

INSIDE

- 1995 GeoVentures, p. 4
- Environmental Education, p. 9
- Southeastern Section Meeting, p. 15
- North-Central-South-Central Section Meeting, p. 18

Stability or Instability of Antarctic Ice Sheets During Warm Climates of the Pliocene?

James P. Kennett

Marine Science Institute and Department of Geological Sciences,
University of California Santa Barbara, CA 93106

David A. Hodell

Department of Geology, University of Florida, Gainesville, FL 32611

ABSTRACT

During the Pliocene between ~5 and 3 Ma, polar ice sheets were restricted to Antarctica, and climate was at times significantly warmer than now. Debate on whether the Antarctic ice sheets and climate system withstood this warmth with relatively little change (stability hypothesis) or whether much of the ice sheet disappeared (deglaciation hypothesis) is ongoing. Paleoclimatic data from high-latitude deep-sea sediments strongly support the stability hypothesis. Oxygen isotopic data indicate that average sea-surface temperatures in the Southern Ocean could not have increased by more than ~3 °C during the warmest Pliocene intervals. A small rise in Southern Ocean temperatures may have caused limited melting of the ice sheets and associated marine transgression, but maximum sea level rise was likely less than 25 m above the present level. Recently discovered evidence from the Antarctic dry valleys indicate relative stability of the Antarctic climate-cryosphere system since middle Miocene time (~14 Ma).

INTRODUCTION

The Antarctic cryosphere is the largest accumulation of ice on Earth and comprises some $30 \times 10^6 \text{ km}^3$ (Fig. 1). If all Antarctic ice melted, sea level would rise by ~70 m. The Antarctic ice sheets are divided at the Transantarctic Mountains into a small (3.3 km^3), marine-based sheet in the west and a larger (26 km^3), continent-based sheet to the east (Fig. 1). The West Antarctic ice sheet is grounded below sea level and may thus be vulnerable to small changes in surface temperatures of the Southern Ocean and in sea level (Mercer, 1978). In contrast, the more stable East Antarctic ice sheet is largely grounded on bedrock above sea level.

The Antarctic ice sheets and adjacent Southern Ocean act together to form the Antarctic ocean-cryosphere system, representing one of the most important components of Earth's climate system, by strongly influencing global atmospheric and ocean circulation (Cattle, 1991). The Southern Ocean is an integral part of the Antarctic environmental system because the cold, circumpolar current maintains thermal isolation of the continent. The ocean is bounded to the north by the Antarctic convergence, or Polar Front zone that separates cold, nutrient-rich Antarctic surface waters

to the south from warmer, less nutrient-rich Subantarctic surface water. Upwelling of deep water in the circum-Antarctic links the mean chemical composition of ocean deep water with the atmosphere through gas exchange (Toggweiler and Sarmiento, 1985). The evolution of the Antarctic cryosphere-ocean system has profoundly influenced global climate, sea-level history, Earth's heat budget, atmospheric composition and circulation, thermohaline circulation, and the development of Antarctic biota.

Given current concern about possible global greenhouse warming, understanding the history of the Antarctic ocean-cryosphere system is important for assessing future response of the Antarctic region to global warming. As a result, paleoclimatologists have turned their attention to times when climate was warmer than today. The early Pliocene was one such interval. During that time (4.8 to 3.2 Ma), climate was warmer than at any other time within the past 7 m.y. (Kennett and Vella, 1975; Elmstrom and Kennett, 1986). Did this early Pliocene warmth lead to major deglaciation of the Antarctic ice sheets and significant warming of the Southern Ocean?

Stability Hypothesis

Until recently, most workers believed that the East Antarctic ice sheet had grown to its approximate present form by the middle Miocene (~14 Ma) and then remained relatively stable under polar desert climate due to continental thermal isolation by

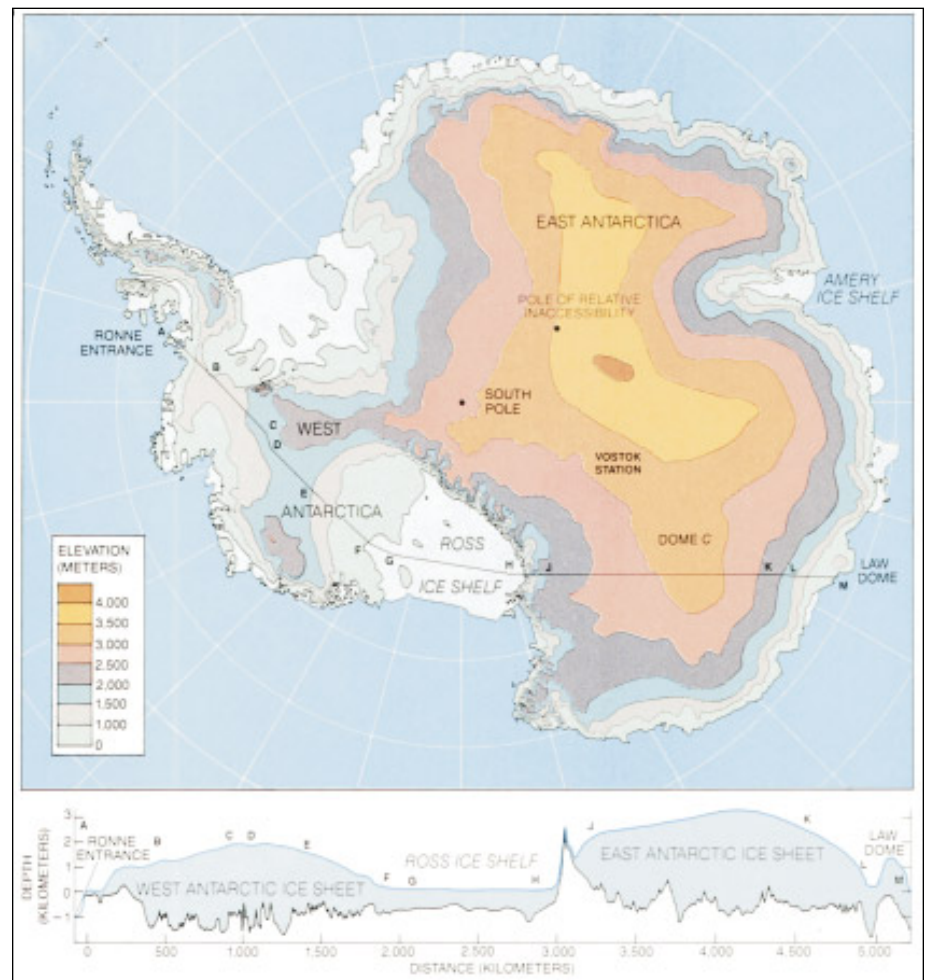


Figure 1. Elevation of Antarctic ice sheets showing the continental ice sheet on East Antarctica and the marine-based ice sheet on West Antarctica that is largely grounded below sea level. The history and stability of these ice sheets differ in that the West Antarctic ice sheet is less stable and developed later (late Miocene) than the East Antarctic ice sheet, which is believed to have developed to its approximate present form by the middle Miocene (~14 Ma). (From *The Antarctic Ice* by U. Radok, copyright ©1985 by Scientific American, Inc. All rights reserved.)

the cold circum-Antarctic current ("stability hypothesis"—Shackleton and Kennett, 1975; Kennett, 1977; Clapperton and Sugden, 1990; Kennett and Hodell, 1993). This implies that the Antarctic cryosphere-ocean system is robust and that the ice sheet is difficult to remove because of powerful thermal inertia of the Antarctic circumpolar current and strong negative feedbacks tending to maintain stability. Once tectonic changes such as the opening of the Tasmanian Seaway and Drake Passage permitted circumpolar flow, the Antarctic continent became

thermally decoupled from lower latitudes. By 20 Ma, during the early Miocene or shortly thereafter, a vigorous circumpolar current had undoubtedly been established (Kennett, 1977; Lawver et al., 1992). Today the Drake Passage imposes a unique dynamic constraint on poleward transport of warm water because persistent westerly winds in the circumpolar belt deflect warm surface waters northward. Also the position of the Antarctic circumpolar current is fixed partly by seafloor

Ice Sheets continued on p. 10



Figure 2. Oblique aerial view looking south across the western Olympus Range toward the western Asgard Range in the dry valleys sector of the Transantarctic Mountains, Antarctica. Note detached mesas and buttes, remnants of the upper planation surface. Denton et al. (1993) suggested that these upland landscapes resemble those on the Colorado Plateau and formed under similar semi-arid desert conditions. The dry valley landscapes date to the middle-to-late Miocene and exhibit remarkable slope stability, indicating a hyperarid, cold desert environment since that time. This geomorphological evidence argues against major deglaciation and warm Antarctic climates during the Pliocene. Photo from Denton et al. (1993, p. 171; used with permission).

IN THIS ISSUE

Stability or Instability of Antarctic Ice Sheets During Warm Climates of the Pliocene?	1
Officers and Councilors—1995	2
In Memoriam	2
Forum	3
1995 GeoVentures	4
Seattle wrap-up	6
Students' Corner	6
1994 Presidential Address (<i>abstract</i>) ..	7
New <i>GSA Bulletin</i> Editors	8
IEE and GEPOP	9
Penrose Conference Scheduled	12
Letter from Washington	13
GSAF Update	14
Southeastern Section Meeting	15
North-Central–South-Central Meeting	18
Alternates Receive Research Grants ...	22
Classifieds	22

GSA TODAY

January 1995
Vol. 5, No. 1

GSA TODAY (ISSN 1052-5173) is published monthly by The Geological Society of America, Inc., with offices at 3300 Penrose Place, Boulder, Colorado. Mailing address: P.O. Box 9140, Boulder, CO 80301-9140, U.S.A. Second-class postage paid at Boulder, Colorado, and at additional mailing offices. **Postmaster:** Send address changes to *GSA Today*, Membership Services, P.O. Box 9140, Boulder, CO 80301-9140.

Copyright © 1995, The Geological Society of America, Inc. (GSA). All rights reserved. Copyright not claimed on content prepared wholly by U.S. Government employees within the scope of their employment. Permission is granted to individuals to photocopy freely all items other than the science articles to further science and education. Individual scientists are hereby granted permission, without royalties or further requests, to make unlimited photocopies of the science articles for use in classrooms to further education and science, and to make up to five copies for distribution to associates in the furtherance of science; permission is granted to make more than five photocopies for other noncommercial, nonprofit purposes furthering science and education upon payment of the appropriate fee (\$0.25 per page) directly to the Copyright Clearance Center, 27 Congress Street, Salem, Massachusetts 01970, phone (508) 744-3350 (include title and ISSN when paying). Written permission is required from GSA for all other forms of capture, reproduction, and/or distribution of any item in this journal by any means. GSA provides this and other forums for the presentation of diverse opinions and positions by scientists worldwide, regardless of their race, citizenship, gender, religion, or political viewpoint. Opinions presented in this publication do not reflect official positions of the Society.

SUBSCRIPTIONS for 1995 calendar year:
Society Members: *GSA Today* is provided as part of membership dues. Contact Membership Services at (800) 472-1988 or (303) 447-2020 for membership information. **Nonmembers & Institutions:** Free with paid subscription to both *GSA Bulletin* and *Geology*, otherwise \$45 for U.S., Canada, and Mexico; \$55 elsewhere. Contact Subscription Services. **Single copies** may be requested from Publication Sales. Also available on an annual CD-ROM, (with *GSA Bulletin*, *Geology*, *GSA Data Repository*, and an Electronic Retrospective Index from 1972-to-current) for \$89 to members, \$125 to others; and in an annual, hardbound, library edition for \$45. Order from Membership Services. **Claims:** For nonreceipt or for damaged copies, members contact Membership Services; all others contact Subscription Services. Claims are honored for one year; please allow sufficient delivery time for overseas copies.

STAFF

Prepared from contributions from the GSA staff and membership.
Executive Director: Donald M. Davidson, Jr.
Science Editor: Eldridge M. Moores
Department of Geology, University of California, Davis, CA 95616
Forum Editor: Bruce F. Molnia
U.S. Geological Survey, MS 917, National Center, Reston, VA 22092
Managing Editor: Faith Rogers
Production & Marketing Manager: James R. Clark
Production Editor and Coordinator: Joan E. Manly
Graphics Production: Joan E. Manly, Kim Thomas

ADVERTISING

Classifieds and display: contact Ann Crawford (303) 447-2020; fax 303-447-1133

This publication is included on GSA's annual CD-ROM, *GSA Journals on Compact Disc*, and also is available in an annual, hardbound, archival edition. Call GSA Publication Sales for details.

Printed with pure soy inks on recyclable paper in the U.S.A.

GSA Officers and Councilors for 1995



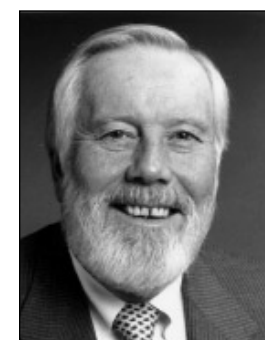
David A. Stephenson
President
South Pass Resources, Inc.
Scottsdale, Arizona



Eldridge M. Moores
Vice-President
University of California
Davis, California



William R. Dickinson
Past President
Tucson, Arizona



David E. Dunn
Treasurer
University of Texas—Dallas
Richardson, Texas

Councilors (1993–1995)

Gail M. Ashley
Rutgers University
Piscataway, New Jersey
Mark Cloos
University of Texas at Austin
Austin, Texas
Sharon Mosher
University of Texas at Austin
Austin, Texas
Anthony J. Naldrett
University of Toronto
Toronto, Ontario, Canada

Councilors (1994–1996)

Keros Cartwright
Illinois State Geological Survey
Champaign, Illinois
John A. Cherry
University of Waterloo
Waterloo, Ontario, Canada
George H. Davis
University of Arizona
Tucson, Arizona
Leigh H. Royden
Massachusetts Institute of Technology
Cambridge, Massachusetts

Councilors (1995–1997)

Maryellen Cameron
National Science Foundation
Arlington, Virginia
James A. Helwig
Mobil Oil Corporation
Dallas, Texas
Thomas L. Holzer
U.S. Geological Survey
Menlo Park, California
Orrin H. Pilkey, Jr.
Duke University
Durham, North Carolina

Call for applications and nominations for GSA BOOKS SCIENCE EDITOR

GSA solicits applications and nominations of persons qualified to serve as GSA Books Science Editor. The term of the current Editor will end December 31, 1995, and the new Editor will begin a three-year term at that time.

This is not a salaried position, but GSA pays expenses for secretarial assistance, mail, telephone, and copying and for travel to meetings of the GSA Publications Committee. The GSA headquarters staff handles copyediting and production of books from accepted manuscripts.

Interested persons should submit a vita, a list of publications, and a letter describing relevant qualifications, experience, and objectives. Nominations should include a letter and the nominee's written permission, vita, and publications list. Applications and nominations should be sent BEFORE FEBRUARY 15, 1995, to: Donald M. Davidson, Jr., Executive Director, Geological Society of America, P.O. Box 9140, Boulder, CO 80301.

Duties

- Encourage submission of appropriate manuscripts or collections of manuscripts to GSA for publication as a Memoir or Special Paper.
- Respond to inquiries, oral or written, about possible manuscripts.
- Inform prospective authors and volume editors about GSA policies and procedures.
- Appoint volume editor(s) and supervise selection of reviewers for multi-paper volumes.
- Select and recruit reviewers for single-paper volumes; send out manuscripts for review. Advise author(s) about necessary revisions.
- Inform volume editors on procedures for review and revision of papers.
- Review each proposed volume upon receipt of final draft from author(s) or volume editor(s). If volume is up to standard,

forward it to GSA headquarters with a recommendation for publication.

- Keep the GSA Committee on Publications and the headquarters staff informed about the flow of manuscripts and other GSA book business.

The GSA Books Science Editor should have

- Strong, broad background in geological sciences.
- Good organizational and English language skills.
- Willingness to invest the necessary time (up to 20 hours/week).
- Familiarity with many earth scientists and their work.
- Ability to make decisions.
- Perspective on trends in the geosciences and objectivity regarding subject matter.
- Patience, courtesy, and tact in dealing with authors and editors.
- Persistence in finding and recruiting suitable reviewers.

In Memoriam

William D. Chawner
Milton, Florida
August 20, 1994

William J. Gealy
Evanston, Illinois
October 20, 1994

J. C. Harksen
Mills, Wyoming
November 8, 1994

Edward J. Koszalka
Fort Lauderdale, Florida
August 12, 1994

H. Wesley Peirce
Tucson, Arizona
November 17, 1994



GSA ON THE WEB

What's new on the GSA home page on the World Wide Web? If you haven't yet connected to the Web, the Universal Resource Locator (URL) is <http://www.aescon.com/geosociety/index.html>.

- *Information for Contributors to Publications of the Geological Society of America* is a guide for authors preparing manuscripts for the *GSA Bulletin*, *Geology*, and book series. It's in the **Publications** section of the home page.
- You will also find, in the **Publications** section, information for placing classified or display ads, for ordering author article reprints, for ordering mailing labels, for ordering GSA publications and journal subscriptions, and information about submitting abstracts for GSA's 1995 meetings. You can also find the tables of contents for the current month of *GSA Bulletin* and *Geology* in this section.
- Are you thinking about proposing a Theme Session for the 1995 GSA Annual Meeting in New Orleans? Check the **Meetings** section and choose 1995 Annual Meeting for instructions.
- For current information on any of the GSA Section meetings, go to **Meetings** and choose the Section you want to know about.
- *GSA Research Grants* in the **Administration** section explains what grants are available, and how to acquire an application for a grant.
- The **Administration** section also has a schedule of upcoming Penrose Conferences, application information for the GSA Congressional Science Fellowship, and nomination information for GSA medals and awards.
- If you want to know more about the GSA Employment Service or about becoming a GSA Campus Representative, check the **Membership** section, which also has information on nominating a member to fellowship and on obtaining forms for applying to become a GSA Member or Student Associate.
- The **GSA Institute for Environmental Education** heading offers information on the GEPOP program (*Geology* and *Environment Public Outreach Program*) and a newsletter.
- See the **Geoscience Calendar** section for a listing of meetings of general geological interest.

