

**INSIDE**

- Penrose Conferences p. 275
- Rocky Mountain Section Meeting p. 276
- Cordilleran Section Meeting p. 275

## New Gravity Model for Earth Science Studies

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Knowledge of Earth's gravity field has increased greatly in the past few years, due to the need for more precise knowledge of satellite orbits and for military purposes. However, there has been a favorable fallout for earth science. For several years, short-wavelength sea surface and gravity anomalies have been used to learn about the topography and tectonics of the seafloor, but new gravity data allow for studies of longer wavelength phenomena in the oceans—and on land as well.

Observational data about Earth's gravity field, from different sources, is incorporated in an Earth gravity model, which is a convenient way of describing the gravity field anywhere on Earth. The gravity model is a spherical harmonic series of the gravitational potential. The potential can then give the gravity field—i.e., both geoid and gravity anomalies. The coefficients of the terms of the spherical harmonic series have been determined by using satellite laser ranging for the lower degree and order terms (model JGM-1; Lerch et al., 1992) and by more extensive surface, or near-surface, databases for higher degree and order coefficients (model OSU91A; Rapp et al., 1991). Model JGM-1 was developed by a combined effort of the University of Texas Center for Space Research and the Gravity Modeling group at NASA Goddard Space Flight Center and is used here up to degree and order 70. Model OSU91A for degree and order 70 through 360 was developed by Ohio State University. These two models are joined here to give a full spherical harmonic expression through degree and order 360. This should show information about the gravity field down to a scale of approximately the circumference of Earth (40,000 km) divided by 360, or about 110 km.

This model gives comprehensive data for the variation of gravity over all the continents and oceans. While it is impracticable to develop a harmonic series detailed enough to show variations of a few tens of kilometers (along-track filtering of ERS-1 and Geosat and Seasat data are needed for that; see, e.g., Sandwell and Smith, 1992), the 360° model presented here highlights regional variations and more absolute values across the spatial spectrum.

The geoid and free-air gravity anomaly maps of Earth shown in Figure 1 were made from the combined 360° model. The geoid and gravity anomalies were calculated for each half degree, then interpolated to a 10 km grid. The geoid heights are shown as color shadings over the ETOPOS topographic relief, which also has a 10 km gridding. The anomalies are shown as shaded relief referred to an ellipsoid whose inverse flattening factor is 298.2564. This 10 km gridded data set is convenient for crustal modeling.

Regarding the gravity anomaly map, one may comment on several interesting features. Lows of -40 to -90 mgal are seen over the Hudson Bay region, in the western North Atlantic, in the southern border of Australia, over the Pacific trenches, and off East Africa in the Indian Ocean. The well-known low south of India shows considerable detail; the northward track of India and other details are evident. Over land, the lows of central Africa, eastern Saudi Arabia, and north and south of the Himalayas are prominent. Highs are seen on the landward side of subduction zones, over the Alps and the Himalayas. The longer wavelength aspects of these lows and highs must be accounted for in theories of convection within Earth and continental drift.

The mid-ocean ridges are of special interest. The axis of the Mid-Atlantic Ridge has varying types of positive gravity anomalies; the larger anomalies are at higher latitudes, north and south. The faster spreading East Pacific Rise shows almost no anomaly. The Indian Ocean shows anomalies that have little relation to the axis of the Mid-Indian Ocean Ridge. Small

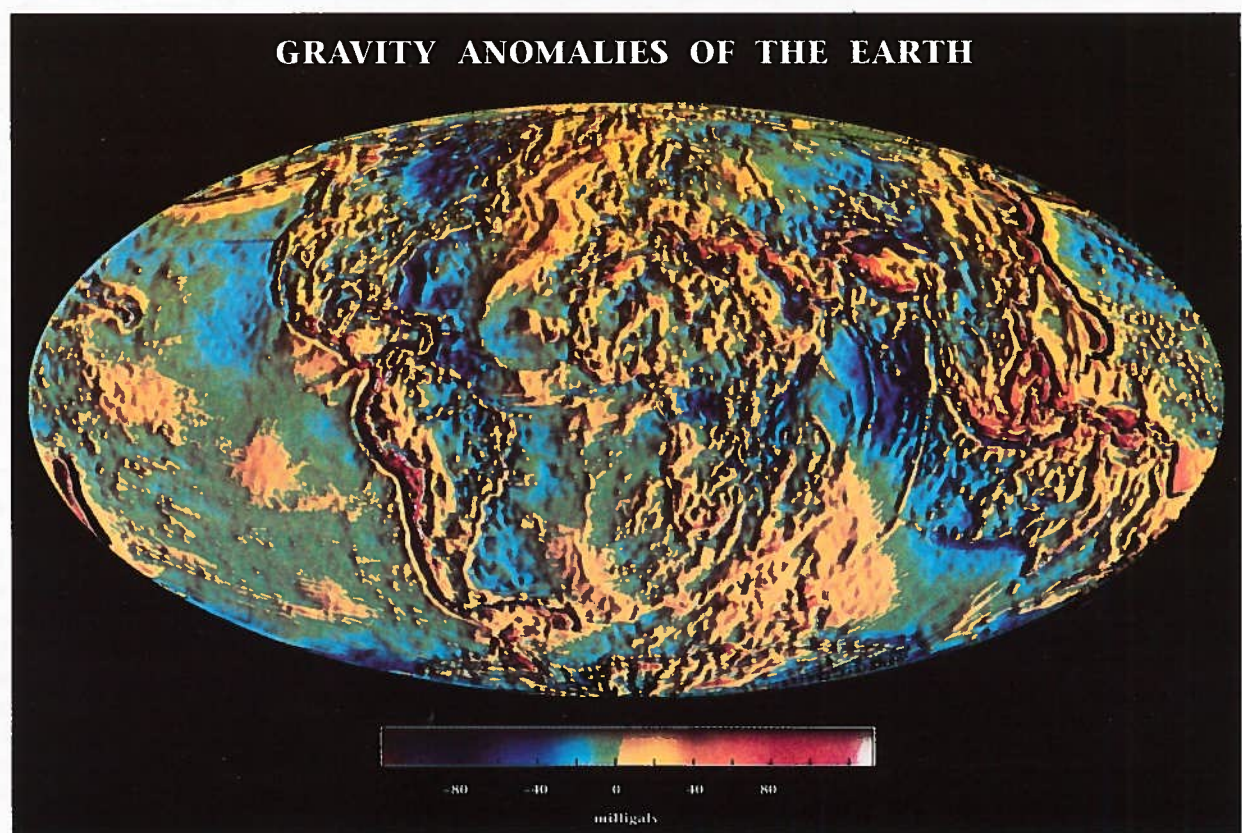
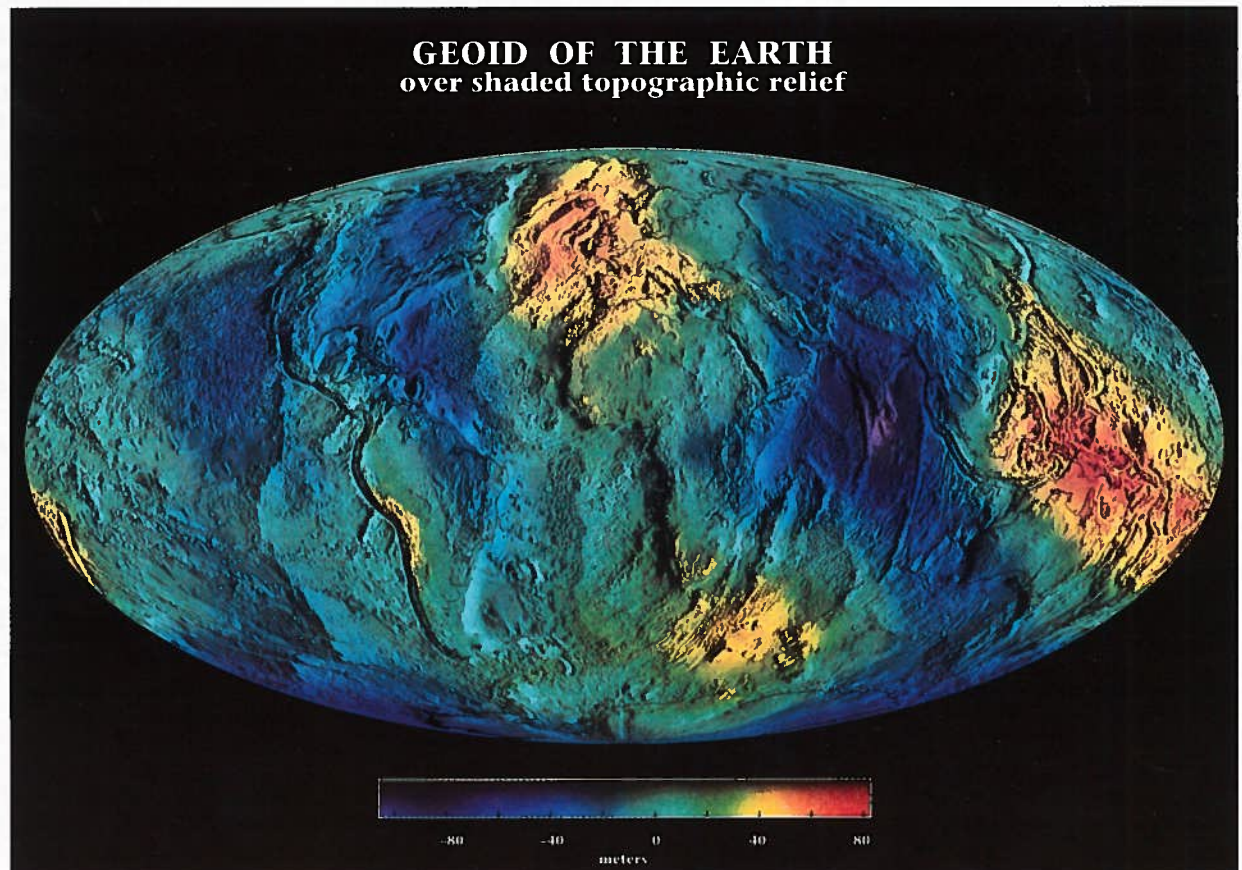


Figure 1. A: Geoid map of Earth, overlying shaded relief topography. B: Free-air gravity anomalies. Mollweide equal area projection.

and Sandwell (1992) found that gravity anomaly roughness was related to spreading rate. Our maps show this to be true for the Atlantic and East Pacific Rise, and perhaps south of Australia, but not in the Indian Ocean. For the North Atlantic Ridge, especially south of the Charlie-Gibbs Fracture Zone, there are smaller gravity anomaly highs that parallel the axial high.

All of the subduction zones around the Pacific, the arc systems of the Western Pacific, near the Caribbean and Scotia arcs, the Indonesian arc, and

the Hellenic arc show sharp negatives, but so does the southern border of Australia and some parts of the Antarctic coast where no subduction zones have been postulated. Invariably, the land side of a subduction zone shows a high, usually exceeding 80 mgal. On the seaward side of a subduction zone there may be a lesser high extending to different distances from the trench, depending upon which zone is involved.

**Gravity Model** continued on p. 270

<b>New Gravity Model for Earth Science Studies</b> .....	269
Washington Report .....	270
SAGE Remarks .....	271
GSA Honors 50-Year Fellows .....	271
A Letter that Changed (and Saved) Lives .....	272
Call for Nominations Reminder .....	272
1995 GeoVentures .....	273
GSAF Update .....	274
In Memoriam .....	274
Penrose Conferences Scheduled .....	275
Section Meetings—	
Rocky Mountain .....	276
Cordilleran .....	277
About People .....	276
GSA Division News .....	277
Call for 1995 Annual Meeting Theme Proposals .....	278
Book Reviews .....	280
Meetings Calendar .....	283
<i>Bulletin</i> and <i>Geology</i> Contents .....	286
Classifieds .....	286

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Bruce F. Molnia

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

## Geology, Washington, D.C.—Style

### Geology by Committee

The past few months have seen the release of two National Research Council (NRC) reports related to geologic hazards and their prevention. The reports, "Practical Lessons from the Loma Prieta Earthquake" and "Mt. Rainier: Active Cascade Volcano," represent an approach to geological problem solving significantly different from traditional field studies and map preparation. These reports are excellent examples of understanding and defining a problem by committee. The reports are informative, effective, well written, and timely. The Mount Rainier report is subtitled "Research Strategies for Mitigating Risk from a High, Snow-Clad Volcano in a Populous Region."

The concept of geology by committee is not new. For decades, environmental impact statements and special geological publications, such as symposium volumes, have been produced by committees or groups of scientists. Generally, environmental impact statements are prepared to serve as a compendium of information and a catalog of potential risks to be used in the decision-making process of a planned action. They are minimally circulated. Symposium volumes are generally technical geological publications aimed at peers in the earth science community.

These two NRC reports have different purposes. These reports, while useful to the earth science community, are not intended for earth scientists. They are aimed at the media, the Congress, state legislators, and federal and state government preparedness agencies such as the Federal Emergency Management Agency (FEMA). The ultimate target is the general public.

The Loma Prieta report presents 40 "practical lessons," each accompanied by a recommendation. Lloyd Cluff, chair of the committee that prepared the report, referring to both the Loma Prieta (1989) and Northridge (1994) quakes stated, "One of the most jarring lessons from these [quakes] may be that earthquake professionals have long known many of the things that could have been done to reduce the devastation. The aftermath of these earthquakes should make clear the need to close the gap between what scientists know about earthquake mitigation and what is used by governments and individuals."

Cluff hoped that the information in the Loma Prieta report, combined with the lessons from the Northridge quake, would cause governments in California and other areas with high probabilities of quake occurrence to "quickly take additional steps to reduce the risk of damage and injuries and to improve the ability of emergency services to respond to the needs of quake victims."

Among the lessons learned are: (L1) investments made in earthquake

preparedness and hazard and risk mitigation paid off; (L2) government and business leaders were greatly surprised that earthquake professionals knew so much about the potential hazards of areas like San Francisco's Marina District, but that so little was done prior to the quake; (L3) uneven and inappropriate emergency responses resulted from the inability of emergency-response decision makers to know where the worst damage had actually occurred and from their dependence on news media reports; (L4) even where seismic geology was well known, surprises occurred; (L7) the intensity of seismic shaking is critically dependent upon the nature of the soil and shallow geologic structures; (L8) liquefaction mitigation methods worked, although significant liquefaction damage occurred in adjacent areas of unimproved ground; (L11) where specific geotechnical engineering measures had been taken to compact artificial fills, these fills performed well; (L12) with the appropriate application of existing knowledge and with more attention to detail, professionals could have significantly reduced the loss of life and damage; (L16) damage to many structures resulted from design or construction errors that should have been found during the building inspection process at the time of construction; (L22) extensive damage to transportation structures, such as older bridges, should be expected in other geographic areas in the event of an earthquake; (L24) the results of earthquake research have not been transferred to many potential users; (L28) disaster recovery laws are biased toward returning to pre-earthquake conditions, even when those conditions represent high earthquake risk; (L29) preexisting social problems such as homelessness will be made

### Gravity Model continued from p. 269

In places in the South Pacific, east-west lineations are seen where the anomaly oscillates about zero. The same is seen in the Indian Ocean and central Atlantic. The lineations seem to be oriented in the direction of spreading and may or may not be related to the linear gravity anomalies that have been investigated near the Easter microplate in the Pacific.

With the new relaxing of East-West relations, new data sets will be released (e.g., see Kogan and McNutt, 1993), and improved higher order models will be made. Grids of geoid heights, gravity anomalies, and topographic data used in these figures are available via anonymous ftp to geodesy.gsfc.nasa.gov.

### ACKNOWLEDGMENTS

We appreciate the assistance and comments provided by S. Nerem,

worse immediately after a destructive earthquake; (L30) there was an outpouring of unselfish concern even though the disaster response often created widespread confusion and coordination problems; (L31) rushed post-earthquake inspections of damaged buildings resulted in some inaccurate and emotional assessments that led to inappropriate actions, such as demolition, in the spirit of public safety; (L35) more effective public education is needed about risks related to natural gas leakage; (L37) many of the most successful mitigation efforts were the result of state legislation, yet many jurisdictions have not adopted seismic safety requirements to protect the local population; (L38) low-income people were most seriously impacted because they typically live in old, seismically weak buildings that are not properly maintained; (L39) international media coverage and increased earthquake awareness resulted from the quake coinciding with the World Series; and (L40) the recovery from destructive earthquakes is expensive for everybody. Perhaps the most important message is that mitigation activities are cost effective.

The Loma Prieta report is the result of a 1993 NRC-Earthquake Engineering Research Institute symposium held to analyze the results of research conducted on the earthquake. Symposium sponsors included the U.S. Geological Survey (USGS), the National Science Foundation, FEMA, and the National Institute of Standards and Technology.

The Mt. Rainier report states, "Mt. Rainier is capable of eruptions of small to very large magnitude"; "Explosive eruptions from Mount Rainier could send clouds of tephra high into the atmosphere ..."; "Major edifice failures, glacier outburst floods, and lahars could occur in the absence of volcanic eruptions ..."; and "Damage caused by debris flows could be substantial."

Like the Loma Prieta report, this report is also the result of a workshop. This one was held in 1992 to draft a research plan for the volcano. Mt. Rainier had previously been designated as a "decade volcano" as part of the United Nation's International Decade for Natural Disaster Reduction's Volcano Demonstration Project. Mt. Rainier was selected because it has an extensive but poorly studied geological and historical record of activity; it poses a hazard to surrounding, highly populated regions such as Seattle and

D.C.—Style continued on p. 271

F. Lerch, N. K. Pavlis, R. H. Rapp, and B. D. Tapley.

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Tacoma; and it poses an additional threat because of its extensive cover of snow and ice. If quickly melted, this snow and ice cover could produce catastrophic floods and mudflows.

Richard Fiske, chair of the NRC committee that prepared this report, stated that although the possibility of an eruption in the near future is remote, such an eruption could kill thousands of people and cripple the economy of the Pacific Northwest.

The science plan presented in the report focuses primarily on the research needed to understand the development and the behavior of the volcano and to monitor potential hazards. Research components include geologic mapping, petrologic and geochemical studies, geophysical surveys, lahar studies, and edifice stability assessments. Monitoring components include seismic monitoring, ground-deformation monitoring,

hydrothermal activity monitoring, monitoring changes in surface appearance, and stream monitoring.

As with the Loma Prieta report, mitigation is also emphasized. The Mt. Rainier report identifies the "important elements of an effective mitigation program" as (1) communication and (2) planning and implementation of risk-mitigation measures. The types of communication needed are communication within the scientific community, communication between scientists and responsible authorities, communication between scientists and the public, and communication between responsible authorities and the public.

The report identifies the measures that "should be considered for implementation in order to significantly reduce risk from volcanic hazards to people and property." These are: analyses to identify regions and populations at risk; land-use planning and economic

incentives to discourage inappropriate use of high-risk areas; and engineering solutions to mitigate risk from specific volcanic hazards.

The report concludes that "the implementation of the Mount Rainier Decade Volcano Demonstration Project is the responsibility of the scientific community." That community is to develop an implementation plan that should provide guidance on priorities for research and monitoring activities based on scientific significance and value to risk-mitigation efforts; funding of research and monitoring activities deemed to be of high priority; mechanisms for coordinating the efforts of scientists to avoid unnecessary duplication, particularly in the use of instrumentation or collection of samples from wilderness and other environmentally sensitive areas with limited access; and mechanisms for balancing the needs of scientists for access, samples, and data with the needs

of federal and state agencies to fulfill their research, public safety, and land-management missions.

Only time will tell whether these reports will be effective. New legislation, better communication, improvements in state and federal earthquake preparedness, increased public earthquake awareness, and broader mitigation requirements will be indicators that the Loma Prieta report has reached its intended audience. The preparation, adoption, and implementation of a plan for the Mt. Rainier Decade Volcano Demonstration Project will be the sign of success for the Mt. Rainier report. That the USGS believes the geology-by-committee approach works is shown by the Survey's request to the NRC to evaluate the Ward Valley, Nevada, proposed waste disposal site in a similar fashion. ■

## SAGE REMARKS



### The Wind is Changing

Lisette Clemons, Cherry Creek Schools, Aurora, Colorado

There is an ever-so-slight cool bite in the air. To some, it is the first sign that the seasons will change. Fall is in the air. To a teacher, it is the call to come back to the classroom to begin a new school year. When I feel this special wind, I get excited and start thinking of all the possibilities ahead of me. Even though the students may not feel the wind, they too are ready to return to school.

Science is my favorite subject to teach, and we start the year with a unit on Rocks and Minerals. I start the school year with this unit because I've found that young children have a natural fascination with the earth and all things natural. I am always delighted by the number of rock and mineral collections that are brought to the school during this opening semester. My students will stand in front of the class and animatedly tell the tale of each piece. These stories abound with shared memories of parents, siblings, and friends all enjoying the wonders of nature. The majority of my students are nine years old, and many of them have been collecting rocks and minerals since they were three or four.

These collections act as a tremendous launching point for discussions of the characteristics of minerals such as luster, color, hardness, and cleavage. I can only describe the enthusiasm of young science students for these natural wonders as a hunger. They are hungry to know how rocks are formed, hungry to understand mineral composition, and, most important, hungry to explore.

Although it seems that the fascination for rocks and minerals is almost universal in the young student, I see a disturbing trend in the older student. I can best describe this trend with a personal experience. One of my young students had an older sibling who had a tremendous collection of rocks, minerals, and sands that she had collected from three continents. Her fourth-grade teacher had told me about her extensive collection, so I asked my student to ask her sister to bring it into the classroom. I was astounded to learn that the older sister had thrown her entire collection into the trash. The only explanation given was

that the girl had lost interest and didn't have a need for the collection anymore. After my initial shock wore off, I put together the lesson: we as professionals must recognize and attempt to overcome this attitude if we are to capture and maintain a child's earth fascination.

Even though children have a natural fascination with their earth environment, that fascination must be reinforced and encouraged if it is to lead to in-depth study and commitment as an adult. I believe we as earth professionals must commit our time and resources to fostering that natural fascination with the earth sciences. A straightforward way of contributing is to simply call the schools near your home and volunteer to give presentations in your respective field of expertise. The principals or the science authority in the school will be delighted to hear from you and will pass on your name and phone number to their teachers. Don't think that you don't have anything of interest to show the children. Children want to learn more, and they need to see professionals working in and enjoying the earth sciences. It's likely that, whatever your presentation style, your enthusiasm will reinforce the child's desire to learn. What's more, the professionals who have come to our building have unanimously agreed that they too gained something from the experience.

