary (carb.)
525 experimental
550 Planetology
575 Quaternary Geology
600 Regional Geology
620 Remote Sensing
621 photogeology
622 photogrammetry
630 Science Editing
650 Sedimentology
651 sed. processes
652 sed. environments
720 Stratigraphy
750 Structural Geology
751 tectonics
752 tectonophysics
753 rock mechanics
800 Volcanology

Applicants seeking employment in:
☐ Academic ☐ Government ☐ Industry ☐ Other _____

***Minimum* degree required:**
☐ None ☐ B.A. or B.S. ☐ M.A. or M.S. ☐ Ph.D.

***Minimum* professional experience:**
☐ None ☐ 1–5 years ☐ 6-plus years

Experience desired (years):

	None	1–5	6-plus
Administrative	☐	☐	☐
Exploration/Production	☐	☐	☐
Field	☐	☐	☐
Research	☐	☐	☐
Teaching	☐	☐	☐

Employment in: ☐ U.S. only ☐ U.S. with foreign assignments ☐ Either

I am interested in interviewing applicants through the GSA Employment Service at the 2001 Annual Meeting in Boston, Massachusetts.

Signature (required) _____

Date _____

1. I agree to use this service for valid recruiting purposes.
2. I agree that no placement charges will be assessed to any applicant participating in the GSA Employment Matching Service.

Total fee enclosed ..... $ _____

Or invoice requested ..... $ _____

5/01

NEW GSA MEMBERS

The Geological Society of America welcomes the following 1,010 new members (including 158 transfers from associate status), elected from October 2000 through January 2001.