Bruce F. Molnia

Effects of Potential Geothermal Development on the Thermal Features of Yellowstone National Park—Part 2

The December 1994 forum presented three perspectives dealing with the stewardship and multiple use of some of our nation's most visited and treasured public lands, the impact of proposed drilling on thermal features within Yellowstone National Park. Federal decision makers are relying increasingly on the scientific community to provide input that will result in educated and defensible decisions. As was described in last month's forum, knowledgeable and informed scientists used the available technical information about the geothermal regime in and about Yellowstone (most of which was presented in the eight chapters of U.S. Geological Survey [USGS] Water Resources Investigations Report 91-4052, "Effects of potential geothermal development in the Corwin Springs Known Geothermal Resource Area, Montana, on the thermal features of Yellowstone National Park," edited by M. L. Sorey [referred to here as "WRIR 91-4052"]) and reached different answers about the impact and merits of a proposed geothermal drilling activity. The two perspectives here are rebuttal responses to the December presentations.

PERSPECTIVE 4: Rebuttal To Friedman

Michael L. Sorey, W. C. Evans, and
Yousif K. Kharaka

In Perspective 3 [*GSA Today*, December 1994] Friedman raised several points of scientific disagreement with the USGS study and took issue with the conclusion that limited use of geothermal wells in the La Duke Hot Spring area would have no discernible effect on the hot springs of Yellowstone National Park. We present four main points of disagreement between Friedman and the authors of WRIR 91-4052.

Degree of Connection Between Geothermal Systems. Friedman disagrees with the interpretation that differences in chemical and isotopic characteristics of thermal waters in the Corwin Springs Known Geothermal Resource Area and in Yellowstone indicate that Mammoth Hot Springs and La Duke Hot Spring are associated with separate geothermal systems, even though both appear to include deep reservoirs within Paleozoic carbonate rocks. His view is that the concentration and isotopic composition of all chemical species reflect only water-rock interaction during final fluid flow from a common deep reservoir to these spring areas. This implies that these characteristics are controlled by the last rocks the water flows past (or through) before reaching the surface. We maintain, instead, that the characteristics of many chemical species (including Cl, B, Br, Li, and ^{18}O enrichments) will be controlled by reactions within reser-

voirs in the deepest and/or hottest parts of the flow system. During subsequent flow of thermal water from deep reservoirs, characteristics of these more conservative species can only be shifted significantly by mixing. Mixing models required to obtain the chemical compositions of La Duke and Bear Creek thermal waters from Mammoth-type thermal waters were discussed in WRIR 91-4052, but were found to be relatively complex and unrealistic. The bottom line on this issue, however, is that our evaluation of the effects of geothermal development in the Corwin Springs area on thermal springs in Yellowstone is based on the assumption that hydrologic connections could be established during development; thus, our evaluation does not depend solely on interpretations of the chemical and isotopic characteristics of thermal waters.

Differences in Helium Isotopic Ratios and Concentrations. R/RA values for helium isotopic ratios ($^3\text{He}/^4\text{He}$) are near 8 in Mammoth thermal waters but only 0.1 in thermal waters from La Duke Hot Spring. Friedman asserted that this difference results from a large addition of radiogenic ^4He within the flow system leading from beneath the Mammoth area to La Duke that dilutes and masks a smaller ^3He component. This assertion is based on higher He concentrations in gas from the La Duke area compared with concentrations reported for samples collected from ground level and downhole samplers in well Y-10 at Mammoth. However, the pressure of CO_2 in Y-10 fluid exceeds 5 bar, causing the well to flow whenever opened to the atmosphere and degassing to occur at depths above 55 m. Gas concentrations measured in samples from this well must therefore be corrected for prior gas loss to obtain fluid gas concentrations that can be directly compared to those in thermal waters from the La Duke area. Because the thermal waters in question are of mainly meteoric origin, all should have similar concentrations of Ar derived initially from atmospheric saturation. Gas loss prior to sample collection results in drastic depletion of Ar as well as He, providing a clear signal that gas loss has occurred and a method of quantifying such loss. Methods were described in WRIR 91-4052 for gas-concentration correction, based on Ar balance, to calculate a range of He concentrations for the undegassed fluid. The corrected He concentrations at Y-10 are close to those for La Duke thermal waters, thus severely limiting the extent to which addition of radiogenic ^4He could reduce the $^3\text{He}/^4\text{He}$ ratio.

Accuracy of Determinations of Thermal-Water Discharge at La Duke. Friedman questioned the accuracy of sulfate concentrations determined by ion chromatography and argued that potential errors in the sulfate determinations could result in differences of 20%–50% in calculated thermal-water discharge rates, greater errors being associated with periods of greater stream flow and lower sulfate concentrations. We agree that WRIR 91-4052

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).

Deadline for nominations for 1996 is **FEBRUARY 15, 1995.**

Penrose and Day Medals, and Honorary Fellowship

Nominations for 1995 Penrose and Day Medals and for Honorary Fellowship in the Society are due 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.

Deadline for nominations for 1995 is **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, Student Associates, or, in exceptional circumstances, GSA employees may be nominated for consideration. Any GSA member or employee may make a nomination for the award. Awardees will be selected by the Executive Committee, and all selections must be ratified by the Council. Awards may be made annually, or less frequently, at the discretion of Council. This award will be presented during the Annual Meeting of the Society. 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.

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.

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.

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). Deadline for nominations for 1995 is **MARCH 31, 1995.**

claims more accuracy than is typically obtained by this method. We maintain, however, that for samples that have essentially the same chemical composition (matrix), it is possible to make sulfate determinations to an accuracy of +0.2 mg/L for concentrations on the order of 25 mg/L and to minimize errors in the determination of differences between two sulfate concentrations by using special laboratory procedures involving replication and

internal standards. Indeed, we might have expected more variability in the thermal-water discharge results than was actually observed because of the other factors noted in Perspective 2 [*GSA Today*, December 1994]. Instead, consistent results were obtained for six sets of measurements made over a range of river flow of 24,000 to 111,000

Correction

In *GSA Today*, v. 4, p. 297, second column from left, the 23rd line from the bottom should be "its author, Rep. Pat Williams (D—MT)"

Forum continued on p. 21

1995 GEOVENTURES

GEO TRIP

Geology of the Grand Canyon—Lee's Ferry to Pierce Ferry

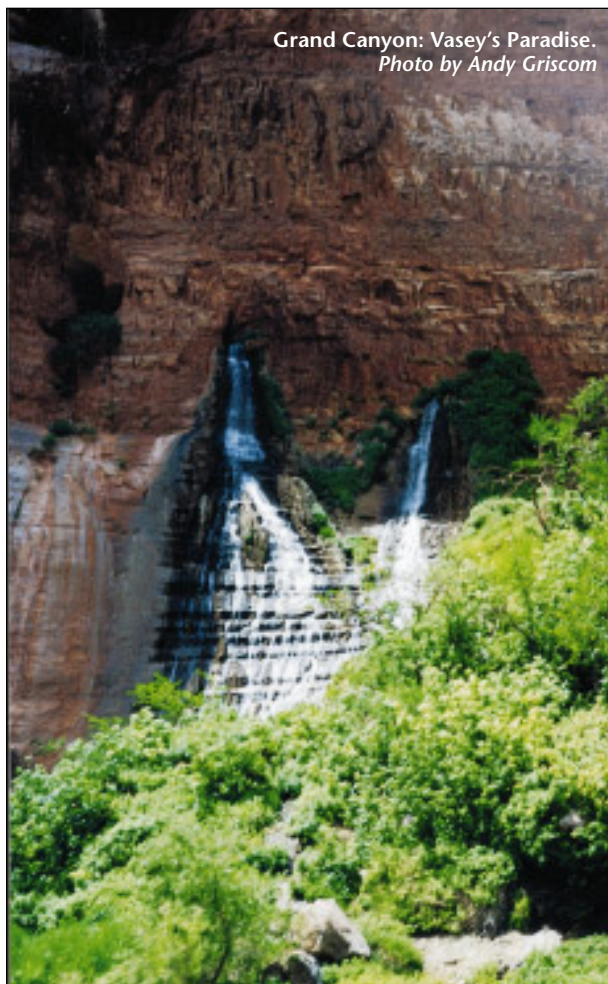
April 21–28, 1995
8 days, 7 nights

Scientific Leaders

Stanley Beus,
Professor Emeritus, Dept.
of Geology, Northern
Arizona University

Ivo Lucchitta,
U.S. Geological Survey,
Flagstaff, Arizona

Stan Beus's research includes Paleozoic biostratigraphy, paleontology, and paleoecology, with emphasis on late Paleozoic studies and the geology of the Grand Canyon. Ivo Lucchitta's interests are: continental extension (from the perspective of Colorado Plateau–Basin and Range interface); history of Grand Canyon and Colorado River; and Quaternary geology and geomorphology, especially as applied to southwestern drainage systems. These leaders, with their enthusiasm for Grand Canyon and its environs, are well prepared to provide you with a unique educational experience.



Grand Canyon: Vasey's Paradise.
Photo by Andy Griscom

Schedule

April 20, Thursday Travel day from home to Las Vegas
April 21, Friday Depart Las Vegas for put-in at Lee's Ferry
April 22–28, Saturday–Friday River days
April 28, Friday Take-out at Pierce Ferry (Lake Mead) for bus trip back to Las Vegas
April 29, Saturday Travel day from Las Vegas to home

Tapeats Limestone, Bright Angel Shale, Vishnu Schist. Explore the classic stratigraphy of one of the world's most fascinating and accessible geologic records. Although millions have traveled the Colorado River's erosional path through the Kaibab plateau, GSA's trip offers a rare combination of expert geological leadership and stimulating intellectual companionship.

Outfitter, Meals, Transportation. Arizona River Runners will be our river company. We will camp on sand beaches within the canyon and eat three hearty and delicious meals per day. Transportation from Las Vegas to Lee's Ferry and from Pierce Ferry to Las Vegas is by bus.

Requirements. Other than sleeping in a tent, or perhaps having to put up with a few hours of rain, there is nothing particularly rigorous about this trip. Activity may be physically demanding, depending on the hikes you choose. Participants should be able to get in and out of a raft with large tubes. The rapids ride is absorbed easily by the large motorized rafts. There is no hike or mule ride out.

Weather. The dates are prior to the commercial season, and only one boat company can start in this period, so the river and the campsites are more likely to be ours exclusively. You will be saving several hundred dollars because of the early season rates. We can expect warm, clear, sunny days with an ambient temperature of 70°F, and cool nights.

Included in the fee (see box) are guidebooks to the river; geologic guides; transportation to and from Las Vegas and the river; waterproof bags for clothes; life jacket; camping gear including two-person tent, sleeping bag and pad, and eating utensils; continental breakfast before put-in on day 1 and all river meals; soft drinks on the river. **Not included** are airfare to Las Vegas; nights and meals in Las Vegas; alcoholic beverages. ♦

1995 GeoVentures Fee Schedule

Name	Grand Canyon	Montana	Colorado	Iceland
Type	GeoTrip	GeoHostel	GeoHostel	GeoTrip
Dates	April 21–28	June 17–22	June 24–29	July 16–29
No. of Days	8	6	6	14
Member Fee	\$1450	\$500	\$520	\$2780
Nonmember Fee	\$1550	\$550	\$570	\$2880
Deposit	\$250	\$100	\$100	\$250
Balance Due	March 1	April 15	April 15	April 15
100% Deposit refund date (less \$20/\$50 processing fee)	March 1	April 15	April 15	April 15

GEOHOSTEL

Geological History of Southwestern Montana

June 17–22, 1995 • 6 days, 6 nights • Western Montana College, Dillon, Montana

Scientific Leader

Robert Thomas, Department of Geosciences, Western Montana College

Currently an assistant professor of geology at Western Montana College, Rob Thomas has been involved in geological field camps in the Dillon area since 1986. A graduate of the University of Washington, Rob has studied the patterns and processes of Cambrian mass extinctions, but his current research involves the origin and timing of extensional tectonism in southwestern Montana.

Schedule

June 17, Saturday Welcoming get-together
June 18–22, Sunday–Thursday Classes and field trips
June 20, Tuesday Western Barbecue
June 22, Thursday Farewell Party

The beautiful Beaverhead Valley of southwestern Montana was visited by the Lewis and Clark expedition nearly 200 years ago, and human activity has little changed this part of Big Sky Country since then. The valley is surrounded by the mountain peaks (>11,000 ft) of the Blacktail Deer, Pioneer, Ruby, and Tobacco Root Mountains. The base for our trips will be the small college town of Dillon, best known for its abundant wildlife, trout streams, pioneer history, and spectacular geology. The GeoHostel will include field trips to the fold-and-thrust belt structure in the Beaverhead Valley, Cretaceous intrusions, ore mineralization and glaciation in the Pioneer Mountains, fossil insects and plants in the Ruby Valley, Cenozoic extensional tectonics along the northern edge of the Yellowstone hotspot tract, and thermal features in Yellowstone National Park. Trips we will be both full and half-day. Plenty of leisure time will be available to enjoy the solitude of the "last best place" in America.



A glacial tarn on the high peaks of the Pioneer Mountains, southwestern Montana. Photo by Rob Thomas.

Lodging, Meals, Transportation. The group will be lodged for six nights at Western Montana College, Dillon, Montana, single-occupancy (or double for couples) dormitory-style rooms. Meals will include breakfast and a sack lunch daily through Thursday, western barbecue on Tuesday evening, a farewell dinner on Thursday evening, and breakfast on Friday before check-out. Field trip transportation will be in air-conditioned, 15-passenger rental vans.

Included in the fee (see box) are classroom programs and materials; field trip transportation; lodging for six nights; meals outlined above; welcoming and farewell events.

Not included are air transportation to and from Dillon, Montana; transportation during hours outside class and field trips; meals and other expenses not specifically included. ♦

GEOHOSTEL

Scenic Geology of Northwestern Colorado and Dinosaur National Monument

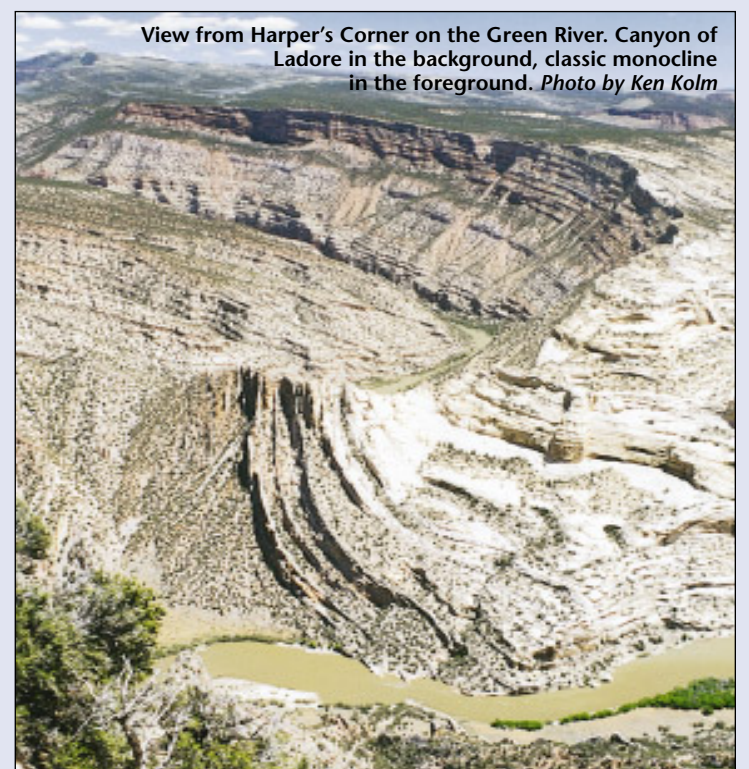
June 24–29, 1995 • 6 days, 6 nights • Colorado Mountain College and Vernal, Utah

Scientific Leaders

Gregory Holden
and

Kenneth Kolm,
Department of Geology and Geological
Engineering, Colorado
School of Mines

Ken Kolm and Greg Holden are among the brightest and most refreshing of the younger generation of geologists. Experienced GeoHostel Leaders, Ken and Greg received their doctoral degrees from the University of Wyoming, and both are currently associate professors at the Colorado School of Mines.



View from Harper's Corner on the Green River. Canyon of Ladore in the background, classic monocline in the foreground. Photo by Ken Kolm

**CALL TODAY!
HOLD A SPOT FOR YOUR-
SELF AND FRIENDS.**

We encourage you to make your decision as soon as possible. There is high interest in these trips, and several people have registered already.

General Fee Information: If you have been with us previously on a GeoTrip, the surcharge will be waived. Please remind us of this when you register. Sorry, there is no fee waiver for GeoHostels due to their low, operation margin. However, if you attend both 1995 GeoHostels, you will receive a \$50 discount.

Single/shared Accommodation: Some trip fees are based on double occupancy. If you wish single accommoda-

tions, a limited number of rooms are available at an extra cost on a first-come, first-served basis. In the case of double occupancies, we will do our best to help find a suitable roommate, but if none is found, the single rate will apply. Please read the lodging information.

Age Limitations: In general, the age limit is 21; however, the age limit is 16 for the Grand Canyon trip if the participant is accompanied by a parent.

Health: You must be in good physical and mental health. Any physical condition requiring special attention, diet, or treatment must be reported in writing when the reservation is made. We reserve the right to decline any person as a member of a trip. We also reserve the

right to require a person to withdraw from the trip at any time when such action is determined to be in the best interests of the health, safety, and general welfare of the group.

Special Needs: We will do our best to accommodate special needs, including dietary requirements and physical disabilities. Please feel free to call and discuss your situation with us.

Air Travel: Arrangements are handled by the individual unless specified as group travel in the description. Cain Travel, GSA's official travel agency, is ready to help you find the least expensive routing to your destination. Call Cain at 1-800-346-4747 toll free, or (303) 443-2246 collect from outside the U.S.,

fax 303-443-4485. 8:30 a.m. to 5:30 p.m. MT, Monday through Friday.