A young earth science professional did something for our school that combined both her love of rocks and minerals and an entrepreneurial spirit. Melody Ulen is the founder and director of Earth Treasures, an educational fund-raising earth science business. She comes to the school and does a presentation for the students centered around fossils, minerals, and crystals. Then the students organize, set up, and run a retail "Rock Shop" in the school. Twenty-five percent of sales revenue goes to the students. In the words of one of our parents, "This is the first quality fund raiser I have ever seen in a school. It is both educational and profitable." This program is very interdisciplinary, because the students learn to run a business, practice math skills, and share their science and geography

knowledge. Our students chose to use their profits to help an inner city Denver school with its science program by supplying science equipment for it. Everybody wins! Ms. Ulen's program was on a school-wide scale, but you can make a significant impact by simply volunteering an hour or two.

That cool bite in the air this year draws me back to the classroom with a renewed desire to reinforce that

wonderful natural fascination that children have for our Earth. I am now profoundly aware that such a fascination can be fleeting, and we as parents, teachers, and earth professionals must join forces to nurture our children's innate interest.

For more information on Earth Treasures, please contact Melody Ulen at (303) 232-0783. ■

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# A Letter That Changed (and Saved) Lives

Murray W. Hitzman,  
1993–1994 Congressional Science Fellow



Sometimes a single letter can change the world—at least for some people. Though I didn't know it at the time, such a letter, addressed to Senator Lieberman (D-CT), arrived on my desk on January 17, 1994. The letter had nothing to do with earth science, but since it involved a "scientific" issue, it fell to me to reply.

The letter asked the senator to help initiate a study of the potential long-term health effects of a radium treatment for aerotitis media (blockage of the eustachian tubes) given to U.S. Navy submariners. The letter was well written; it did not lay blame. The

author had researched the issue and had previously published a letter on the subject in the *New England Journal of Medicine*.

## Burned Out

The treatment in question was termed radium nasopharyngeal irradiation. Rods tipped with capsules containing radium-226 were inserted up the nose of a patient into the nasopharyngeal cavity. The rods were left in place for 8–10 minutes during which beta and gamma radiation from the radium literally "burned out" lymphoid tissue. The treatment was developed in

the 1940s by the Navy to provide an efficient, reliable means of curing aerotitis media. Most individuals were given two or three treatments, although in some cases many more treatments were administered.

My first reaction to the letter was shock; placing a radioactive source into a cavity at the base of the brain to burn tissue appeared foolhardy. But upon reflection, the development of the treatment made sense. In the 1940s the long-term dangers of ionizing radiation were not well known. During World War II many servicemen suffered from aerotitis media, and a quick cure was needed to maintain military effectiveness.

Because Connecticut contains the Navy's submarine school and is home to many veteran submariners, and because the Senate Government Affairs Committee, of which Senator Lieberman is a member, was holding a January 25 hearing on human radiation experiments, I decided to actively pursue the issue. I phoned the author of the letter to ask for additional information, and I made calls to confirm that such treatments were used by the Navy and that they could, theoretically, cause adverse health effects. I discovered that a limited medical study of the radium treatment conducted in 1982 had found a "statistically significant" excess of malignant neoplasms of the head and neck in those treated.

I drafted a memorandum to the senator outlining the issue and later discussed it with him. He decided that the first task was to try to help the submariners who had undergone the radium treatment. At the committee hearing, Senator Lieberman raised the issue with the Secretary of Energy, the Secretary of Veterans Affairs, and with representatives of the Department of Defense. They stated that the issue would be examined to decide whether the veterans concerned should be provided with medical care.

The hearing received extensive media coverage. The senator's questions about the submariners and the agencies' responses were widely reported in the Connecticut press. As a result, our office received a number of calls. It soon became clear that radium treatments had also been given to Army Air Force personnel who suffered from pressure equalization problems, as well as to children with adenoid problems, a common childhood ailment.

## The Push for a Study

As a scientist I felt there were valid reasons to initiate an epidemiological study. I urged the senator to push for a study that would include civilians as well as veterans. The senator asked me to draft letters to the Centers for Disease Control asking that they consider undertaking a study and to Secretary of Veterans Affairs Jesse Brown asking what program was being implemented for veterans who had received the treatment.

Press releases from the senator's office concerning these letters served to heighten awareness of the issue. The office received additional calls from those who claimed to have had the treatment, many with relatively rare head and neck problems. The author of the original letter had been talking to the press and was deluged with phone calls. One was from an ex-Navy submariner, James Garrity, Jr., who had been treated and who read about the senator's concerns in his local newspaper. Garrity and the author of the original letter, Stewart Farber, formed the Submarine Survivors Group and, with their own money, set up an information hotline (telephone 617-

471-5647). By late March, several thousand people, many of them from Connecticut, had called the hotline.

To talk to people who had been treated, Senator Lieberman held an open meeting in Groton, Connecticut—home of the Navy submarine school—in late March. He met both veterans and civilians to learn first-hand of some of their medical problems and fears. The senator told them that he would work to get a study conducted to determine whether the treatments posed long-term health risks.

## A Victory

In late April, the senator received a letter from secretary Brown stating, "Any veteran who believes he or she has an illness possibly related to radium exposure during military service may contact the most convenient VA medical center or regional office for information on applying for medical care and/or initiating a compensation claim." This was a great victory—veterans were now allowed to claim radium treatment as a possible reason for applying for benefits. But there was still no commitment to initiate an epidemiological study, and there was no means of dealing with civilians who had been treated.

By May, the Submarine Survivors Group reported that they had received several tens of thousands of calls from people across the country who claimed they had been treated; many said they had brain, neck, or thyroid cancer. Some who had read about the issue in the papers had gone to their physicians for a checkup and had discovered that they had head or neck cancer. Luckily, the cancer had been detected early in a number of cases, giving them a good chance of survival. Garrity, who had been suffering from a number of minor ailments, went to his doctor; advanced nasopharyngeal cancer was diagnosed.

This issue was no longer solely a scientific one of initiating a study to determine potential health effects. While such a study was urgently needed, the results would not be known for years. In the meantime, many could die from diseases possibly related to this treatment. It was clear from the phone calls that people could be saved if they got a checkup. Simply getting the word out that the radium treatment might pose health risks could, and had, saved lives.

The most important action the senator could take in the short term was to publicize the issue so that people who had undergone radium treatment would seek medical attention. The senator decided that the most immediate means of highlighting the issue would be to hold a Senate Subcommittee on Clean Air and Nuclear Regulation hearing and attempt to get wide media coverage.

The aims of the hearing would be (1) to bring attention to the issue, (2) to get the Department of Defense to contact servicemen who had undergone the treatment, (3) to have the Department of Health and Human Services issue a medical alert stating that those who had undergone radium treatment should see a physician, and (4) to have the agencies work together to conduct an epidemiological study to determine whether radium nasopharyngeal irradiation truly posed health risks.

## Preparations

With the health care debate raging and senators trying to salvage some of

## Reminders

### CALL FOR NOMINATIONS

Materials and supporting information for any of the following nominations may be sent to GSA Executive Director, Geological Society of America, P.O. Box 9140, Boulder, CO 80301. For more detailed information about the nomination procedures, refer to the October 1994 issue of *GSA Today*, or call headquarters at (303) 447-2020, extension 136.

#### Officers and Councilors

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

Nominations for 1996 officers and councilors must be received at GSA headquarters no later than **FEBRUARY 15, 1995**.

#### Penrose and Day Medals, and Honorary Fellowship

Nominations for GSA's Penrose and Day Medals and for Honorary Fellowship in the Society are due at headquarters by **FEBRUARY 1, 1995**.

#### Young Scientist Award (Donath Medal)

The Young Scientist Award was established in 1988 to be awarded to a young scientist (35 or younger during the year in which the award is to be presented) for outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the earth sciences. The award, consisting of a gold medal called the Donath Medal and a cash prize of \$15,000, was endowed by Dr. and Mrs. Fred A. Donath.

For the year 1995, only those candidates born on or after January 1, 1960, are eligible for consideration. In choosing candidates for the Young Scientist Award, scientific achievement and age will be the sole criteria. Nominations for the 1995 award must include

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

Nominations for the 1995 Young Scientist Award must be received at GSA headquarters by **FEBRUARY 1, 1995**.

#### Distinguished Service Award

The GSA Distinguished Service Award was established by Council in 1988 to recognize individuals for their exceptional service to the Society. GSA Members, Fellows, Associates, or, in exceptional circumstances, GSA employees may be nominated for consideration. Any GSA member or employee may make a nomination for the award. Awardees will be selected by the Executive Committee, and all selections must be ratified by the Council. Awards may be made annually, or less frequently, at the discretion of Council. This award will be presented during the Annual Meeting of the Society. Deadline for nominations for 1995 is **MARCH 1, 1995**.

#### National Awards

The deadline is **April 30, 1995**, for submitting nominations for these four awards: William T. Pecora Award, National Medal of Science, Vannevar Bush Award, Alan T. Waterman Award

Letter continued on p. 273

their August recess, scheduling a hearing would not be easy. We decided to hold the hearing on Monday, August 29, which was expected to be during the recess, so that there would be a chance for significant media coverage. Senator Lieberman insisted that I get agreement for the hearing from other senators on his subcommittee. This involved a series of staff briefings to inform them of the issue. It was not until August 12 that I obtained all the approvals. I had already informally contacted potential witnesses, and, on the afternoon of August 12, I called to tell them that we needed their testimony by August 18.

The hearing was to have two panels. The first would consist of a doctor who could testify on the treatment and possible health effects; Garrity and another person who had both undergone the treatment and were currently suffering ill health; and Farber. Representatives from the Departments of Health and Human Services, Veterans Affairs, and Defense would comprise the second panel.

I spent the next week reviewing testimony with witnesses and trying to line up media coverage. The Congressional liaisons for the agencies were wary. Was the senator trying to make them look bad? Would he embarrass the witnesses? This fear was particularly acute with the Department of Defense—they had administered the treatment to servicemen. Would the senator try to lay all the blame on them? I insisted that the senator was not out to pillory the agencies, that he simply wanted to help those who were treated, and I hoped that the agencies would come forward with proactive plans.

On the Friday morning before the hearing, I finally managed to convince both the Navy and Air Force congressional liaisons of our intentions. Late that evening the testimony was faxed to our office after having been reviewed by the Office of Management and Budget at the White House. The agency testimony looked good—it appeared that the senator had largely obtained the promises he had requested.

## Adrenaline Rush

The hearing itself was an adrenaline rush. The cameras from television networks ABC, NBC, CNN, and C-Span were there, and the media desk was full with reporters. The testimony from the first panel went well, and the senator's questioning highlighted the importance of both a study and a near-term medical alert.

The second panel was more tense. The witness from the Department of Health and Human Services balked when asked whether the department should issue a medical alert. I was afraid the deals that had been struck by phone might unravel. But to our surprise, the Deputy Surgeon General of the Navy stated after his prepared testimony that he had received the treatment as a child. The senator asked him if he, as a doctor, had himself checked regularly for possible head and neck problems. He answered that of course he did, and that he would recommend special checkups to anyone else who had been treated.

Nothing more really needed to be said. The Deputy Surgeon General of the Navy had said it all—get a checkup. That message went out on the afternoon radio broadcast of National Public Radio and was aired on CNN and the ABC nightly news. The phones in the senator's office began ringing off the hook.

After the hearing I walked over to the Capitol with Jim Garrity and Stewart Farber. We were very moved as we looked up to the Capitol dome and reflected on the oddity of a science fellow, a veteran, and an environmental scientist being thrown together because of a letter, and how fortunate it was that Senator Lieberman took up the issue. Jim was dying of cancer, but he was happy because others had been, and would be, saved. One person can write a letter and one letter can save many lives.

## Epilogue

I have tried in my articles for *GSA Today* during the past year to provide vignettes of how the policy process works in Congress. They will have been successful if they communicated



The Geological Society of America

## Congressional Science Fellowship 1995-1996



The Geological Society of America is accepting applications for the 1995-1996 Congressional Science Fellowship. The Fellow selected will spend a year (September 1995-August 1996) in the office of an individual member of Congress or a congressional committee for the purpose of contributing scientific and technical expertise to public policy issues and gaining firsthand experience with the legislative process. The American Association for the Advancement of Science conducts an orientation program to assist the Fellow seeking a congressional staff position in which he or she can work on major legislative issues.

### Criteria

The program is open to highly qualified postdoctoral to mid-career earth scientists. Candidates should have exceptional competence in some area of the earth sciences, cognizance of a broad range of matters

outside the Fellow's particular area, and a strong interest in working on a range of public policy problems.

### Award

The GSA Congressional Science Fellowship carries with it a \$38,000 stipend, and limited health insurance, relocation, and travel allowances. The fellowship is funded by GSA and by a grant from the U.S. Geological Survey. (Employees of the USGS are ineligible to apply for this fellowship. For information about other programs, contact AAAS or the Geological Society of America.)

### To Apply

Procedures for application and detailed requirements are available in the geology departments of most colleges and universities in the United States or upon request from: Executive Director, Geological Society of America, P.O. Box 9140, Boulder, CO 80301.

**DEADLINE FOR RECEIPT OF ALL APPLICATION MATERIALS IS FEBRUARY 15, 1995**

a simple message—individuals do make a difference. You can have an impact on public policy if you choose. You don't need to run for office or be a member of a congressional staff or a high-paid lobbyist. Through the hearing process, during the give and take of crafting legislation, or even through a simple, well-written letter to your senator or representative, you can influence policy. As earth scientists we have, too often, stood aloof from the legislative fray. Make your training and experience count in the widest possible sense. Join the process to help

your representatives in Washington, your state capitol, or your community make better policy. They need your help. Democracy only works when we all participate. ■

*Murray W. Hitzman, 1993-1994 GSA Congressional Science Fellow, served on the staff of Senator Joseph I. Lieberman (D-CT). The one-year fellowship is supported by GSA and by the U.S. Geological Survey, Department of the Interior, under Assistance Award No. 1434-93-G-2382. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.*

# 1995 GEOVENTURES

GeoVentures are a special benefit created for GSA members, but are open also to guests and friends. GeoVentures is the overall name for adult educational and adventure experiences of two kinds: GeoTrips or GeoHostels. Both are known for expert scientific leadership. Fees for both are low to moderate (relative to the length of time and destination) and include lodging and meals as designated. The venues, however, are quite different.

## Choose from two types of GSA GeoVentures—

	<b>GeoHostels</b>	<b>GeoTrips</b>
Length .....	5 days	1 to 3 weeks
Cost .....	Under \$500	Over \$1000
Site .....	College campuses or resort towns, North America	Worldwide
Time of Year .....	Summer	Anytime
Traveling .....	Limited. Possible one or two 1/2-day field trips	Daily change of site
Ground		
Transportation .....	Provided by participants	Provided by GSA
Physical		
Requirements .....	None	May be physically demanding
Education .....	Daily classroom programs and field excursions	Informal, outdoor field instruction

For details contact the GeoVentures Coordinator today:  
 Phone: 1-800-472-1988 ext. 134 or 141 or (303) 447-2020  
 E-mail: [ecollis@geosociety.org](mailto:ecollis@geosociety.org) or [mball@geosociety.org](mailto:mball@geosociety.org)  
 FAX: 303-447-0648

## GEOHOSTELS

### **The Geological History of Southwestern Montana**

Western Montana College  
 Dillon, Montana  
 Leader: Robert Thomas, Western Montana College  
 JUNE 17-22

### **Geology and Hydrogeology of Northern Colorado: Dinosaur National Monument to Steamboat Springs**

Colorado Mountain College  
 Steamboat Springs, Colorado, and Vernal, Utah  
 Leaders: Gregory Holden and Kenneth Kolm, Colorado School of Mines  
 JUNE 24-29

## GEOTRIPS

### **Grand Canyon**

Lees Ferry down river to Pearce Ferry  
 Takeout and return to Las Vegas  
 Leaders: Ivo Luchitta, USGS-Flagstaff  
 Stan Beus, Northern Arizona University, Flagstaff  
 APRIL 22-28

### **Iceland (tentative)**

Leader: Haraldur Sigurdsson  
 Dates to be decided (July or August)

**More information in  
 December GSA Today  
 REGISTRATION BEGINS  
 JANUARY 1, 1995**

Robert L. Fuchs

## The Foundation's Special Funds—IV

### J. Hoover Mackin Award—\$18,000

The Mackin Award is under the direction of the Quaternary Geology and Geomorphology Division. This is an annual award for outstanding student research in the field of geomorphology.

The Mackin Award Fund was established in 1971 for the purpose of honoring an outstanding geomorphologist. J. Hoover Mackin was born in 1905. He transcended serious illness in his youth (two years immobilized as the result of polio) to attend New York University and Columbia University, receiving the Ph.D. degree from Columbia in 1937. He was an instructor, and later, professor at the University of Washington for 28 years. In 1961 he was appointed the Farish Professor of Geology at the University of Texas at Austin. His work was concentrated in the Pacific Northwest, the northern Rocky Mountains, and the Appalachians, and in addition to his expertise in geomorphology, his work included engineering geology, structural geology, economic geology, field petrology, and lunar geology. Mackin was warm and people-oriented, popular with students and field companions. He has been described as witty, good-tempered, absent-minded, warm, salty, and a true gentleman. He died in 1968.

The most recent recipients of the Mackin Award (1994) are Amy Church of the University of Vermont (\$500), for "Geomorphic Response to Colonial Land Use Changes in Vermont," and Robert Viens of the University of Washington (\$1000), for "The Dynamic Response of Tidewater and Freshwater Calving Glaciers to Millennial-scale Climatic Change."

### John T. Dillon Alaska Research Award Fund—\$29,000

The John T. Dillon Fund 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. John Dillon obtained the Ph.D. degree from the University of California at Santa Barbara in 1975. He worked briefly for the USGS in southern California and then joined the Alaska Department of Natural Resources. His eleven-year employment with the Alaska Survey was focused on the tectonics of northern Alaska. John 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.

An indefatigable field geologist, John Dillon died in the field in a plane crash in 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 1994 recipient of the Dillon research grant is Tracy Marie Siebert of Miami University, for "Petrologic Significance of Mafic to Intermediate Volcanism at the Skookum Creek Volcanic Complex, Wrangell Volcanic Field, Alaska." The amount of the grant was \$1650.

### Memorial Fund—\$1100

Contributors may specifically designate gifts for this fund in memory of an individual or individuals. Also, it

has been the policy of the Foundation to place any memorial gifts here that are not earmarked for another fund or special purpose. From time to time money is disbursed from this fund to support GSA programs, at the discretion of the trustees.

### Minority Fund—\$18,000

The Minority Fund supports student research grants, special programs, and other activities in geoscience that are directed toward minorities, for the purpose of arousing interest in science, supporting earth science education and research, and stimulating careers in geology or other disciplines. Money from the fund has been used for field trips, study materials, student research grants, and scholarships. In 1994 the Committee on Research Grants awarded \$1000 to minority students who were among the successful grant applicants.

### Don't Despair—Help is Coming

The end of 1994 is not very far away, and it is just possible that some of you may be a bit stressed, thinking about taxes that will be due before

### In Memoriam

**Richard H. Durrell**  
Cincinnati, Ohio  
June 6, 1994

**Louis Franklin**  
Abilene, Texas  
April 9, 1994

**Takashi Fujii**  
Ibaraki, Japan  
July 16, 1994

**Shailer S. Philbrick**  
Ithaca, New York  
August 19, 1994

**J. Donald Ryan**  
Hellertown, Pennsylvania  
September 20, 1994


**C. F. Stewart Sharpe**  
Falls Church, Virginia  
August 21, 1994

**Martin L. Stout**  
Whittier, California  
September 23, 1994

April 15, 1995. Your 1994 tax bill can be lowered with some year-end planning and action. In the December issue of *GSA Today* you will find some ideas that may be helpful in reducing this year's tax liability. ■

### Donors to the Foundation—August 1994

<p><b>Doris M. Curtis Memorial</b> Grover E. Murray*</p> <p><b>Shirley J. Dreiss Memorial</b> Susan L. Brantley Leonard Konikow Leo F. Laporte Darryll T. Pederson William W. Simpkins Clifford Voss</p> <p><b>GEOSTAR</b> Detlef A. Warnke Herbert E. Wright</p> <p><b>IEE</b> Robert J. Sterrett</p>	<p><b>J. Hoover Mackin Award</b> Dwight L. Schmidt</p> <p><b>Bruce L. "Biff" Reed Scholarship</b> David Brew James C. Ratte Mr. and Mrs. Riesen</p> <p><b>Research</b> Dennis Netoff</p> <p><b>SAGE</b> Philip Hughes Jonathan Levy Cathleen L. May</p>	<p><b>Unrestricted—Foundation</b> Harry M. Snowden*</p> <p><b>Unrestricted—GSA</b> Barbara M. Palen</p> <p><b>Second Century Fund</b> Genevieve Atwood* Robert H. Dott* Gordon P. Eaton* Philip E. LaMoreaux* Joe W. Peoples* Leigh Royden Brian J. Skinner*</p> <p>* Century Plus Roster (gifts of \$150 or more)</p>
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## GEO STAR

Supporting The Advancement of Research

GSA Foundation  
3300 Penrose Place  
P.O. Box 9140  
Boulder, CO 80301  
(303) 447-2020

Enclosed is my contribution in the amount of \$ \_\_\_\_\_ for:

<input type="checkbox"/> Foundation Unrestricted	<input type="checkbox"/> GSA Unrestricted
<input type="checkbox"/> J. Hoover Mackin Fund	<input type="checkbox"/> John T. Dillon Fund
<input type="checkbox"/> Memorial Fund in honor of _____	<input type="checkbox"/> Minority Fund

Please add my name to the Century Plus Roster (gifts of \$150 or more).

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The Geological Society of America

## Research Grants Program 1994



The primary role of the Research Grants Program is to provide partial support for research by graduate students at universities in the United States, Canada, Mexico, and Central America. GSA strongly encourages women, minorities, and persons with disabilities to participate fully in this grants program. Eligibility is not restricted to GSA members. New application forms are available each fall in the geology departments of colleges and universities offering graduate degrees in earth sciences. Forms are mailed in September to GSA Campus Representatives and department secretaries and chairpersons in the United States, Canada, and Mexico. They are also available upon request from the Research Grants Administrator, Geological Society of America, P.O. Box 9140, Boulder, Colorado 80301. *Please use only the 1995 application and appraisal forms.*

Confidential evaluations from two faculty members are required from candidates for the M.S. or Ph.D. degree and must accompany applications submitted. PLEASE USE THE "APPRAISAL OF APPLICANT" FORMS, WHICH ACCOMPANY THE 1995 APPLICATION FORMS. Application forms will not be accepted by facsimile.