Jason G. Aase
Robert E. Abbott
Cherri J. Adair
Chad W. Adams
Deborah J. Agenbroad
Jeff G. Agnew
Galih W. Agusetiawan
Michael T. Aide
Stavena L. Akins
Adeeba I. Al-Hurban
William H. Albright
Douglas L. Alexander
Alex L. Alexeev
Huda M. Allawati
Matthew C. Allen
Matthew D. Anders
Jennifer L.B. Anderson
Kevin B. Anderson
Louise A. Anderson
Kevin T. Andras
Zahie Anka
Alejandra Arciniega-Ceballos
Charles R. Ardoin
Evan V. Arntzen
Miguel A. Arriaga
Estella A. Atekwana
Carole M.T. Augereau
Than T. Aung
Kerry L. Ayers
Jochen Baier
Matthew A. Bailey
Renata Bailey
Joseph R. Baker
Clara M. Balasko
Alice M. Baldridge
Subhotosh Banerjee
Gerardo G. Barba
Timothy J. Bardsley
Lori Barg
Joel D. Barker
Jaime D. Barnes
Daniel O. Barnhurst
Wendy Barrow
Laura S. Barta
James W. Bartholomew
Emily Bartlett
Mark A. Bash
Damon J. Bassett
Mark S. Baum
Shay Beanland
William C. Beard III
Yannick C. Beaudoin
Adam L. Bedell
Sean P. Bemis
Frank W. Benacquista
Matthew B. Bendernagel
David C. Benner
Peter Berger
Carleton R. Bern
Aiguo Bian
Bob Bingham
Dennis K. Bird
Enrico Biscaro
Susanne E. Biteman
Martin Bizzarro
Leif T. Bjornson
Shawn R. Blaesing-Thompson
Christopher M. Blake
Suzanne M. Blakeney
Matthew J. Bogar
Goetz H.R. Bokelmann, GSA Fellow
Kristen A. Bollman
Sarah Boon
Sebastian Bordage
Penelope J. Boston
Gabriel J. Bowen
J. Richard Bowersox
Jerry L. Boyd II
Suzanne A. Boyd
Aimee Bradley
Rick Brainerd
Joy Branlund
David C. Brewster
Jose B. Brilha
Kara Bristow
Christopher T. Brixius
Kenneth J. Brooks
Matthew I. Brookshier
David W. Broughton
Julie Broughton
Eric L. Brown
Timothy E. Brown
James V. Browning
Althea R. Bruce
Derek S. Brunner
Norman Scott Buchanan
Koll Y. Buer
Michael E. Bulleri
George S. Burr
Michael R. Burston
Jason Burt
Dalia Bushra
Nicholas J. Butterfield
Christina M. Butzer
Janelle M. Byman
Randy Calcote
Ethan J. Caldwell
Thomas E. Callicrate
Andy J. Caneday
Cody T. Cantrell
Paul Capolino
Daniel K. Capps
Anders E. Carlson
Cathleen Carlson-Cornejo
Karen M. Carney
Robert L. Carpenter
Steven B. Carpenter
Tracey L. Carpenter
Gary A. Carver
Benjamin H. Cashman
Paul Castleberry
Mary Walton Cathey
Pablo Cervantes
Christopher G. Chaffin
Joyia E. Chakungal
Eric J. Chapman
Steven W. Chapman
Xavier Chatellier
Jay W. Chennault
Megan L. Cherry
Emily Chetwin
Yi-Ju Chien
Krista Chomicki
Chuck Ciampaglio
Giuseppe Cippitelli
Alan H. Clark
Cory C. Clechenko
Eric J. Cline
Michael L. Cline
Drew H. Coleman
Erin M. Colie
Allen G. Collins
Jennifer P. Collins
Kelli L. Collins
Marline R. Collins
Andrew G. Conly
Mark Coolbaugh
Torrey J. Copfer
Paula C. Coppock
David Reide Corbett
Elise C. Cormier
Yovanna Cortes Di Lena
Pamela M. Cossette
J. Patrick Costello
Alejandro Cuevas Covarrubias
Eric P. Cox
Erin A. Crawley
Jason Crosswhite
Jill O. Crotwell
Anita E. Csoma
Patricia J. Culligan
Lyz A. Cullmann
Michelle L. Cunico
William L. Cunningham
Howard Cyr
Jessica L. Czajkowski
Kelsie A. Dadd
Neal R. Dannemiller
Gene Darnell
Sarah B. Das
Chris Daughney
Christopher C. Davidson
Kevin J. Davis
Michael G. Davis
Mike Davis
Michelle M. Debus
Richard W. Debus
David Decker
Jeffrey S. Deems
Maya T. Del Margo
Irina Delusina
Thomas A. DelVecchio
Katie A. Denham
Ross Denton
André Desrochers
Thomas S. Devilbliss
Lorie M. Dilley
Paul J. Dobak
Megan L. Dockter
Holly E. Dodson
Carol Farkas Doe
Linda L. Donohoo
Thomas A. Douglas
Heidi M. Dowd
Jason P. Downs
Amy E. Draut
Josef D. Dufek
Mirela Dumitrescu
Jay Dunlap
Robert A. Dunn
Cynthia J. Durbin
Kathleen Dykes
Thomas E. Eastler
Monica G. Easton
Louis Scott Eaton
Blake D. Edgar
Keith W. Ehlert
Ingrid L. Ekstrom
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Masud F. Elahi
Joe T. Elkins
Kevin M. Ellett
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Kris Esterson
Lawrence R. Etri
Charlotte Evans
Olalekan K. Fawumi
Alisa K. Felton
Colin B. Ferguson
Nicholas F. Ferina
Anetta R. I. Fernando
Bill Fetter
Aaron A. Fiaschetti
Manuel Filgueira-Rivera
Mara Finkelstein
Fred N. Finley
Emily S. Finzel
Paul C. Fitzgerald
Paul A. Flamm
Mark S. Flaum
Adam Flege
Jeremy Flemmer
Elizabeth Flemming
Katherine A. Folk
Diane R. Fordik
Michael R. Fortwengler
Pamela M. Foster
Jamie L. Egger Foucher
Deborah D. Foust
Phillip Fowler
Reina L. Foxx
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Karen E. Frey
Alana M. Fuierer
Elizabeth Fuller
Joseph Furia
A. Joyce Furrer
Rebecca Fusee
Joel E. Gagnon
John J. Galler
Kusali Gamage
Jeff D. Gamlin
Caroline B. Garrett
Patrick Garrow
Luis Miguel G.G. Gaspar
Terry A. Gates
Angela M. Gaubert
Bjarni Gautason
Kera L. Gautreau
Tsigabu A. Gebrehiwet
Sebastian Geiger
Shari L. Generaux
William Miles Gentry
Erik R. Gerking
Leon R. Geschwind
David Gibson
Jeffery D. Gill
Murray K. Gingras
Sara E. Giorgi
Robert J. Glass
Dwight K. Gledhill
Raymond D. Glenn
Rebecca L. Glover
Jean-Philippe Gobeil
Kimball Goddard
Deborah R. Goldblum
Juan M. Gomez-Gonzalez
Margaret L. Gooding
David Goss
William E. Gottobrio
Cheryl L. Goudy
Stephen Jay Gould
Sherif I. Gowelly
Brita R. Graham