Cancellation Processing Fee: Deposits and payments are refundable up to the cut-off time, less processing fees of \$20 for GeoHostels and \$50 for GeoTrips. Termination of a trip in progress for any reason will not result in a refund, and no refund will be made for unused parts of the trip.

Itineraries and Other Information: Detailed itineraries for each GeoVenture and helpful travel information are available from GSA. Feel free to call, fax, or E-mail: Edna Collis, GSA GeoVentures, P.O. Box 9140, Boulder, CO 80301; (303) 447-2020 or 1-800-472-1988, fax 303-447-0648, E-mail: ecollis@geosociety.org

GEO TRIP

Iceland: Fire and Ice

July 16-29, 1995 • 14 days, 15 nights

Scientific Leaders

Haraldur Sigurdsson, Graduate School of Oceanography, University of Rhode Island

Haukur Johannesson, Natural History Institute, Reykjavik, Iceland

A native of Iceland and professor of oceanography, *Haraldur Sigurdsson* is a leading volcanologist with an international reputation for his research on many aspects of volcanism in Iceland, Italy, Mexico, Colombia, the United States, and Indonesia, among others. *Haukur Johannesson* has devoted most of his career to the geologic mapping of the uncharted volcanic regions of Iceland. He is an expert in the tectonic structure and origin of the Iceland basalt plateau and is also very knowledgeable about the natural history of Iceland in general.

Schedule

July 16, Sunday Travel day from Baltimore or New York to Reykjavik, evening departure on Icelandic Air
July 17-29, Mon.-Sat. Iceland GeoTrip
July 30, Sunday Travel day from Reykjavik to next gateway

This trip will reveal many unaltered and fresh geologic features that can be seen nowhere else on land. Expect to acquire a newly expanded understanding of volcanoes, hotspots, and rifts. There will be great views of steep-walled and flat-topped hyaloclastite ridges derived from subglacial eruption, young hyaloclastite islands produced by submarine eruptions, great explosion craters, tephra cones, calderas, blocky obsidian flows, waterfalls descending into the rift valley, and, of course, extraordinary glacial panoramas.

Lodging, Meals, Transportation. During most of the trip, the group will stay in country hotels (Edda hotels), rural secondary and high schools operated as simple but comfortable summer hotels. Food will be provided at all lodging locations, plus picnics during the day. Travel will be by four-wheel-drive mountain trail bus and by car ferry to the volcanic Westmann Islands.

Air Transportation. The Baltimore gateway has the best connecting flights to most of North America. Round trip travel from Baltimore to Reykjavik will be on IcelandicAir. The current group round-trip fare is \$748. Trip participants are required to travel on the group flight so that everyone can benefit from the advantages of a group reservation. You may use air mile coupons for your domestic flights, however.

Schedule

June 24, Saturday Welcoming get-together
June 25-29, Sunday through Thursday Classes and field trips
June 29, Thursday Farewell Party

Steamboat Springs, Colorado, in a high, green mountain valley, will be our base for two loop trips to explore the geology of northwestern Colorado, from Precambrian basement to Tertiary volcanic rocks. We'll also take a three-day trip west to see Dinosaur National Monument and the isolated back country that surrounds it. High points of the trip will be remote Brown's Hole (original hideout of Butch Cassidy's Wild Bunch), intimate views into and a raft trip through the deep canyons of Dinosaur National Monument, and a tour of the dinosaur quarry itself.

Lodging, Meals, Transportation. The group will stay on Saturday, Sunday, Wednesday, and Thursday at Colorado Mountain College, Steamboat Springs, in single rooms (doubles for couples). Lodging on Monday and Tuesday nights will be at the EconoLodge in Vernal, Utah, in double occupancy accommodations. Single rooms for Monday and Tuesday nights, are available for the single-supplement fee of \$50. Meals will include breakfast and a sack lunch on Sunday, Monday, and Thursday, lunch on Tuesday during the raft float trip or optional van trip, a farewell dinner on Thursday evening, and breakfast on Friday before check-out. Field trip transportation will be in air-conditioned, 15-passenger rental vans.

Included in the fee (see box) are classroom programs and materials; field trip transportation; lodging for six nights (single occupancy, or double for couples); meals outlined above; raft float trip (or optional van trip); welcoming and farewell events. **Not included** are air transportation to and from Steamboat Springs, Colorado; transportation during hours outside class and field trips; breakfast on Tuesday; breakfast and lunch on Wednesday; and other expenses not specifically included.♦



Travel arrangements are being handled by Volcano Tours—TR Consultants, which can help you with plans for your entire itinerary (1-800-923-7422, fax 401-247-0270). They will also offer a brief post-trip option to Greenland.

Included in the fee (see box) are all meals in Iceland; double-occupancy lodging; comfortable bus and ferry transportation; transfers and entrance fees; baggage handling; geologic road log, and field guidebook. **Not included** are airfare to and from Reykjavik; and hotel nights and meals, if any, in Baltimore.♦



GEOVENTURES REGISTRATION FORM

If you would like to send a deposit to hold your reservation, please pay by check or credit card, which will be used only for this deposit. If all of your payments are by check, instead of credit card, you will receive a \$25 refund at the end of the trip. You will receive further information and a confirmation of your registration within one week after we receive your reservation.

Name _____

Institution/Employer _____

Mailing Address _____

City _____ State ____ Country _____ ZIP _____

Phone: () _____ () _____
Business Home

Guest Name _____

GSA Member #	Deposit Per Person	No. of Persons	Total Deposit
GT951—Grand Canyon	\$250	_____	_____
GT952—Iceland	\$250	_____	_____
GH953—Southwestern Montana	\$100	_____	_____
GH954—Northern Colorado	\$100	_____	_____

TOTAL DEPOSIT _____

I've enclosed no deposit, but I'm interested. Please send more information.
 VISA MasterCard American Express

Credit Card # _____ Exp. Date _____

Signature _____

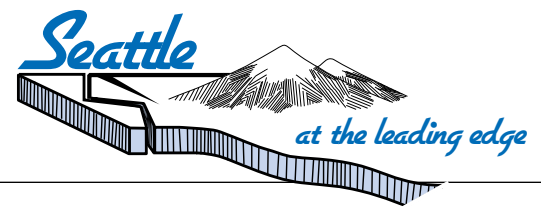
Make checks payable to: **GSA 1995 GeoVentures**

Please mail Registration Form and check or credit card information to:
1995 GSA GeoVentures, GSA Meetings Department
P.O. Box 9140, Boulder, CO 80301
Phone: 1-800-472-1988 or (303) 447-2020: ext. 134 or 141
E-mail: ecollis@geosociety.org or mball@geosociety.org

Fax: 303-447-0648

Environmental Meeting—At The Leading Edge

Sandra Rush and Stephanie Pas, Newsroom with a View



Seattle, with its coastline, mountains, and varied terrain, was the perfect setting for a meeting of geologists. The 5,950 participants at the 1994 GSA Annual Meeting enjoyed a program that offered environmental issues as a primary focus. Regional environmental topics, such as salmon habitat, waste management, and earthquake potential, as well as national environmental concerns, dominated a large number of the 197 sessions at the meeting.

GSA's Institute for Environmental Education (IEE) led off the meeting on Sunday with a well-attended symposium entitled "Crucial Environmental Issues: Fear and Loathing at the Leading Edge," which was cosponsored by GSA's Geology and Public Policy Committee. This third annual IEE forum aired sometimes opposing views from the standpoints of science, policy, economics, and the law regarding earthquake awareness and prediction, habitat loss and modification, low-level radioactive waste disposal, and contamination of ground water.

Information on new findings, significant issues, and innovative studies were disseminated to the public worldwide through the more than 25 media representatives who attended the 1994 Annual Meeting. Reporters from the Associated Press, *Earth* magazine,

Science, *Natural History*, *Tacoma News Tribune*, *Seattle Times*, and *Seattle Post-Intelligencer*, as well as local radio and television networks, were present. The Swiss Broadcasting Network and the London-based *New Scientist* also sent representatives. On-air interviews were arranged for National Public Radio and CNN radio as well as local radio stations, and the major Seattle-area television stations aired news from the meeting. The local media were particularly interested in a study of the Whidbey Island fault (Washington) by Sam Johnson of the U.S. Geological Survey, who discovered that the fault had been affected by large-scale earthquakes and that continued activity on the island indicates the possibility of future quakes. The local media also focused on a theme session on the Pacific Northwest salmon population and its relation to geology. A press conference held before the formal presentation gave news



Sunny in Seattle, at the start of the 1994 GSA Annual Meeting.



The 17-meter-long poster of GLORIA sonar images of sea floor (Bering Sea, Aleutian island arc, and Gulf of Alaska) drew attention and stimulated discussion.

reporters an opportunity to interview David Montgomery and Thomas Dunne of the University of Washington and to find out why the Pacific Northwest salmon population is so reduced.

Two studies of general public interest received national attention. One was by University of Michigan geochemistry student Henry Fricke, who found that oxygen isotopic analysis of tooth enamel from Viking settlements in Greenland reveals evidence of the temperature drop that coincided with Europe's Little Ice Age, thought to have led to the settlers' demise. The colder the climate, the less of the heavier oxygen isotope is contained in precipitation, according to Fricke.

The other study involved the Cretaceous-Tertiary boundary and reptiles.

Through a new computer program, Paul Markwick of the University of Chicago traced the global fossil record of crocodiles, alligators, and their relatives over the past 100 million years. Markwick found that crocodiles thrived while dinosaurs disappeared at the K-T boundary 65 million years ago. However, climate changes 35 and 1 million years ago reduced the crocodile population; therefore, Markwick reasoned, climate change at the time of the K-T boundary should also have been evidenced in crocodile populations.

In a special Wednesday evening session, Eugene Shoemaker of the U.S. Geological Survey in Flagstaff kept 1,000 geologists spellbound with his

Seattle continued on p. 7



1994 Awards Ceremony (left to right): F. Michael Wahl, GSA Distinguished Service Award; David Walker, Day Medalist; Dallas Peck, AGI Medal in Memory of Ian Campbell; David Stephenson, 1995 GSA President; An Yin, Young Scientist Award (Donath Medal); Luna Leopold, Penrose Medal; William Dickinson, 1994 GSA President.

The Students' Corner

Donald M. Davidson, Jr., GSA Executive Director

President's Student Forum

Both Bill Dickinson (past president) and Dave Stephenson (president) were present to field questions and guide dialogue at the President's Forum, held Wednesday afternoon at the Seattle Annual Meeting. About 50 students attended over the course of the event (1.5 hours) as well as several GSA headquarters staff members. Three of the issues discussed stand out. First was the matter of whether GSA could provide an orientation session for students who are new to an annual meeting—after all, the meeting is a major event with a great deal going on. (GSA staff feels this is an excellent suggestion, and we wish to make the orientation process available to all comers.)

The matter of whether GSA can reduce student registration fees for the annual meetings elicited considerable interest among those assembled. Bill Dickinson pointed out that student registrations are already subsidized by

GSA, and that while not to the extent of some other societies, the GSA Foundation does provide matching, competitive travel awards to students through the GSA Sections for both annual and section meetings up to the limit of available funding. More recently, GSA has supported some undergraduate expenses to the annual meeting through its Top Seniors program. (GSA is deeply committed to support of student activities and hopes to expand beyond the current support level as funding permits. Students should contact section secretaries for information. See *Student Travel Grants* on p. 7.)

Finally, students raised the question of undergraduate research and scholarship support. Stephenson responded that GSA is only able to support graduate research projects and modest subsidies for graduate students at Penrose conferences. Other items were discussed, but these were the major issues, and we would welcome commentary from any of our readers.

Employment Issues

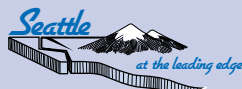
Dave Stephenson and I attended a meeting on November 14 involving Board of Earth Sciences and Resources members of the National Academy, presidents and executive directors of earth science societies, and appropriate guests, mainly geoscientists working as congressional science fellows or within various government agencies, e.g., NSF, DOE. The focus of the sessions was to develop a dialogue on the topic of "Education and Employment Trends for Earth Scientists." Gordon Eaton, director of the USGS, provided the keynote address, which clearly defined a number of challenges to the geoscience community over the manner in which we continue to conduct business, particularly in higher education, as well as the political future of the Survey itself. At the end of the day, Bill Fisher (University of Texas, Austin) provided a salubrious counterpoint to Eaton's keynote in stressing adaptation by the earth science community in dealing with questions of employment, training, and the like. Between these two, groups of speakers representing private-sector industries, governmental and higher education researchers, and

professional societies all took a crack at defining, dissecting, or assessing the topic at hand. A summary of the tea leaves yielded some obvious conclusions.

Employment levels throughout the earth sciences, particularly in the United States, are likely to remain steady or diminish with the exception of "pockets" in environmental geology, which are difficult to define either geographically or by subdiscipline. Prospective employees are expected to have skills beyond those associated with technical ability, including but not limited to foreign language, computer, communication, creativity, business, entrepreneurial, economics, and political. In short, employee adaptability seemed one distinct focus of the dialogue, while change across all levels of the educational enterprise was the other.

Issues addressing the role of earth scientists in the public policy arena and the scope of the earth sciences were also woven into the fabric of the discussion, as were considerations on the nature of the professoriate (e.g., thou shalt not clone Ph.D.s). ■

1994 Statistics



Technical Program

Abstracts submitted	2858
Abstracts presented	2628
Abstracts rejected or withdrawn	230
Percentage of abstracts accepted	92%
Poster presentations (including theme posters)	650
Oral presentations	1678
Oral presentations, discipline sessions	858
Oral presentations, theme sessions	820
Oral presentations, symposia	300
Highest number of concurrent oral sessions	18

Registration

Professional	3636
Student	1418
Exhibitor	540
Guest	356
Total attendance	5950

Short Courses

Number of GSA-sponsored courses	12
Participants	359

Field Trips

Number of trips	26
Participants	633

Exhibits

Number of booths	229
Number of exhibiting companies	160

Employment Service

Applicants	204
Employers	23
Interviews	218
Positions available	57

1994

Annual Meeting Sponsors

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

C. C. Filson Co.

Fisons Instruments

Miners, Inc.

Rockware, Inc.

Springer-Verlag

John Wiley & Sons, Inc.

Worth Publishers

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 State University*

See November 1994 *GSA Today* for a complete list of field trips.



1996

Denver, Colorado • October 28-31

Colorado Convention Center, Marriott City Center

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

Technical Program Chair: *John D. Humphrey, 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, MS 913, P.O. Box 25046

Denver Federal Center, Denver, CO 80225

phones: Charles A. Pillmore, (303) 236-1240 ; Ren A. Thompson (303) 236-0929

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

GSA SECTION MEETINGS

NORTHEASTERN SECTION

Radisson Hotel and Conference Center in Cromwell, Hartford, Connecticut, March 20-22, 1995. Information: Gregory McHone, Graduate Liberal Studies Program, Wesleyan University, 255 High St., Middletown, CT 06457, (203) 344-7930, fax 203-344-7957.

SOUTHEASTERN SECTION

Knoxville Hilton Hotel, Knoxville, Tennessee, April 6-7, 1995. Information: Robert D. Hatcher, Jr., Dept. of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-2368, fax 615-974-2368, E-mail: bobmap@utkvtx.utk.edu.

NORTH-CENTRAL and 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.*

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

Seattle continued from p. 6

slides and personal recollections about the discovery and tracking of last July's spectacular collision of fragments of comet Shoemaker-Levy 9 on the planet Jupiter.

New technologies made scientific data more accessible. Visualization technologies were used for the Hydrogeology Division and COGEOINFO theme sessions, and for many of the most interesting poster presentations. The newest images from April and October 1994 were available from the Spaceborne Imaging Radar-C/X-band Synthetic Aperture Radar (SIR-C/X-SAR), the most advanced imaging radar system to fly in Earth orbit. On Thursday the University Navstar Consortium demonstrated the use of the Global Positioning System, and John Delaney took his audiences on a virtual field trip to the seafloor of the Juan de Fuca Ridge, past seamounts, fault scarps, and

other deep-sea geologic formations. Many took advantage of the opportunity to experience individual "trips" after the formal presentations.

Three weeks prior to the meeting, each preregistrant was sent the entire technical program on disk (including all information except the abstract itself). The program was also on the World Wide Web in September. The program-on-disk will be accessible for the Mac and will be available with improved sorting routines for 1995, and use of GSA's Web home page will be expanded. GSA is planning for receipt of abstracts via E-mail for 1996.

With the Seattle meeting, GSA became one of the few associations in the country to mail registration badges and tickets in advance. Preregistrants arrived with their badges and tickets, needing only to pick up a program from the Convention Center Lobby, ready to participate in the 1994 meeting, *At the Leading Edge*. ■

Lost at the 1994 Annual Meeting. Irreplaceable dolomite drill core sample from a Thursday afternoon poster session. It was attached by Velcro to a poster board in Booth 86. If you found this sample please contact the GSA Meetings Department, (303) 447-2020, ext. 141.



The Times Are Always Changing: The Holocene Saga

1994 GSA Presidential Address
William R. Dickinson

ABSTRACT

Most people erroneously view the modern Holocene environment of their own personal experience as a persistent condition born in durable form at the end of an almost mythical glaciation, and subject to fundamental change only through deleterious effects produced by modern industrial civilization. We have no more important philosophical task as geoscientists than to dispel this widespread illusion of global constancy. The Holocene

panorama of cultural memory evolved over millennia of transition, driven by processes set in motion by deglaciation, and experienced significant postglacial climatic fluctuations. Holocene landscapes were also the first interglacial landscapes in Earth history influenced by the behavior of anatomically modern humans. We were on the scene, devising the cultures that led inexorably to varied civilizations, from the onset of Holocene time.