The Geological Society of America awarded over \$300,000 in grants in 1994. The grants went to 238 students doing research for advanced degrees. The average amount awarded was \$1275. The largest grant was \$2000, but there is no predetermined maximum amount.

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

ALL APPLICATIONS MUST BE SUBMITTED ON THE 1995 FORMS AND POSTMARKED BY FEBRUARY 15, 1995

## Fault-related Folding

August 22–27, 1995

The long-recognized geometric association between folding and faulting has led to a proliferation of quantitative yet often contradictory models. These models are based on our understanding of the geometric elements of fold-fault systems, but they generally carry assumptions about kinematics, and, either directly or indirectly, about dynamics. Recent observations of fold growth by repeated seismic slip on buried faults has highlighted the importance of understanding fold-fault geometries in terms of the process that led to these geometries. At present, there appears to be little consensus with regard to many of the fundamental questions about fold-fault growth. For example, both field and subsurface observations indicate a diversity of fold-fault geometries; how do the kinematics and dynamics vary for these structures? The widespread use of balanced cross sections has tended to make our perspective of orogenic struc-

tures two-dimensional, which could lead us to erroneous conclusions. What are the rules governing three-dimensional fold-fault geometry, and what do they tell us about the evolution of these structures? To what extent are fold growth and fault propagation self-similar? What is the connection between buckle propagation and fault propagation: do dominant wavelength selection or initial perturbation theories apply to these structures? Finite and incremental strain studies commonly lead to kinematic interpretations that in some cases contradict the predictions of forward models; what rheologies best describe natural structures, and are theoretical predictions consistent with empirical data? Finally, are active folds that grow by repeated slip on buried faults good analogues for ancient fault-related folds?

The purpose of this conference, to be held August 22–27, 1995, in Banff, Alberta, Canada, is to consider the

interrelation between folding and faulting processes from an interdisciplinary perspective and to go beyond our current understanding of two-dimensional fold-fault relations. We hope to bring together field geologists, geophysicists, experimentalists, and theoreticians to evaluate the geometry, kinematics, and dynamics of fault-related folding and consider to what extent model predictions match field and laboratory data. We particularly encourage applications from scientists studying active fold-fault complexes and the implications for processes of fold-fault growth. The conference will provide a forum for interaction between the academic community and the petroleum industry, and the conference format will be designed to foster discussion and to assess future research objectives. It will include two days of field trips among some of the classic fault-related fold localities of the southern Canadian Rockies.

Participation in the conference will be limited to 80 people, including 15 graduate students. Attendance for international participants and graduate students may be subsidized. The registration fee will include meals and lodging, two field trips, and other conference costs.

Co-conveners of the conference are: **Donald M. Fisher**, Department of Geosciences, Pennsylvania State University, University Park, PA 16802, (814) 865-3206, fax 814-863-7823, E-mail: fisher@geosc.psu.edu; **David Anastasio**, Department of Earth and Environmental Sciences, Lehigh University, Bethlehem, PA 18015-3188, (610) 758-5117, fax 610-758-3677, E-mail: kja2@lehigh.edu; **Eric Erslev**, Department of Earth Resources, Colorado State University, Fort Collins, CO 80523, (303) 491-6375, fax 303-491-6307, E-mail: erslev@picea.cnr.colostate.edu.

### Application

**Deadline: March 1, 1995.**

To apply for the conference, please provide the following information: (1) name and position; (2) organization and mailing address; (3) phone number, fax number, and E-mail address if available; (4) your field of interest; and (5) a brief statement as to what your interest and experience have been with regard to the conference topic. Interested participants should send a letter of application to David Anastasio, address above. Applicants will be notified by April 1, 1995. ■

## Fault Rocks

August 31–September 4, 1995

A Geological Society of America Penrose Conference titled "Fine-grained Fault Rocks" will be held August 31–September 4, 1995, in Leavenworth, Washington, in the North Cascade Mountains of Washington State. This international conference is partially supported by the National Science Foundation and the National Earthquake Hazards Reduction Program.

The conference will address all aspects of fine-grained fault rocks, which mark localized high-strain zones in Earth's crust. Such zones may contain fault gouge, ultracataclasite, pseudotachylyte, and ultramylonite, depending on crustal level, slip rate, and other environmental factors. Active and ancient exhumed faults and shear zones commonly contain one or more types of fault rocks whose timing and genetic relations may be complex. The fine-grained fault rocks may have unique mechanical and/or physical properties that are central to many questions of fault mechanics and meta-

morphic reactions. The rheology and other physical properties of fault rocks are central to many questions of fault mechanics, fluid transport in the crust, and metamorphic reactions. They preserve vital evidence of kinematic evolution and deformational style, which are used to decipher past and present tectonism. They retain chemical evidence for the passage of fluids and thus reveal information on the tectonic setting, magmatic history, and thermal evolution of orogens. The fault rocks are notable targets for isotope geochronology, owing to intense recrystallization, the growth of new minerals, the passage of fluids, and in some cases shear heating or melting. The nature, development, and physical properties of fault rocks are vital to advancing our understanding of earthquake nucleation and dynamics, mineralization and fluid migration, and near-surface problems in hydrology, engineering, and earthquake hazard analysis.

This conference will bring together experts on all aspects of fault-rock

study, including experimental approaches, field-based investigations, studies of fluids in faults and shear zones, deformation mechanisms involved in fault-rock formation, physical properties of fault rocks, petrologic studies, and stable and radiogenic isotope analysis of fault rocks and shear zones.

Some topics we wish to discuss include: (1) What do specific fault rocks reveal about the mechanical properties, and therefore the associated geologic hazards, associated with a fault or shear zone? (2) What can be inferred about the timing, volume, and composition of fluids flowing through faults and shear zones with reference to specific coeval fault rocks at various crustal levels? (3) What do the textures, particle size distributions, and operative deformation mechanisms observed in naturally and experimentally formed fault rocks reveal about such parameters as temperature, stress, and strain rate? (4) Which fault rocks are amenable to geochronometric techniques? (5) What are the spatial, temporal, and genetic relations among the fine-grained fault rocks? (6) How can a multidisciplinary approach to fault-rock studies better elucidate the evolution of faults and shear zones? (7) Does the current classification scheme require modification, extension, or loosening? (8) Should fault-rock terminology be developed or modified for better application in the field? (9) How do fine-grained fault rocks influence fluid flow in fault and shear zones?

Participation in the conference will be limited to about 70 persons. All interested scientists are encouraged to apply. Attendance for graduate students and postdoctoral researchers will be subsidized, and these individuals are

also encouraged to apply. Depending on cosponsor support, the registration fee is expected to be under \$500, including meals, lodging, a one-day field trip, and other conference expenses. On the field trip to nearby exposures in the Cascade Mountains, we will examine a wide variety of fault rocks produced during Cretaceous orogenesis and subsequent unroofing. We will inspect ductilely deformed granitoids and peridotites, pseudotachylyte and cataclasite within metasedimentary rocks, and shallow-level faulting within a tonalite batholith.

Formal invitations will be mailed in May 1995. Conveners of the conference are: **Jerry F. Magloughlin**, Department of Geological Sciences, 1006 C.C. Little Building, University of Michigan, Ann Arbor, MI 48109-1063, (313) 747-0664, fax 313-763-4690, E-mail: jerry.magloughlin@um.cc.umich.edu; **Fred M. Chester**, Department of Earth and Atmospheric Sciences, St. Louis University, 3507 Laclede Ave., St. Louis, MO 63103, (314)-658-3124, fax 314-658-3117, E-mail: chester@slu.edu; **John G. Spray**, Department of Geology, University of New Brunswick, Fredericton, N.B. E3B 5A3, Canada, (506) 453-3550, fax 506-453-5055, E-mail: jgs@unb.ca.

**Application deadline: April 1, 1995.** To apply for the conference, please provide the following information: (1) name and position; (2) organization and mailing address; (3) phone number, fax number, and E-mail address, if available; (4) your field of interest; and (5) a brief statement about what your interest and experience have been with regard to the conference topic. Send applications to Jerry Magloughlin at the address above. ■

### Northeastern Section Announces Student Research Grants

The Northeastern Section of the Geological Society of America announces the initiation of a student research grant program in 1995. The grants are competitive and available to both undergraduate and graduate students.

To be considered for a research grant:

- The student must be enrolled at an institution within the Northeastern Section.
- The student must be a Student Associate or a graduate student member of GSA.
- Applications must be postmarked no later than February 7, 1995.
- Grants will be awarded in April 1995.

For further information or a copy of the research grant application form, please contact:

Kenneth N. Weaver, Secretary NEGSA, Maryland Geological Survey  
2300 St. Paul Street, Baltimore, MD 21218  
(410) 554-5532, fax 410-554-5502

### Have you considered convening a Penrose Conference?

These topical conferences provide the opportunity for exchange of information and ideas on current issues from the science of geology and related fields. For guidelines, contact GSA headquarters at (303) 447-2020, ext. 131; fax 303-447-1133; or E-mail admin@geosociety.org.

# ROCKY MOUNTAIN SECTION, GSA 47th Annual Meeting

Bozeman, Montana  
May 18-19, 1995

The Rocky Mountain Section of the Geological Society of America will meet jointly with the Rocky Mountain Section of the Paleontological Society of America and the Southwest Section of the National Association of Geology Teachers in the Strand Union Conference Center on the campus of Montana State University in Bozeman, Montana. The host for the meeting is the Department of Earth Sciences at Montana State University.

## ENVIRONMENT

Bozeman, a community of 32,000, is 90 miles north of Yellowstone National Park. A wide variety of rock types and ages are represented in the Bozeman area, including 4 Ga basement rocks, Middle Proterozoic clastic and carbonate rocks of the LaHood Formation (Belt Supergroup), Paleozoic and Mesozoic marine shelf strata, volcanoclastic assemblages related to Late Cretaceous and early Tertiary igneous centers, and more recent Tertiary basin-fill sedimentary rocks. The Gallatin Valley overlaps the Middle Proterozoic Belt basin, the Sevier orogenic belt, the Laramide foreland province, several igneous provinces, and the eastern margin of the Basin and Range province. The tectonomagmatic effects of the Yellowstone hotspot have overprinted all of the above over the past two million years. The Gallatin Valley is surrounded by glaciated mountains.

The meeting will be held in the Strand Union building on the Montana State University campus (student population 10,000). The Strand Union offers cafeteria-style food. Food is also available two blocks north of campus on College Street. Shuttle service to restaurants and lodging facilities in town will be provided. On-campus housing will be available for those wishing to use these facilities. May can be a rainy and/or snowy month. Mean May precipitation is 3.2 inches. The average minimum May temperature is 37 °F and the average maximum temperature is 63 °F; the mean May temperature is 50 °F. Expect a wide range of weather conditions. Transportation to Bozeman includes air service by Northwest, Delta, Frontier, and Horizon Air. Interstate 90 passes through town.

## About People

GSA Fellow **J. Freeman Gilbert**, Scripps Institution of Oceanography, has been awarded an honorary doctorate by the University of Utrecht and has been elected a foreign associate of the Italian Accademia Nazionale dei Lincei.

Fellow **Morris W. Leighton**, Illinois State Geological Survey, is the 1994 recipient of the John T. Galey Public Service Memorial Award from the American Institute of Professional Geologists.

Fellow **David L. Southwick** has been appointed director of the Minnesota Geological Survey in St. Paul.

Member **Edward M. Stolper** has become chair of the Division of Geological and Planetary Sciences at the California Institute of Technology, Pasadena.

SEPM (Society for Sedimentary Geology) has awarded its William H. Twenhofel Medal to GSA Fellow **Robert J. Weimer** (Colorado School of Mines, Golden), conferred honorary membership on Fellows **Peter A. Scholle** (Southern Methodist University, Dallas, Texas), **Roderick W. Tillman** (Tulsa, Oklahoma), and **John L. Wray** (Colorado Springs, Colorado), and awarded the Raymond C. Moore Medal to Fellow **Earle F. McBride** (University of Texas, Austin).

## CALL FOR PAPERS

Technical papers are invited for presentation in conventional theme sessions, symposia, and poster sessions. Papers dealing with all aspects of the Rocky Mountain region as well as those of general geologic interest will be considered for presentation and discussion. Technical sessions will allow 15 minutes for presentation and 5 minutes for questions and discussion. Session chairs and speakers are asked to adhere stringently to these time limits.

## FIELD TRIPS

Both premeeting and postmeeting field trips are planned. For details, contact the respective field trip leaders. General questions should be addressed to David Mogk, Field Trip Coordinator, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6916, fax 406-994-6923, Internet: uesdm@msu.oscs.montana.edu. Both premeeting and postmeeting trips to Paradise Valley are planned to provide an opportunity to explore the outstanding local geology. A guide for self-led local field trips in the Gallatin Valley will be available for purchase upon registration.

## Premeeting

1. **The Yellowstone Valley from Livingston to Gardiner, Montana: A Microcosm of Northern Rocky Mountain Geology.** Wednesday, May 17, 1995. Classic examples of and exceptions to regional geologic evolution from Archean lithogenesis to modern land-use planning. John Montagne, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6917,

fax 406-994-6923; S. G. Custer, J. E. Elliott, D. R. Lageson, W. W. Locke, C. Montagne, D. W. Mogk, J. G. Schmitt, A. D. Barnosky. (Also offered postmeeting.)

2. **Sedimentology and Tectonics of the Bannack-McKnight Canyon-Red Butte Area, Southwest Montana: New Perspectives on the Beaverhead Group and Sevier Orogenic Belt, Southwest Montana.** Tuesday and Wednesday, May 16 and 17, 1995. Jim Schmitt, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6903, fax 406-994-6923, Internet: uesjs@msu.oscs.montana.edu; David Lageson and Chris Haley.

3. **Patterns and Processes of Cambrian Mass Extinctions: An Integrated Approach.** Wednesday, May 17, 1995. Sponsored by the Rocky Mountain Section of the Paleontological Society. This trip will visit the classic Nixon Gulch locality in the Gallatin Valley. Rob Thomas, Department of Geosciences, Western Montana College, Dillon, MT 59725, (406) 683-7615, Internet: r\_thomas@wmc.edu; Dave Backus and Matt Saltzman.

## Postmeeting

1. **The Yellowstone Valley from Livingston to Gardiner, Montana: A Microcosm of Northern Rocky Mountain Geology.** Wednesday, May 17, 1995. Classic examples of and exceptions to regional geologic evolution from Archean lithogenesis to modern land-use planning. William Locke, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6917, fax 406-994-6923; S. G. Custer, J. E. Elliott, D. R. Lageson, C. Montagne, J. Montagne, J. G. Schmitt, A. D. Barnosky. (Also offered premeeting.)

2. **Hydrogeologic Aspects of Remediation of Metal-Mine Impacts on Upper Clark Fork Superfund Sites, Butte, Montana.** Saturday, May 20, 1995. Those using air transportation may wish to consider a flight leaving Butte if your return connection is planned for Saturday. Ted Duame, Montana Bureau of Mines and Geology, Butte, MT 59701, (406) 496-4157, fax 406-496-4344.

3. **Tertiary Tectonics of the Northern Border Zone of the Yellowstone Hotspot Track, Montana and Idaho.** Saturday and Sunday, May 20 and 21, 1995. Jim Sears, Department of Geology, University of Montana, Missoula, MT 59812, (406) 243-2341, fax 406-243-4028, Internet: jwsears@selway.umt.edu; Bill Fritz, Rob Thomas, Susanne Janecke.

## SYMPOSIA

General sessions will include general geology, Quaternary geology, igneous geology and volcanology, metamorphic geology, structural geology, stratigraphy and sedimentation, tectonics, paleontology and paleobotany, and earth science education. The following symposia will include both invited papers and selected volunteered papers. Prospective authors are encouraged to contact the respective conveners. General questions should be addressed either to Dave Lageson, (406) 994-3331, fax 406-994-6923, Internet: uesdl@msu.oscs.montana.edu; or to Jim Schmitt, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6903, fax 406-994-6923, Internet: uesjs@msu.oscs.montana.edu.

1. **The Yellowstone Valley from Livingston to Gardiner, Montana: A Microcosm of Northern Rocky**

**Mountain Geology.** Classic examples of and exceptions to regional geologic evolution from Archean lithogenesis to modern land-use planning. John Montagne, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6915, fax 406-994-6923, Internet: ueswl@msu.oscs.montana.edu; Bill Locke.

2. **Tertiary Tectonics of the Northern Border Zone of the Yellowstone Hotspot Track, Montana and Idaho.** Jim Sears, Department of Geology, University of Montana, Missoula, MT 59812, (406) 243-2341, fax 406-243-4028, Internet: jwsears@selway.umt.edu; Bill Fritz, Rob Thomas, Susanne Janecke.

3. **Late Cretaceous-Early Paleogene Paleofaunas and Paleoenvironments of the Northern Rocky Mountains.** Sponsored by the Rocky Mountain Section of the Paleontological Society. Rob Thomas, Department of Geosciences, Western Montana College, Dillon, MT 59725, (406) 683-7615, Internet: r\_thomas@wmc.edu; Jason Lillegraven.

4. **Patterns and Processes of Mass Extinction: An Integrated Approach.** Sponsored by the Rocky Mountain Section of the Paleontological Society. Rob Thomas, Department of Geosciences, Western Montana College, Dillon, MT 59725, (406) 683-7615, Internet: r\_thomas@wmc.edu.

5. **Geology (Hydrogeology, Geomorphology, Sedimentation, and Stratigraphy) of Metal-Mine Impact and Remediation in the Rocky Mountains.** William Woessner, Department of Geology, University of Montana, Missoula, MT 59812, (406) 243-5698, fax 406-234-4028, Internet: gl\_www@selway.umt.edu.

6. **Recent Advances in Understanding the Sevier Orogenic Belt of the Western United States.** Jim Schmitt, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6903, fax 406-994-6923, Internet: uesjs@msu.oscs.montana.edu; David Lageson.

## SHORT COURSE

A short course introducing ArcView 2 provides a foundation for becoming a successful ArcView software user. This course gives a conceptual overview and hands-on experience needed to take full advantage of ArcView's advanced display, analysis, and presentation mapping functions. This class will be presented on Tuesday and Wednesday, May 16 and 17, 1995, by staff at the Montana State University Geographic Information and Analysis Center. Coordinator: John P. Wilson, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6907, fax 406-994-6923, Internet: uesjw@msu.oscs.montana.edu.

## ABSTRACTS

Abstracts are limited to 250 words and must be submitted camera ready on official 1995 GSA abstract forms available from the Abstracts Coordinator, Geological Society of America, P.O. Box 9140 Boulder, CO 80301, (303) 447-8850, Internet: ncarlson@geosociety.org. An original and five copies are required for each abstract. Authors of symposium papers should send their abstracts directly to the appropriate convener (the first name in the list of symposium organizers above). All other abstracts should be sent to David Lageson, Technical Program Chair, Rocky Mountain GSA, Department of Earth

Rocky Mountain continued on p. 277



Sciences, Montana State University, Bozeman, MT 59717-0348. Abstracts will be reviewed for informative content and format, appropriate geographic coverage (Rocky Mountain region), and originality. To simplify scheduling and provide opportunities for a diversity of views, only one volunteered paper may be presented by each individual, although a person may also be a co-author of additional papers. One exception to this rule will be made: authors presenting papers on advances in earth science education may also present a paper in another technical section.

**ABSTRACT DEADLINE:**  
**Friday, January 20, 1995.**

### PROJECTION EQUIPMENT

All slides must be 2" x 2" and fit standard 35 mm carousel trays. Two projectors and two screens will be available for all oral sessions. Authors are strongly encouraged to bring their own preloaded carousels. The organizing committee will not be responsible if a carousel is unavailable for your talk (but will provide a limited number of carousels for general use with availability at the author's risk).

### POSTER SESSIONS

Poster sessions will be located adjacent to the exhibit and registration area. If you wish to present a poster, please indicate this preference on your abstract form. A special poster session, Undergraduate Research in Geology, is outlined below. Questions regarding posters should be directed to Dave Lageson or Jim Schmitt (addresses above).

### STUDENT PRESENTATIONS

Both graduate students and undergraduate students are strongly encouraged to present the results of their research in poster sessions, symposia, or general sessions. The Geology Division of the Council on Undergraduate Research will sponsor a special poster session to highlight the research done by undergraduate students. In order to participate in this session, the first author on the paper must be an undergraduate student. Students are encouraged to submit abstracts for posters on any topic in geology and should indicate interest in participation in the Undergraduate Research in Geology Poster Session on the abstract form. The Paleontological Society will sponsor an award for the best student paper in paleontology. A non-student can be coauthor, but the student must be both the presenter and the senior (primary) author. To be eligible, the speaker must be currently enrolled in a graduate or undergraduate program or have completed such a program no longer than one month prior to the meeting. The award will be a one-year subscription to *Paleobiology*.

### EXHIBITS

Exhibits are planned for the registration-poster-session area. The cost per booth is \$50 for a 12 x 10 ft space. Additional adjacent booths may be purchased for \$50 each to expand display space. For further information and space reservations, please contact Melanie Stocks, MSU Conference Services, Room 280F, Strand Union, Montana State University, Bozeman, MT 59717-0402, (406) 994-3333, fax 406-994-3228, Internet: acfms@msu.oscs.montana.edu.

### STUDENT TRAVEL SUPPORT

The Rocky Mountain Section has funds available to support Student Associates of the Geological Society of America who plan to attend the meeting. Preference for support will be given to presenters of papers and posters and to group applications. Students are strongly encouraged to apply for these grants. Send a letter of application which identifies all student travelers in the group, GSA Student Associate member numbers, and a summary of costs to Rocky Mountain Section Secretary Ken Kolm, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401, (303) 273-3932, fax 303-273-3858, Internet: kkolm@mines.colorado.edu. If you are presenting a paper or poster, please include a copy of your notification of acceptance. Applications must be received by Ken Kolm by Friday, April 14, 1995.

### SPECIAL EVENTS

Planned events include a welcoming reception in the evening on Wednesday, May 17, 1995. An alumni reception will be held on Thursday evening, May 18, 1995. Those schools wishing to have an alumni meeting area reserved in the ballroom at the Strand Union should register with Steve Custer, Meeting Chair, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348. A banner with your school name over the reserved area will be provided. Deadline for reservation is May 1, 1995. The Structure and Tectonics Division of GSA will hold a reception Thursday evening, May 18, 1995. The annual business meeting of the Geological Society of America Rocky Mountain Section will be held on Friday, May 19, 1995, at noon. The annual business meeting of the Paleontological Society Rocky Mountain Section will be held on Thursday, May 18, 1995, at noon.