NEW GSA MEMBERS

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Briana Greer
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Michael W. Guidry
Joseph T. Gurrieri
George D. Guthrie
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J.D. Haines
Seth Haines
Tim M. Hall
Jacquelyne E. Hams
Eric Hand
Krisha N. Hansel
Ian R. Hardesty
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Daniel F. Harrington
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Melanie Hartman
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Hugh J. Hawthorne
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Mark A. Hemphill-Haley
Penny Henderson
Jonathan R. Hendricks
Joel W. Hennessy
Jan Hermanson
Israel Hernandez
Linda V. Hernick
Robert W. Hess
Kenneth A. Hickey
Ivan C. Higuera-Diaz
Nancy Hilbun
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Patrick G. Hourican
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Debra L. Hughson
Lorena Ibañez
Elsayed Ali Hermas Ibrahim
Susan K. Jagoda
Jesse N. Japitana
Karen G. Jensen
Helen E. Jewell
Concepcion Jimenez-Lopez
Qusheng Jin
Julie M. Johannes
Timothy Johnsen
J.L. Johnson
Kathleen Esther Johnson
Kevin T.M. Johnson
Jon Paul Jones
Matthew A. Jones
Anders Bjorn Ulrik Jonsson
Thomas H. Jordan
Thomas E. Jordan
Vishwas B. Joshi
Celeste A. Journey
Tamie J. Jovanelly
Diana Jozwik
M. Brian Junck
Christopher H. Jung
Itoh Junichi
Edna Kaiser
Ravi Kanda
Evan O. Kane
David A. Katz
Jennifer E. Kay
Anton T. Kearsley
Corinn C. Keblinsky
Katy Keller
Andrew W. Kendrick
Chris B. Kennedy
Keith R. Kepple
Andrew Kerr
Michael E.A. Kerr
Paul R. Kester
Heyward M. Key
Donna D. Khallouf
Lora Kiger
Young-Woo Kil
Thomas Wade Killingsworth
Christopher S. Kim
Dongwon Kim
Sang-Tae Kim
Brian C. King
Helen L. King
Lisa Kirkendale
Russell A. Kirkham
Tamer Koksalan
Mossbah M. Kolkas
Gregory J. Korniewicz
Karen A. Koutrakos
Hemin A. Koyi
Clare E. Kramer
Garrett M. Kramer
Julie Kramer
Kalen J. Kramer
Geoffrey S. Kristof
Jason N. Krothe
Andrew Z. Krug
William C. Krugh
Kimberly R. Kuhlman
Robert R. Kulp
Stephanie Kuzio
Amy M. Kwiatkowski
Shawn E. LaBounty
Eric Lachance
Gerald T. Ladd
Jenny H. LaGesse
France Lagroix
James E. Landmeyer
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Peter B. Lask
Jorge H. Laux
Aletha J. Lee
Dennis P. Lee
Robert C.L. Lee
Rene Lefebvre
Stephen J. Lemieux
Shawn M. Len
Christopher J. Lepre
Mark E. Lesh
Elizabeth R. Leslie
Jacob M. Letts
Joshua M. Letts
Fred S. Levitan
Gayle M. Levy
Christine J. Lewis
Dave Lewis
Ted Lewis
Zheng-Hua Li
Shirley A. Libed
Karin Lichtenstein
Robert C. Liebermann
Jeffrey P. Light
Joseph R. Liles
Yu-Feng Lin
Eric K. Linscheid
Monika Lipinski
Joanna L. Lipske
Joanne M. Livingston
F. Caroline Lo Re
Dottie Lofstrom
Paul S. Lombardi
Teresa G. Longazo
Jennifer Loomis
Ivan Lopez Ruiz-Labranderas
Julio Velez Lopez
Nathaniel J. Lorentz
Michael G. Loso
Kirsti Loukola-Ruskeeniemi
Sofya L. Low
Jared D. Lubben
C. Joel Luckow Jr.
Matthew J. Lundberg
Kari A. Lundeen
Michele Y. Mabry
James MacDonald
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About the Author

A GSA member, the author found fame when he took advantage of the GSA Bookstore's Members' Corner Book Display. His book gained national exposure at GSA meetings held around the country. The author now splits his time between Woods Hole, Massachusetts, and Saint-Tropez.