The marked drawdown of global sea level during the past glaciation

implies that no modern coastlines could have occupied their present positions for more than a few millennia. All coastal ecosystems are made up of species which had to migrate prodigious distances as sea level rose and climatic regimes shifted latitudinally. Along deltaic coasts, moreover, Holocene progradation reversed initial marine transgression by adding vast tracts of new ground to the margins of the continents. All living biotas of coastal wetlands are ephemeral associations caught at an arbitrary point along a spectrum of progressive adjustment to changing conditions. Terrestrial ecosystems have endured analogous migrations and modifications as the Holocene interglacial landscape evolved from Pleistocene antecedents.

Throughout the course of Holocene environmental changes, people have been active, manipulating as well as adapting to their surroundings. The rate of expansion of human cultures around the postglacial world was remarkably rapid, with civilizations based on agriculture extant on all major land masses

within the first few millennia of Holocene time. Even where no fields were tilled and no flocks tended, aboriginal peoples fired the landscape extensively and systematically as their primary approach to land management. Most Holocene environments evolved from the start of postglacial time with the impact of human activity as a part of the natural order.

As we strive in the future for sustainability of the human condition, we cannot expect beneficent natural forces to restore Earth to some fancied primeval condition of perpetual balance that is irretrievable because it never existed. Our only option is to understand ecosystems and landscape evolution well enough to elect wise behavior in the context of a further development of human culture.

Note: the full text of Bill Dickinson's presidential address, which he gave on October 24, 1994, at the GSA Annual Meeting in Seattle, is in the January issue of the Geological Society of America Bulletin (v. 107, no. 1, p. 1-7). ■

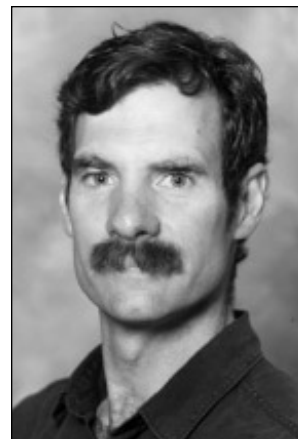
New Editors Start Work on GSA Bulletin

Two new science editors for the *Geological Society of America Bulletin* begin three-year terms this month: Lynn M. Walter, University of Michigan, and John W. Geissman, University of New Mexico. They succeed John E. Costa, U.S. Geological Survey Cascades Volcano Observatory, and Arthur G. Sylvester, University of California, Santa Barbara; both served two three-year terms as *Bulletin* science editors.

Walter has been an associate professor in the Department of Geological Sciences at the University of Michigan, Ann Arbor, since 1989. She had been an assistant professor at Washington University (St. Louis, Missouri) and a research assistant professor at the University of Miami (Florida), where she earned her Ph.D. in marine geology. She categorizes her range of research expertise as surficial process geochemistry—hydrogeochemistry, sediment diagenesis, and sedimentology. She has been an Associate Editor of the *Bulletin* for several years.

Geissman, a professor in the Department of Earth and Planetary Sciences at the University of New Mexico, has taught at UNM since 1984. Before that, he was at the Colorado School of Mines. He received his Ph.D. from the University of Michigan, Ann Arbor. His research focuses on paleomagnetism and rock magnetism related to geologic processes. Like Walter, Geissman was in his second term as a *Bulletin* Associate Editor when he applied for the editor position.

The science editors for GSA publications work closely with headquarters staff in Boulder, Colorado, to ensure that submitted manuscripts are critically reviewed and in appropriate format for the journals or books. The *Bulletin* editors enlist a panel of Associate Editors to help them determine what papers should be published in the journal. In 1994, on average, 15 manuscripts per month were submitted to the *Bulletin*. The science editors receive no



John W. Geissman



Lynn M. Walter

salary for their work, but GSA pays their *Bulletin*-related expenses.

All manuscripts submitted to the journal must be sent to: *Bulletin*, Geological Society of America, 3300 Penrose Place (for courier mail) or P.O. Box 9140, Boulder, CO 80301, *not* to the science editors. ■

Greetings!

John Wm. Geissman, Department of Earth and Planetary Sciences, University of New Mexico, Internet: geissman@bootes.unm.edu

Lynn M. Walter, Department of Geological Sciences, University of Michigan, Internet: lmwalter@umich.edu

As the new co-editors of the *Geological Society of America Bulletin*, we look forward to serving the Society as it heads into the 21st century. We already are seeing changes in our profession: how we do science, how our science is funded, how the importance of our science is measured, and last, but by no means least, how our science is published. Through these changes we will strive to maintain the *Bulletin* as a premier geoscience journal. (Over the past 10 years, the journal impact factor for the *Bulletin*, as well as *Geology*, has been in the top ten percentile of all ranked geoscience journals.) We also want to be flexible and innovative in molding

the *Bulletin* into a journal that best fits the rapidly changing needs of professional earth scientists.

We have given considerable thought to our approach to handling the challenging task in front of us. We have received numerous comments from Society members about what the *Bulletin* should or should not be. We appreciate the input and encourage your continued feedback. The following general comments reveal some of our philosophical and professional viewpoints, which will influence our joint editorship.

1. As GSA members, we should remember that the *Bulletin* is our

journal. As one of the few noncommercial, general journals remaining in geoscience, it occupies a unique niche.

2. We solicit integrative, innovative contributions that deal with all aspects of the earth sciences. In particular, we encourage contributions that deal with topical arenas of geoscience research such as, but not limited to, global and environmental change, paleoclimate, and active tectonics. Critical reviews of current research in areas of widespread interest are also welcome.


3. We do not view the *Bulletin* as solely an "archival" journal containing only lengthy reports. We encourage brevity and emphasize that such practice will expedite the review and publication process. We plan to maintain flexibility in the length of contributions published in the *Bulletin*.

4. Besides the authors, the real workers behind the making of the *Bulletin* are the reviewers and the Associate Editors. We emphasize that your efforts will be taken into utmost consideration

in the assessment of manuscripts considered for the *Bulletin*. We will make every effort to reduce the time manuscripts spend in review without sacrificing the rigor of the review process.

Our editorial assistants are Catherine Ratcliff at the University of New Mexico and Victoria C. Hover at the University of Michigan. Both women have degrees in the geosciences and are themselves authors of geoscience contributions. ■

A reminder

 Now you can order Geological Society of America (GSA) books & maps from the

Geological Society of London Publishing House in Bath, England

Since February 1993, The Geological Society of London (GSL) has been the official distributor for the GSA's books, maps, and transects throughout the United Kingdom and Europe. They stock a large inventory of GSA publications at Bath, England, ready for immediate shipment.

If you reside in the United Kingdom or Europe, consider ordering our publications from Bath. Your orders are filled at the GSA's regular prices, and you'll receive your publications much faster from the GSL than if you order from the U.S. Members of the GSA may still claim their membership discount when ordering from Bath.

To order from Bath, contact:
The Geological Society
Publishing House
Unit 7, Brassmill Enterprise Centre
Brassmill Lane
Bath BA1 3JN (U.K.)
Telephone (0225) 445046;
FAX (+44 225) 442836

Earth conservation

The challenge for science and technology

International Trade Fair and Congress for the Geosciences and Geotechnica



Cologne, May 2 – 5
1995

Hans J. Teetz, Cologne International Trade Fairs, Inc., c/o German American Chamber of Commerce, Inc., 40 West 57th Street, New York, N.Y. 10019-4092, Tel. 212-974-8835/36/37, Telefax 212-974-8838;

LOS ANGELES: 5220 Pacific Concourse Drive, Suite 280, Los Angeles CA 90045, Tel. 310-297-7977/7978, Fax 310-297-7966

— Return slip — — — — —
Please send us: Application form for exhibiting Application form for attending congress General information brochures

Name: _____
Company name: _____
Address: _____

GSA Today



► The preservation of the natural habitats of the earth – for ourselves and our descendants – has for some time provided a common global objective for the fields of economics, science and politics and geotechnica. The earth sciences and geopolitics now have a true international forum – geotechnica. This trade fair presents the complete world spectrum of currently available earth science – and geotechnical-related specialist know-how under one roof – from mining to environmental technology, from the allocation of former waste disposal sites to redevelopment, from waste disposal to recycling. geotechnica presents it all. In parallel with this specialists

event the geotechnica congress will take place once again from May 3–5. The general theme of the congress will be "Geosciences and geotechnica poised between ecology and economy – from resources to recycling" and will cover in-depth the essential life elements for the preservation of life on planet Earth – soil and water, air and climate.

geotechnica '95: A forum for the world at the heart of Europe

- 500 exhibitors
- 20,000 professional visitors
- 25,000 sq. metres of exhibiting space
- 2,000 congress participants

The Future Lies Behind Us

Fred A. Donath
Executive Director, GSA Institute for Environmental Education

As geologists, we are traditionally taught to look at the present as the key to the past. But, we are, in fact, traveling along a two-way street. We can also look to the past to interpret geologic features we observe in the present. In recent years, geologists grappling with diverse environmental challenges such as the future performance of geologic environments for hazardous waste disposal or the prediction of earthquakes, mass movements, and other geologic hazards, have studied past events and processes to gain insights into future events and processes. Thus, geology has been evolving into a predictive science to better serve the needs of society. Although lacking precision in its predictive capabilities, geology nevertheless offers the best means of understanding and forecasting those natural events and processes that can have

great impact on the human condition. Geologists would be well advised to look also to the past in a very different way if they truly value their profession and the opportunities it has provided them. For, the future of the science can also be seen in the past.

The Absence of Input


Science, particularly funding for major scientific initiatives, was dominated in the several decades of the "Cold War" by concerns over national security. Science in the immediate future will be dictated by its ability to address current societal concerns—many of which are environmental—and to be "relevant." Geoscience is not well represented in the development of major legislation and national initiatives dealing with matters germane to the discipline. Biological scientists commonly fail to recognize the often predominant role of geologic processes in affecting habitat, engineers can overlook the sometimes controlling influence of natural processes as they design major projects, and predictions of future performance of geologic sites for hazardous waste disposal are not uncommonly made by applied mathematicians and others with limited understanding of geologic media and processes. Why is geology—so integral to the understanding needed to deal effectively with such matters—so often missing or ineffectively represented? How can that be changed? Science will move on with or without us. What can we do to assure our meaningful participation?

Public Education Provides an Avenue

My rhetorical questions might have no simple answers, but our past actions—or lack thereof—should not be taken as a template for the future. It is my conviction that the answer to my second question lies in public education. The public will not look to geo-

Institute for Environmental Education Public Information and Education Techniques Workshops

APPLICATION FORM



Name _____

Address _____

Phone _____

Workshop (please check preference)

Sunday, March 19, 1995—Hartford, Connecticut (Northeastern Section)

Saturday, April 8, 1995—Knoxville, Tennessee (Southeastern Section)

Saturday, April 29, 1995—Lincoln, Nebraska (North-Central and South-Central Sections)

Saturday, May 20, 1995—Bozeman, Montana (Rocky Mountain Section)

Future Workshop (to be scheduled)

A completed GEPOP Network Enrollment Form MUST accompany this application form.

Send to: Geological Society of America, Institute for Environmental Education,
P.O. Box 9140, Boulder, CO 80301; fax 303-447-1133

Donath Steps Down as Executive Director of IEE

Fred A. Donath, who played a major role in establishing GSA's Institute for Environmental Education, has resigned his position as its executive director. For the past four years, Donath contributed virtually full time to further the mission and objectives of IEE through programs such as the IEE Annual Environmental Forum and the Geology and Environment Public Outreach Program. At the American Geological Institute's ceremony in Seattle honoring prominent American geoscientists, Donath received AGI's Award for Outstanding Contribution to the Public Understanding of Geology.

Donath has more than 35 years experience in geoscience studies and research. As a geology professor at Columbia University, he gained international recognition for his contributions to studies of earth faulting and folding, sedimentary rock diagenesis, and experimental rock deformation. Later, he became head of the Geology Department at the University of Illinois at Urbana-Champaign, and also served as the founding editor of the *Annual Review of Earth and Planetary Sciences*. During the 1980s, Donath worked as a private consultant before joining the Earth Technology Corporation in California as principal geoscientist and, later, vice president of research and development.

He gained extensive experience in the area of high-level radioactive waste management and disposal and served as a resource person for the U.S. Nuclear Regulatory Commission, the U.S. Department of Energy, and the President's Intergovernmental Review Group for the Isolation of Nuclear Waste. He has testified before the U.S. Senate and U.S. Nuclear Regulatory Commission on nuclear waste problems, and, most recently, has been a member of the Environmental Management Advisory Board of the U.S. Department of Energy.

GSA Executive Director Donald M. Davidson, Jr., will serve temporarily as acting director of IEE.

science without knowing what geoscience has to offer. I strongly believe, further, that the cornerstone of public education is K-12 education. That is why GSA's Science Awareness through Geoscience Education (SAGE) is so important. But we must do more. We cannot afford to wait for a decade to see the results of our efforts in primary and secondary education realized in an informed public. Nor can we abandon our efforts after graduation. Too many pressing environmental problems already exist and will continue to appear. Recent natural events have caused monumental losses and untold emotional stress. Other environmental issues threaten to polarize the public and lead to exorbitant and unnecessary costs while causing acrimonious stagnation. These realities and potential consequences reflect an absence of geological input, and they illustrate the need for GSA's Institute for Environmental Education. Now is the time to respond, and the public education needed to ameliorate or prevent such effects is an important objective of IEE.


IEE and GEPOP Program Development

IEE's stated mission is to serve as an educational interface between the geological community and the public

on matters of the environment, and to promote the "application of geology to the wise use of Earth." An important aspect of that mission involves assisting the geologic community in educating itself on environmental matters. It does that through the sponsorship of forums, symposiums, theme sessions, and workshops at GSA annual and section meetings.

To aid and encourage communication both within and beyond the geologic community into the private and public sectors, IEE has established the Geology and Environment Public Outreach Program (GEPOP), described in the February 1994 issue of *GSA Today*. In building its network of individuals and organizations, IEE has received positive response and now has strong representation in every GSA Section. For more efficient and selective distribution of information appropriate to participants' interests, IEE has developed a computerized data base that permits sorting based on geographic location, societal affiliations, expertise, professional applications and interests, and other variables (see GEPOP Network Enrollment Form below). The data base will be maintained at GSA headquarters in Boulder, Colorado, and


Future continued on p. 10



The Institute for Environmental Education

Geology and Environment Public Outreach Program

GEPOP Network Enrollment Form



Name: _____ Title: _____

Mailing Address: _____

Telephone: _____ Fax: _____ E-Mail: _____

<p>ORGANIZATION (select one)</p> <p><input type="checkbox"/> Academia</p> <p><input type="checkbox"/> Consulting firm</p> <p><input type="checkbox"/> Government, nonregulatory</p> <p><input type="checkbox"/> Government, regulatory</p> <p><input type="checkbox"/> Industry</p> <p><input type="checkbox"/> Nonprofit</p> <p><input type="checkbox"/> Retired</p> <p><input type="checkbox"/> Secondary education</p> <p><input type="checkbox"/> Self-employed</p> <p><input type="checkbox"/> Other (please specify) _____</p>	<p>POSITION (select one)</p> <p><input type="checkbox"/> Administrator</p> <p><input type="checkbox"/> Applied scientist</p> <p><input type="checkbox"/> Consultant</p> <p><input type="checkbox"/> Educator</p> <p><input type="checkbox"/> Engineer</p> <p><input type="checkbox"/> Manager</p> <p><input type="checkbox"/> Professor</p> <p><input type="checkbox"/> Research scientist</p> <p><input type="checkbox"/> Student</p> <p><input type="checkbox"/> Other (please specify) _____</p>	<p>GSA SECTION MEMBERSHIP (select one)</p> <p><input type="checkbox"/> Cordilleran Section</p> <p><input type="checkbox"/> North-Central Section</p> <p><input type="checkbox"/> Northeastern Section</p> <p><input type="checkbox"/> Rocky Mountain Section</p> <p><input type="checkbox"/> South-Central Section</p> <p><input type="checkbox"/> Southeastern Section</p>
---	--	--

Please fill out both sides

AFFILIATION(S) (check all that apply)

<p><input type="checkbox"/> AAAS (Am. Assoc. Adv. Sci.)</p> <p><input type="checkbox"/> AAPG (Am. Assoc. Petrol. Geol.)</p> <p><input type="checkbox"/> AEG (Assoc. Engineering Geol.)</p> <p><input type="checkbox"/> AGID (Assoc. Geosci. Int'l. Devel.)</p> <p><input type="checkbox"/> AGU (Am. Geophysical Union)</p> <p><input type="checkbox"/> AIH (Am. Inst. Hydrology)</p> <p><input type="checkbox"/> AIPG (Am. Inst. Prof. Geol.)</p>	<p><input type="checkbox"/> AWG (Assoc. Women Geoscis.)</p> <p><input type="checkbox"/> CMS (Clay Mineral Soc.)</p> <p><input type="checkbox"/> GIS (Geosci. Info. Soc.)</p> <p><input type="checkbox"/> GS (Geochemical Soc.)</p> <p><input type="checkbox"/> GSA (Geol. Soc. Am.)</p> <p><input type="checkbox"/> MSA (Mineralog. Soc. Am.)</p> <p><input type="checkbox"/> NABGG (Nat. Assoc. Black Geol. Geophys.)</p>	<p><input type="checkbox"/> NAGT (Nat. Assoc. Geol. Teachers)</p> <p><input type="checkbox"/> NESTA (Nat. Earth Sci. Teachers Assoc.)</p> <p><input type="checkbox"/> NWWA (Nat. Water Well Assoc.)</p> <p><input type="checkbox"/> SEG (Soc. Economic Geol.)</p> <p><input type="checkbox"/> SEPM (Soc. Sed. Geol.)</p> <p><input type="checkbox"/> SSA (Seismological Soc. Am.)</p> <p><input type="checkbox"/> SSSA (Soil Science Soc. Am.)</p>
---	--	--

Ice Sheets *continued from p. 1*

topography and by the westerly surface wind stress, which is strongly dependent upon land-mass distribution (Gordon, 1988). These critical tectonic factors were not appreciably different during the Pliocene than today (Lawver et al., 1992). Faunal and sedimentological data indicate strong stability in the position of the circumpolar current during the late Neogene; northward and southward migrations of the Polar Front zone have been minor in relation to the vast breadth of the Southern Ocean (Lazarus and Caulet, 1993). The net effect of the relatively stable position of the Antarctic circumpolar current has been long-term thermal insulation of the Antarctic continent and resulting stability of the Antarctic cryosphere.