### GUEST PROGRAM

Bozeman offers an abundance of galleries and boutiques downtown, the Museum of the Rockies, historical tours, blue-ribbon trout fishing on the Gallatin and Madison Rivers, nearby hot springs, and alpine hiking in the Bridger and Gallatin mountain ranges. Organized activities will depend upon the number of preregistered guests.

### ACCOMMODATIONS

Blocks of rooms will be reserved at several motels. In addition, housing will be available in the dorms on campus. Housing information and a list of room blocks and locations will be provided in the final announcement. Shuttles between campus and the main motel areas will run May 17-19.

### DETAILED INFORMATION

More detailed information regarding registration, accommodations, activities, and program will be provided in the final announcement in the February issue of *GSA Today* and as part of the Rocky Mountain Section *Abstracts with Programs*. Questions and suggestions may be addressed to Steve Custer, GSA Meeting Chair, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6906, fax 406-994-6923, Internet: uessc@msu.oscs.montana.edu. ■

### Preliminary Announcement and Call for Papers

## CORDILLERAN SECTION, GSA 91st Annual Meeting

**Fairbanks, Alaska  
May 24-26, 1995**

The Cordilleran Section of the Geological Society of America, together with the Alaska Geological Society and the Association of Geological Engineers, will meet on the Fairbanks campus of the University of Alaska. The meeting is hosted by the Department of Geology and Geophysics and the Geophysical Institute.

### SETTING

Fairbanks is located in the rolling hills of the "Golden Heart" of Alaska, on the banks of the Chena River. Fairbanks began as a gold rush community and has a strong mining tradition. The University of Alaska Fairbanks campus continues this tradition and is home to a variety of geological and geophysical research groups, including the Quaternary Research Center, Alaska Volcano Observatory, Tectonics and Sedimentation Research Group, and Alaska Earthquake Information Center.

Although Fairbanks is known for extreme weather, late May is usually beautiful, with the birch and aspen trees in full foliage, and the temperature in the 60s. Fairbanks is served by several national airlines, by the Alaska Railroad, and by highways from both south-central Alaska and Canada. Fairbanks also serves as a starting point for a variety of destinations within interior Alaska, including the Alaska Range and Brooks Range.

### CALL FOR PAPERS

**Abstract deadline:**  
**January 30, 1995**

Papers are invited for presentation in oral technical sessions, symposia, theme sessions, and poster sessions. Papers dealing with all aspects of the Cordillera, as well as those of general geological interest, will be welcomed. Oral presentations in technical and theme sessions will be limited to 20 minutes. Symposia may allow longer times for presentation at the option of the conveners and technical chair.

Abstracts must be submitted camera ready on official 1995 GSA abstract forms. These forms are available from the Abstracts Coordinator, Geological Society of America, P.O. Box 9140, Boulder, CO 80301 (303) 447-2020, ext. 161, or E-mail: ncarlson@geosociety.org.

An original and five copies of all abstracts (both volunteered and invited) should be sent to Catherine Hanks, Geophysical Institute, University of Alaska, Fairbanks, AK 99775, (907) 474-5562, E-mail: chanks@dino.

gi.alaska.edu. We suggest that participants in theme sessions and symposia send an additional copy to the convener of the session or symposium. GSA rules prohibit any individual from presenting more than one volunteered paper, although a person may also be a co-author of papers presented by others, and may present additional papers invited to symposia.

### REGISTRATION

**Preregistration deadline:**  
**April 17, 1995**

For lower registration fees and to assist the local committee in planning, please preregister.

Preregistration will be handled by GSA headquarters. Registration forms will appear in the February issue of *GSA Today*.

### FIELD TRIPS

For details regarding specific field trips, please contact the trip leader(s). General questions should be addressed to Don Triplehorn or Wes Wallace, Department of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775; Triplehorn: (907) 474-6891; Wallace: (907) 474-5386; fax: 907-474-5163.

### Premeeting

- 1. Superfund Remedial Investigations at Eielson Air Force Base, Alaska.** One day. Richard E. Lewis and Mark T. Murphy, Geology & Geophysics, MSIN K6-84, Pacific Northwest Laboratory, Richland, WA 99352; Lewis: (509) 376-9789, E-mail: re\_lewis@pnl.gov; Murphy: (509) 376-8337, E-mail: mt\_murphy@gate.pnl.gov.
- 2. Southern Alaskan Tectonic Transect—Valdez to Fairbanks.** Three days. Warren J. Nokleberg and George Plafker, Branch of Alaskan Geology, U.S. Geological Survey, Menlo Park, CA 94025; Nokleberg: (415) 329-5732, E-mail: wnokleberg@isdml.wr.usgs.gov; Plafker: (415) 329-5689.

*Cordilleran continued on p. 278*

### GSA Division News

Divisions recognized the following individuals at the 1994 Annual Meeting in Seattle for their service to the Division and/or contributions to the geological sciences. (For a listing of other award recipients honored at the Seattle meeting, see page 260 of the October 1994 issue of *GSA Today*.)

#### Engineering Geology Division

*Robert S. Yeats, Richard H. Jahns Distinguished Lecturer*

#### Structural Geology and Tectonics Division

*Rolando Armijo, Best Paper Award  
Paul Tapponnier, Best Paper Award  
Han Tonglin, Best Paper Award*

3. **Fairbanks Loess Deposits.** One day. Jim Beget, Department of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775, (907) 474-5301; and Dave Hopkins.

4. **Alaska Range and Tanana Valley Flightseeing Trip.** One day. Keith Crowder, Department of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775, (907) 474-7810, fax 907-474-5163.

5. **Geology of the Healy Coal Field.** One day. Don Triplehorn, Department of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775, (907) 474-6891; and Gary Stricker, U.S. Geological Survey, Coal Branch, P.O. Box 25046, Denver, CO 80225.

6. **The Alaska Pipeline and Permafrost Tunnel.** Half day. Nils I. Johansen, Department of Mining and Geological Engineering, University of Alaska, Fairbanks, AK 99775-5800, (907) 474-6878.

### Postmeeting

7. **Northern Alaska—Brooks Range Transect—Fairbanks to Prudhoe Bay.** Three to four days. Gill Mull, Alaska Division of Geological and Geophysical Surveys, Fairbanks, AK 99775, (907) 474-7147; Tom Moore, USGS, MS 904, 345 Middlefield Road, Menlo Park, CA 94025-3591 (415) 329-5713, E-mail: tmoore@mojave.wr.usgs.gov; Wes Wallace, Department of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775, (907) 474-5386.

8. **Structural and Metamorphic History of the Seward Peninsula Blueschist Terrane and Associated Gneiss Domes: A Record of Burial or Exhumation?** Four days. Brian E. Patrick, Department of Geological Sciences, University of California, Santa Barbara, CA 93106, (805) 893-4530, E-mail: patrick@magic.ucsb.edu; and Elizabeth L. Miller, Department of Geology, Stanford University, Stanford, CA 94305, (415) 723-1149, E-mail: miller@pangea.stanford.edu.

9. **Quaternary and Bedrock Geology of the Central Alaska Range.** Three days. Dan Mann, Alaska Quaternary Center, University of Alaska, Fairbanks, AK 99775, (907) 474-7925.

10. **Geology of Denali Park.** Two days. Phil Brease, National Park Service, P.O. Box 9, Denali Park, AK 99755, (907) 683-9551, fax 907-683-9639.

11. **General and Economic Geology of the Fairbanks Area.** One or two days. Rainer Newberry, Department of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775, (907) 474-6895, fax 907-474-5163.

12. **Recent Eruptions of Augustine Volcano.** Four days. Jim Beget, Department of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775, (907) 474-5301; Juergen Kienle, Geophysical Institute, University of Alaska, Fairbanks, AK 99775.

13. **Fairbanks District Gold Mining Operations.** One day. James A. Madonna, Mining Extension, University of Alaska, Fairbanks, AK 99775-5960, (907) 474-7702.

The following field trips are designed for primary and secondary teachers of earth sciences but are open to all interested geoscientists. For more information on any of these trips, please contact Roland Gangloff, University of Alaska Museum, P.O. Box 756960, Fairbanks, AK 99775-6960, (907) 474-7862, E-mail: ffrag@acad3.alaska.edu.

### Premeeting

14. **Mammoths, Permafrost, and Gold—Fairbanks and the Last Ice Age.** Half day, Saturday, May 20.

### Postmeeting

15. **Granite, Volcanoes, and Ocean—The Geologic Foundation of Fairbanks and Vicinity.** Half day, Saturday, May 27.

16. **The Rock Cycle—A Dynamic View of the Alaska Range, Delta to Summit Lake.** One day, Saturday, May 27.

### SYMPOSIA

The following symposia will include both invited papers and selected volunteered papers. Please contact the respective conveners for information about the specific symposia. Individuals interested in convening additional symposia or needing general information should contact Catherine Hanks, Geophysical Institute, University of Alaska, Fairbanks, AK 99775, (907) 474-5562, E-mail: chanks@dino.gi.alaska.edu.

1. **Deep-Crustal Structure and Tectonics of Alaska and Adjacent Regions.** Warren J. Nokleberg and George Plafker, Branch of Alaskan Geology, U.S. Geological Survey, Menlo Park, CA 94025; Nokleberg: (415) 329-5732; Plafker: (415) 329-5689.

2. **Gold in the Northern Cordillera.** Rainer Newberry, Department of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775, (907) 474-6895, fax 907-474-5163.

3. **Glaciers of Beringia: Glaciological Process and the Geologic Record.** Dan Mann, Alaska Quaternary Center, University of Alaska, Fairbanks, AK 99775, (907) 474-7925.

4. **High-Latitude Geomorphology and Global Changes.** Dave Hopkins, Alaska Quaternary Center, University of Alaska, Fairbanks, AK 99775, (907) 474-6894.

5. **Early Humans in the Arctic: Archaeological Sites and their Paleoecological Settings.** Richard Reanier, Reanier and Associates, Seattle, Washington, (206) 323-6423.

### THEME SESSIONS

Theme sessions are volunteered papers submitted on a specific topic.

For information about a specific theme session, please contact the convener(s) of the theme session. Individuals interested in organizing additional theme sessions or needing general information should contact Catherine Hanks, Geophysical Institute, University of Alaska, Fairbanks, AK 99775, (907) 474-5562, E-mail: chanks@dino.gi.alaska.edu.

1. **Proterozoic and Paleozoic Carbonate Systems of Alaska and Northwestern Canada.** Jim Clough, Alaska Division of Geological and Geophysical Surveys, Fairbanks, AK 99775, (907) 474-7147; and Robert B. Blodgett, U.S. Geological Survey, 970 National Center, Reston, VA 22092, (703) 648-5267, fax 703-648-5420.

2. **Metamorphic Belts of Northern and Central Alaska: A Comparison of Protolith Packages, Tectonic Affinities, and Metamorphic and Structural Histories.** Alison Till, USGS, 4200 University Drive, Anchorage, AK 99508-4667, (907) 786-7444, E-mail: atill@tardaddy.wr.usgs.gov; and Cynthia Dusel-Bacon, USGS, MS 904, 345 Middlefield Rd., Menlo Park, CA 94025, (415) 329-5719, E-mail: cdusel@isd.mnl.wr.usgs.gov.

3. **New Developments in the Geology and Geophysics of the Arctic Ocean Basin.** Lawrence A. Lawver, Institute for Geophysics, University of Texas, 8701 N. MoPac Expressway, Austin, TX 78759-8397, (512) 471-0433, fax 512-471-8844, E-mail: larry@utig.ig.utexas.edu; Art Grantz, USGS, Menlo Park, California, E-mail: agrantz@mojave.wr.usgs.gov; Bill Witte, Geophysical Institute, University of Alaska, 903 Koyukuk Dr., P.O. Box 757320, Fairbanks, AK 99775-7320, (907) 474-7460, fax 907-474-7290, E-mail: bwitte@dino.gi.alaska.edu.

4. **Devonian Tectonics and Sedimentation in the Cordillera and Circum-Arctic.** Keith Crowder, Department of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775, (907) 474-7810, fax 907-474-5163.

5. **New Concepts and Discoveries in Alaskan Petroleum Basins.** John Decker, ARCO Alaska, Inc., P.O. Box 100360, Anchorage, AK 99510-0360, (907) 265-1521.

6. **Uplift Studies and Their Applications to Structural and Stratigraphic Problems.** Paul Layer, Geophysical Institute, University of Alaska, Fairbanks, AK 99775-7320, (907) 474-7460, fax 907-474-7290, E-mail: player@dino.gi.alaska.edu.

Cordilleran continued on p. 279

## Theme for 1995 Annual Meeting in New Orleans: Bridging the Gulf

The theme for the 1995 Annual Meeting in New Orleans is *Bridging the Gulf*. This theme has several meanings. In particular, we wish to draw attention to the Gulf of Mexico/Caribbean, and the surrounding American continents. The emphasis will be on bridging the knowledge gap that exists across a region divided by political boundaries and language but sharing a common geologic framework. *Bridging the Gulf* also addresses the need to develop a closer link between technology and the science of geology and to educate the public on issues critical to the development of intelligent policies on the environment and geologic hazards. We also wish to bridge the gulf between the past and the future with both a retrospection on the past 30 years of plate tectonics and a look at the future as geology responds to society's needs. Finally, we view the city of New Orleans, the Mississippi

River, its delta, and the Gulf Coast as a laboratory where the long-term effects of humans on the environment can be examined. To this end, the keynote symposium, "The Mississippi River: Control and Consequences," will address the questions raised by man's need to modify his surroundings to ensure a reasonable lifestyle. We invite theme sessions and symposia on the broad range of topics related to our theme. More importantly, however, is our interest in furthering the scientific knowledge of the attendees by developing a strong program of diverse interest to the geoscience community. We call on our colleagues to help us develop a well-rounded program that reflects a broad spectrum of current research and technology in the geosciences.

—Laura Serpa, Terry Pavlis  
1995 Technical Program Chairs

## How to Propose Theme Sessions for the 1995 GSA Annual Meeting

Deadline for proposals: January 2, 1995—  
Please submit with Theme Proposal Form

### Theme Session Guidelines

Theme sessions are focused by topic, but do not require formal sponsorship by an organization. The stronger theme sessions, however, do benefit from active support (hard work) by those interested in the success of the session. Theme sessions are a way of arranging *volunteered* abstracts into interdisciplinary groupings that make for scientific sense.

The sessions, which can be either oral or poster but not mixed, have variable lengths depending on the submitted number of pertinent and high-quality abstracts. *However, usually a minimum of 16 oral or 16 poster abstracts is required for either an oral or a poster theme session. If, at the abstracts deadline, sufficient abstracts have not been received, the theme session will be dropped, and the papers continued in the review process for standard discipline sessions.*

*Persons or groups who wish to nominate a theme session should:*

#### 1. Designate a theme session advocate.

This person would encourage (*not invite*) abstracts that will fit the theme session's concept. Society or division membership may help the advocate in this process. No doubt, when the theme session title is announced, other papers will be voluntarily submitted in addition to those that were solicited or intended.

The theme session advocate will serve as liaison with GSA's Joint Technical Program Committee (JTPC). Therefore, the name of the theme session advocate should be included with the proposal. The theme session advocate will generally contribute an abstract to the session and (for oral presentations) will usually assume the responsibility of session chairman. The theme session advocate

Theme continued on p. 279

**Cordilleran** continued from p. 278

(907) 474-5514, E-mail: player@giuaf.gi.alaska.edu; and Paul O'Sullivan, School of Earth Sciences, La Trobe University, Bundoora, Victoria 3083, Australia, phone 61-3-479-3517, E-mail: geopbo@lure.latrobe.edu.au or pos@mojave.latrobe.edu.au.

**7. Cretaceous Magmatism, Metamorphism and Gneiss Dome Development from Canada to Alaska and the Russian Far East.** Elizabeth L. Miller and Jeffrey M. Amato, Department of Geology, Stanford University, Stanford, CA 94305, (415) 723-1149, E-mail: miller@pangea.stanford.edu; and James E. Wright, Department of Geology and Geophysics, Rice University, Houston, TX 77251.

**8. Quaternary Geology and Paleoclimates in the Western Arctic and Subarctic.** Mary Edwards and James Beget, Department of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775; Edwards: (907) 474-5014; Beget: (907) 474-5301, fax 907-474-5163.

**9. Advances in Geological Applications of Space-borne SAR.** Craig Lingle, Geophysical Institute, University of Alaska, Fairbanks, AK 99775, (907) 474-7679, E-mail: clingle@gi.alaska.edu.

**10. Magmas of the Aleutian and Cascade Arcs.** John Eichelberger, Geophysical Institute, University of Alaska, Fairbanks, AK 99775, (907) 474-5530, E-mail: eich@gi.alaska.edu; and Terry Keith, USGS, 4200 University Drive, Anchorage, AK 99508-4667, (907) 786-7443, E-mail: tkeith@tardaddy.wr.usgs.gov.

**11. Seismology and Tectonics and Subduction Zones.** Doug Christensen and Steve McNutt, Geophysical Institute, University of Alaska, Fairbanks, AK 99775; Christensen: (907) 474-7426, E-mail: doug@deus.gi.alaska.edu; McNutt: (907) 474-7131, E-mail: steve@deus.gi.alaska.edu.

**12. Contaminant Transport and Fate: Focus on Western U.S. Hydrogeologic Settings.** Kent Keller, Washington State University,

(509) 335-3040, E-mail: ckkeller@wsuvm1.csc.wsu.edu.

**13. Remedial Investigations in Cold Climates: CERCLA/RCRA Examples from Alaska.** Mark T. Murphy, Geology and Geophysics, MSIN K6-84, Pacific Northwest Laboratory, Richland, WA 99352, (509) 376-8337, E-mail: mt\_murphy@gate.pnl.gov; and Jennifer L. Roberts, Alaska Department of Environmental Conservation, 3601 C Street, Suite 1334, Anchorage, AK 99503, (907) 563-6529.

## SHORT COURSES AND WORKSHOPS

**1. Internet for Geologists.** Steve Smith, Rasmuson Library, University of Alaska, Fairbanks, AK 99775, (907) 474-6655; and Julia Triplehorn, Geophysical Institute Library, University of Alaska, Fairbanks, AK 99775, (907) 474-7503.

**2. Geoscience Applications of SAR and Other Remote Sensing Data.** Ken Dean, Geophysical Institute, University of Alaska, 903 Koyukuk Drive, P.O. Box 757320, Fairbanks, AK 99775-7320, (907) 474-7364, fax 907-474-7290, E-mail: kdean@dino.gi.alaska.edu.

## PROJECTION EQUIPMENT

Each lecture room will be equipped with two standard 35 mm carousel projectors and an overhead projector. A limited number of carousels will be available, but speakers may want to bring their own. A speaker ready room will also be available. Other equipment, such as video projectors, big-screen video systems, or special audio equipment, is available but must be requested in advance.

## EXHIBITS AND POSTERS

A large hall where coffee and light refreshments will be available will also be used for poster displays and exhibit booths. For more information on the exhibit booths, please contact Roland Gangloff, University of Alaska Museum, P.O. Box 756960, Fairbanks, AK 99775-6960, (907) 474-7862, E-mail: ffrag@acad3.alaska.edu.

## EARTH SCIENCE EDUCATION

A special two-evening workshop is planned for K-12 earth science educators. The emphasis of the workshop will be on teachers sharing successful classroom techniques on how to make earth science more real and understandable to students. The workshop will include a special tour of the Geophysical Institute and University of Alaska Museum.

In addition to the workshop, there will be two half-day field trips on the Saturdays before and after the meeting that will emphasize the local geology and are designed to encourage subsequent teacher-led trips (see field trip descriptions). These field trips are not limited to workshop participants.

This K-12 program is cosponsored by the Alaska Science Teachers Association and the GSA Cordilleran Section Committee on Education. Teachers wishing to participate in the workshop, in one or both of the field trips, or in registering for the entire K-12 program for one college credit in continuing education should contact Roland Gangloff, University of Alaska Museum, P.O. Box 756960, Fairbanks, AK 99775-6960, (907) 474-7862, E-mail: ffrag@acad3.alaska.edu.

## STUDENT SUPPORT

The GSA Cordilleran Section has funds available for grants to support GSA Student Associates of the section who are presenting or are coauthors of papers presented at the meeting. Students are strongly encouraged to apply for these grants, and we anticipate that most students who qualify will be funded to some degree. For further information and application forms, contact Cordilleran Section Secretary Bruce A. Blackerby, Department of Geology, California State University, Fresno, CA 93740, (209) 278-2955 or -3086, E-mail: bruceb@zimmer.csufresno.edu. Applications should include certification that the student is presenting a paper and is a GSA Student Associate of the Cordilleran

Section. All applications must be received by March 15, 1995.

## SPOUSE AND GUEST ACTIVITIES

Spring in Interior Alaska has a lot to offer the nongeologists in the family. Preliminary plans include:

1. Day trip to Chena Hot Springs to hike local trails and soak in the hot springs.
2. Visit the University of Alaska's Large Animal Research Station and see musk oxen, reinbou, and carideer. Later, take a tour of the University of Alaska Museum.
3. Be a prospector! Pan for gold in historic Goldstream Valley.
4. See the riverboat *Nenana* and shop for Native Alaskan arts and crafts in Fairbanks' historic theme park.

More detailed information will be in the final announcement in the February issue of *GSA Today*.

## ACCOMMODATIONS

Details of available on- and off-campus housing for the meeting will appear in the February issue of *GSA Today*. We strongly recommend that participants make use of the university student apartment complex, but we will also arrange special rates at several hotels. The hotels fill early, so we urge you to book rooms as soon as the final announcement is released. For more information, contact the meeting chair, David Stone (address below).

## OTHER INFORMATION

Complete information regarding registration, accommodations, field trips, symposia and theme sessions, and other activities will appear in the February issue of *GSA Today* and as part of the *Abstracts with Programs* for 1995. Requests for additional information or suggestions should be sent to the General Chair, David Stone, Geophysical Institute, University of Alaska, Fairbanks, AK 99775, (907) 474-7622, fax 907-474-7290, E-mail: ffdbs@acad3.alaska.edu. ■

**Theme** continued from p. 278

will not otherwise be identified or linked to the theme session in the published *Abstracts with Programs* volume.