For information on the Members' Corner, contact Ann Crawford, 1-800-472-1988, ext. 1153, acrawford@geosociety.org. Books must be of direct relevance to the earth sciences. Selection of materials will be at the discretion of the GSA director of publications.

2002 GSA Section Meetings

CALL FOR PAPERS

NORTHEASTERN SECTION
March 25–27, 2002

Sheraton Springfield, Springfield, Mass. **For meeting information:** Sheila Seaman, Dept. of Geosciences, University of Massachusetts, 233 Morrill Science Center, Amherst, MA 01003-5820, sjs@geo.umass.edu.

Abstract deadline:
December 18, 2001

SOUTHEASTERN AND NORTH-CENTRAL SECTIONS
April 3–5, 2002

Hyatt Regency Hotel and Lexington Civic Center, Lexington, Ky. **For meeting information:** John D. Kiefer (kiefer@kgs.mm.uky.edu), or James C. Cobb (cobb@kgs.mm.uky.edu), Kentucky Geological Survey.

Abstract deadline:
December 19, 2001

SOUTH-CENTRAL SECTION
April 11–12, 2002

Sul Ross State University Center, Alpine, Texas. **For meeting information:** Kevin Urbanczyk, Dept. of Earth & Physical Science, Sul Ross State University, SRSU Box C-143, Alpine, TX 79832-0001, kevinu@sulross.edu.

Abstract deadline:
December 27, 2001

ROCKY MOUNTAIN SECTION
May 7–8, 2002

Southern Utah University Campus, Cedar City, Utah. **For meeting information:** Robert Eves, Dept. of Geology, Southern Utah University, Cedar City, Utah, (435) 586-1934, fax 435-865-8051, eves@suu.edu.

Abstract deadline: February 4, 2002

CORDILLERAN SECTION
May 13–15, 2002

Oregon State University, Corvallis, Oregon. **For meeting information:** Robert S. Yeats, Dept. of Geosciences, Oregon State University, 104 Wilkinson Hall, Corvallis, OR 97331-5506, yeatsr@geo.orst.edu.

Abstract deadline: February 7, 2002

NORTH, SOUTH, EAST, WEST, AND POINTS BETWEEN:

2001 Section Meetings Spanned the Country from Vermont to California

The five Section Meetings (the Rocky Mountain and South-Central sections held a combined meeting) held in March, April, and May were both busy—just ask the organizers!—and productive. Following are the newly elected and reelected Section officers. But first, GSA would like to recognize and thank Kenneth N. Weaver, past Secretary-Treasurer of the Northeastern Section, and Bruce A. Blackerby, past Secretary-Treasurer of the Cordilleran Section, for their many years of service. Headquarters staff members have found them to be a pleasure to work with. Ken and Bruce, we look forward to seeing you at GSA events.

A sincere "thank you" to all the outgoing officers for volunteering your services and a warm welcome to all the newly elected and reelected Section officers. You are appreciated!

SECTION OFFICERS
2001–2002

CORDILLERAN SECTION
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Donald W. Neal, Secretary-Treasurer
Larry D. Woodfork, Past Chair

2002 GSA Annual Meeting

Denver, Colorado
Colorado Convention Center
October 27–30

Technical Program Chair

John W. Geissman
University of New Mexico

Due Date for Pardee Keynote Symposia and Topical Proposals:
January 17, 2002

Call for Field Trip Proposals

We are interested in proposals for half-day, single-day, and multi-day field trips, beginning or ending in or near Denver and dealing with all aspects of the geosciences.

Due Date for Field Trip Proposals:
October 1, 2001

Please Contact the Field Trip Chair

Eric A. Erslev
Department of Earth Resources
Colorado State University
Fort Collins, CO 80523
(970) 491-5661
fax 970-491-6307
erslev@cnr.colostate.edu

For More Information:

(303) 447-2020 or 1-800-472-1988, fax 303-447-0648
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Future GSA Meeting:
2003—Seattle, Washington, November 2–5

NEW OFFER TO GSA MEMBERS

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Since 1953, the *Australian Journal of Earth Sciences* has published refereed papers on all aspects of earth sciences, particularly in the Australian, New Zealand, and Southeast Asian regions. Papers include research, review, and short articles (the latter are given priority in the publication schedule), along with discussions and replies to papers recently appearing in the *Journal*. It is published six times per year, consisting of about 1,100 pages annually and including color figures. The *Journal* is available in both print and online versions.