Deglaciation Hypothesis and the Sirius Group

More recently, workers have proposed a competing hypothesis ("deglaciation") suggesting that pre-Pleistocene ice sheets were smaller and of lower profile than today and were formed in much warmer conditions (Webb and Harwood, 1991; Barrett et al., 1992). This model also invokes large changes in the volume of the Antarctic cryosphere; reductions to about two-thirds of the present size of the East Antarctic ice sheet during Pliocene intervals, complete loss of the West Antarctic ice sheet, and considerable warming (>5 °C) of Antarctic surface waters. Support for major deglaciation and warming of Antarctica is largely inferred from the presence of reworked oceanic diatoms (as young

as late Pliocene age—3.1 to 2.5 Ma; Webb and Harwood, 1991) in sedimentary deposits of the Sirius Group, found at high altitudes (~2000–2500 m) in the Transantarctic Mountains. The Sirius Group consists of lodgment tills interbedded with glaciofluvial, glaciolacustrine, and colluvial sediments containing fossil plant material representing evidence for remarkable warmth, even as close as 500 km from the South Pole (Webb and Harwood, 1991; Hill and Truswell, 1993). The diatoms are inferred to have lived in marine basins within the Antarctic craton and, together with associated basinal sediments, were carried up the Transantarctic Mountains by developing ice sheets after ~2.5 Ma, the age of the youngest diatoms in Sirius sedimentary rock.

Other evidence cited in support of the deglaciation hypothesis includes vertebrate fauna and δ¹⁸O of bivalves from the Vestfold Hills (Quilty, 1993), highstands of sea level during the middle Pliocene (Haq et al., 1988; Dowsett and Cronin, 1990), and warming of Antarctic surface waters inferred from Pliocene planktonic microfossil assemblages (Abelman et al., 1990; Ishman and Rieck, 1992).

The deglaciation hypothesis implies that the Antarctic ice sheets are unstable and susceptible to decay during times of warm climatic conditions such as those reached during the Pliocene. By analogy, Barrett (1991) suggested that the ice sheets may become unstable at elevated CO₂ levels and temperatures predicted to be extant, due to global warming, by the year 2100.

EVIDENCE FROM DEEP-SEA SEDIMENTS

If such major warming and deglaciation occurred during the Pliocene, clear evidence should exist in marine sediments from the Southern Ocean and in glacioeustatic changes on continental margins. Results from deep-sea drilling in the Southern Ocean have led to major advances in the understanding of climate, oceanography, and the biota of the Antarctic continent and surrounding ocean (Kennett and Barron, 1992). Marine sedimentary evidence presented here supports relative stability of the Antarctic cryosphere-climate-ocean system during the late Neogene. Geomorphological evidence from the continent also indicates that hyperarid, cold desert conditions have persisted on Antarctica since about the middle Miocene (Fig. 2; Marchant et al., 1993; Denton et al., 1993), with little temperature increase above modern values.

Pliocene Climatic History: Oxygen Isotopic Evidence

One of the most useful tools for estimating past changes in temperature and global ice volume is the measurement of stable isotopes of oxygen in foraminiferal tests. Since the δ¹⁸O of calcite is dependent on both the temperature and oxygen isotopic composition of seawater (controlled largely by ice volume), separating the temperature and ice volume signals has proven difficult for paleoclimatic reconstructions.

Increased temperature and reduced global ice volume have long been inferred for the early Pliocene from oxygen isotopic values that were lower

than today (Shackleton and Kennett, 1975; Hodell and Venz, 1992; Shackleton et al., 1994). Different views exist, however, as to the magnitude of temperature and ice reduction represented by the oxygen isotopic signal. At one extreme, Raymo (1992) suggested major Antarctic deglaciation (50% reduction in ice) during the early Pliocene, whereas Kennett (1977) argued for relative stability of the ice sheets.

Hodell and Venz (1992) provided critical constraints on estimates of the magnitude of Pliocene ice volume and temperature change, using high-resolution oxygen isotopic records of benthic and planktonic foraminifera from Ocean Drilling Program (ODP) Site 704 in the Subantarctic sector (47°S) of the southeast Atlantic (Fig. 3). Compared with earlier results, this record has proven crucial for interpretations of ice-sheet history because both planktonic and benthic foraminifera were analyzed from a high-latitude location. Prior to 3.2 Ma in the Pliocene, benthic δ¹⁸O values were always less than or equal to Holocene values (i.e., 3‰) and fluctuated by only ~0.5‰. The full range of the planktonic oxygen isotopic variations (0.75‰) were slightly greater than the benthic fluctuations, reflecting larger surface-water temperature changes. However, minimum foraminiferal δ¹⁸O values were never more than 0.5‰ to 0.6‰ lower than Holocene values (i.e., 2.3‰). The δ¹⁸O signal from Site 704 can be interpreted to represent *either* a maximum 2.5 °C warming of Subantarctic surface waters *or* a maximum 60% reduction in continental ice volume (Hodell and Venz,

Ice Sheets *continued on p. 11*

Future *continued from p. 9*

information will be made available to participants through the World Wide Web on the Internet, or through direct requests to IEE.

At the GSA Annual Meeting in Seattle, IEE sponsored its first workshop on public information and education techniques. The objectives were to provide a group of geoscientists—representing geographic, disciplinary, and

affiliatory diversity—with insights and information on such topics as what is newsworthy; how to make news, become news, present news, and distribute news; how to select the most effective medium for a story; news as public information and education; ethical obligations and responsibilities; and establishing credibility with the media.

The workshop in Seattle was led by Victor J. Yannacone, Jr., and Kevin Mol-

loy. Both have extensive experience in media interface training. Yannacone is an environmental lawyer whose past experience includes successful litigation related to banning the use of DDT, saving the Florissant (Colorado) Fossil Beds, and filing the initial class action complaint that later became known as the Agent Orange litigation. Molloy is an award-winning journalist and editor-in-chief of a chain of weekly newspapers on Long Island within the

metropolitan New York news area. He has first-hand knowledge about highly controversial news issues and the interface of federal, state, and local political jurisdictions with their concomitant bureaucratic turf wars. Among geoscience topics he covers on a regular basis are ground-water remediation and the effects of pollution on sole-source aquifers, the impact of storms and littoral drift on barrier beaches, and the effects of salinity changes in estuarine environments.

Future Involvement

The success of the Seattle endeavor, as indicated by postworkshop comments of the participants, has led to the planning of four additional media workshops this spring in conjunction with the GSA Section meetings in Hartford, Connecticut, Knoxville, Tennessee, Lincoln, Nebraska, and Bozeman, Montana. Victor Yannacone and Kevin Molloy will again lead the workshops, which will include "hands-on" activity in which participants practice the techniques. Enrollments for the individual workshops will necessarily be limited, but all interested geoscientists are encouraged to submit an application even if they are not available for the currently scheduled workshops. The application form is printed on p. 9 of this issue of *GSA Today*.

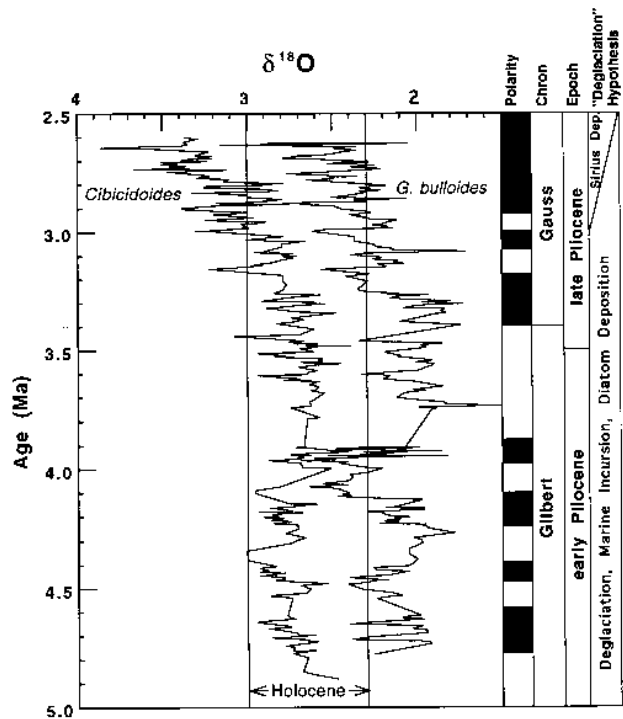
If you are interested in participating in the IEE public outreach program on geology and the environment, or simply wish to be kept informed about IEE activities, please complete the GEPOP Network Enrollment Form on p. 9 and 10 and mail or fax it to the address on the form. ■

EXPERTISE (check all that apply)	PROFESSIONAL APPLICATION	ADDITIONAL INTERESTS	CATEGORY (check all that apply)	POTENTIAL GEPOP ROLES (check all that apply)
<input type="checkbox"/> Archaeological geology			Education	Ongoing Activities
<input type="checkbox"/> Computers/mathematical geology	<input type="checkbox"/>	<input type="checkbox"/>	Education, primary	<input type="checkbox"/> Media liaison
<input type="checkbox"/> Economic geology	<input type="checkbox"/>	<input type="checkbox"/>	Education, secondary	<input type="checkbox"/> Leadership liaison
<input type="checkbox"/> Engineering geology	<input type="checkbox"/>	<input type="checkbox"/>	Education, higher	<input type="checkbox"/> Info clearinghouse
<input type="checkbox"/> Environmental geology	<input type="checkbox"/>	<input type="checkbox"/>	Education, public	<input type="checkbox"/> Speakers' bureau
<input type="checkbox"/> Geochemistry, aqueous/organic			Natural Science	<input type="checkbox"/> Network coordination
<input type="checkbox"/> Geochemistry, other	<input type="checkbox"/>	<input type="checkbox"/>	Ecosystem management	Events
<input type="checkbox"/> Geoscience education/information	<input type="checkbox"/>	<input type="checkbox"/>	Energy resources	<input type="checkbox"/> Organization
<input type="checkbox"/> Geophysics/tectonophysics	<input type="checkbox"/>	<input type="checkbox"/>	Engineering	<input type="checkbox"/> Publicity
<input type="checkbox"/> Hydrogeology	<input type="checkbox"/>	<input type="checkbox"/>	Hazard mitigation	<input type="checkbox"/> Speaking
<input type="checkbox"/> Hydrology	<input type="checkbox"/>	<input type="checkbox"/>	Land use management	<input type="checkbox"/> Teaching
<input type="checkbox"/> Marine geology	<input type="checkbox"/>	<input type="checkbox"/>	Mineral resources	<input type="checkbox"/> Materials preparation
<input type="checkbox"/> Mineralogy	<input type="checkbox"/>	<input type="checkbox"/>	Remediation	Ideas
<input type="checkbox"/> Paleoceanography/paleoclimatology	<input type="checkbox"/>	<input type="checkbox"/>	Restoration, ground-water	<input type="checkbox"/> Network recruitment
<input type="checkbox"/> Paleontology/paleobotany	<input type="checkbox"/>	<input type="checkbox"/>	Restoration, habitat	<input type="checkbox"/> Issue identification
<input type="checkbox"/> Petroleum geology	<input type="checkbox"/>	<input type="checkbox"/>	Waste management	<input type="checkbox"/> Topic identification
<input type="checkbox"/> Petrology, igneous/metamorphic	<input type="checkbox"/>	<input type="checkbox"/>	Water resources	<input type="checkbox"/> Sponsor identification
<input type="checkbox"/> Quaternary geology			Social Science	<input type="checkbox"/> Other (please specify)
<input type="checkbox"/> Geomorphology/physical geography	<input type="checkbox"/>	<input type="checkbox"/>	Community relations	
<input type="checkbox"/> Remote sensing/GIS	<input type="checkbox"/>	<input type="checkbox"/>	Decision making	
<input type="checkbox"/> Sedimentary geology	<input type="checkbox"/>	<input type="checkbox"/>	Dispute resolution	
<input type="checkbox"/> Soil science	<input type="checkbox"/>	<input type="checkbox"/>	Economics, environmental	
<input type="checkbox"/> Stratigraphy	<input type="checkbox"/>	<input type="checkbox"/>	Ethics, environmental	
<input type="checkbox"/> Structural geology/tectonics	<input type="checkbox"/>	<input type="checkbox"/>	Ethics, professional	
<input type="checkbox"/> Volcanology	<input type="checkbox"/>	<input type="checkbox"/>	Journalism, environmental	
<input type="checkbox"/> Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>	Law, environmental	
	<input type="checkbox"/>	<input type="checkbox"/>	Planning, land use	
	<input type="checkbox"/>	<input type="checkbox"/>	Policy development	
	<input type="checkbox"/>	<input type="checkbox"/>	Regulatory development	
	<input type="checkbox"/>	<input type="checkbox"/>	Sustainable development	
	<input type="checkbox"/>	<input type="checkbox"/>	Other (please specify)	

Send to: Geological Society of America
Institute for Environmental Education
P.O. Box 9140
Boulder, CO 80301
Fax: 303-447-1133

IEE is interested in your ideas on topics, audiences, and activities for the outreach program, and on your insights regarding obstacles to environmental decision making. Referrals of people or other relevant programs are also welcome. Use a separate sheet if necessary. Thank you.

Figure 3. Oxygen isotopic record of benthic (*Cibicidoides*) and planktonic (*Globigerina bulloides*) foraminifers from ODP Site 704 (Hodell and Venz, 1992). The vertical lines represent the present Holocene values at Site 704 for *Cibicidoides* (3.0‰) and *G. bulloides* (2.3‰). Note that during the Pliocene prior to ~3.0 Ma, $\delta^{18}\text{O}$ values were generally less than Holocene values, indicating less ice volume and/or higher temperatures in the Subantarctic than today. The minimum $\delta^{18}\text{O}$ values, however, are only 0.6‰ less than those of the Holocene, and the amplitude of the signal is dampened, indicating relative climatic stability. The deglaciation hypothesis (see right column) predicts warming of 5 °C and ~60% reduction in Antarctic ice volume, which would result in minimum $\delta^{18}\text{O}$ values ~1.85‰ less than those of the Holocene; such low values are not observed in the record.



Ice Sheets continued from p. 10

1992). The most reasonable interpretation is that the lower $\delta^{18}\text{O}$ values reflect both increased temperature and decreased ice volume. This is because it is unlikely that major deglaciation of the East Antarctic and possibly the West Antarctic ice sheets could have occurred in the absence of significant Antarctic warming (Huybrechts, 1992).

A 0.6‰ decrease in oceanic $\delta^{18}\text{O}$ might potentially reflect a 60% reduction in Antarctic ice volume, but only in the absence of any increase in temperature, which we believe is untenable. The "deglaciation" hypothesis predicts an increase in high-latitude surface-water temperatures of 5 °C and a two-thirds reduction in Antarctic ice volume (Webb and Harwood, 1991). This amount of warming and deglaciation would result in a decrease of ~1.85‰ in $\delta^{18}\text{O}$ values, compared to the observed decrease of only ~0.6‰. The melting of only one-third of the Antarctic cryosphere would cause a decrease of ~0.3‰ in ocean $\delta^{18}\text{O}$ values, but the remaining ~0.3‰ decrease would represent a maximum surface-water temperature increase of only ~1.5 °C. The upshot is that the observed oxygen isotopic changes in the early Pliocene of the Subantarctic are insufficient to accommodate both substantial Southern Ocean warming and major deglaciation.

The relatively small amplitude of the $\delta^{18}\text{O}$ signal during the Pliocene (~±0.25‰) indicates that the Antarctic climate system, as reflected in ocean water temperatures and ice volume, operated within relatively narrow limits during the early Pliocene (Hodell and Venz, 1992). The Pliocene variation in $\delta^{18}\text{O}$ (0.5‰–0.6‰) represents only about one-third of the 1.6‰ to 1.8‰ signal observed during the late Pleistocene. The dampened nature of the Pliocene $\delta^{18}\text{O}$ signal also is supported by high-resolution records of Pliocene benthic $\delta^{18}\text{O}$ variations from an eastern equatorial Pacific drilled site (Shackleton et al., 1994). The minimum benthic $\delta^{18}\text{O}$ values during the early Pliocene at this site were also only ~0.6‰ to 0.7‰ less than today's value. This permits major decreases in ice volume only in the absence of warming of deep Pacific waters (Shackleton et al., 1994).

Pliocene Sea-Level History

Evidence for marine transgressions has been widely reported for the Pliocene (Haq et al., 1988; Dowsett and Cronin, 1990). These sea-level highstands were almost certainly glacio-eustatic in origin, but the absolute magnitude of the sea-level rise is debated. Haq et al. (1988) estimated the rise to be up to 60 m, a figure considered too high by other workers (e.g., Greenlee and Moore, 1988). Melting of all Antarctic ice would raise sea level by about 70 m, melting of just the West Antarctic ice sheet would raise sea level

by 5 m, and melting of the Greenland ice sheet would raise sea level by 7.4 m. We assume that the Greenland ice sheet would not have survived in the case of major melting of Antarctic ice. With the exception of that of Haq et al. (1988), most estimates of sea-level rise would not permit total deglaciation of Antarctica during the Pliocene. A reduction in Antarctic ice volume to two-thirds of present volume, as suggested by Webb and Harwood (1991), would require a sea-level rise of ~54 m (47 m for East Antarctica; 7 m for Greenland).

Stratigraphic studies at Enewetak Atoll indicate early Pliocene sea-level highstands up to 29–36 m above that of the present (Wardlaw and Quinn, 1991). Similarly, Krantz (1991) estimated early Pliocene sea-level highstands up to 25–35 m for the U.S. Middle Atlantic coastal plain. For the same region, Dowsett and Cronin (1990) estimated a sea-level highstand of 35 ± 18 m between 3.5 and 3.0 Ma. The oxygen isotopic records do not necessarily preclude a maximum sea-level rise of 35 m (= 0.35‰ assuming a late Pleistocene $\delta^{18}\text{O}$ ice volume calibration), but the amount of warming would be too small (1.4 °C at most or equivalent to 0.35‰) to have caused major Antarctic deglaciation in the first place. Average sea-surface warming of 2 °C at high southern latitudes and sea level 25 m higher than today are conceivable for brief periods during the Pliocene. However, the amount of warming and deglaciation would have been less than these maximum estimates in most of the Pliocene.