2. After choosing a theme title, **select no more than three of the categories that are listed in the right-hand margin of the 1995 Abstract Form.** These should be the categories that best describe the interdisciplinary aspects of the theme session. Pick carefully because *authors who submit abstracts to a theme session will need to select both the theme session and one of the abstract categories.*
3. **Choose a presentation mode.** The standard modes of presentation are half-day oral and poster sessions scheduled Monday through Thursday. Theme modes are to be either all poster or all oral, not mixed. Usually 16 papers are presented. If many more papers are submitted, a second session on the same topic may be scheduled.
4. **Fill in the cover sheet (available from the GSA Meetings Department) and send it with your proposal.** Particularly, include a brief (50-words) description of the theme session. It will be used for publication

later, in the "Call For Papers" in *GSA Today* and other GSA mailings.

**Items 1, 2, AND 3 must be completed and communicated to JTTC prior to JANUARY 2, 1995.**

5. **Review abstracts for scientific quality.** Immediately following the July 12, 1995, abstract submittal deadline, abstracts (including those for the theme session) will be reviewed for quality. The members of the JTTC will be responsible for obtaining reviews of these abstracts. These reviewers are not named by the advocate, but chosen by the JTTC organizations.

The theme session advocate will have the opportunity at this time to arrange the abstracts he or she has deemed appropriate into a tentative order of presentation. This will aid the JTTC in scheduling the presentation order of abstracts for the theme session.

**Remember: Abstracts submitted for theme sessions are not invited. None can be guaranteed acceptance.**

The JTTC meeting on August 11-12, 1995, will arrange the technical program for the 1995 Annual Meeting. In this task, the JTTC will keep in mind suggestions from various societies and divisions as well as those from theme session advocates in an attempt to

accommodate the needs and desires of as many persons as possible. **The theme advocate does not control the time or date of the session.** Themes are scheduled Monday through Thursday. *Quality of the technical program as a whole, however, will take precedence over all other considerations.* An appropriate time slot for any theme session will be selected after consultations with the JTTC representatives and the Technical Program Chairs.

Send theme proposals to: Laura Serpa or Terry Pavlis, University of New Orleans, Dept. of Geology and Geophysics, 2000 Lake Shore Dr., New Orleans, LA 70148, office:

(504) 286-6810, fax: 504-286-7396, E-mail: serpa@geology.uno.edu, tpavlis@geology.uno.edu. ■

### See the World Wide Web for invitation and proposal form.

The World Wide Web address at the Universal Resource Locator is: <http://www.aescon.com/geosociety/index.html>. Theme proposal information appears on the Web under the header for the New Orleans Meeting.

Call GSA Meetings Department today to receive a

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**NEW ORLEANS**  
BRIDGING THE GULF

**The Oregon Earthquake Handbook.** Vern Cope. Vern Cope, P.O. Box 19843, Portland, OR 97280, 1993, \$11.95.

Where earth science research uncovers relations that ultimately impact public safety, it is crucial to communicate this information in a form that elicits response from the general public. Vern Cope has stepped into this arena with an informative, well-written and well-researched book, *The Oregon Earthquake Handbook*. Large-magnitude earthquakes along the Cascadia subduction zone were recognized as a threat to public safety during the 1980s. As the implications of this research began to be known, a dialogue among government agencies, businesses, earth scientists, and engineers resulted in upgrading of building codes and development of emergency management plans in Oregon. Involving the general public, however, is a more complicated process. Cope is neither a geologist nor an expert in emergency management, but a concerned citizen who became aware of the earthquake research and recognized the need to translate that research into a form accessible to individuals and families. *The Oregon Earthquake Handbook* goes a long way in accomplishing this task.

The book is divided into two parts. The first provides a summary of the pertinent geology and explains how the concern over a great earthquake came about, when everyone knows that Oregon "doesn't have earthquakes." The style is easy to read, spiced with colloquial expressions,

and uncomplicated by technical words; diagrams are clear and informative. After he establishes the threat and the need for personal action, Cope moves on to suggestions for individual and family response. Part two presents lists of items to be included in a disaster preparedness kit. Why certain items are suggested is woven into a scenario of what the Pacific Northwest would be like immediately after a large earthquake. Securing homes before The Big One is also covered. The roles of local, regional, state, and federal governments and what citizens may expect to occur in times of dire emergency are skillfully presented and should assure the skeptic that government at all levels is taking the earthquake issue seriously. Cope lists earthquake-related hazards in different parts of the state and steps that lessen damage. Throughout part two, Cope approaches the issues involved as matters of choice—choices that may make a difference when the big quake happens.

Vern Cope has developed a little book that serves as a model in communicating a grave public safety issue to the public. Even if you do not live in the Pacific Northwest, it is worth examining this book for its approach. The measure of success for this book is how many people take action to prepare themselves for the future. The earth science community can perform a service by recommending Cope's book to friends and neighbors. I plan on using it as required reading in some of my general education courses.

Michael L. Cummings  
Portland State University  
Portland, OR 97207

**Thrust Tectonics.** Edited by K. R. McClay. Chapman & Hall, London, 1992, 447 p., U.S.\$48.00.

This book is a result of an international conference on thrust tectonics held at Royal Holloway and Bedford New College, University of London, in 1990. The book includes 36 research papers dealing with both theoretical aspects of thrust systems (geometries, kinematics, and mechanics) and their development in the context of regional tectonics. All the authors are well-respected researchers who worked on thrust-related problems for many years and made critical contributions to our understanding of thrust tectonics. The book is divided into eight parts: (1) theoretical aspects and thrust mechanics, (2) physical modeling, (3) thrust geometries and thrust systems, (4) Pyrenees, (5) Alps, (6) Himalayas, (7) North American Cordillera, and (8) glossary of thrust tectonics terminology. This collection of papers summarizes major advances in thrust tectonics in the 1980s. Researchers who have followed the progress of thrust tectonics closely may find that most of the papers in this book either had been published elsewhere or were published in journals at roughly the same time as that of the publication of this book. Thus, the book doesn't provide the results of unpublished research, a shortcoming. However, all the papers are concisely written and deal with a variety of subjects. In addition, excellent references on various topics of thrust tectonics are included, a feature that should be particularly useful to researchers and students who are working on thrust-related problems. For the same reason, geologists whose specialties are not in structural geology and tectonics may also find it useful as a reference book.

An Yin  
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**Understanding Catastrophe: Its Impact on Life on Earth.** Edited by Janine Bourriau, Cambridge University Press, New York, 1992, 213 p., \$29.95.

I recall, as a child in Africa, crossing rivers during a time of floods. On the nearest high ground to each major crossing was a small corrugated iron shack. When the flood came and the low-level bridge was inundated, out of nowhere would appear our saviour, a helpful Indian entrepreneur. He would open his shack to reveal tea, bottled milk, tins of goodies, cooking spirit, kerosene. We would buy our food, cook porridge from the muddy water, light lamps, and settle down until the flood subsided. Then, when the bridge rails reappeared, helpful men attached ropes to the VW bug and guided it across, half-floating, and we would drive to the next big river, only to repeat the experience as the next inundation was on its way. And so on: it could take many days to get to my boarding school. Of course, we should have had more supplies, but we did not understand catastrophe. The entrepreneur did. Indeed, for him it was no catastrophe at all, but an expected event: splendid business, and he deserved every cent of his profits.

"Understanding catastrophe" is almost an oxymoron. Can we actually understand sudden events, and if so, can we, like the shack-keeper, profit

from that knowledge? Geology has spent centuries unsuccessfully attempting to come to terms with the conflicting evidence for catastrophe (which, literally in Greek, means "downturning") and uniformity. The founders of modern geology lived in the aftermath of the great Lisbon earthquake of 1755, with its aftershocks across European society (as exemplified by Voltaire's *Dr. Pangloss and Candide*). Catastrophes, both natural and political, were to be expected, and Noah's flood was not seen as anything odd. Indeed, paleontology seemed to confirm the validity of a global flood: not just one, but a number of periods of time occupied by systems of life had occurred in Earth history, and the boundaries between the periods were placed at times of global catastrophe. The discovery of evidence for glaciation confirmed the idea that massive changes had occurred. Then, of course, came Lyell and Darwin. Darwin, in Chile, had the luck to witness and to survive one of the greatest of all historic earthquakes, which he then consigned to its proper place not as a catastrophe but in uniformity of tectonics. Noah retreated to the verge of myth. Catastrophe became an impolite word; I remember being convinced as a student that the boundaries between periods were mostly little local difficulties in Britain and Europe, of small global significance.

Of course, the flood came back. Even Noah's deluge re-emerged as a likely inundation in Mesopotamia: not global, of course (the text surely refers to the then known and recorded "world" of what is now southern Iraq), but nevertheless geologically interesting in terms of Holocene climate. But more was to come. The K/T controversy got going. Though still not absolutely proven, it is now conventional wisdom that a catastrophe did occur. There are geologically more recent surprises too. We now know that Terminations 1a and 1b, which ended glaciation, were very sudden events indeed. The renewed debate has turned out to be a catastrophe for actualistic uniformity. This cloud-capped globe is a stranger and more uncertain place than we had dreamed. Tempests do occur.

*Understanding Catastrophe* is a collection of invited lectures given at Darwin College, Cambridge, in 1990. It suffers the defects of its "lecture series" origin: partial coverage, unbalanced opinion, and the like, defects that are far outweighed by the delight of reading thoughtful insight, careful, but untrimmed either by the rigors of the decontroversialization process that journals and most symposia impose, or by the duty of balance imposed by a textbook. It is a book that is fun to read, full of odd (and sometimes irrelevant) interesting fact and opinion, diverse, worthwhile.

The essays span widely across the natural world and scientific history. R. P. Kirshner takes the big catastrophe picture: supernovae and the like. Not, I hope, anything that will bother us now, but fascinating in its relevance to the Hadean. And I recall a meeting that we once had in Ottawa, deliberately unminuted to allow honest opinion, to discuss risk. One prophet started talking about solar risk. We thought this pretty far-fetched, until a week later a magnetic storm proved him right, cut out the Quebec power lines and blacked out much of the U.S. east coast. Alvarez and Asaro follow this with the great dinosaur story, enjoy-

## PUBLICATIONS NEWS FROM GSA

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WATCH THIS COLUMN FOR NEWS ABOUT GSA PUBLICATIONS

### RECENTLY RELEASED!

#### SEISMOTECTONICS OF THE CENTRAL CALIFORNIA COAST RANGES

edited by I. B. Alterman, R. B. McMullen, L. S. Cluff, and D. B. Slemmons, 1994

This work is an outgrowth of a symposium bringing together the newest information on the seismotectonics of the recent past and contemporary coastal California. It provides a wide range of studies of the region stretching from about San Simeon south to Point Conception and into the Santa Barbara Channel. The volume is subdivided into sections on (1) the tectonic setting of the offshore and onshore Santa Maria Basin, (2) the San Simeon/Hosgri fault system, and (3) the distribution and nature of seismicity in the region. SPE292, 246 p., w/ 3 loose inserts, paperback, indexed, ISBN 0-8137-2292-6, \$67.00

#### BASINS OF THE RIO GRANDE RIFT: STRUCTURE, STRATIGRAPHY, AND TECTONIC SETTING

edited by G. R. Keller and S. M. Cather, 1994

A collection of papers presenting recent research results on the Rio Grande rift, particularly its many prominent basins. The papers cover a wide range of techniques and approaches but are all focused on the structure, stratigraphy, and tectonic setting of the rift and the basins that characterize it. SPE291, 316 p., paperback, indexed, ISBN 0-8137-2291-8, \$72.50

#### THE ORDOVICIAN DEICKE AND MILLBRIG K-BENTONITE BEDS OF THE CINCIANNATI ARCH AND SOUTHERN VALLEY AND RIDGE PROVINCE

by J. T. Haynes, 1994

The author presents findings of an investigation of the petrology, diagenetic history, and stratigraphy of the Ordovician Deicke and Millbrig K-bentonite beds in the southeastern United States. These two K-bentonites are altered volcanic ash, representing the airfall deposits of two of the largest single-vent volcanic eruptions in the Phanerozoic rock record. A description of the primary and authigenic minerals is followed by interpretation of the origin and diagenetic history of both beds. SPE290, 84 p., paperback, ISBN 0-8137-2290-X, \$32.00

#### LATE CENOZOIC LAVA DAMS IN THE WESTERN GRAND CANYON

by W. K. Hamblin, 1994

Describes and documents the spectacular interplay of volcanism, fluvial erosion, and tectonic uplift in a unique area where this interplay can be seen in three dimensions. It contains numerous maps, photos, and cross-sections of frozen lava cascades and the remnants of a sequence of 13 major lava dams that once formed huge barriers to the Colorado River. MW183, 144 p., hardbound, w/4 pocket-plates, ISBN 0-8137-1183-5, \$85.00

#### THE GEOLOGY OF ALASKA

edited by G. Pfaffler and H. C. Berg, 1994

Get a comprehensive overview of the geology, tectonic evolution, and mineral resources of Alaska and adjacent areas of the continental margin. Plates include statewide maps showing geology, physiography, lithotectonic terranes, metamorphic rocks, igneous rocks, sedimentary basins, isotopic age data, neotectonics, isostatic gravity, magnetics, and metallic mineral deposits. GNA-G1, 1,066 p., hardbound, w/14 plates in slipcase, 1 microfiche card, indexed, ISBN 0-8137-5219-1, \$135.00

#### PHANEROZOIC EVOLUTION, NORTH AMERICAN CONTINENT-OCEAN TRANSECTS

edited by R. C. Speed, 1994

This volume presents syntheses in 12 chapters of the tectonic evolution of continent-ocean transitions of North America (Canada-Mexico-U.S.A.) since the Precambrian. The syntheses are interpretations based on the 19 continent-ocean transects across North American margins published by GSA. CTV001, 514 p., indexed, hardbound, ISBN 0-8137-5305-8, \$75.00

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able, controversial, and salutary as always, and Rudwick then goes into the history of Darwin and catastrophism and much more besides. The Victorian savants would have known that St. Augustine had long since demolished what we now call the "fundamentalist" chronology, and Rudwick points out that we should be careful in accusing people like Buckland of simple-minded literalism in reading Genesis. Lyell and Sedgwick clearly got stuck into the problem of distinguishing between uniformity and catastrophe, much of which depends on the bounds placed on the system being considered. What is catastrophe for the dinosaur—a meteorite—is uniformity for the evolving solar system. Following this is a fascinating comparison between evolution and catastrophe theory by Zeeman—I wonder what the cladists will make of this—and then three actualistic essays about modern earthquakes, storms and famines by Vita-Finzi, Cook, and Garnsey. Finally, Roy Porter finishes the book with a discussion of that other peril of the apocalypse: disease, specifically tuberculosis.

These are erudite essays, mostly (some are lightweight), open and thoughtful, not biased in response to either of the twin perils that afflict modern earth science—on the one side fundamentalism in all its forms, reducing ideas to dogma; on the other its twin, political correctness in its widest sense, forcing fact and opinion into predetermined Stalinist molds. Here is diversity, often infuriating or wrong, but stimulating to read. Catastrophe *does* occur, and is immensely important in the geological record; continuity also rules, and dominates the length of time. I wrote my Ph.D. thesis in Darwin College, where these lectures were given, on a table that had once belonged to Talleyrand. The master-politician of France, he held office in ancien regime, Revolution, Empire and restored monarchy, through all the catastrophes: *plus ça change, plus c'est la même chose*.

Not cheerful subjects, these, reminding us of the biological fragility of our species, of our physical environment, and of our society. Yet there is benefit in catastrophe too: flooding rivers sustain riverbank biota (and keep kids happily out of school); we would prefer not to live in a Flintstonian world, chased by dinosaurs; no doubt many U.S. children owe their existence to the magnetic storm that cut the power. Catastrophes can have their benefit, and are part of the scheme of things. Geologically, we need to recognize that both catastrophe and continuity occur as different aspects of a single system, and to be cautious in future lest climatic catastrophe occur from the actions of our society. We would do well to take this book for some thoughtful reading in the field.

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### Setting the Record Straight

The review of the book *Oceanic Basalts* published in the November 1992 issue of *GSA Today* was written by Peter Schiffman, University of California, Davis, CA 95616.

**Roadside Geology of Mount St. Helens National Volcanic Monument and Vicinity.** Patrick T. Pringle. *Washington Department of Natural Resources, Division of Geology and Earth Resources Information Circular 88, 1993, 120 p.*

It has been over 14 years since the very explosive and deadly eruption of Mount St. Helens Volcano. Public interest continues and active research is underway around this volcano. Patrick T. Pringle's Information Circular is divided into four parts and addresses the most important and interesting facets of the volcano and the surrounding areas. The book was written for the general public but also at a level that professional geologists and other geoscientists will find valuable, especially in planning field trips in the area.

The Introduction is directed to lay persons, and Pringle's instructions on how to use this guide include a section on units of geologic time that ties in major geologic events that occurred in the Mount St. Helens area and throughout the Cascades province. He defines some of the shorthand abbreviations that are not explained in other works. The glossary in Part VI, although not comprehensive, includes those terms that the general public will find helpful in understanding some of the geologic processes and concepts discussed. In addition, the section summarizing recent eruptive activity and hazards leads the reader into a very interesting and well-written assessment of these events.

Part I has a well-balanced coverage of the early history of the area and brings the reader along to the present. Following a discussion of the geologic history and the modern eruptive periods of the volcano, Pringle asks questions that should lead readers to try to better visualize the size and severity of the main eruption and subsequent series of events.

In Part II Pringle offers the reader a variety of guides to the geology of the area. This section is most useful to individuals or organizations planning field trips. The road logs are accurate and contain well-illustrated and clearly explained sketches and photographs.

Part III, A Geologic Primer, is of particular importance to the general public visiting the area. Pringle includes a significant amount of text to prepare the reader to better use the roadside geology logs, and the well-illustrated figures and photographs help the reader to visualize the geology, volcanic structures, and processes. Geologists or others with some experience or training in geology could skip this section; for others, it could serve as a review.

Part IV, References, includes a rather complete list of current and older publications on the area.

The book's many useful qualities include its convenient size and format. It can be slipped into a jacket pocket or into the backpack of a hiker or skier. The numerous well-captioned sketches and photographs illustrate the dra-

matic scenery and exciting geologic processes that define the Mount St. Helens National Monument. They also allow readers to visualize those areas that they are not able to visit. Pringle's book summarizes a vast amount of material in a compact, well-written roadside guide to the geology of an area that has a large number of visitors, including hikers, skiers, rock climbers, and backpackers. The book should be a useful and helpful reference for teachers at all levels who wish to take students into volcano country and to adequately explain to these students what they are viewing.

Robert A. Matthews  
University of California  
Davis, CA 95616-8650

### The Great Paleozoic Crisis—Life and Death in the Permian.

Douglas H. Erwin, *Columbia University Press, New York, 1993, 327 p. \$55 (cloth), \$26 (paper).*

Did you ever want to know what really happened to Earth during its near death experience some 250 million years ago? Doug Erwin's new book introduces you to that ancient world, the plants and animals that inhabited it, and the remarkable and multifarious events that resulted in the "great divide" separating two major eras of Earth history. In a very readable and lucid style, Erwin presents details of the Permian Period and the set of events leading up to and following that "mother of all mass extinctions." The book is not just another compilation of Permian casualties and discussions of potential death agents. It is first and foremost a journey into historical geology—the thread that I believe weaves earth science into a coherent discipline. It also helps us appreciate deductive science at its best.

The chapters present and integrate a formidable array of findings and interpretations resulting from 150 years of intensive research on the Permian. Introductory chapters treat the birth of stratigraphy, the founding of the Permian System, a discussion of boundary stratotypes and details of the most important Permian-Triassic sections. Topics include mixed faunas, the precision of regional correlations, and the types of biases that obscure a clear view of the mass extinction. Erwin also addresses Permian life, climate, sea-level changes, glaciation, and flood basalts and how they compare both qualitatively and quantitatively. A relation between subduction rates and global sea-level change seems inescapable.

Icehouse, greenhouse, and salt-boxes—one chapter addresses aspects of Pangaeian climate. There is a good treatment of theoretical approaches to climate modeling. Erwin admits that sediments and fossils are often more reliable indicators of climate than are predictions from the models. His chapter on geochemical changes includes global carbon cycle, carbon and sulphur isotopes, and cerium anomalies. It includes his "Compleat Idiot's Guide to Stable Isotopes," which he unabashedly admits was really written for himself. I found the chapter "Cycles of Change" especially interesting. It proceeds from Al Fischer's climate supercycles to the recent work of Worsley and colleagues, exploring the relations between mantle processes such as

superplumes and climate. In a deductive science such as geology, one is driven to prove causal relations from correlations. Erwin finds correlations between flood basalts and extinction scientifically unfulfilling because in answering everything they fail to provide needed direction toward future research.

As when we read a real murder mystery, near the end of the book we reach the long-awaited moment where the culprits are identified and the mystery solved. Although it is not terribly surprising, I won't reveal this part except to say that it is liberally sprinkled with fascinating theoretical considerations in which Erwin presents some of his own insight, including his agenda for future research. In spite of all the fuss about what caused the Permian extinctions, I found the last chapter on the aftermath the most fascinating. It starts with the Early Triassic (Scythian) perturbation, with its low faunal diversity, and proceeds through the biotic recovery to the great Mesozoic radiation that began during the Middle Triassic, revealing along the way some intriguing insights into the dynamics of evolution.

Erwin delivers an impressive array of information on the great Paleozoic crisis. He strives for an even-handed

Books continued on p. 282

### Just published in Israel!

Geological Institute of the Russian Academy of Sciences - Moscow, Russia



### Geological Structure of the North-Eastern Mediterranean (Cruise 5 of the Research Vessel 'Akademik Nikolaj Strakhov')

V. A. Krashennnikov and J. K. Hall, editors

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- Micropaleontology (Foraminifers, Radiolaria, Diatoms)
- Analysis of rocks dredged from Eratosthenes Seamount - proposed 1995 JOIDES-ODP drill site
- Tectonics of the NE Mediterranean Sea
- Tectonics of the Mamonnia (Cyprus) and Baer-Bassit (Syria) ophiolite complexes

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modern approach, presenting some of the most arduous controversies in a very diplomatic style while still interjecting many of his own viewpoints. I found the book informative, entertaining, and well illustrated. It is graced by numerous Scotese paleogeographic maps and includes a glossary and an impressive bibliography. I recommend this book not only to earth scientists but to university students as well.

George D. Stanley, Jr.  
University of Montana  
Missoula, MT 59812-1019

**Origin and Early Evolution of the Metazoa.** Edited by Jere H. Lipps and Philip W. Signor III, Plenum Press, New York, 1992, 570 p.