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32nd International Geological Congress to Take Place in Florence in 2004

Gian Gaspare Zuffa, *Chairman, 32nd IGC Scientific Program Committee*

In collaboration with and under the sponsorship of the International Union of Geological Sciences (IUGS), the 32nd International Geologic Congress (IGC) will be held in Florence, Italy, a city of artistic heritage and cultural traditions. The recently remodeled pentagonal fortress of the Fortezza Da Basso, a wide area in the heart of the town, will host the event. A variety of modern, integrated spaces near the session rooms will be available to display a large number of posters, hold short courses and meetings of scientific associations, accommodate an exhibition, and more.

The 32nd IGC is being organized in cooperation with a number of perimediterranean countries grouped in the GEOMED Consortium. Italy and the Mediterranean area offer a variety of possibilities for outstanding field trips on the most diverse geological subjects, from well-studied mountain chains such as the Alps and Apennines to the active volcanic areas surrounding Naples, Mount Etna in Sicily, and the Aeolian Islands in the Tyrrhenian Sea. The location also offers the possibility of focusing on recent devastating natural hazards and on the geological aspects of famous archaeological sites such as Pompeii and Paestum.

32nd International Geological Congress

From the Mediterranean toward a Global Renaissance—Geology, Natural Hazards, and Cultural Heritage

August 20–28, 2004, Florence, Italy
www.32igc.org

Deadline for proposals: September 30, 2001

Call for Symposium, Workshop, and Short Course Proposals

The 32nd IGC, approved at the August 2000 IGC in Rio de Janeiro, centers on the need for the international geological community to foster new ideas and models for implementing a close interplay between pure science and its applications.

The congress will include topics related to the spectrum of earth sciences as well as thematic sessions. While a significant number of scientific sessions will be devoted to themes related to the Mediterranean area, natural hazards, and cultural heritage, content also will address the requirements of this congress, which meets only every four years. We invite proposals for symposia, workshops, and short courses on all subjects. Themes accepted as appropriate for the meeting by the Scientific Program Committee will be included in the first circular, distributed in spring 2002.

General symposia will include issues related to the whole spectrum of earth science disciplines. Special symposia will focus on interdisciplinary issues and the latest scientific advancements. Poster sessions will be organized to interact positively with the oral sessions. Workshops will be held before and after the congress at the University of Florence (located near the congress venue) or in other Italian universities and institutions. Pre- and post-congress short courses will be held at the University of Florence; short courses held concurrently with the congress will be held at the Fortezza Da Basso Conference Venue.

For proposal forms, visit www.32igc.org or e-mail Chiara Manetti, cmanetti@geo.unifi.it. Completed proposal forms are due by September 30, 2001, to Chiara Manetti, Università degli Studi di Firenze, Dipartimento di Scienze della Terra, Via La Pira, 4, 50121 Firenze, Italy, tel./fax: 055-2382146. Acceptance of proposals will be acknowledged by early spring 2002.

International Geological Congress Travel Grants Program

In 1990, a fund management agreement between the 28th International Geological Congress (IGC), GSA, and the GSA Foundation established a travel grant program to help young geoscientists with U.S. residency or citizenship to attend IGC meetings.

An evaluation and selection committee for the 32nd IGC travel grant program will screen the applicants and award the grants. In addition to the age, residency, and citizenship requirements stipulated in the agreement, committee members use criteria such as whether applicants have abstracts accepted by the IGC, the quality of the abstracts, whether the abstracts are invited, whether applicants are co-chairing sessions, their justification for attending, their student status, and the quality of the letters of recommendations that accompany applications.

The 31st IGC Travel Grants Program awarded $18,175 to 13 recipients.

Information on the IGC travel grant program for attendance at the 32nd IGC, to be held in Florence, Italy, in 2004 will be advertised later this year and in 2002. Plan now to apply if you are a resident or citizen of the U.S. and will be under 40 years of age at the time of the Florence-hosted 32nd IGC.