Sea-level changes during Pliocene-Pleistocene time led to multiple ice-sheet grounding episodes over the Antarctic continental shelf (Alonso et al., 1992), but these events were not

related to major continental deglaciation, nor were they necessarily related to major changes in ice-sheet volume.

Ice-Sheet History: Ice-rafted Detritus

The presence of ice-rafted detritus (IRD) in sediments far to the north of the Antarctic continent in northern Antarctic and Subantarctic waters is a clear indication of major continental ice sheets. IRD is transported far northward when icebergs are common and sea-surface temperatures cold enough to prevent rapid melting. IRD is absent or rare far to the north of the continent during times of reduced continental glaciation and a warmer Southern Ocean. A reduction in Antarctic ice volume by two-thirds and an increase in Southern Ocean sea-surface temperature by more than 5 °C would have led to a major decrease in the flux of IRD and a southward contraction in its distribution.

The stratigraphic distribution of IRD was presented quantitatively by Warnke et al. (1992) for late Neogene Subantarctic sequences of the South Atlantic (50°S). IRD in this area was transported in icebergs from the Weddell Sea area. In the southwest Atlantic (ODP Sites 699 and 701), IRD first appeared at ~6 Ma and has been present continuously, although in varying amounts, up to the present time (Fig. 4). The IRD record in Antarctic

Ice Sheets continued on p. 12

ENERGY AND THE ENVIRONMENT:

APPLICATION OF GEOSCIENCES TO DECISION MAKING

1995 U.S. Geological Survey McKelvey Forum
Washington, D.C., February 13–16, 1995

ISSUES:

- What are the energy resources of the future based on scientific, technologic, economic, environmental, and sociopolitical factors?
- How does the natural occurrence of oil, gas, and coal impact the atmosphere, water quality, and climate changes?
- What are the environmental effects of energy resource development?
- How is geological information used in formulating regulatory policy?

SPECIAL FEATURE:

A highlight of the Forum will be a panel discussion on the technologic, economic, political, and social aspects of energy resources of the future, and their impact on the environment. Panel members will state their positions and field questions from the moderator, other panel members, and the audience.

Moderator: Ken Bode, Host of *Washington Week in Review*

Panel Members:

Mr. Thomas Bechtel, Director, Morgantown Energy Technology Center, U.S. Department of Energy
Mr. Daniel Becker, Chief, Global Warming and Energy Program, Sierra Club
Mr. Michael German, Senior Vice President, American Gas Association
Gen. Richard Lawson, President, National Coal Association
Dr. Jeremy Leggett, Greenpeace
Dr. Dale Nesbitt, Economist and Senior Vice President, Decision Focus, Inc.
Dr. Nahum Schneidermann, Chevron Overseas Petroleum
Mr. Reginal Spiller, Deputy Assistant Secretary for Gas and Petroleum Technology, U.S. Department of Energy

FOR INFORMATION CONTACT:

U.S. Geological Survey
P.O. Box 25046 MS 934
Denver, CO 80225-0046
(303) 236-5769 Fax (303) 236-8822
E-mail: mckelvey@bpgsvr.cr.usgs.gov



Short-Course Series

Statistical Methods in Ground-Water Pollution

February 27-March 3, 1995

Instructors:
D. Helsel and E. Gilroy
(USGS)

This course focuses on the basis of modern statistical methods, increasingly used to analyze ground-water flow and water quality data; extensive discussions of applications to actual data sets; includes hands-on training with MINITAB® statistical software.

For more information contact the IGWMC.

international ground water modeling center



Colorado School of Mines
Golden, Colorado 80401-1887
Phone: (303) 273-3103
FAX: (303) 384-2037

waters of the Kerguelen Plateau (ODP Site 751; 58°S; Breza, 1992) and Maud Rise (65°S; Kennett and Barker, 1990) shows an upward increase in IRD abundance during the early Pliocene. The Pliocene was marked by persistent delivery of IRD in many parts of the Southern Ocean, with no suggestion of significant reduction in the northward distribution of iceberg sediment transport (Warnke et al., 1992). This almost certainly would have occurred in response to large-scale deglaciation of Antarctica. The records indicate continued existence of major continental ice sheets on Antarctica during the Pliocene.

Pliocene History of the Polar Front (Opal-Carbonate Transition)

The Polar Front zone is marked by a transition from biosiliceous productivity and diatom ooze to the south to dominantly biocalcareous productivity and foram-nannofossil ooze to the north. Deep water wells up south of the zone and creates weakly stratified, chemically homogeneous waters of the Antarctic circumpolar current. The upwelling results in high diatom productivity and formation of the biosiliceous ooze belt. The history of the Antarctic biosiliceous belt is well known from deep-sea drilled sites. Siliceous biogenic sediments appeared in the Antarctic during the late Oligocene-early Miocene, reflecting a progressive increase in upwelling, as a result of the development of circumpolar flow when the Drake Passage opened (Kennett and Barker, 1990). On Maud Rise, for example, sedimentation was almost exclusively biosiliceous from the middle late Miocene to the Quaternary. This and other evidence indicates that the biosiliceous belt, and presumably the Antarctic circumpolar current, has remained well established far north of the Antarctic continent since at least the late Miocene.

A major warming and southward retreat of the Polar Front zone during the Pliocene would have caused a southward retreat of the siliceous-calcareous boundary. Instead, biosiliceous sediments continued to dominate the

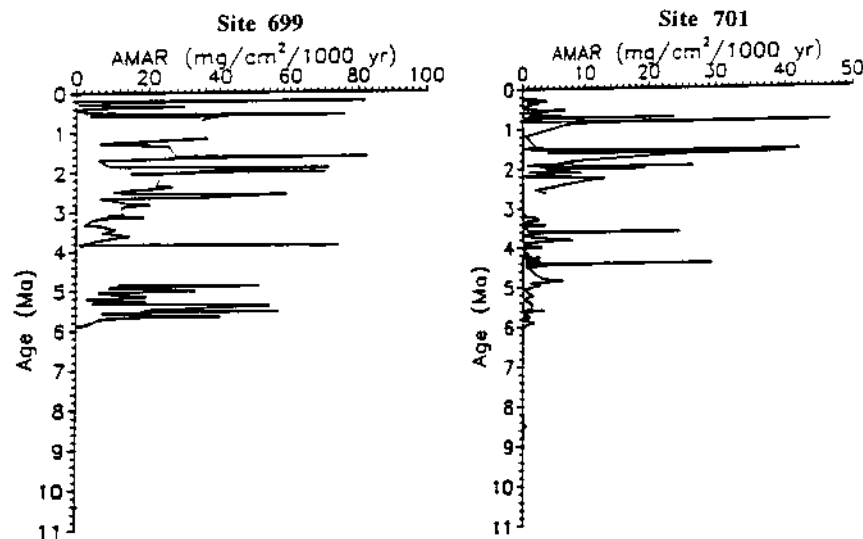


Figure 4. Apparent mass accumulation rate (AMAR) of coarse-grained ice-rafted detritus (IRD) at ODP Site 699 (lat 51°32.5'S, long 30°40.6'W) and 701 (51°9.1'S, 23°12.7'W) from the Subantarctic sector of the southwest Atlantic Ocean (from Warnke et al., 1992). The persistent occurrence of IRD in the Subantarctic throughout the Pliocene argues against major deglaciation of the Antarctic continent.

Southern Ocean, and calcareous microfossils remained rare to absent in Pliocene sediments (Lazarus and Caulet, 1993). Experimental studies indicate that sediment-forming calcareous nannoplankton do not form coccoliths (calcareous platelets) at temperatures below 3 °C (Burckle and Pokras, 1991). Furthermore, coccoliths are almost completely absent in sediments south of the Polar Front today. Absence of calcareous nannofossils in Antarctic Pliocene sedimentary deposits suggests that surface-water temperatures were then also lower than 3 °C. The sedimentologic data provide no compelling evidence to support major southward migration of the biosiliceous belt during the Pliocene, implying that a broad zone of cold Antarctic waters continued to isolate the continent.

Planktonic Microfossils and Antarctic Surface-Water Temperatures

Early Pliocene siliceous planktonic microfossil assemblages in Antarctic waters have long been considered indicative of temperatures warmer than the present day (Ciesielski and Weaver, 1974; Abelmann et al., 1990). However, the amount of warming is

debated. Estimates for average Antarctic surface-water temperatures range from >~10 °C, from silicoflagellates (Ciesielski and Weaver, 1974), to ~5 to 10 °C, based on radiolarians and diatoms (Abelmann et al., 1990), to <3 °C, based on an absence of calcareous nannofossils (Burckle and Pokras, 1991). These estimates compare with average modern sea-surface temperatures of ~1 °C in winter and <3.5 °C in summer. In close agreement with Burckle and Pokras (1991), our interpretations of oxygen isotopic data suggest that Pliocene Antarctic sea-surface temperatures were higher than those of today but lower than 3 °C. If $\delta^{18}\text{O}$ values in Site 704 are interpreted solely as a temperature signal, then Subantarctic waters were no more than 2.5 °C warmer than today.

The Southern Ocean biota is among the most distinctive on Earth. It contains a very high level of endemism in many taxonomic groups, reflecting relative isolation of the fauna since the formation of the Polar Front zone (Clarke and Crame, 1989). A large fraction of the Antarctic siliceous microfossil planktonic assemblage from the early Pliocene consists of endemic species (Barron and Baldauf, 1989; Abelmann et al., 1990). If significantly

warmer waters had displaced cold Antarctic waters far to the south during the Pliocene, the Antarctic biota would have lost much of its endemism. Instead, biotic exchange between Antarctica and lower latitudes has been very limited. For instance, Antarctic waters have been marked by strong endemic radiolarian faunas since the middle Miocene (Lazarus and Caulet, 1993). The modern Antarctic invertebrate and vertebrate fauna contain abundant taxa exhibiting considerable specialization to the environmental extremes, suggestive of long-term environmental stability. Such stability is also suggested by within-site invertebrate diversity as high as anywhere in the world (Clarke and Crame, 1989). Pliocene warming must have been of insufficient magnitude to reverse developing endemism of the Antarctic biota, including plankton (Barron and Baldauf, 1989; Abelmann et al., 1990; Lazarus and Caulet, 1993).

Terrestrial Vegetation: Marine Sediment Evidence

Except for occasional reworked palynomorphs, pollen and spores are absent in late Neogene Southern Ocean sequences (Burckle and Pokras, 1991). If major deglaciation had occurred during the Pliocene, it is likely that vegetation would have been present, at least in coastal areas, supplying pollen and spores to nearby marine sediments. This would be expected especially if the fossil vegetation associated with high-altitude Sirius deposits is of Pliocene age as interpreted by Webb and Harwood (1991). No evidence of terrestrial vegetation has been found in numerous sites drilled close to the continent. The youngest pollen assemblages reported from Antarctica that unequivocally reflect coeval continental vegetation are Oligocene in age (Truswell, 1986; Mildenhall, 1989). The absence of Neogene pollen has generally been interpreted to reflect the demise of continental vegetation during the middle Cenozoic in response to the development of the Antarctic cryosphere (Truswell, 1986).

Ice Sheets continued on p. 13

Penrose Conference Scheduled

The Argentine Precordillera: A Laurentian Terrane?

October 14–20, 1995

A Geological Society of America Penrose Conference, "The Argentine Precordillera: A Laurentian Terrane?" and associated field trips will be held October 14 to 20, 1995, in San Juan, Argentina, in the foothills of the Argentine Precordillera. It will be followed immediately by a related 1–2-day conference in Jujuy, Argentina, and a 5-day trans-Andean field trip across northern Argentina and Chile sponsored by IGCP Project 376 (Laurentia-Gondwana Connections Before Pangaea). (For information about the Jujuy conference, contact Victor Ramos, Dept. de Geología, Universidad de Buenos Aires, Ciudad Universitaria, 1428 Buenos Aires, Argentina; E-mail: ernesto@geotec.uba.ar.)

The main objective of the Penrose Conference will be to review in the

field, and discuss in San Juan, the evidence for the hypothesis that the early Paleozoic age rocks in the provinces of San Juan and Mendoza are parts of an exotic terrane displaced from eastern or southeastern Laurentia during the Ordovician. These rocks represent Cambrian and Early Ordovician age carbonate bank and adjacent slope-facies sediments similar in stratigraphy and faunas to coeval rocks of eastern or southeastern Laurentia. Recently, Grenville ages for the basement of this terrane have been determined, and Ordovician (Iapetus) K-bentonites have been found, further supporting the connection to eastern or southeastern Laurentia. Paleomagnetic data are consistent with a possible collision of eastern Laurentia with western Gondwana in the Ordovician. The Ouachita

margin of Laurentia has been proposed as a source for the exotic terrane.

Confirmation of an eastern or southeastern Laurentian source for this terrane and the timing of its transfer to Gondwana will radically alter conventional understanding of global early Paleozoic paleogeography, paleoenvironmental development, and tectonics prior to the assembly of Pangaea.

The conference will bring together an international group of geologists best equipped to evaluate the hypotheses discussed above. This group will include North American geologists familiar with the Cambrian and Ordovician faunas and depositional systems and the early Paleozoic tectonics of the Appalachian and Ouachita orogens, and Argentine and European geologists familiar with the stratigraphy and faunas of the exotic terrane and the tectonics of the early Paleozoic orogen adjacent to its inboard margin.

Participation in the conference will be limited to about 70 persons. The conference fee, which is not yet determined, will include registration, food and lodging, and field trip costs. Lim-

ited support is planned for qualified graduate students.

Formal invitations will be mailed in May 1995. Co-conveners of the conference are: **Ian W. D. Dalziel**, Institute for Geophysics, University of Texas at Austin, 8701 N. Mopac Blvd., Austin, TX 78759-8397, (512) 471-0431, fax 512-471-8844, E-mail: ian@utig.ig.utexas.edu; **Allison R. (Pete) Palmer**, Institute for Cambrian Studies, 445 N. Cedarbrook Rd., Boulder, CO 80304-0417, (303) 443-1375, fax 303 443-1375, E-mail: palmera@spot.colorado.edu; **Luis H. Dalla Salda** and **Carlos A. Cingolani**, Centro de Investigaciones Geológicas, University of La Plata, calle 1 Nro. 644, 1900 La Plata, Argentina, fax 54-21-25-8696.

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 as to what your interest and experience have been with regard to the conference topic. Send applications to Ian W. D. Dalziel at address above. ■

CONCLUSIONS

Marine sediments contain a compelling range of evidence indicating that ocean and terrestrial climates of Antarctica and the Southern Ocean remained cold and relatively stable during early Pliocene global warmth and that Antarctica did not experience major deglaciation. We suggest that isotopic and other data from deep-sea sediments are inconsistent with a two-thirds ice volume decrease ($\approx > 47$ m sea-level rise) and 5 °C high-latitude surface-water warming advocated by the deglaciation hypothesis (Webb and Harwood, 1991). Antarctic surface-water temperatures are unlikely to have increased by more than ~3 °C. Significant warming in the Arctic during the Pliocene is not matched by equivalent warming in the Antarctic. The relative robustness of the late Neogene Antarctic climate system is supported by modeling experiments by Robin (1988), who suggested that the Antarctic cryosphere expands in steps due to

feedback loops that drive the system toward greater stability. Thus, once a large ice sheet is formed, it will not disappear unless climate becomes much warmer than during its formation.

We believe that with the formation of both ice sheets by the end of the Miocene, the modern Antarctic cryosphere-ocean system became well established (Kennett, 1977). The deep-sea sediment record from the Southern Ocean supports relative stability of the Antarctic cryosphere-ocean system since the late Miocene. This interpretation is in conflict with the deglaciation hypothesis. We suggest that an assigned late Pliocene age for the Sirius Group requires reevaluation, since this is the foundation of the deglaciation hypothesis. Studies are also required to establish alternative mechanisms for the emplacement of late Neogene diatoms in Sirius Group outcrops.

ACKNOWLEDGMENTS

Our studies on Antarctic paleoenvironmental evolution at the University of California, Santa Barbara, and the

University of Florida are funded by the National Science Foundation and have benefited from long association with the Deep Sea Drilling Project and the Ocean Drilling Program. We appreciate useful critical reviews by Margaret L. Delaney and Eugene W. Domack, and helpful discussions with many colleagues.

REFERENCES CITED

- Abelmann, A., Gersonde, R., and Speiss, V., 1990, Pliocene-Pleistocene paleoceanography of the Weddell Sea—Siliceous microfossil evidence, *in* Bleil, U., and Thiede, J., eds., *Geological history of the polar oceans: Arctic versus Antarctic*: Amsterdam, Kluwer, p. 729–759.
- Alonso, B., Anderson, J. B., Diaz, J. I., and Bartek, L., R., 1992, Pliocene-Pleistocene seismic stratigraphy of the Ross Sea: Evidence for multiple ice sheet grounding episodes: Contributions to Antarctic Research, v. 3, Antarctic Research Series 57, p. 93–103.
- Barrett, P. J., 1991, Antarctica and global climate change: A geological perspective, *in* Harris, C., and Stonehouse, B., eds., *Antarctica and global climate change*: Boca Raton, Florida, Lewis Publishers, p. 35–50.
- Barrett, P. J., Adams, C. J., McIntosh, W. C., Swisher, C. C., and Wilson, G. S., 1992, Geochronologic evidence supporting Antarctic

deglaciation three million years ago: *Nature*, v. 359, p. 816–818.

Barron, J. A., and Baldauf, J. G., 1989, Tertiary cooling steps and paleoproductivity as reflected by diatoms and biosiliceous sediments, *in* Berger, W. H., et al., eds., *Productivity of the ocean: Present and past* (Dahlem Workshop Life Research Report, 44): Chichester, UK, John Wiley & Sons, p. 341–354.