Few intervals of geologic time were as critical in the evolution of the biosphere as the latest Proterozoic to Early Cambrian. Within a span of no more than 50 million years from the Vendian to the Early Cambrian Period, metazoan animals burst onto the scene in a series of waves of evolutionary radiation. The past two decades have also seen a tremendous revolution in the study of upper Precambrian and Lower Cambrian strata. First, a global program of correlation has attempted to redefine the Cambrian-Precambrian boundary, and after long debate, a boundary stratotype section has been chosen in Newfoundland. Paleontologists have documented history and environments of soft-bodied and skeletonized fossil development within an increasingly refined time framework for the latest Vendian and Early Cambrian. Meanwhile, geochemical studies have shown some intriguing isotopic anomalies in the late Precambrian that reflect global events which may relate to the early development of metazoans. Clearly, the time is ripe for the major synthesis of this research on the late Precambrian and Cambrian environments, biostratigraphy, and paleobiology.

*Origin and Early Evolution of the Metazoa*, compiled by Jere Lipps and Philip Signor, provides an admirable synthesis of the many approaches that are being brought to bear on this critical juncture in metazoan evolution. In a series of 16 papers by 20 authors, the book deals with a wide array of topics that bear on the issue of early metazoan evolution and its environmental context. The book is divided into five sections: (1) the introductory chapters by Signor and Lipps, (2) late Proterozoic (Vendian) organisms, facies, and paleoecology (three chapters), (3) evolutionary radiation of the Early Cambrian faunas (seven chapters), and (4) overviews of late Proterozoic and Cambrian metazoans (two chapters).

The faunas of the Ediacarian or Vendian are nicely reviewed in two chapters of this book. Despite controversies as to the exact evolutionary affinities of the Vendian animals, they clearly represent a group of relatively large organisms that flourished nearly globally during a relatively brief interval of geologic time prior to the advent of abundant shelly fossils in the Cambrian. Fedonkin provides a survey of the taphonomy, distribution, and systematics of the "Vendozoa," with photographic illustrations of many of the typical forms. Many new forms of Ediacarian metazoan fossils are illustrated, including an intriguing "soft-bodied trilobite" that may have produced the trace *Diplichnites* (scratch marks). A high point of the book is Jenkins's

excellently illustrated overview of the sedimentary setting and community paleoecology of Ediacarian faunas from the Avalon Peninsula in Newfoundland, Charnwood Forest in England, Namibia, and the Ediacara Hills themselves. Environments of the early metazoans were surprisingly diverse, ranging from shallow to peritidal sands to deep-water slope facies in which the metazoans are buried by turbidites (in the Newfoundland example).

Crimes reviews and contrasts trace fossils across the Vendian to Early Cambrian interval and concludes that there were important ethological changes and rapid diversification of behavioral grades across this boundary.

Charles Darwin regarded the abrupt appearance of metazoans in the Cambrian as a critical and vexing mystery in the history of life. Yet, evidence for an abrupt "Cambrian explosion" has become even more dramatic with recent discoveries. Evolutionary radiations of the Early Cambrian are dealt with in some detail in part 3 of this book. Chapters by Rozanov and Zhuravlev and that by Jiang Zhi-Wen provide exceptionally useful reviews of the largely obscure literature (from a biased western viewpoint) on classic Lower Cambrian "small shelly" faunas of the former Soviet Union and China, respectively. Particularly useful is Rozanov and Zhuravlev's mini-atlas of excellent line drawings of the small shelly fossils. Although it would have been helpful for the reader to have better labels on these drawings, this is still one of the best available sources for illustrations of the "small shellys" from *Aldanella* to *Zhijianites*.

Chapters by Signor and Mount and by Landing, detail the stratigraphic context for the Early Cambrian adaptive radiation of trace-producing and small shelly organisms in two areas, the White-Inyo mountains of California, and the newly adopted Proterozoic-Cambrian boundary sections in Newfoundland. Both papers conclude that the first appearances of various taxa in any given stratigraphic section are diachronous and related to sedimentary facies. The superb review of the Newfoundland section by Landing underscores the importance of the long pre-Tommotian equivalent interval (also termed Nemakit-Daldynian or Manykaian), which, indeed, is longer than all the rest of the Early Cambrian Epoch. This chapter also emphasizes the fact that some of the classic Siberian Tommotian sections and those of the Meishucunian sections in China are markedly incomplete and have major unconformities that delete much of the record of the earliest Cambrian. Many nonexperts will be surprised to learn that the Tommotian is not the basal Cambrian and that many of its "small shelly" fossils are Lazarus taxa (species that reappear after a long period of absence from the fossil record) which had already made an appearance at a much earlier time, albeit still only some 543 million years ago, according to the most recent absolute dates.

Four chapters review the systematics and the early evolutionary radiations of individual phyla. Debrenne surveys the diversification and rapid decline of the archeocyatha, which she regards as a taxon of sponges. Popov discusses the origin and early evolution of the brachiopods and concludes that they form two distinct clades, the Brachiopoda *sensu stricto* (articulates and calcitic inarticulates) and the phosphatic Lingulata; both groups appear in the Tommotian Stage. Sprinkle reviews

the four subphyla of early echinoderms and their sedimentary environments.

Briggs and Fortey present results of their cladistic analysis of Cambrian (and some later) arthropods. Counter to claims by Stephen Gould in his book *Wonderful Life*, many of the "weird wonders" of the Burgess Shale and other Cambrian Lagerstätten apparently can be accommodated within existing major taxa. Briggs and Fortey recognize three major clades of early arthropods: the trilobites, the chelicerates, and a primitive paraphyletic group that roughly corresponds to the crustacea.

Three of the chapters in this book provide broader syntheses of evolutionary and environmental changes associated with the abrupt early radiations of soft-bodied and skeletonized metazoans. Bengtson and Conway Morris survey the biomineralogy of Early Cambrian organisms. They stress the abrupt appearance of distinctive biomineralized skeletal types, in as many as 40 different clades of organisms within the Early Cambrian.

One perspective of the Early Cambrian revolution of skeletonized forms is provided by Brasier, who notes that the lingulates, early ostracodes, aglaspid arthropods, and a host of extinct "small shellys" are phosphatic. The buildup of dissolved phosphates in late Proterozoic anoxic ocean bottom waters is posited by Brasier as an enormous reservoir for dissolved nutrients. The late Vendian and Early Cambrian global transgressions then produced upwellings of these phosphate-rich bottom waters onto shallow shelves, which permitted biotic diversification, especially of phosphate-secretors. Although controversy exists as to the relative importance of phosphate vs. aragonite secretors in the early Cambrian, the evolution of metazoans undoubtedly played a very significant role in the control of biogeochemical cycles and permanently altered the geochemistry of the early Paleozoic seas.

Knoll's excellent synthesis on the conditions that preceded early metazoan adaptive radiation emphasizes the strong positive  $\delta^{13}\text{C}$  anomalies observed in the late Vendian carbonates. He attributes these anomalies to

the large-scale burial of isotopically light ( $^{12}\text{C}$  enriched) organic matter in anoxic bottom waters of rapidly opening oceans. In turn, burial of reduced organic matter permitted a relatively rapid rise in global atmospheric oxygen levels that triggered the rise of metazoans in the late Precambrian.

In the final chapter of the book, Valentine presents a broad, if somewhat speculative, overview of the evolution of animal phyla. He postulates relatively explosive evolution, within perhaps no more than 10 million years, of complex and larger coelomate animals originating from a grade that no longer exists: triploblastic, hemocoelic, wormlike organisms that lacked a true coelom. The origin of skeletons is just part of this explosive diversification of metazoan animals. High mutation rates may have characterized the newly appearing organisms prior to adaptation of genomes for self repair. However, physical environmental changes proposed by Knoll and Brasier, but, more important, the availability of ecological niches, must have promoted the rapid diversification of metazoans.

*Origin and Early Evolution of the Metazoa* presents a rich cross section of the exciting new ideas and models bearing upon this most explosive of evolutionary episodes in the history of life. These ideas and speculations are supported by a wealth of detailed observations and illustrations, many of them comparatively new. By bringing together this varied synthesis of ideas and basic observations, the book represents a landmark in the study of early metazoan life. Nearly all of the chapters provide useful summaries and illustrations. Some provide truly provocative and innovative syntheses of the rapidly accruing database on early metazoan evolution. For these reasons, this book will be widely read and cited. It will form a basic text for graduate seminars in paleontology and is a "must read" for all those interested in the broader themes of life history. I commend the editors for assembling such an outstanding compendium.

Carlton Brett  
University of Rochester  
Rochester, NY 14627 ■

## Global Change Postdoctoral Fellowships Offered

The U.S. Department of Energy (DOE), Office of Health and Environmental Research (OHER), Environmental Sciences Division (ESD), has established the Global Change Distinguished Postdoctoral Fellowships to support research on projects related to the U.S. Global Change Research Program (USGCRP). These fellowships address the nation's global change activities that are carried out by DOE and other federal departments and agencies represented on the Subcommittee on Global Change Research of the Committee on the Environment and Natural Resources.

### Eligibility

Applicants must have received a doctoral degree in an appropriate discipline after March 31, 1992, or must complete all such requirements prior to starting the appointment. The starting date must be between April 1 and September 30, 1995. Degrees in the life, physical, earth, environmental, economic, social, and computer sciences, as well as engineering and supporting scientific fields, are appropriate.

### Application Information

Completed applications and all supporting materials must be received by December 15, 1994. Appointment offers will be made in March 1995.

For more information and application material, write or call: Global Change Distinguished Postdoctoral Fellowships, Science/Engineering Education Division, Oak Ridge Institute for Science and Education, P.O. Box 117, Oak Ridge, TN 37831-0117, (615) 576-9934.

**GSA Penrose Conferences****August 1995**

■ **Fault-related Folding**, August 22–27, 1995, Banff, Alberta, Canada. Information: David Anastasio, Department of Earth and Environmental Sciences, Lehigh University, Bethlehem, PA 18015-3188, (610) 758-5117, fax 610-758-3677, E-mail: kja2@lehigh.edu.

■ **Fault Rocks**, August 31–September 4, 1995, Leavenworth, Washington. Information: Jerry F. Magloughlin, Department of Geological Sciences, 1006 C.C. Little Building, University of Michigan, Ann Arbor, MI 48109-1063, (313) 747-0664, fax 313-763-4690, E-mail: jerry.magloughlin@um.cc.umich.edu.

**October 1995**

■ **Mesozoic Evolution of the Cordilleran Continental Margin in Central and Southern California**, October 6–11, 1995, Tehachapi, California. Information: Andrew Barth, Department of Geology, Indiana/Purdue University, Indianapolis, IN 46202-5132, (317) 274-1243, E-mail: ibsz100@indyvax.iupui.edu.

**1994 Meetings****November**

■ **Carolina Geological Society Annual Meeting and Field Trip**, November 4–6, 1994, Raleigh, North Carolina. Information: Skip Stoddard, Dept. of MEAS, Box 8208, North Carolina State University, Raleigh, NC 27695-8208, (919) 515-7939, fax 919-515-7802, E-mail: stoddard@meavax.nrrc.ncsu.edu.

■ **Investigations of Lithosphere Architecture and Development**, November 5–9, 1994, Taos, New Mexico. Information: Alan Levander, Rice University, (713) 527-6064, fax 713-285-5214. Send by E-mail a letter of application to Liz McDowell at liz@iris.edu.

■ **Glacial-Interglacial Sealevel Changes in Four Dimensions**, November 5–10, 1994, St. Martin, Germany. Information: Josip Hendekovic, European Science Foundation, 1 quai Lezay-Marnésia, 67080 Strasbourg Cedex, France, phone 33-88-76-71-35, fax 33-88-36-69-87.

■ **International Symposium on the Cenozoic Tectonics and Volcanism of Mexico**, November 7–11, 1994, Puerto Vallarta, Jalisco, Mexico. Information: Hugo Delgado Granados, Inst. de Geofísica, UNAM, Circuito Exterior, C.U., Coyoacán 04510, México D.F., phone (525) 622-4145, 622-4119, 622-4124, fax 525-550-2486, Internet: hugo@tonatiuh.igcofcu.unam.mx; or Gerardo Aguirre Díaz, Estación Regional del Centro, Inst. de Geología, UNAM, Apdo. Postal 376, Guanajuato, Gto, 36000, México, phone and fax 524-732-3038.

■ **Geology and Resources of the Eastern Frontal Belt, Ouachita Mountains, Oklahoma**, November 15–17, 1994, Poteau, Oklahoma. Information: Neil H. Suneson, Oklahoma Geological Survey, Sarkeys Energy Center, Room N-131, 100 East Boyd St., Norman, OK 73019-0628, (405) 325-3031.

■ **International Geological Correlation Program Project 351, Early Paleozoic Evolution in Northwest Gondwana**, November 29–December 7, 1994, Rabat, Morocco. Information: Naima Hamoumi, Dépt. de Géologie, Faculté

des Sciences de Rabat, B.P. 1226 RP Rabat, Morocco, phone 212-7-7719-57, fax 212-7-77-42-61, telex 36607 M.

■ **Northwest Mining Association 100th Annual Convention**, November 30–December 2, 1994, Spokane, Washington. Information: Northwest Mining Association, 10 N. Post, Ste. 414, Spokane, WA 99201-0772, (509) 624-1158, fax 509-623-1241.

**December**

■ **25th Annual Underwater Mining Institute**, December 1–4, 1994, Monterey, California. Information: Karyne Chong Morgan, Underwater Mining Institute, 811 Olomehani St., Honolulu, HI 96813-5513, (808) 522-5611, fax 808-522-5618, Internet: 70673.534@compuserve.com, Compuserve 70673.534.

■ **American Geophysical Union Fall Meeting**, December 5–9, 1994, San Francisco, California. Information: AGU Meetings Dept., 1994 Fall Meeting, 2000 Florida Ave., N.W., Washington, DC 20009, (202) 462-6900, fax 202-328-0566, E-mail: meetinginfo@kosmos.agu.org.

■ **Tectonic Evolution of Southeast Asia**, December 7–8, 1994, London, UK. Information: Robert Hall, Geological Sciences, University College, Gower St., London WC1E 6BT, UK, phone 44-784-443592, fax 44-71-387-1612, E-mail (Internet): robert.hall@ucl.ac.uk.

■ **Symposium on Inverse Problems: Geophysical Applications**, December 12–14, 1994, Yosemite Fish Camp, California. Information: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688, (215) 382-9800, fax 215-386-7999, E-mail: meetings@siam.org.

**1995 Meetings****February**

■ **Mathematical and Computational Issues in the Geosciences, Third SIAM Conference**, February 8–11, San Antonio, Texas. Information: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688, (215) 382-9800, fax 215-386-7999, E-mail: meetings@siam.org.

■ **U.S. Geological Survey McKelvey Forum on Energy and the Environment: Application of Geosciences to Decision Making**, February 13–16, 1995, Washington, D.C. Information: Dudley D. Rice, U.S. Geological Survey, P.O. Box 25046, MS 971, Denver, CO 80225, (303) 236-5711, fax 303-236-8822, E-mail: rice@bpgsvr.cr.usgs.gov.

■ **Paleokarst: Macroscopic Dissolution Features in the Rock Record**, February 17–21, 1995, Bahamian Field Station, San Salvador Island, Bahamas. Information: John Mylroie, Department of Geosciences, P.O. Box 5448, Mississippi State, MS 39762, (601) 325-8774, fax 601-325-2907.

**March**

■ **American Association of Petroleum Geologists and Society for Sedimentary Geology (SEPM) Annual Convention**, March 5–8, 1995, Houston, Texas. Information: Michelle Mayfield, AAPG Annual Meetings Manager, P.O. Box 979, 1444 S. Boulder Ave., Tulsa, OK 74101-0979, (918) 584-2555, fax 918-584-2274.

■ **Prospectors and Developers Association of Canada Convention**, March 5–8, 1995, Toronto, Ontario. Information: Prospectors and Developers Association of Canada, 34 King St. East, 9th Floor, Toronto, Ontario M5C 2X8, Canada, (416) 362-1969, fax 416-362-0101.

■ **GSA Northeastern Section Annual Meeting**, March 20–22, 1995, Hartford, Connecticut. Information: Norman H. Gray, Dept. of Geology and Geophysics, University of Connecticut, 354 Mansfield Road, Storrs, CT 06269-2045, (203) 486-4434.

■ **Michigan: Its Geology and Geologic Resources**, March 23–24, 1995, East Lansing, Michigan. Information: S. Paul Sundeen, Michigan DNR Geological Survey Division, P.O. Box 30256, Lansing, MI 48909, (517) 334-6930, fax 517-334-6038.

■ **Oklahoma Geological Survey Workshop on the Ames Structure and Similar Features**, March 28–29, 1995, Norman, Oklahoma. Information: Kenneth S. Johnson and Jock A. Campbell, Oklahoma Geological Survey, University of Oklahoma, 100 East Boyd, Rm. N-131, Norman, OK 73019, (405) 325-3031, fax 405-325-7069.

**April**

■ **Sinkholes and the Engineering and Environmental Impacts of Karst Fifth Multidisciplinary Conference**, April 2–5, 1995, Gatlinburg, Tennessee. Information: B. F. Beck, P. E. LaMoreaux & Associates, Inc., Box 4412, Oak Ridge, TN 37831, (615) 483-7483.

■ **Geological Society of South Africa Centennial Geocongress**, April 3–7, 1995, Johannesburg, South Africa. Information: Congress Secretariat, Centennial Geocongress, P.O. Box 36815, Menlo Park, 0102, South Africa, phone and fax 27-12-47-3398.

■ **2nd International Symposium on Fractals and Dynamic Systems in Geoscience**, April 4–7, 1995, Frankfurt am Main, Germany. Information: Jörn H. Kruhl, Geol.-Pal.Inst., JW Goethe-Universität, Senckenberganlage 32, D-60054 Frankfurt/M., Germany, 49-69-7982106, fax 49-69-7982958.

■ **10th Himalaya-Karakoram-Tibet Workshop**, April 4–8, 1995. Information: David A. Spencer, Geologisches Institut, ETH-Zentrum, CH-8092 Zürich, Switzerland, phone 41-1-632-3698, E-mail: daspencer@erdw.ethz.ch.

■ **GSA Southeastern Section Annual Meeting**, April 6–7, 1995, Knoxville, Tennessee. Information: Harry Y. McSween, Dept. of Geological Sciences, University of Tennessee, 306 G&G Building, Knoxville, TN 37996-1410, (615) 974-5498.

■ **National Fossil Exposition XVII**, April 7–9, 1995, Macomb, Illinois. Information: Gilbert Norris, 2623 34th Ave. Ct., Rock Island, IL 61201, (309) 786-6505.

■ **Geological Society of Nevada Symposium III: Geology and Ore Deposits of the American Cordillera**, April 10–13, 1995, Reno, Nevada. Information: Bob Hatch, Chairperson, Geological Society of Nevada, P.O. Box 12021, Reno, NV 89510, (702) 323-4569, fax 702-323-3599.

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■ **Mechanics of Jointed and Faulted Rock, Second International Conference**, April 10–14, 1995, Vienna, Austria. Information: H. P. Rossmanith, Institute of Mechanics, Technical University Vienna, Wiedner Hauptstrasse 8-10/325 A-1040 Vienna, Austria, phone 43-1-58-801-5514, fax 43-1-587-58-63, E-mail: rossmanith@emch80.una.ac.at.

■ **Eighth Annual Symposium on the Application of Geophysics to Engineering and Environmental Problems**, April 23–27, 1995, Orlando, Florida. Information: EEGS, Mark Cramer, P.O. Box 4475, Englewood, CO 80155, (303) 771-6101.

■ **Third International Symposium on In Situ and On-Site Bioreclamation**, April 24–27, 1995, San Diego, California. Information: Betty Weaver, Symposium Coordinator, The Conference Group, 1989 West Fifth Ave., Suite 5, Columbus, OH 43212-1912, toll-free (U.S. and Canada) 800-783-6338, or (614) 424-5461, fax 614-488-5747.

■ **GSA South-Central/North-Central Sections Joint Annual Meeting**, April 27–28, 1995, Lincoln, Nebraska. Information: Robert F. Diffendal, Conservation and Survey Division, 133 Nebraska Hall, University of Nebraska, 901 N. 17th

Meetings continued on p. 284

Meetings continued from p. 283

Street, Lincoln, NE 68588-0517, (402) 472-7546; Page C. Twiss, Dept. of Geology, Kansas State University, Thompson Hall, Manhattan, KS 66506, (913) 532-6724.

#### May

**Water Pollution Modelling, Measuring and Prediction Third International Conference**, May 1-3, 1995, Porto Carras, Greece. Information: Liz Johnstone, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton SO40 7AA, UK, phone 44-703-293-223, fax 44-703-29-2853, E-mail: CMI@uk.ac.rl.ib.

**1995 International High-Level Radioactive Waste Management Conference**, May 1-5, 1995, Las Vegas, Nevada. Information: American Nuclear Society, 555 N. Kensington Ave., La Grange Park, IL 60525. (Summary deadline: November 11, 1994).

**Geotechnica 95**, Geosciences and Geotechnology Amid Ecological and Economic Considerations, May 2-5, 1995, Cologne, Germany. Information: Alfred Wegener Stiftung, Wissenschaftszentrum, Ahrstrasse 45, 53175 Bonn, Germany.

**American Association of Petroleum Geologists Pacific Section Annual Convention**, May 3-5, 1995, San Francisco, California. Information: Les Magoon, U.S. Geological Survey, 345 Middlefield Road, MS 999, Menlo Park, CA 94025, (415) 354-3006, fax 415-354-3224.

**Water Resources at Risk**, May 14-18, 1995, Denver, Colorado. Information: Helen Klose, American Institute of Hydrology, 3416 University Ave., S.E., Minneapolis, MN 55414, (612) 379-1030, fax 612-379-0169.

**17th International Geochemical Exploration Symposium**, Exploring the Tropics, May 15-19, 1995, Townsville, Queensland, Australia. Information: Russell Myers, 171GES, National Key Centre in Economic Geology, James Cook University, Townsville, Q4814, Australia, phone 61-77-814486, fax 61-77-815522.

**Geological Association of Canada-Mineralogical Association of Canada Joint Annual Meeting**, May 17-19, 1995, Victoria, British Columbia, Canada. Information: Chris Barnes, General Chair, SEOS, University of Victoria, P.O. Box 1700, Victoria, B.C. V8W 2Y2, Canada, fax 604-721-6200.

**GSA Rocky Mountain Section Annual Meeting**, May 18-19, 1995, Bozeman, Montana. Information:

Stephan G. Custer, Dept. of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6906.