CLASSIFIED Advertising

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Positions Open

GEOLOGICAL ENGINEERING FACULTY UNIVERSITY OF MISSOURI—ROLLA

The Department of Geological and Petroleum Engineering at the University of Missouri—Rolla invites applications for a tenure-track position in geological engineering. Rank will depend upon qualifications and previous experience in an area considered critical to the mission of the program. A Ph.D. in geological engineering or a related field is required and registration as a professional engineer or the qualifications to become registered are strongly desired. Appropriate areas of expertise include: GIS and remote sensing applications in geological engineering, engineering geology and geotechnics, groundwater hydrology and contaminant transport, applied geomorphology, or geo-environmental and geo-environmental and geo-materials engineering. Other areas of geological engineering that complement the mission and ongoing strengths of the program will be considered. The successful candidate should possess a strong commitment to undergraduate and graduate teaching and advising, and the successful candidate must demonstrate funding.

The University of Missouri—Rolla offers B.S., M.S., and Ph.D. degrees in geological engineering. It is located in scenic south-central Missouri about 100 miles southwest of St. Louis, in the midst of some of the more complex and interesting geology in the U.S. Outdoor activities and recreational opportunities are plentiful, and Rolla is characterized by good public schools, medical facilities, and a relaxed, pleasant mid-western lifestyle. Additional information about the department and UMR may be obtained by visiting www.umr.edu.

Interested candidates should submit a curriculum vitae; a statement of teaching interests and research accomplishments; and the names, addresses, and telephone numbers of at least three professional references. The deadline for receipt of applications is August 1, 2001, although the selection process will begin immediately upon receipt of applications. Starting date will be September 1, 2001.

Send application materials to: Human Resources Services, Reference Number R50742, University of Missouri—Rolla, 1202 North Bishop, 1870 Miner Circle, Rolla, MO 65409-1050. The University of Missouri—Rolla is an equal opportunity employer.

FLORIDA STATE UNIVERSITY

Assistant Professor and Scholar Scientist—Earth Surface Processes. The Florida State University invites applications and nominations for two faculty positions, an assistant professor and a scholar scientist, associated with the Center for Earth Surface Processes Research (CESPR). Specialty areas are open and may be complementary to current research of CESPR members (e.g., river/floodplain dynamics, coastal wetlands, sediment transport, landscape evolution, karst hydro-geomorphology), or involve areas that bridge surface processes and related Earth or ecological sciences (e.g., coastal oceanography, biophysical processes). We particularly welcome applications from individuals possessing a flair for meshing theoretical, experimental, and/or field-based work in Earth surface processes with tools of computational science, including visualization, algorithm/code development and/or data assimilation.

The CESPR is an interdisciplinary center focused on fusing advanced computing with studies of flow and transport in hydrological and geomorphic systems and involves a major collaboration between the Department of Geological Sciences and the School of Computational Science and Information Technology (CSIT). As a new, competitively awarded Center of Excellence, the CESPR represents a major university commitment to support excellence in research and student training in Earth surface processes.

These positions, beginning as early as January 2002, will be appointed jointly in Geological Sciences and CSIT. The assistant professor position is a tenure-track appointment; the scholar scientist position is a non-tenure–track faculty appointed for three years, with the possibility of renewal.

Applications should include a vita, a statement of research and teaching interests, and names of at least three references, including e-mail addresses and telephone numbers. Applications may be submitted by e-mail, as PDF files, to: cesprfaculty@gly.fsu.edu, or via normal mail to: CESPR Faculty Search, Department of Geological Sciences, Florida State University, Tallahassee, FL 32306-4100. Review of applications will begin August 17, 2001, continuing until the positions are filled.

Florida State University is an EO/AA employer committed to diversity in hiring and a public records agency.

ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE AT UNIVERSITY OF MIAMI

Rosenstiel School of Marine and Atmospheric Science at University of Miami invites applications for six postdoctoral positions within the areas of global climate change, remote sensing, and computer science applications in environmental studies. These positions are sought as part of the Rosenstiel School's continuing commitment to research in fundamental processes involving global and regional observations as made by satellite and in situ sensors. The need for six new postdoctoral positions is prompted by the recent addition of several new programs at the school, namely: Center for Southeastern Tropical Advanced Remote Sensing (CSTARS), the SeaKeepers vessel of opportunity program, and the Air-Sea Interaction Facility. Depending on their interests and qualifications, the applicants could work in connection with one of these programs or with faculty in any division of the school. For more information on these programs, see school's Web site at http://www.rsmas.miami.edu/.