Breza, J. R., 1992, High resolution study of ice-rafted debris, ODP Leg 120, Site 751 southern Kerguelen Plateau, *in* Proceedings of the Ocean Drilling Program, Scientific Results, Volume 120: College Station, Texas, Ocean Drilling Program, p. 207–221.

Burckle, L. H., and Pokras, E. M., 1991, Implications of a Pliocene stand of *Nothofagus* (southern beech) within 500 kilometres of the South Pole: *Antarctic Science*, v. 3, p. 389–403.

Cattle, H., 1991, Global climate models and Antarctic climatic change, *in* Harris, C., and Stonehouse, B., eds., *Antarctica and global climatic change*: Boca Raton, Florida, Lewis Publishers, p. 21–34.

Ciesielski, P. F., and Weaver, F. M., 1974, Early Pliocene temperature changes in the Antarctic seas: *Geology*, v. 2, p. 511–515.

Clapperton, C. M., and Sugden, D. E., 1990, Late Cenozoic glacial history of the Ross Embayment, Antarctica: *Quaternary Science Reviews*, v. 9, p. 252–272.

Ice Sheets continued on p. 22

Letter from Washington

Jill Schneiderman



I'm happy to have the opportunity to communicate with my colleagues about my activities and experiences up on Capitol Hill as GSA's 1994–1995 Congressional Science Fellow. For those readers unfamiliar with the program, the American Association for the Advancement of Science has, since 1973, administered the Congressional Science and Engineering Fellowship Program. During the first 20 years of the program, more than 500 scientists and engineers sponsored by 40 professional organizations worked as Fellows on the staffs of approximately 200 personal and committee offices in the House and Senate, and within the Congressional Budget Office, the Congressional Caucus for Women's Issues, the Congressional Research Service, and the Office of Technology Assessment. The purpose of the program is (1) to teach policy making to scientists by providing them an immediate role in legislative processes; (2) to train scientists to participate effectively in policy making; and (3) to bring science expertise to members of Congress.

Societies including the American Geophysical Union, American Veterinary Medical Association, Triangle Coalition for Science and Technology Education, Federation of American Societies of Food Animal Sciences, American Chemical Society, American Society of Mechanical Engineers, Soil Science Society of America, National Society of Professional Engineers, American Psychological Association, American Physical Society, American Institute of Physics, and Institute of Electrical and Electronics Engineers have sponsored 29 Fellows on Capitol Hill this year. We are a diverse lot: recent Ph.D.s, research scientists, educators, engineers, racetrack veterinarians, psychologists, and scientists embarking on careers in science policy.

"Science in the National Interest," President Clinton's August 1994 report that outlines goals for fundamental science and education, quoted Vassar College alumna Vera Rubin of the Carnegie Institution of Washington: "... scientists both in and outside of academia must take seriously their

mission to educate in science and science appreciation those who will and will not be scientists." This sentiment prompted me to apply for the GSA fellowship, for I believe that an interdisciplinary science curriculum integrating policy issues with investigations in natural sciences is critical for dynamic undergraduate science education. In my role as Congressional Science Fellow, I see myself as a liaison between government and the geoscience community working toward comprehension of policy and science issues in reciprocal arenas. I am eager to share this year's "insider's" view of the policy-making process with our colleagues and to articulate their potential role in it.

The first eight weeks of the fellowship included a three-week orientation, two weeks of placement interviews, one week at the annual GSA meeting, and two weeks learning my way around my new office. It has been tremendously eye-opening and thought-provoking. The orientation was an exhaustive introduction to the workings of the U.S. government, executive, legislative, and judiciary branches. Top-level policymakers explored with us topics including: domestic and international perspectives on post-Cold War science and technology policy; science and technology as instruments of foreign policy; historical perspectives on White House science advising; megascience projects and international cooperation; science and technology policy and U.S. economic competitiveness; science, technology, and global environmental issues; intellectual property rights; international security; executive branch and congressional budget processes; legislative process; congressional committees and floor procedures; lobbying the Congress; and communicating science policy news. What we tried to understand could have been at least a semester-long course in science policy. One education resource I recommend from this orientation is the film "An Act of Congress"; narrated by E. G. Marshall, it chronicles

the progress of legislation that led to passage of the Clean Air Act and conveys the excitement of science policy-making on Capitol Hill.

We lunched and spoke with Senator Jay Rockefeller (D—W. Va, Commerce, Science and Transportation committee) and Representative George Brown (D—Calif., Science, Space and Technology committee, chair); overloaded on resources available to us from the Congressional Research Service; visited and tried to absorb the mission of the Office of Technology Assessment, General Accounting Office, and White House Office of Science and Technology Policy; and toured the Old Executive Office Building, a magnificent Victorian building with mansard roofing constructed between 1871 and 1888 to house the State, War, and Navy departments.

After entertaining practical suggestions from former science Fellows on how to search for and locate a potentially stimulating office to work in for our fellowship year, we occupied an office in the Hart Senate Office Building and began the job interview process. We'd been advised to take our time and use the opportunity to educate ourselves through interviews about the structure, processes, and goals of Senate and House personal offices and committees. We began this process on September 22, two weeks before the end of the 103rd Congress. The interviews in congressional offices at that frantic moment afforded us a glimpse of the pace and agenda of politics in a waning Congress that we'd not have seen had we been Fellows beginning in an odd year (1993 or 1995). I interviewed with 15 personal offices (House and Senate) and four committees.

After weighing several options (there are always more offices looking for Fellows than there are Fellows to go around), I chose to work for Senator Tom Daschle (D—S. Dak.). He is a second-term Senator, not up for reelection, is co-chair of the Democratic Policy Committee, and serves on the following committees: Finance, Veterans' Affairs, Indian Affairs, Select Ethics, and Agriculture, Nutrition and Forestry. He also chairs the Subcommittee on Agricultural Research, Conservation, Forestry and General Legislation, which has jurisdiction over U.S. Forest Service lands. Since the number of staff in a Senator's office is a function

of state population, the number of staff working in Senator Daschle's office is relatively small. That fact guarantees that I will have substantial opportunities to work on a range of issues in a variety of venues. I am working closely with a legislative assistant responsible for environmental issues who is trained as a forest ecologist. Our complementary expertise will serve the Senator well as we work on policy issues grounded in a respectful appreciation of the earth as a system of interacting reservoirs: geosphere, hydrosphere, biosphere, and atmosphere. Though only two weeks into my assignment (as I write this), I've already done substantive work (reading, writing, reporting) on an ecosystem management bill for U.S. Forest Service land, a proposal to form a National Institute for the Environment, and legislation related to interstate transportation of municipal solid waste. We also anticipate working on mining law reform, Superfund, wetlands issues as part of a farm bill, pesticide legislation, and the Clean Water Act when the 104th Congress convenes this month (January 1995).

Campaign rhetoric was mean-spirited, wealthy candidates spent personal fortunes to get elected, and voters were cynical or lazy. Though free television time and postage for bona fide candidates and an election day holiday would alleviate pressures on candidates and voters, such simple measures were not taken. Still, approximately 59 new democracies have started since 1989, and most of them have chosen our system of government or a mixed system that includes substantial aspects of democracy. I look forward to using this forum as a means to engage our colleagues in considerations of the role of geoscientists in policy-making in what Sir Winston Churchill called "the worst form of government, except all those other forms that have been tried from time to time." ■

Jill S. Schneiderman, 1994–1995 GSA Congressional Science Fellow, is serving on the staff of Senator Thomas Daschle (S. Dak.). Schneiderman may be contacted at (202) 224-2321. The one-year fellowship is supported by GSA and by the U.S. Geological Survey, Department of the Interior, under Assistance Award No. 1434-94-G-2509. 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.



Flawn Gift will Support IEE

The Institute for Environmental Education will be the recipient of income from a Foundation fund established by Trustee and former GSA President Peter T. Flawn. In making this gift, which is part of GSA's Second Century Fund for Earth • Education • Environment, Peter Flawn stated he is persuaded that if the environmental movement is to be successful over the long term, it must be based on sound geological science. "I have been active with the Environmental Defense Fund and the Nature Conservancy, and I have concluded that they could profit from IEE's programs. The lack of basic information on the history of Earth and its processes must be addressed if we are to make sound public policy decisions," said Flawn in a letter accompanying the gift.

Peter Flawn is a graduate of Oberlin College, with graduate degrees from Yale University. Initially he was employed by the U.S. Geological Survey; later he joined the Texas Bureau of Economic Geology, where he was a research scientist and geologist for eleven years. He then served 10 years as director of the bureau, followed by 15 years at the University of Texas in both Austin and San Antonio, where he held a variety of positions, including director of the Division of Natural Resources and Environment, professor of Geological Sciences and Public Affairs, vice president, executive vice president, and president. He currently holds the title of president emeritus. In addition to the leadership role he has played at GSA, Flawn has been active in many



Peter T. Flawn

other earth science-related organizations such as AAPG, AGI, AASG, NAS, NAE, NRC, and SEG. He is a director of six corporations, including Global Marine, Harte-Hanks Communications, Radian, and Tenneco and has published six books and major reports plus 65 papers and articles. Peter Flawn and his wife Priscilla reside in Austin, Texas.

GSA President Dave Stephenson, a hydrogeologist and president of the environmental firm South Pass Resources, commented on the Flawn gift, "IEE is an important part of GSA's growing public outreach activities. The amount of sound scientific information that the Society can bring before the public is strictly limited by the funding available for these programs, and Pete Flawn's farsightedness in creating the Peter T. Flawn Endowment Fund enables us to go just that much further in filling this role in the environmental sector for which the Society is so uniquely qualified." ■

Foundation Trustees Meet in Seattle

The Foundation's Board of Trustees held its annual meeting during the GSA meeting in Seattle in October. The board voted to expand its number to ten trustees from the existing nine. In addition, the retirement of Trustee William Heroy at the conclusion of his five-year term, which has been in addition to his many prior years of service to GSA that included treasurer and member of the Committee on Investments, created two vacancies on the board. Trustees are chosen from a list of candidates approved by GSA Council. Selected as new trustees for five-year terms were Claire Davidson and Carel Otte. The board elected officers for the forthcoming year: Charles J. Mankin, Chair, Paul Bailly, Vice Chair, Robert L. Fuchs, President, Donald M. Davidson, Vice President, and Donna L. Russell, Secretary/Treasurer.

The board approved a 1995 operating budget of \$250,808, of which 50% will be directed toward Second Century Fund activities. The 1995 budget will support a Foundation staff of one full-time and three part-time employees.

Also on financial matters, the Trustees accepted a recommendation of the GSA Committee on Investments that the portfolios of GSA and the Foundation be pooled for investment purposes only, thus allowing more efficient money management and better overall portfolio performance. GSA staff members outlined the 1995 GSA budget for the Trustees.

Other business included a report on Second Century Fund progress by Foundation President Fuchs, with emphasis on the current Industry Support Program for Earth Science. The trustees suggested various sources of funding, for follow-up by the Second Century Fund Committee and the Foundation staff. Education Coordinator Ed Geary reviewed the SAGE program, and IEE Executive Director Fred Donath discussed the results of the recently held IEE media training workshop, along with ideas for expanding this kind of activity. The Board heard a proposal that described a new Smithsonian/IMAX film—"The Making of America." ■

Donors to the Foundation—October 1994

Archaeological Geology Division Award
Sharon A. Geil

Claude C. Albritton, Jr. Memorial
Charles F. Berkstresser, Jr.
Bonnie A. Blackwell
Arthur A. Socolow

Biggs Excellence in Earth Science Education
Erlece P. Allen
Charles F. Berkstresser, Jr.
James D. Greybeck
F. D. Holland, Jr.
James F. Prescott

Allan V. Cox Student Research
John W. Geissman
Judson Mead*

Doris M. Curtis Memorial
John D. Bloch
Peter J. Hutchinson
Robert A. Larson
Alan F. Thomson
DeWitt VanSiclen

John T. Dillon Alaska Research Award
David D. Adams

Shirley J. Dreiss Memorial
Carolyn S. DeVine
John A. Dracup*
Steve Ingebritsen*
Leslie Smith
Riley and Virginia Woodson

Dwornik Planetary Geoscience Award
Jay F. Piper

Engineering Geology Division Award
Robert A. Larson

John C. Frye Environmental Award
Charles F. Berkstresser, Jr.
Robert A. Larson
Shinjiro Mizutani

GEOSTAR
Charles F. Berkstresser, Jr.
H. Basil S. Cooke
Jack E. Harrison
Nancy Lindsley-Griffin
David W. Moore
Walter C. Pusey, III
Virgil D. Winkler
Hiromitsu Yamagishi

History of Geology Division Award
Charles F. Berkstresser, Jr.
Arthur Mirsky*
Sarah E. Newcomb

Arthur D. Howard Fund
Hans H. Renz
Richard L. Threet

Hydrogeology Division Award Fund
Charles F. Berkstresser, Jr.

Institute for Environmental Education
Charles F. Berkstresser, Jr.
Donald F. Goodell

Robert A. Larson
Arthur Mirsky*
Charles Woodruff, Jr.*

J. Hoover Mackin Award
Thomas L. T. Grose
Richard F. Madole
Richard L. Threet

Carol G. and John T. McGill Fund
William Barry

Antoinette Lierman Medlin Scholarship
Lawrence L. Brady
Lindgren Chyi
Richard F. Meyer

Minority
Charles F. Berkstresser, Jr.
Donald F. Goodell
Jay F. Piper

Penrose Conferences
Charles F. Berkstresser, Jr.
Walter C. Pusey, III

Rip Rapp Archaeological Geology Award
Arthur Mirsky*

Bruce L. "Biff" Reed Scholarship
Bradford D. Pearson*

Research Grants
Charles F. Berkstresser, Jr.
Drew M. Clemens
James C. Cole
Cynthia A. Evans
Michael Garcia
William K. Hart
Roscoe Jackson, III*
James Lawrence
Stephen F. Lintner
Tom Parsons
Frank M. Schneider
James R. Shannon
Stephen J. Urbanik

SAGE
Charles F. Berkstresser, Jr.
Rachel Cowan
Cynthia A. Evans
Donald F. Goodell
Peter L. Kresan
Barbara H. Murphy
Edmondo Sugar
David L. Warburton
W. Arthur White

Second Century Fund
Katharine Fowler Billings*
Marland P. Billings*
Boettcher Foundation*
Peter T. Flawn*
Christopher C. Mathewson*
Christine and T. Michael Moreland*
Dorothy M. Palmer
Leon T. Silver*
David A. Stephenson*
John Wiley & Sons, Inc*

Unrestricted—GSA Foundation
Mamoru Adachi
J. Kaspar Arbenz
Thomas D. Barrow*
Michael Boran*
William P. Brosge

Virginia P. Byers
Victor Colombini
John H. Eric
Parrish N. Erwin, Jr.
Steven P. Esling
Robert Folinsbee*
John E. Frost
Sharon A. Geil
Yasuo Ikeda
Allen H. Johnson
Robert B. Johnson
Charles E. Kirschner
Phillip S. Kistler
Robert E. Lauth
Edmund Livingston
Lawrence E. Mannion
Scott L. Manske
Ann G. Metzger
Arthur Mirsky*
Eldridge Moores*
Siegfried Muessig
Jack E. Oliver*
Walter C. Pusey, III
Robert R. Remy
Charles Seedorff*
Richard H. Sibson
George C. Soronen
David J. Springer
Charles H. Summerson*
Christopher J. Talbot
Roger D. K. Thomas
William Thordarson
Gary W. Wallace
John W. Webb
Donald E. White
Matthew Willis
Virgil D. Winkler
Anthony K. Yeo
Frederick Young

Unrestricted—GSA
Wayne Belcher
Charles F. Berkstresser, Jr.
Lawrence Chasteen
Ernest Dobrovolny
Peter A. Drobeck
Garth R. Edwards
Judy Ehlen
Rud A. Gees*
Sharon A. Geil
William C. Gussow
William P. Hewitt
James D. Hume
E. Dean B. Laudeman
Benedikt L. Lehner
Marvin D. Mangus
Maurice J. Mundorff
Yujiro Ogawa
D. P. Price
David S. Robertson
Robert M. Rohlf
John E. Szatai
Irvin L. Tailleru
Herbert Tischler
Laurence Trudell
Virgil D. Winkler
Gordon A. Young

Women In Science
Charles F. Berkstresser, Jr.
James C. Cole
Cynthia A. Gardner
Corolla K. Hoag

* Century Plus Roster (gifts of \$150 or more)

Thanks from Alaska

The Department of Geology and Geophysics at the University of Alaska, Fairbanks, thanks the many geoscientists around the country who expressed their support during its recent crisis. In part due to this large outpouring of support, the department has been reinstated by the university administration, and looks forward to hosting the GSA Cordilleran Section during May 1995.

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

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

Foundation—Unrestricted Institute for Environmental Education
 GSA—Unrestricted

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

I am interested in establishing a fund at the GSA Foundation that would provide future support for outreach programs such as IEE or SAGE. Please contact me.

PLEASE PRINT

Name _____

Address _____

City/State/ZIP _____

Phone _____

Final Announcement

SOUTHEASTERN SECTION, GSA 44th Annual Meeting

**Knoxville, Tennessee
April 6-7, 1995**



The 1995 Southeastern Section Meeting of the Geological Society of America will be hosted by the Department of Geological Sciences at the University of Tennessee, Knoxville, in cooperation with the Oak Ridge National Laboratory and the Tennessee Division of Geology. Affiliated organizations meeting concurrently are the Southeastern Section of SEPM, the Southeastern Section of the National Association of Geology Teachers (NAGT), and the Southeastern Section of the Paleontological Society.

SETTING

Knoxville (population 335,000, including adjacent Knox County) is situated in the Valley and Ridge province of east Tennessee, northwest of the Great Smoky Mountains and southeast of the Cumberland Plateau. The city is home to the main campus of the University of Tennessee and is just a few miles from Oak Ridge, the site of Oak Ridge National Laboratory and other Department of Energy installations, and from Gatlinburg, the gateway to the Great Smoky Mountains National Park. The Southeastern Section meeting will be held in the downtown **Knoxville Hilton**, which is within easy walking distance of the university and numerous restaurants.