**1995 World Geothermal Congress**, May 18-31, Florence, Italy. Information: George Frye, Executive Director, International Geothermal Association, LBL 50C, Rms. 106-108, One Cyclotron Road, Berkeley, CA 94720, (510) 486-4584, fax 510-486-4889.

**Basement Tectonics 12th International Conference**, May 21-26, 1995, Norman, Oklahoma. Information: M. C. Gilbert, Conference Chairman, School of Geology and Geophysics, University of Oklahoma, 810 Sarkeys Energy Center, Norman, OK 73019-0628, (405) 325-3253, fax 405-325-3140

**Fifth Annual Goldschmidt Conference**, May 24-26, 1995, University Park, Pennsylvania. Information: Suzanne St. Pierre, (814) 865-7557, fax 814-865-3749.

**GSA Cordilleran Section Annual Meeting**, May 24-26, 1995, Fairbanks, Alaska. Information: David B. Stone, Dept. of Geology and Geophysics, University of Alaska, Fairbanks, AK 99775-0760, (907) 474-7565.

**National Association of Geology Teachers Eastern Section Annual Meeting**, May 25-28, 1995, Toronto, Ontario. Information: Robert C. Lord, Conference Coordinator, Suite 1507, 1300 Marlborough Court, Oakville, Ontario L6H 2S2, Canada.

**Walter A. Bell Symposium on Paleobotany and Coal Science**, May 28-June 1, 1995, Sydney, Nova Scotia. Information: Erwin L. Zodrow, University College of Cape Breton, P.O. Box 5300, Sydney, Nova Scotia, B1P 6L2, Canada, fax 902-562-0119, or Paul C. Lyons, U.S. Geological Survey, MS 956, Reston, VA 22092, fax 703-648-4227.

**June SEG International Field Conference on Carbonate-hosted Lead-Zinc Deposits**, June 3-6, 1995, St. Louis, Missouri. Information: Martin Goldhaber, U.S. Geological Survey, P.O. Box 25046, MS 973, Federal Center, Denver, CO 80225-0046, fax 303-236-3200, E-mail: mgold@helios.cr.usgs.gov.

**35th U.S. Symposium on Rock Mechanics**, June 4-7, 1995, Lake Tahoe, California-Nevada. Information: Jaak Daemen, Mining Engineering, MS 173, University of Nevada, Reno, NV 89557-0139, (702) 784-4309, fax 702-784-1766; or Richard Schultz, Geological Engineering, MS 173, University of Nevada, Reno, NV 89557-0139, (702) 784-4318, fax 702-784-1766.

**Clay Minerals Society 32nd Annual Meeting**, June 4-8, 1995, Baltimore, Maryland. Information: Patricia Jo Eberl, Clay Minerals Society, P.O. Box 4416, Boulder, CO 80306, (303) 444-6405, fax 303-444-2260.

**Seventh International Symposium on the Ordovician System**, June 12-16, 1995, Las Vegas, Nevada. Information: Margaret N. Rees, 7th ISOS, Dept. of Geoscience, University of Nevada, Las Vegas, NV 89154-4010, (702) 895-3890, fax 702-895-4064, E-mail: rees@nevada.edu.

**Water Resources and Environmental Hazards: Emphasis on Hydrologic and Cultural Insight in the Pacific Rim**, June 25-28, 1995, Honolulu, Hawaii. Information: A. Ivan Johnson, A. Ivan Johnson, Inc., 7474 Upham Ct., Arvada, CO 80003, (303) 425-5610.

**European Coal Conference**, June 26-July 1, 1995, Prague, Czech Republic. Information: European Coal Conference '95, Faculty of Science, Charles University, Albertov 6, 128 43 Prague 2, Czech Republic, phone 42-2-24915472, fax 42-2-296084. (Abstract deadline: February 28, 1995.)

#### July

**International Union of Geodesy and Geophysics XXI General Assembly**, July 2-14, 1995, Boulder, Colorado. Information: IUGG XXI General Assembly, c/o AGU 2000 Florida Ave., NW, Washington, DC, (202) 462-6900, fax 202-328-0566, E-mail: iugg\_xxiga@kosmos.agu.org.

**Eleventh Symposium on Coastal Sedimentology**, July 3-9, 1995, Niteroi, Brazil. Information: Cleverton Guizan Silva, Dept. de Geologia/LAGE-MAR, Universidade Federal Fluminense, Av. Bento de Maria da Costa 115-a, Charitas, Niteroi, R.J. 24.370-190, Brazil, fax 55-21-711-9917.

**First Australian Conodont Symposium and Boucot Symposium (in honor of Art Boucot)**, July 18-21, 1995, North Ryde, New South Wales, Australia. Information: Ruth Mawson, Centre for Ecostratigraphy and Palaeobiology, School of Earth Sciences, Macquarie University, North Ryde, NSW, 2109 Australia, 61-2-850 8336, fax 61-2-850 8428, E-mail: rmawson@laurel.ocs.mq.edu.au.

**Seventh International Williston Basin Symposium**, July 23-25, 1995, Billings, Montana. Information: W. Kipp Carroll, General Chairman, (406) 245-2367.

#### August

**3rd International Field Conference and Symposium on Intraplate Magmatism (IGCP 336): Petrology and**

**Metallogeny of Volcanic and Intrusive Rocks of the Midcontinent Rift System**, August 22-September 1, 1995, Duluth, Minnesota. Information: Penny Morton, Dept. of Geology, University of Minnesota, Duluth, MN 55812, (218) 726-7962, fax 218-726-8275, E-mail: pmorton@ua.d.umn.edu.

**Orogenic Lherzolites and Mantle Processes 2nd International Workshop**, August 24-September 5, 1995, Granada, Spain. Information: H. G. Barszczus, Géofluides GBE/ISTEEM-C.P. 057, Université de Montpellier 2, 34095 Montpellier Cedex 5, France, phone 33-6714-3933, fax 33-6714-4774, E-mail: barszczus@dstu.univ-montp2.fr.

**Mineral Deposits: From Their Genesis to Their Environmental Impacts**, 3rd Biennial SGA Meeting, August 28-31, 1995, Prague, Czech Republic. Information: Jan Pasava, Czech Geological Survey, Klarov 131/3, 118 20 Praha 1, Czech Republic, phone 42-2-537011, fax 42-2-7980965.

**Tectonics and Metallogeny of Early/Mid Precambrian Orogenic Belts**, August 28-September 1, 1995, Montreal, Canada. Information: J. A. Percival, Geological Survey of Canada, 601 Booth St., Ottawa, Ontario K1A 0E8, Canada, (613) 995-4723, fax 613-995-9273, E-mail: jpercival@601C.gsc.emr.ca, or J. N. Ludden, Dept. de Géologie, Université de Montréal, CP 6128, Succ. A, Montréal, Québec H3C 3J7, Canada, (514) 343-7389, fax 514-343-5782, E-mail: luddenj@ere.umontreal.ca.

**Third Hutton Symposium: The Origin of Granites**, August 28-September 2, 1995, College Park, Maryland. Information: Michael Brown, Dept. of Geology, University of Maryland, College Park, MD 20742, (301) 405-4082, fax 301-314-9661.

#### September

**Karst Waters and Environmental Impacts Fifth International Symposium and Field Seminar**, September 10-20, 1995, Antalya, Turkey. Information: Gültekin Günay, P.O. Box 357, Kızılay, 06420 Ankara, Turkey, (312) 235-2543, fax 312-235-2862.

**Third Thematic Conference on Remote Sensing for Marine and Coastal Environments**, September 18-20, 1995, Seattle, Washington. Information: ERIM, P.O. Box 134001, Ann Arbor, MI 48113-4001, (313) 994-1200, ext. 3234, fax 313-994-5123.

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

## GSA SECTION MEETINGS

### NORTHEASTERN SECTION

**Radisson Hotel and Conference Center in Cromwell, Hartford, Connecticut, March 20-22, 1995.** Submit completed abstracts to: Norman H. Gray, Department of Geology and Geophysics, University of Connecticut, 354 Mansfield Rd., Storrs, CT 06269-2045, (203) 486-4434. *Abstract Deadline: November 21, 1994.*

### SOUTHEASTERN SECTION

**Knoxville Hilton Hotel, Knoxville, Tennessee, April 6-7, 1995.** Submit completed abstracts to: Robert D. Hatcher, Jr., Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-6565. *Abstract Deadline: December 16, 1994.*

### NORTH-CENTRAL/SOUTH-CENTRAL SECTIONS

**University of Nebraska, Lincoln, Nebraska, April 27-28, 1995.**

Submit completed abstracts to: David Loope, 332 Bessey Hall, University of Nebraska, Lincoln, NE 68588-0340, (402) 472-2647. *Abstract Deadline: January 6, 1995.*

### ROCKY MOUNTAIN SECTION

**Montana State University, Bozeman, Montana, May 18-19, 1995.** Submit completed abstracts to: David R. Lageson, Department of Earth Sciences, Montana State University, Bozeman, MT 59717-0348, (406) 994-6913. *Abstract Deadline: January 20, 1995.*

### CORDILLERAN SECTION

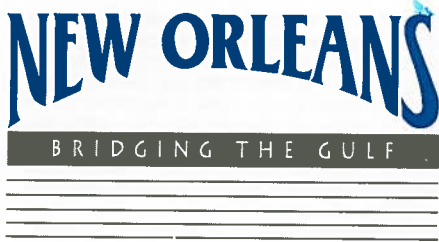
**University of Alaska, Fairbanks, Alaska, May 24-26, 1995.** Submit completed abstracts to: Catherine Hanks, Geophysical Institute, University of Alaska, Fairbanks, AK 99775-0800, (907) 474-5562. *Abstract Deadline: January 30, 1995.*



# GSA ANNUAL MEETINGS

## 1995

New Orleans, Louisiana  
November 6-9  
Ernest N. Morial  
Convention Center,  
Hyatt Regency New Orleans



**General Chair:** William R. Craig, University of New Orleans  
**Technical Program Chair:** Laura Serpa, University of New Orleans  
**Field Trip Chair:** Whitney Autin, Louisiana Geological Survey  
**Symposium and Theme Proposals Due:** January 2, 1995

Send theme proposals to:

Laura Serpa or Terry Pavlis, University of New Orleans,  
Department of Geology and Geophysics, 2000 Lake Shore Dr.,  
New Orleans, LA 70148, (504) 286-6801, fax 504-286-7396,  
E-mail: serpa@geology.uno.edu or tpavlis@geology.uno.edu.

### Call for 1995 CONTINUING EDUCATION COURSE PROPOSALS PROPOSALS DUE DECEMBER 1, 1994

The GSA Committee on Continuing Education invites those interested in proposing a GSA-sponsored or cosponsored course or workshop to contact GSA headquarters for proposal guidelines. Continuing Education courses may be conducted in conjunction with all GSA annual or section meetings. We are particularly interested in receiving proposals for the 1995 New Orleans Annual Meeting or the 1996 Denver Annual Meeting.

Proposals must be received by December 1, 1994. Selection of courses for 1995 will be made by February 1, 1995. For those planning ahead, we will also consider courses for 1996 at that time.

For proposal guidelines or information contact:  
Edna A. Collis, Continuing Education Coordinator,  
GSA headquarters, 1-800-472-1988, ext. 134.  
ecollis@geosociety.org

For general information call the GSA Meetings Department,  
1-800-472-1988 or (303) 447-2020, ext. 141; E-mail: mball@geosociety.org.

## 1996

Denver, Colorado, October 28-31  
Colorado Convention Center, Radisson Hotel Denver

**General Chairs:** Kenneth E. Kolm and Gregory S. Holden,  
Colorado School of Mines

**Technical Program Chair:** John E. Warne, Colorado School of Mines

**Call for Field Trip Proposals:** Please contact the Field Trip Chairs listed below.

**Charles L. Pillmore, Ren A. Thompson**  
U.S. Geological Survey, MS913, P.O. Box 25046  
Denver Federal Center, Denver, CO 80225  
phones: Charles A. Pillmore, (303) 236-1240  
Ren A. Thompson (303) 236-0214.

For general information call the GSA Meetings Department,  
1-800-472-1988 or (303) 447-2020, ext. 141; E-mail: mball@geosociety.org.

### Student Travel Grants

The GSA Foundation will award matching grants up to a total of \$3500 each to the six GSA Sections. The money, when combined with equal funds from the Sections, will be used to assist GSA Student Associates traveling to the 1995 GSA Annual Meeting in New Orleans in November and to the 1995 Section meetings. Contact your Section Secretary for application procedures.

Cordilleran .....	Bruce A. Blackerby .....	(209) 278-2955
Rocky Mountain .....	Kenneth E. Kolm .....	(303) 273-3932
North-Central .....	George R. Hallberg .....	(319) 335-4500
South-Central .....	Rena M. Bonem .....	(817) 755-2361
Northeastern .....	Kenneth N. Weaver .....	(410) 554-5532
Southeastern .....	Harold H. Stowell .....	(205) 348-5098

### GSA Thanks the 1994 Annual Meeting Sponsors

For the Seattle Annual Meeting, the following exhibitors have generously donated funds to support the meeting. GSA is most appreciative of this support and thanks these companies.

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## 1995 Field Trips

The theme of the 1995 Annual Meeting is "Bridging the Gulf," and the field trips will be in keeping with that spirit. The geology ranges from the volcanics of Mexico to the Paleozoic rocks of Alabama, and from mountains to the interior of a salt dome. Included will be Appalachian structure, salt dome tectonics, and stratigraphy from lower Paleozoic to Holocene. Environmental and land use aspects will include delta building, coastal erosion, Mississippi River deposition and flood control, industrial water use and disposal, gravel quarrying and agriculture. All this will be interspersed with the culture of an area rich with history: Pre-Columbian Indian, Colonial, Cajun, and plantation development, Civil War forts and battlefields, and a lively and varied present-day population.

In all, we are offering a great variety. We have the leaders to take you to the best of our geology and to share with you their enthusiasm for it. We believe you will have a hard time deciding which trip to take.

All trips begin and end in New Orleans unless otherwise indicated. With lower airfares on Saturday night stay-over flights, you can pay for a pre- or postmeeting field trip with the savings.

The following list is tentative, and trip costs are preliminary estimates; all are subject to change. Further details will be given when registration begins in June 1995. Trips are led by active researchers and are technical in nature, although students are definitely encouraged to attend.

For further information, contact the trip leader or the 1995 Field Trip Chair Whitney Autin, Louisiana State University, Institute for Environmental Studies, 42 Atkinson Hall, Baton Rouge, LA 70803-5705, (504) 388-3420, fax 504-388-4286, or Co-Chair Duncan Goldthwaite, Independent Petroleum Geologist, 4608 James Drive, Metairie, LA 70003, (504) 887-4377.

### PREMEETING

**1. Explosive Volcanism and Pyroclastic Deposits in East-Central Mexico: Implications for Future Hazards.** Tuesday, October 31 through Sunday, November 5. Claus Seibe, Instituto de Geofísica, Universidad Nacional Autónoma de México, Cuidad Universitaria, Circuito Exterior, C.P. 04510 Chicane, México D.F., México, phone 6-22-41-19. Maximum: 24. Estimated cost: \$350, plus airfare. This trip will start and end at the Mexico City airport; participants will make their own flight arrangements. The end of the trip is scheduled to connect with a Continental Airlines flight that arrives in New Orleans at 2:34 p.m., Sunday, November 5.

**2. Regressive and Transgressive Depositional Systems of the Mississippi River Delta Plain: Atchafalaya and Lafourche Delta Complexes.** Saturday, November 4 through Sunday, November 5. Shea Penland, Coastal Studies Institute, Louisiana State University, Baton Rouge, LA 70803, (504) 388-8670; S. Jeffress Williams; Harry H. Roberts. Maximum: 30. Estimated cost: \$130. This trip will include landings at Isles Derniers, which will involve wading ashore from small boats. Appropriate footwear (sneakers) is recommended.

**3. Wisconsinan to Holocene Soils, Landscapes, and Flood Plain Evolution of the Lower Mississippi Valley.** Friday, November 3 (evening) through Sunday, November 5. Andres Aslan, Dept. of Geological Sciences, University of Colorado, Boulder, CO

80309, (303) 492-6313; Whitney Autin. Maximum: 40. Estimated cost: \$190.

**4. Neogene Stratigraphy and Geomorphology of the Eastern Gulf of Mexico.** Saturday, November 4 through Sunday, November 5. Ervin G. Otvos, Gulf Coast Research Laboratory, P.O. Box 7000, Ocean Springs, MS 39564-7000, (601) 872-4200. Maximum: 40. Estimated Cost: \$160.

### HALF DAY—CONCURRENT WITH THE MEETING

**5A, 5B. Engineering Geology of the New Orleans Area: Water, Water, Everywhere.** 5A: Tuesday, November 7, 7:30 a.m. to 12:30 p.m. 5B: Wednesday, November 8, 7:30 a.m. to 12:30 p.m.

Roger T. Saucier, USAE Waterways Experiment Station, Attn: CEWES-EV-I, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, (601) 634-3233; Jesse O. Snowden. Maximum: 40 (each trip). Estimated cost: \$60.

### POSTMEETING

**6. Geological and Cultural Excursion: Jackson, Mississippi, to Baton Rouge, Louisiana.** Thursday, November 9 (evening) through Saturday, November 11 (evening). Maureen K. Corcoran, USAE Waterways Experiment Station, Attn: CEWES-GG, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, (601) 634-3334. Maximum: 40. Estimated cost: \$190.

**7. Paleogene Molluscan Biostratigraphy of the Eastern Gulf Coastal Plain.** Thursday, November 9 (evening) through Sunday, November 12 (morning). Charles R. Givens, Dept. of Earth Science, Nicholls State University, Thibodaux, LA 70310, (504) 448-4165; David Dockery. Maximum: 40. Estimated Cost: \$260.

**8. Structural Geology of the Southern Appalachians.** Thursday, November 9 (evening) through Saturday, November 11 (evening). William A. Thomas, Dept. of Geological Sciences, University of Kentucky, Lexington, KY 40506-0059, (606) 257-3758. Maximum: 40. Estimated cost: \$220.

Although the trip ends in New Orleans, the bus can make a stop, in the early afternoon on Saturday, at the Birmingham, Alabama, airport for anyone wishing to depart from there.

**9. Cultural Adaptation to Landforms in the Lower Mississippi Valley.** Friday, November 10, 8 a.m. to 6 p.m. Charles E. Pearson, Environments, Inc., 1260 Main Street, Baton Rouge, LA 70802, (504) 383-7455; Donald W. Davis. Maximum: 40. Estimated cost: \$75.

**10. Industrialization and Water Resources of the Baton Rouge-New Orleans Corridor.** Friday, November 10, 8 a.m. to 5 p.m. Ivy Dupree, Dow Chemical Co., P.O. Box 150, Building 3602 E., Plaquemine, LA 70765, (504) 353-1630; Raphael G. Kazmann; Donna Andrus. Maximum: 40. Estimated cost: \$70. Complimentary lunch will be served at Dow Chemical plant in Plaquemine.

**11. Structure and Tectonics of the Cote Blanche Island Salt Dome: Relation to Salt Dome Utilization.** Friday, November 10, 8 a.m. to 6 p.m. Donald H. Kupfer, 7324 Menlo Drive, Apt. 3, Baton Rouge, LA 70808, (504) 766-4566; James T. Neal. Maximum: 36. Estimated cost: \$75.