The six fellowships being offered will fall into one of the following topic areas:

REGIONAL CLIMATE ASSESSMENT OF THE ATMOSPHERE-OCEAN SYSTEM. This would include the diagnosis and assimilation of satellite and in situ observations, high-resolution modeling of the coupled system, and process studies of relevance to climate. One (1) position.

MASS TRANSFER OF GREENHOUSE GASES ACROSS THE AIR-WATER INTERFACE. The investigation will center on a wind-wave tank in which the affects of waves and breaking waves, turbulence, bubbles, and spray can be explored. A strong background in fluid mechanics is required and experience in surface chemistry. One (1) position.

PASSIVE AND ACTIVE MICROWAVE TECHNIQUES FOR INVESTIGATION OF LAND, OCEAN AND ICE

PROCESSES. The use of satellite imaging, particularly synthetic aperture radar (SAR), for studies in surface changes associated with volcanoes, wind fields of tropical storms, detection of ocean features and ships, and radiation transfer. The investigations will be carried out at the new CSTARS, where multi-sensor imagery will become available in real time. A strong background in physics is required and experience in oceanography and/or geology. One (1) position.

AUTONOMOUS IN SITU OCEAN AND ATMOSPHERIC MEASUREMENTS PROGRAM. Developing a strategy for the effective and efficient use of vessels (ships) and other platforms (buoys, piers, lighthouses, etc.) of opportunity for the autonomous acquisition and transmission of remotely collected oceanographic and meteorological data. Two (2) positions.

COMPUTER SYSTEMS AND APPLICATION DESIGN. Developing computer systems, strategies, and products for handling large data volumes from environmental remote sensing studies. This involves near–real-time acquisition, transmission, processing, and developing user-friendly data products. One (1) position.

The postdoctoral fellowships are being offered for up to two years at an annual salary of $35,000 to $40,000 plus benefits and a research/travel fund. Review of the applications will begin on May 1, 2001, and continue until all positions are filled. Support for these fellowships will come from the Vetlessen Foundation, the International SeaKeepers Society and government contracts.

Applicants should send their curriculum vitae and a list of three references to Dr. Rod G. Zika, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, FL 33149, or by e-mail to: rzika@rsmas.miami.edu. For phone inquires, contact Ms. Lynnette Washington at (305) 361-4731.

MIT—ADMINISTRATOR OF ACADEMIC PROGRAMS

The Department of Earth, Atmospheric, and Planetary Sciences (EAPS) at MIT seeks an individual to manage departmental academic programs. The administrator of academic programs will work with faculty and staff to develop and implement new initiatives for EAPS graduate and undergraduate programs and will oversee all departmental activities. Responsibilities include managing the EAPS Education Office; advising students regarding degree requirements, career options, and policies and procedures; acting as a liaison between the department and internal and external constituencies, including the Woods Hole Oceanographic Institution; overseeing student registration, course scheduling, and production of educational program brochures; supervising the graduate student admissions process, administering graduate student teaching assistantships, fellowships, and awards; coordinating Independent Activities Period (IAP) and field camp activities; and overseeing freshmen advising seminars and Undergraduate Research Opportunities Program (UROP) projects.

Requirements: an advanced degree and background in science (Ph.D. preferred) and three to five years' experience in an academic environment. Must have excellent computer skills. Familiarity with FileMaker Pro and graphics software preferred. Position requires strong interpersonal, organizational, and communication skills.

Interested candidates should submit a resume and cover letter referencing Job No. 01-0443 to: Etaine Smith, MIT Human Resources, P.O. Box 391229, Cambridge, MA 02139-0013. To apply online: web.mit.edu/personnel/www/resume.htm. MIT is an Equal Opportunity/Affirmative Action Employer. MIT is a non-smoking environment.

POSTDOCTORAL SCIENTIST [PDS PIEWETL]
ECOSYSTEMS CENTER
COASTAL WETLAND GEOMORPHOLOGIST
FULL-TIME, EXEMPT

Funding is anticipated for a full-time, year-round postdoctoral scientist position with the Ecosystems Center of the Marine Biological Laboratory to work with a team of wetland ecologists and biogeochemists studying the response of intertidal marshes to sea level rise and watershed perturbations.