**12. Sand and Gravel Mining in the Amite River Flood Plain, Southeastern Louisiana.** Friday, November 10, 8 a.m. to 6 p.m. Joann Mossa, Dept. Of Geography, University of Florida, 3133 Turlington Hall, Gainesville, FL 32611, (904) 392-0494. Maximum: 40. Estimated cost: \$70. ■

# November BULLETIN and GEOLOGY Contents



The Geological Society of America

**BULLETIN**

Volume 106, Number 11, November 1994

## CONTENTS

- 1359-1376 <sup>40</sup>Ar/<sup>39</sup>Ar chronology and volcanology of silicic volcanism in the Davis Mountains, Trans-Pecos Texas  
*Christopher D. Henry, M. J. Kunk, and W. C. McIntosh*
- 1377-1397 A pedotype approach to latest Cretaceous and earliest Tertiary paleosols in eastern Montana  
*Gregory J. Retallack*
- 1398-1412 Erosional denudation of the British Columbia Coast Ranges as determined from fission-track ages of detrital zircon from the Tofino basin, Olympic Peninsula, Washington  
*John I. Garver and Mark T. Brandon*
- 1413-1429 Potassium-argon geochronology of a basalt-andesite-dacite arc system: The Mount Adams volcanic field, Cascade Range of southern Washington  
*Wes Hildreth and Marvin A. Lanphere*
- 1430-1439 Glacial recharge and paleohydrologic flow systems in the Illinois basin: Evidence from chemistry of Ordovician carbonate (Galena) formation waters  
*Alan M. Stueber and Lynn M. Walter*
- 1440-1458 Marine transgressions and regressions recorded in Middle Devonian shore-zone deposits of the Catskill clastic wedge  
*J. S. Bridge and B. J. Willis*
- 1459-1473 Structure of the Hanmer strike-slip basin, Hope fault, New Zealand  
*Ray A. Wood, Jarg R. Pettinga, Stephen Bannister, G. Lamarche, and Timothy J. McMorran*
- 1474-1493 Geological evolution of the southeastern Red Sea Rift margin, Republic of Yemen  
*Ian Davison, Mohamed Al-Kadasi, Salah Al-Khribash, Abdul K. Al-Subbary, Joel Baker, Suzanne Blakey, Dan Bosenice, Chris Dart, Richard Heaton, Ken McClay, Martin Menzies, Gary Nichols, Lewis Owen, and Andrew Yelland*
- 1494-1501 Channel adjustments to changing discharges, Powder River, Montana  
*James E. Pizzuto*
- 1502-1511 Crustal structures and the eastern extent of lower Paleozoic shelf strata within the central Appalachians: A seismic reflection interpretation: Alternative interpretation and reply  
Alternative Interpretation: *Thomas H. Wilson and Robert C. Shumaker*  
Reply: *L. D. Lampshire, C. Çoruh, and J. K. Costain*
- 1513-1516 Guidelines for authors of papers submitted to the *Geological Society of America Bulletin*

# GEOLOGY

VOLUME 22  
NO. 11  
P. 961-1056  
NOVEMBER 1994

- 963 Landscape dissection, isostatic uplift, and the morphologic development of orogens  
*A. R. Gilchrist, M. A. Summerfield, H. A. P. Cockburn*
- 967 Self-indentation of a heterogeneous continental lithosphere  
*Alain Vauchez, Andréa Tommasi, Marcos Egydio-Silva*
- 971 Two-facies interpretation of the basal layer of the Greenland ice sheet contributes to a unified model of basal ice formation  
*Peter G. Knight*
- 975 Volcaniclastic sediments from mid-oceanic Kolbeinsøy Ridge, north of Iceland: Evidence for submarine volcanic fragmentation processes  
*Klas S. Lackschewitz, Jonathan Dehn, Hans-Joachim Wallrabe-Adams*
- 979 Fluid pressure in the frontal thrust of the Oregon accretionary prism: Experimental constraints  
*Harold J. Tobin, J. Casey Moore, Gregory F. Moore*
- 983 Surface-water acidification and extinction at the Cretaceous-Tertiary boundary  
*Steven D'Hondt, Michael E. Q. Pilson, Haraldur Sigurdsson, Alfred K. Hanson, Jr., Steven Carey*
- 987 Intratransform origins of mid-ocean ridge microplates  
*Robert T. Bird, David F. Naar*
- 991 Cenozoic volcanism and two-stage extension in the Salton trough, southern California and northern Baja California  
*Charles T. Herzig, David C. Jacobs*
- 995 Karstification without carbonic acid: Bedrock dissolution by gypsum-driven dedolomitization  
*James L. Bischoff, Ramon Juliá, Wayne C. Shanks, III, Robert J. Rosenbauer*
- 999 Exhumation of the Dabie Shan ultra-high-pressure rocks and accumulation of the Songpan-Ganzi flysch sequence, central China  
*Shangyou Nie, An Yin, David B. Rowley, Yugan Jin*
- 1003 Composition and thickness of the southern Altiplano crust, Bolivia  
*George Zandt, Aaron A. Velasco, Susan L. Beck*
- 1007 Limits on the tectonic significance of rapid cooling events in extensional settings: Insights from the Bitterroot metamorphic core complex, Idaho-Montana  
*M. A. House, K. V. Hodges*
- 1011 Mississippi Valley-type Pb-Zn mineralization in eastern Belgium: Indications for gravity-driven flow  
*Ph. Muchez, M. Slobodnik, W. Viaene, E. Keppens*
- 1015 Flexural deformation due to Amazon Fan loading: A feedback mechanism affecting sediment delivery to margins  
*Neal W. Driscoll, Garry D. Karner*
- 1019 Melt segregation in the continental crust  
*E. W. Sawyer*
- 1023 Rapid drift of large continents during the late Precambrian and Paleozoic: Paleomagnetic constraints and dynamic models  
*Michael Gurnis, Trond H. Torsvik*
- 1027 Lithospheric thinning during the evolution of continental large igneous provinces: A case study from the North Atlantic Tertiary province  
*Andrew C. Kerr*
- 1031 Oblique slip, slip partitioning, spatial and temporal changes in the regional stress field, and the relative strength of active faults in the Basin and Range, western United States  
*Steven G. Wesnousky, Craig H. Jones*
- 1035 Discrete metamorphic events in the Limpopo belt, southern Africa: Implications for the application of P-T paths in complex metamorphic terrains  
*J. M. Barton, Jr., L. Holzer, B. Komber, R. Doig, J. D. Kramers, D. Nylfeler*
- 1039 Vertical-axis rotation associated with folding and thrusting: An example from the eastern Subbetic zone of southern Spain  
*Simon Allerton*
- 1043 Diachronous burial and exhumation of a single tectonic unit during collision orogenesis (Sulitjelma, central Scandinavian Caledonides)  
*Alan P. Boyle, Kevin W. Burton, R. Keith Westhead*
- 1047 Plunge pools and paleoprecipitation  
*Jonathan Nott, David Price*
- Forum**
- 1051 Significance of Silurian stromatolite-sphinctozoan reefs  
*Comment: Jennifer K. Schubert, David J. Bottjer*  
*Reply: Constance M. Soja*
- 1052 Heterogeneous hydrofracture development and accretionary fault dynamics  
*Comment: Mark P. Fischer, Terry Engelder*  
*Reply: Kevin M. Brown, Barbara Bekins, Ben Clennell, David Dewhurst, Graham K. Westbrook*
- 1054 Superplumes or supercontinents?  
*Comment: Ray W. Kent*  
*Reply: Don L. Anderson*
- 1056 Corrections

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### LAWRENCE UNIVERSITY

Tenure-track position at the assistant professor level in structural/tectonic geology beginning September 1995. Examples of appropriate research and teaching interests include igneous/metamorphic petrology, mineralogy, or geophysics. Will teach structural geology, petrology of crystalline rocks, introductory geology, historical geology, and freshman core program. Commitment to interdisciplinary and interdepartmental instruction and to research with undergraduates in specialty and in applicable problems of local environmental interest. A Ph.D. is required by the time of appointment. Send statement of teaching and research interests, c.v., undergraduate and graduate transcripts, and three letters of reference to Prof. Theodore W. Ross, Department of Geology, Lawrence University, Box 599, Appleton, WI 54912, by January 31, 1995. Inquiries only to smithg@lawrence.edu. AA/EOP. Women and minorities candidates are encouraged to apply.

### MANAGER / AMERICAN HERITAGE CENTER (International Archive of Economic Geology) (Position #7386)

Essential Duties: Reporting to the Associate Director/Operations, the manager assumes responsibility for planning, management, and operation of the Anacosta Geological Collection and related petroleum, mining, and geological collections in the American

Heritage Center. Provides reference services and supervises staff assigned to the IAEG. Prepares budgets and monitors expenses. Assists in writing grant proposals and in seeking government, corporation, and foundation support. This position will begin January 1, 1995.

Qualifications: Master's degree in American History, library science, or geology and four years experience or an equivalent combination of education and experience. Prefer certified archivist and four years experience in information management. Some knowledge of mineralogy or geology preferred.

Salary: Starting \$22,140-\$28,572.  
Standard University benefits include 22 days annual leave, medical insurance and TIAA-CREF retirement plan. Send application (indicating position name and number), resume and the names, addresses, and telephone number of three references to: Dr. Michael Devine, Director, American Heritage Center, c/o Human Resources, P.O. Box 3422, Laramie, WY 82071. Closing date for receipt of applications is November 30, 1994. The University of Wyoming is an EEO/AA employer.

### DIRECTOR, NATIONAL MUSEUM OF NATURAL HISTORY SMITHSONIAN INSTITUTION

Applications are sought for the position of Director, National Museum of Natural History, Smithsonian Institution. Located in Washington, D.C., the National Museum maintains a wide range of vigorous programs in research, collections, exhibitions, and education. The Director, as the Chief Operating Officer, is responsible for a budget of 45 million and approximately 700 staff. The position reports to senior management of the Smithsonian and receives assistance from a nationally-constituted advisory board.

Candidates should demonstrate scientific leadership, fundraising experience, ability to conceive and implement multidisciplinary programs, be capable of forcefully representing the Museum to diverse constituencies, and have strong interpersonal skills.

Applicants should send a cv to Ross Simons, Secretary, Search Committee, Smithsonian Institution, 1000 Jefferson Drive, S.W., Room 120, Washington, DC 20560 or call at 202-357-2939 for further information.

The Smithsonian Institution is an Equal Opportunity Employer.

### ARIZONA STATE UNIVERSITY STRUCTURAL GEOLOGY/TECTONICS

The Department of Geology at Arizona State University invites applications for a tenure-track faculty position at the rank of Assistant Professor, with interests in the fields of structural geology and/or tectonics. Applicants are sought whose research will complement existing programs in the department.

The successful candidate will be expected to develop a vigorous research program and to be strongly committed to quality teaching. Ph.D. in geology or related science is required, with emphasis in the fields of structural geology and/or tectonics. Starting date: 16 August 1995.

Send letter of application describing current and near-term research and teaching interests, curriculum vitae, and names and addresses of three potential references to: Prof. James A. Tyburczy, Search

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Committee Chair, Department of Geology, Box 871404, Arizona State University, Tempe, AZ 85287-1404. Phone: (602) 965-2637. Fax: (602) 965-8102.

The closing date for applications is 1 December 1994 and the first day of each month thereafter until the position is filled. Arizona State University is an Equal Opportunity/Affirmative Action Employer.

#### TENURE TRACK POSITION IN GEOLOGY LONG ISLAND UNIVERSITY

The department of Earth and Environmental Science invites applications for a tenure-track position at the assistant professor level, commencing January 1995. Applicants should have an earned doctorate in geology and successful teaching experience with students of diverse backgrounds at all academic levels. We are seeking either a hard-rock petrologist/geophysicist or an invertebrate paleontologist. It will be advantageous for candidates to have experience in teaching earth science/environmental science, to be interested in involving graduate Environmental Science students in active research, and to be interested in seeking grants and in publication. Applications must be postmarked no later than Dec. 1st. Please send curriculum vitae, three letters of reference, transcripts and a personal statement regarding teaching and research interests to: Dr. Robert S. Harrison, Chairman, Department of Earth & Environmental Science, C. W. Post Campus, Long Island University, Brookville, New York 11548. Long Island University is an equal-opportunity/affirmative action employer.

#### EXECUTIVE DIRECTOR QUATERNARY SCIENCES CENTER DESERT RESEARCH INSTITUTE FILING DEADLINE EXTENDED

The Quaternary Sciences Center of the Desert Research Institute is seeking an Executive Director of internationally recognized distinction in the Quaternary Sciences with proven administrative and personnel management skills. The candidate must have 1) Ph.D., 2) a proven ability to obtain significant research grants and contracts in the field of Quaternary Studies, and 3) a record of noteworthy, peer-reviewed publications in national and international journals or forums. In addition, the candidate must have demonstrated 1) creativity in identification of research issues and an ability to pursue research avenues that enhance academic prestige, as well as financial standing, 2) an ability to manage and guide research programs to timely completion, 3) administrative and personnel management skills that maintain high morale, and 4) an aptitude for problem-solving. The Executive Director promotes the needs of the Quaternary Sciences Center and its personnel, and interacts with sponsors to further the strategic goals of the Quaternary Sciences Center and the Desert Research Institute. Salary is state-funded ranging from \$90,000 to \$110,000 (commensurate with applicant's qualifications). Position will be in either Reno or Las Vegas, Nev. Review of applications continues until position is filled. Submit a letter of interest describing how your qualifications meet the position requirements, a vita and a list of five references to: Recruitment Office, Desert Research Institute, University and Community College System of Nevada, P.O. Box 19040, Las Vegas, NV 89132-0040. The Desert Research Institute is an Affirmative Action/ Equal Opportunity Employment Employer and employs only U.S. citizens and persons authorized to work in the U.S.

#### UNIVERSITY OF CALIFORNIA, SANTA BARBARA

The Department of Geography and the Environmental Studies Program invite applications for a joint tenure track faculty position at the Assistant Professor level in the area of soils. The successful applicant must hold a Ph.D. in the earth sciences or related fields (for example, physical geography, geology, soil science, environmental sciences, environmental engineering) with an emphasis in soils: their formation, physical, chemical and biological properties, soil classification and mapping. Applicants with a strong background in soil/water/vegetation relationships/interactions and their study at regional scales by means of mathematical and computer methods including geographic information systems and remote sensing, or with expertise in geomorphology, are strongly encouraged to apply. The appointee to this position is expected to develop a strong research program, work with undergraduate and graduate students, and teach courses at the undergraduate and graduate levels. The Department of Geography and the Environmental Studies Program are multidisciplinary academic units with active research and teaching programs in earth systems and environmental sciences, and on the human dimensions of global environmental processes. The application deadline is January 13, 1995. The starting date is July 1, 1995. Qualified applicants should mail a complete curriculum vitae, a statement of research and teaching interests, and arrange to send three (3) letters of reference to: Dr. Hugo A. Loaicigia, Chair of Soils Search Committee, Department of Geography, University of California, Santa Barbara, CA 93106-4060. The University of California is an Equal Opportunity/Affirmative Action Employer.

#### STRUCTURAL GEOGRAPHY

The Department of Geography and Geology at Eastern Michigan University invites applications for a tenure-track faculty position at the rank of assistant professor in the field of structural geology. The appointment will begin September 1995; Ph.D. at the time of appointment preferred. Additional expertise in igneous or metamorphic petrology, geophysics or economic geology is desired. The faculty member will be expected to teach Structural Geology and other courses in her or his field of expertise, and introductory Earth Science and Geology courses. Participation in the geology Field Camp, taught each summer in Colorado, is also required. Preference will be given to candidates with a strong background in

geological/earth science education. The undergraduate geology program at Eastern Michigan is small but dynamic, and emphasizes teaching and student/faculty interaction. Applicants should send a curriculum vitae, description of teaching and research interests, transcripts, and the names, addresses, and telephone numbers of three references to Position F9503, 204 King Hall, Eastern Michigan University, Ypsilanti, MI 48197. Applications will be reviewed beginning November 15. We encourage women and members of minority groups to consider this opportunity and to identify themselves when applying. EMU is an affirmative action/equal opportunity employer.

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#### Opportunities for Students

**Visiting Fellows and Students/Institute for Rock Magnetism.** Applications are invited for visiting fellowships (regular and student) lasting for up to 3 weeks during the period from March 1, 1995 through August 31, 1995.

Topics for research are open, although fellows are encouraged to take advantage of the chosen focus for cooperative research in a given year. During 1994-5, the focus for research will be the connections between the fundamentals of rock magnetism and paleomagnetic observations.

Short proposals (two pages, single-spaced text plus necessary figures and tables) are due by December 19, 1994 for consideration by the Institute's Review and Advisory Committee (Bob Butler, Chair).

Successful applicants will be notified in early February 1995.

A limited number of travel grants of \$500 are available to researchers who can demonstrate no existing financial resources. No funds are available for per diem expenses.

The Institute Staff (Bruce Moskowitz, Associate Director, and Christopher Hunt, Facilities Manager) will be happy to provide application forms and information necessary for proposal preparation.

Deadline for submission is December 19, 1994 at the following address: Chris Hunt, Facilities Manager Institute for Rock Magnetism, University of Minnesota, 293 Shepherd Laboratories, 100 Union St. SE, Minneapolis, MN 55455-0128, 612-624-5274; Fax: 612-625-7502; E-mail: chunt@maroon.tc.umn.edu

**University of Minnesota.** Opportunities with the Interdisciplinary Research Training Group (RTG) for "Paleorecords of Global Change: Understanding the Dynamics of Ecosystem Response." Rock magnetism and geochemistry (including isotopes) constitute strong research components. Stipend recipients must be citizens, nationals or permanent residents of the U.S. Applications and additional information for the following are available from Michelle Rompf, University of Minnesota, Ecology, Evolution and Behavior, 1987 Upper Buford Circle, St. Paul, MN 55108. Phone (612) 624-4238; Fax: (612) 624-6777.

Postdoctoral Fellowship: available for research training. 18 month appointment. Application deadline January 1, 1995.

Graduate Traineeship: 3-year traineeships available for graduate study in conjunction with interdepartmental RTG in above study. Application deadline January 15, 1995.

Traveling Fellowship: Interdisciplinary Research Training Group (RTG). Graduate students are invited to Minnesota for up to 3 months to enhance training in "Paleorecords of Global Change." Stipend (provided for citizens, nationals or permanent residents of the U.S.), travel and living allowance, and tuition. Application deadline April 1 (for travel July 1 - December 31) and October 1 (for travel January 1 - June 30). For application contact Michelle Rompf, University of Minnesota, Ecology, Evolution and Behavior, 1987 Upper Buford Circle, St. Paul, MN 55108. Phone (612) 624-4238; FAX (612) 624-6777. An Equal Opportunity Educator and Employer.

**Student Travel Grants.** The GSA Foundation will award matching grants to each of the six GSA Sections to assist students wishing to travel to GSA Section and Annual meetings. For applications contact individual Section secretaries. For Section information, contact GSA (1-800-472-1988).

**Two Teaching Assistantships** are available for the spring semester 1995 in the M.A. Program in Geology at Temple University. The 2-year M.A. program offers advanced courses and thesis research opportunities in environmental geology, hydrology, geochemistry, stratigraphy, structural geology, petrology,

and mineralogy. Financial support for every student includes stipend, book allowance, and full tuition for 2 years. Graduates of the program have an excellent record of employment and acceptance into doctoral programs. For information and applications please write or call Mary Louise Hill, Dept. of Geology, Temple University, Philadelphia, PA 19122 (tel. 215-204-8226, fax 215-204 1532). Applications will be accepted until these positions are filled.

**Student Opportunities at UT-Dallas.** The Programs in Geosciences at The University of Texas at Dallas are offering two fellowships as well as competitive assistantships to qualified students. The Excellence in Education Fellowship provides support for a highly qualified incoming geoscience graduate student. An annual stipend of \$15,888 is provided. The Anton L. Hales Fellowship in geophysics, awarded to an exceptional incoming Ph.D. applicant, carries an annual stipend of \$15,000 and a \$500 travel allowance to attend geological and geophysical meetings. Teaching and research assistantships range from \$8500 per nine months for M.S. and entry level Ph.D. students to \$9900 per nine months for Ph.D. candidates after passing their qualifying exam. Additional summer salary is commonly available. Insurance benefits, waiver of out-of-state tuition and up to \$1250 per year in tuition and fee supplements are included for supported students.

The University of Texas at Dallas is located in Richardson, a suburb of Dallas. It was created in 1969 as a component of the University of Texas System. The University is a graduate and undergraduate institution continuing the tradition of research established in the Southwest Center for Advanced Studies, the private research institute that preceded the current campus. There are approximately 8900 students of which a little less than half are graduates. Interested students are encouraged to contact Dr. Kent C. Nielsen, Head, Programs in Geosciences, The University of Texas at Dallas, P.O. Box 830688, Richardson, Texas, 75083-0688. Phone: (214) 690-2401, FAX (214) 690-2537, E-mail: geosci@utdallas.edu.

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Letter of application, curriculum vitae, statement of teaching and research interests, three letters of reference, and other materials of the candidate's choice should be sent to Professor Walter W. Coppinger, Chair, Department of Geology, Trinity University, 715 Stadium Drive, San Antonio, Texas 78212-7200 by December 15, 1994. Letters of nomination are encouraged, as well as nominations by telephone (210) 736-7606, FAX (210) 736-8264, or e-mail to [wcopping@geology.trinity.edu](mailto:wcopping@geology.trinity.edu). Applications from minority and women candidates are especially encouraged. Trinity University is an Equal Opportunity, Affirmative Action Employer.

## Southwest Research Institute Center for Nuclear Waste and Regulatory Analyses (CNWRA)

**The Center for Nuclear Waste Regulatory Analyses** at the Southwest Research Institute is a Federally Funded Research & Development Center engaged in studying various aspects of the national HLW geologic repository program. As the prime contractor to the U.S. Nuclear Regulatory Commission (NRC), the Center conducts technical studies in the areas of geology, hydrology, geochemistry, rock mechanics, performance assessment, and material sciences. This work is conducted to assist the NRC in their review of DOE activities.

#### RESEARCH SCIENTIST (CNWRA)

Participation in research and technical assistance activities involving field work, modeling, and laboratory investigations designed to study neotectonics in the Basin and Range Province. Activities will include investigating relationships between fault slip histories and regional tectonic models, analysis of volcanic-tectonic relationships and investigation of the effects of neotectonics on ground water flow. Work will focus on regional and local scale tectonic processes relevant to the proposed high-level nuclear waste repository at Yucca Mountain, Nevada, in support of the Nuclear Regulatory Commission.

Position requires a M.S. degree (with a minimum of three years experience) or a Ph.D. in Geology. Practical experience in applied neotectonics is preferred. Preference will be given to candidates with a background in geostatistics and probability theory. Applicants should have demonstrated ability to design and conduct field and laboratory investigations and incorporate results of these studies into model (including probability modeling) of tectonic processes relevant to Quaternary and Recent deformation in southwestern Nevada. Occasional work in chemistry lab. Must be able to interface and work closely with other geologists, geochemists, as well as hydrologic and mathematical modelers. Excellent written and oral skills are required.

**Southwest Research Institute** is an applied research and development organization with competitive salaries and a comprehensive benefits program. Please send resumes to:

Southwest Research Institute, Personnel Department, #765, P.O. Drawer 28510, San Antonio, TX 78228-0510; or e-mail: [bjames@swri.edu](mailto:bjames@swri.edu); or FAX to (210) 522-3990.



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## CALL FOR NOMINATIONS

### 1995 John C. Frye Environmental Geology Award

In cooperation with the Association of American State Geologists (AASG), GSA makes an annual award for the best paper on environmental geology published either by GSA or by one of the state geological surveys. The award is a \$1000 cash prize from the endowment income of the GSA Foundation's John C. Frye Memorial Fund.

The 1995 award will be presented at the autumn AASG meeting to be held during the GSA Annual Meeting in New Orleans. Members of the selection committee are Chairman Frank E. Kottowski, New Mexico Bureau of Mines and Mineral Resources; John P. Kempton, Illinois Geological Survey; and Diane L. Conrad, Vermont Division of Geology and Mineral Resources.

#### CRITERIA FOR NOMINATION


Nominations can be made by anyone, based on the following criteria: (1) paper must be selected from GSA or state geological survey publications, (2) paper must be selected from those published during the preceding three full calendar years, (3) nomination must include a paragraph stating the pertinence of the paper, (4) **nominations must be sent to Executive Director, GSA, P.O. Box 9140, Boulder, CO 80301. Deadline: March 31, 1995.**

#### BASIS FOR SELECTION

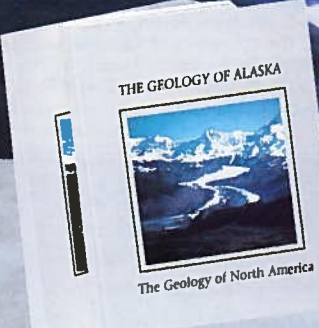
Each nominated paper will be judged on the uniqueness or significance as a model of its type of work and report and its overall worthiness for the award. In addition, nominated papers must establish an environmental problem or need, provide substantive information on the basic geology or geologic process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

#### 1994 AWARD RECIPIENT NAMED

The 1994 award was presented at the GSA Annual Meeting in Seattle to Ronald W. Hoenstine and Ed Lane, Florida Geological Survey, for their paper *Environmental Geology and Hydrogeology of the Gainesville Area, Florida*, Special Publication No. 33 (1991), Florida Geological Survey. The report deals with a wide range of environmental geology aspects, including land-use planning, resource management, and geologic hazards (such as karst subsidence and ground-water contamination), and is easily understood by nonspecialists.



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