DUTIES: The Ecosystems Center is interested in developing scale invariant geomorphic indices of estuarine wetlands and channel networks that will enable us to scale up from plot-level marker horizon and sediment elevation table (SET) measures. We want to know if there is a relation between the stability of coastal wetlands and the geomorphic-fractal signature of wetland drainage networks.

EDUCATION: We seek an individual with a Ph.D. and expertise in image analysis, GIS, drainage networks geomorphology, coastal geology, or wetland ecology. This position will be at the MBL Ecosystems Center located in Woods Hole, Massachusetts, which can be viewed at http://ecosystems.mbl.edu/, but will involve interaction with scientists at the University of South Carolina and Mt. Holyoke College.

DEADLINE: Until a suitable candidate is identified.

Send cover letter with position desired, curriculum vitae, statement of research interests and names and addresses of references to: Marine Biological Laboratory, Attn: Human Resources, reference code [PDS PIEWETL], 7 MBL Street, Woods Hole, MA 02543; telephone (508) 289-7422.

Equal Opportunity/Affirmative Action/Non-smoking workplace.

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TRANSLATION & INFORMATION FOR JAPANESE EARTH SCIENCE. Please visit Earth-J at http://earthj.vis.ne.jp, Email: earthj@mf.vis.ne.jp.

GSA EMPLOYMENT MATCHING SERVICE. Looking for the perfect geo-job? Try using GSA's Employment Matching Service. See pages 19–21 for details.

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

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DHAHRAN, SAUDI ARABIA

College of Sciences
Earth Sciences Department

The Department of Earth Sciences at King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia invites applications for a faculty position at a professor rank in the field of Environmental and Engineering Geology. This position requires someone who is experienced in all aspects of environmental investigations and assessments. Areas of particular interest are interaction of humans with the geologic environment, waste and pollution management, assessing geological hazards and risks, toxic substance control and land use management. Additional requirements are a Ph.D. degree in Environmental Geology / Engineering Geology and at least ten years of industry experience. The successful candidate must be innovative and have the vision and ability to apply advanced scientific and computer techniques to environmental and geological engineering problems. Teaching at the undergraduate and graduate levels and maintaining a strong research program will be expected of the successful candidates.

Salary/Benefits: Two year renewable contract. Competitive salaries based on qualifications and experience. Free furnished air-conditioned on-campus housing unit with free essential utilities and maintenance. The appointment includes the following benefits according to the University's policy: air ticket to Dammam on appointment; annual repatriation air tickets for up to four persons; assistance with local tuition fees for school-age dependent children; local transportation allowance; two months paid summer leave; end-of-service gratuity. KFUPM campus has a range of facilities including a medical and dental clinic, an extensive library, computing, research and teaching laboratory facilities and a recreation center.

To apply: Mail, fax or e-mail cover letter and detailed resume to:

Dean, Faculty & Personnel Affairs
KFUPM, DEPT. ES-2102
Dhahran, 31261, Saudi Arabia
Fax: 966-3-860-2429 E-Mail: faculty@kfupm.edu.sa or es.chairman@kfupm.edu.sa

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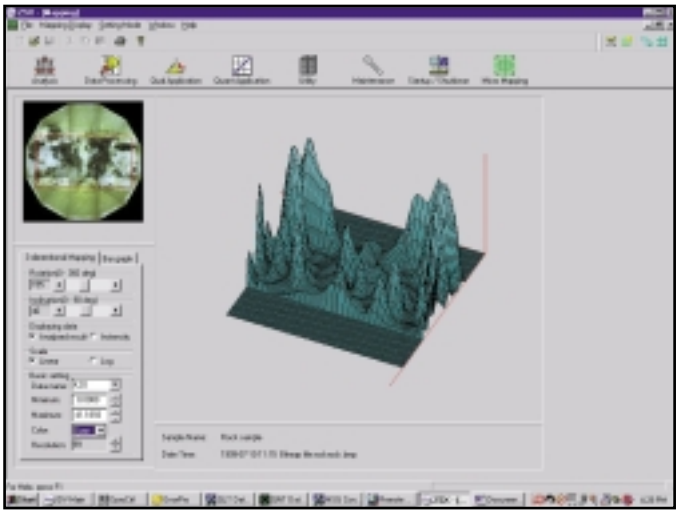

For more information contact Rigaku at:

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Phone: 281-363-1033 • Fax: 281-364-3628

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Web: www.rigaku.com