TRAVEL TO KNOXVILLE

Knoxville is easily reached by car via interstate highways I-40, I-75, and I-81, or by air through McGee-Tyson Airport. Airline service is provided by Delta, USAir, United, and Northwest, and several commuter airlines. Most major car rental firms are located at the airport, and the Hilton provides free shuttle service to the hotel hourly.

REGISTRATION

**Preregistration Deadline:
March 3, 1995**

If you preregister, you will not have to wait in long registration lines to pick up materials in Knoxville because badges will be **mailed** within two weeks prior to the meeting. Save yourself time and money—preregister today!

1. There is a savings in fees if you register by the preregistration deadline! Advance registration is suggested for many of the special activities because of participation limits. Use the preregistration form provided in this announcement.

2. Badges must be worn for access to **ALL** activities, 7:00 a.m. Thursday through 11:00 a.m. Friday.

3. Registration discounts are given to members of both GSA and the associated societies listed on the preregistration form. Please indicate your affiliation(s) to register using the member rates.

REGISTRATION FEES		
	Advance*	On-site
Professional—		
Member	\$55	\$65
Nonmember	\$60	\$65
Student—		
Member	\$15	\$20
Nonmember	\$17	\$25
K-12 Earth		
Science Teachers	\$15	\$20
Guest or Spouse	\$10	\$10

*Deadline is March 3, 1995.

4. Full payment **MUST** accompany preregistration form. Unpaid purchase orders are **NOT** accepted as valid registration. Charge cards are accepted as indicated on the preregistration form. If using a charge card, please recheck the card number given. Errors will delay your registration. The confirmation card will be your receipt for charge-card payments. No other receipt will be sent.

5. Register one professional or student per form. Copy the form for your records.

6. Guest registration is required for those attending guest activities, technical sessions, or the exhibit hall. Guest registrants **MUST** be accompanied by either a registered professional or student. A guest is defined as a nongeologist spouse or friend of a professional or student registrant.

7. Students and K-12 teachers must show a **CURRENT ID** in order to obtain these rates. Students or teachers not having a current ID when registering on site will be required to pay the professional fee.

8. Due to the mailing of badges, it is imperative that **ALL** preregistrations are **RECEIVED** by the preregistration deadline of March 3. All registrations received after March 3 will be held for on-site processing and charged the on-site rates.

9. To leave a message for an attendee at the meeting, dial (615) 523-2300, ext. 353.

Cancellations, Changes, and Refunds

All requests for registration additions, changes, and cancellations must be made in writing and received by March 3, 1995. GSA will refund or credit preregistration fees for cancellations received in writing by March 3. **NO REFUNDS WILL BE MADE ON CANCELLATION NOTICES RECEIVED AFTER THIS DATE.** Refunds will be mailed from GSA after the meeting. Refunds for fees paid by credit card will be credited according to the card number on the preregistration form. There will be **NO** refunds for on-site registration and ticket sales.

On-Site Registration Schedule

Knoxville Hilton Lobby
Wed., April 5 4:00 p.m. to 7:00 p.m.
Thur., April 6 7:30 a.m. to 4:30 p.m.
Fri., April 7 7:30 a.m. to 11:30 a.m.

Accessibility For Registrants With Special Needs

GSA is committed to making the Southeastern Section Meeting accessible to all people interested in attending. If you need any auxiliary aids or services because of a disability, check the appropriate box on the registration form. If you have suggestions or need further information, contact Tami

Krull, GSA headquarters. Please let us know your needs by March 3, 1995.

ACCOMMODATIONS

A block of 175 rooms at the Knoxville Hilton, site of the meeting, has been reserved for attendees, at a special reduced rate of \$79 per night for either single or double occupancy. There is an additional \$12 room charge for each person in excess of two. Attendees should make their own room reservations **before March 4**, by calling toll-free 1-800-HILTONS or by mailing the housing form provided in this announcement. *Reservations will be accepted only on a space-available basis at a higher rate after that date.* To reserve rooms by telephone, state your GSA connection and request a reservation number.

Parking. Meeting attendees who stay at the Hilton may park in the adjacent garage at no cost. Others may park in this garage on a space-available basis for a small charge, or use nearby commercial parking lots.

WELCOME PARTY

Various corporate sponsors will host a welcome party on Wednesday evening, April 5, from 6:00 to 8:00 p.m., at The Foundry in the World's Fair Park, only a short walk from the

Hilton. Light refreshments will be served, and a cash bar will be available. All attendees must register before the party.

TECHNICAL PROGRAM

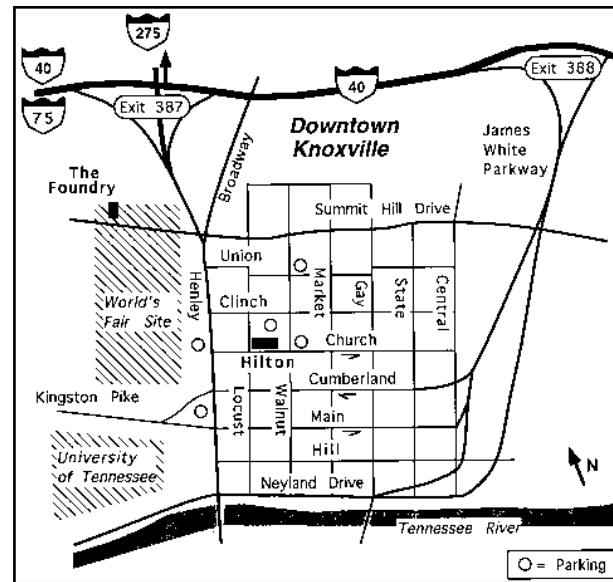
Thirteen symposia, with mostly invited papers, are planned for the meeting, along with several theme sessions. Please contact the conveners for more information. Additional sessions are scheduled for volunteered papers.

Symposia

- 1. Sequence Stratigraphy and Diagenesis of Lower Paleozoic Carbonates.** Sponsored by SEPM. Krishnan Srinivasan and Kenneth R. Walker (University of Tennessee), (615) 974-6017, E-mail: kwalker@freddy.gg.utk.edu.
- 2. Deformation Processes Associated with Plutons.** Robert D. Hatcher Jr. (University of Tennessee) and Richard D. Law (Virginia Tech), (615) 974-2366, E-mail: bobmap@utk.vx.utk.edu.

- 3. Energy and the Environment in the Next Century.** Sponsored by the Institute for Environmental Education. Otto C. Kopp (Uni-

Southeastern continued on p. 16



Knoxville Hilton Housing Form

**Southeastern Section • Geological Society of America
April 6-7, 1994**

In guaranteeing your reservation for a late arrival (arrival after 6:00 p.m.), we require that you do one of the following:

1. Make reservations by HILTRON. Call: 1-800-HILTONS (445-8667), fax 615-525-6832. To receive reduced convention rates use: **CODE-GSA**, or
2. Mail this form with a check or money order covering first night's stay, or provide below the ENTIRE number of your following credit card: American Express, MasterCard, VISA, Diners Club, Carte Blanche, or Discover. Faxes accepted if paying by credit card.

Don't forget the expiration date and your signature.

Accommodations Requested:

Single occupancy (one bed) \$79 Double occupancy (two beds) \$79
There is a \$12.00 per person charge for all rooms with more than two persons; rollaway beds are an extra charge.

Check-out time is 12 noon. Rooms may not be available for check-in until after 3:00 p.m. All reservations subject to local room tax.

The special convention room rate applies during the period April 4-8. Your reservation must be received prior to **March 3, 1995**, and before the group reservations block is filled to assure room accommodations.

Name _____
Address _____
City _____ State/Province _____ ZIP _____
Phone () _____ **Convention Code: GSA**
Arrival on: _____ Departure on: _____
Reserve: _____ rooms(s) for _____ people.
Name(s) of person(s) sharing accommodation: _____
Type of card _____ Card Number _____
Exp. date _____ Signature _____

Send this form and remittance or credit card information to:
Knoxville Hilton, 501 Church Ave. S.W., Knoxville, TN 37902, (615) 523-2300

Southeastern continued from p. 15


University of Tennessee), (615) 974-6399, E-mail: otto@freddy.gg.utk.edu.

4. Disturbance-driven Ecosystems and Biotic Change. Sponsored by the *Paleontological Society*. Michael Gibson (University of Tennessee, Martin) and Douglas Jones (University of Florida Natural History Museum), (901) 587-7430.

5. Geology of Appalachian Coals. James Hower (University of Kentucky Center for Applied Energy Research), (606) 257-0261.

6. Successful Earth Science Teaching Requires "The Right Stuff." Cosponsored by *NAGT* and *GSA Southeastern Section Education Committee*. Don Byerly (University of Tennessee), (615) 974-6007, E-mail: byerly@utkvx.utk.edu.

7. Quantitative Assessments of Metamorphism: Pressure, Temperature, P-T-t, Reaction Progress, and Fluid-Rock Interactions. Loren Raymond (Appalachian State University) and Robert Tracy (Virginia Tech), (704) 262-3049.

 **8. Communicating Geologic Information with Decision Makers and the Public in the Southeast.** Sponsored by the *Institute for Environmental Education*. Dan Walker and Jeffrey Reid (North Carolina Geological Survey), and Stephen H. Stow (Oak Ridge National Laboratory), (615) 594-7830.

9. Paleosols and Paleokarst of the Southeastern U.S.; Genesis and Implications. Sponsored by *SEPM*. Michael Caudil and Steven G. Driese (University of Tennessee), (615) 974-2366, E-mail: driese@utkvx.utk.edu.

10. Great Ideas from Great Professors: Tips for Teaching Introductory Geology. Cosponsored by *NAGT* and *GSA Southeastern Section Education Committee*. Molly Miller (Vanderbilt University) and Gail Russell (University of Southern Mississippi), (615) 322-2976.

11. Mercury Transport and Transformation in the Subsurface. Ralph Turner (Oak Ridge National Laboratory), (615) 574-7856, and Kula Misra (University of Tennessee).

12. Old Wine in New Bottles: The Impact of New Ideas in Southeastern Geology on Ore Depositional Models. Dennis LaPoint (Appalachian Resources), (919) 408-0069, and Geoffrey Feiss (University of North Carolina at Chapel Hill).

13. Regoliths in the Appalachian Highlands Beyond the Wisconsinian Glacial Borders. G. Michael Clark (University of Tennessee), Hugh Mills (Tennessee Tech), and J. Steven Kite (West Virginia University), (615) 974-6006.

14. Assembly and Dispersal of Supercontinents. Nicholas Rast (University of Kentucky), (606) 257-3758.

Theme Sessions

Theme sessions provide a focus for volunteered sessions on specific topics. The following theme sessions are planned.

1. Paleogene Paleontology of the Southeast United States and Gulf of Mexico Rim. Jon Bryan (Okaloosa-Walton Community College) and Richard Fleugeman (Ball State University), (904) 729-5376.

2. The Contributions of Strain to the Formation of the Appalachian Foreland Thrust Belts. William Dunne (University of Tennessee), (615) 974-6005, E-mail: bill@tanasi.gg.utk.edu.

3. Hydrogeology and Hydrogeochemistry of Sapolite. William Sanford (Oak Ridge National Labora-

tory), (615) 576-3464, E-mail: w70@ornl.gov.

4. Contaminant Hydrogeology. Larry McKay (University of Tennessee), (615) 974-0821, E-mail: mckay@freddy.gg.utk.edu.

5. Measurement of Physical and Chemical Parameters in Hydrogeology. William Sanford (Oak Ridge National Laboratory), (615) 576-3464, E-mail: w70@ornl.gov.

PROJECTION EQUIPMENT

All slides must be 2" x 2" and fit a standard 35-mm carousel tray. Please bring your own loaded carousel trays, if possible. Two 35-mm slide projectors, one overhead projector, and two screens will be available for each oral technical session. Label trays with your name, session, left or right screen, and time of paper; give trays to the projectionist at least 20 minutes prior to the beginning of the session. A speaker ready room for previewing slides will be provided.

POSTER SESSIONS


Four half-day poster sessions are planned. Poster booths will be framed by pipe and drape and have three 4' x 8' panels.

The Council for Undergraduate Research will sponsor a student poster session, convened by Jack Beuthin (University of Pittsburgh, Johnstown) to showcase senior theses and other undergraduate research projects.

SPECIAL LECTURE

The Environmental Sciences Division of Oak Ridge National Laboratory will sponsor a special lecture at the conclusion of technical sessions on Thursday afternoon, April 6, at 5:30 p.m. John A. Cherry of the University of Waterloo Centre for Groundwater Research will present a lecture, "Field-Scale Experimental Studies of Contaminant Behaviour in Groundwater." This special presentation will be of interest to a broad spectrum of geoscientists and educators. Cherry is the coauthor of a widely used textbook on ground water and is the recipient of the GSA Meinzer Award and the AGU Horton Award for his research in hydrogeology.

WORKSHOP

 The GSA Institute for Environmental Education will sponsor an all-day workshop on public information and education techniques on Saturday, April 8. The workshop will provide attendees with insights and information on how to deal with all forms of media. See the IEE article on p. 9 of this issue for additional information.

EARTH SCIENCE EDUCATION PROGRAMS

Many undergraduate students will participate in a poster session sponsored by the Council for Undergraduate Research (see Poster Sessions).

Two symposia dealing with teaching introductory-level geology, sponsored by the National Association of Geology Teachers and the GSA Southeastern Section Education Committee, are also planned (see Symposia 6 and 10). In addition, a field trip featuring east Tennessee stratigraphy, structure, and economic geology is planned for K-12 teachers (see Field Trip 9).

SPECIAL ACTIVITIES

GSA Southeastern Section Management Board Meeting,

Wednesday, April 5, 4:30-6:00 p.m., Hilton Suite 319.

GSA Southeastern Section Campus Liaison Breakfast, Thursday, April 6, 6:30-8:00 a.m., Hilton Whispers Lounge.

SEPM Southeastern Section Business Meeting and Luncheon, Thursday, April 6, 12:00 noon, Hilton, room listed in program.

GSA Southeastern Section Committee on Geology and Public Policy Meeting, Thursday, April 6, 12:00 noon, Hilton, suite 319.

GSA Southeastern Section Business Meeting, Thursday, April 6, 5:00-5:30 p.m., Hilton Tanasee.

GSA Southeastern Section Ph.D.-Granting Earth Science Program Chairs Breakfast Meeting, Friday, April 7, 7:00-8:00 a.m., Hilton Market Restaurant.

Combined Breakfast Meeting of the GSA Southeastern Section Education Division and NAGT Officers and State Representatives, Friday, April 7, 7:00-8:00 a.m., Hilton Whispers Lounge.

Paleontological Society Southeastern Section Luncheon, Friday, April 7, 11:30 a.m., location to be announced.

EXHIBITS

Exhibits by business, educational, and governmental institutions will be located conveniently across from the technical session rooms in the Knoxville Hilton. Free beverages will be provided in the exhibit area for participants, and 24-hour security will be provided in the exhibit hall. The number of booths is limited, so plan to reserve space early. Exhibits will be open Thursday, 8:00 a.m.-1:00 p.m., and on Friday, 8:00 a.m.-1:00 p.m. For further information and space reservations, contact Larry McKay, Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-0821, E-mail: mckay@freddy.gg.utk.edu.

FIELD TRIPS

All field trip participants must register for the meeting. Field trip costs include transportation, guidebook (except trip 9), and other items listed in the description. Rates for overnight trips that include lodging assume double occupancy; requests for single occupancy (requiring an additional charge) must be coordinated in advance with the field trip leader. Registration procedures, the form, and deadlines are in this announcement. Registration at the meeting for postmeeting field trips may be possible if trip logistics and space permit. If trips are undersubscribed and canceled, participants will be notified no fewer than 10 days before the meeting, and all field trip fees will be refunded after the meeting. Be aware of cancellation penalties imposed by the airlines. Plan alternatives in advance should the trip you are registered for be canceled. There will be no refunds if participants fail to show up on time for reasons other than serious illness or other emergency. Sponsoring agencies assume no liability whatsoever for failure of participants to show for a trip, for missed connections, or for injury, loss, or damage during or resulting from transportation on the field trips. *The number of participants on most trips is limited, so register early.* Further information, will be sent to trip participants at a later date. The field trip coordinator is William M. Dunne, Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-6005, E-mail: bill@tanasi.gg.utk.edu.

Premeeting

1. Geology and Hydrology of the Department of Energy's Oak Ridge Reservation and Associated Waste Management Issues. April 5. RaNaye Dreier, Peter Lemiszki, and Stephen H. Stow, Environmental Sciences Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6036, (615) 574-7422, E-mail: rdo@stc10.ctd.ornl.gov.

Hydrogeology, historical disposal methods, and innovative remediation and ground-water monitoring activities. Cost: \$30, including transportation, lunch, and guidebook. United States citizenship is required for participation. Limit: 40.

2. Deformation Processes Related to Emplacement of the Rabun Granite in the Eastern Blue Ridge, Georgia and North Carolina. April 4-5. Robert D. Hatcher Jr., Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-2366, E-mail: bobmap@utkvx.utk.edu; Calvin F. Miller, Department of Geology, Vanderbilt University, Nashville, TN 37235; and Dwight Lamb, University of Tennessee.

A multiply deformed early Paleozoic pluton that contains several intrusive phases (early? tonalite and two-mica granite, and later megacrystic adamellite) that record a complex emplacement history. Cost: \$180, including transportation, two nights lodging (double occupancy), two lunches, and guidebook. Limit: 25.

Postmeeting

3. Waulsortian-like Bioherms of Maury and Fort Payne Formations, Tennessee. April 8-9. Frank Stapor and Larry Knox, Department of Earth Sciences, Tennessee Technological University, Box 5062, Cookeville, TN 38505, (615) 372-3121.

Lithofacies, stratal geometries, and fossil communities of Waulsortian-like bioherms in these formations in north-central Tennessee. Cost: \$120, including transportation, two nights lodging (double occupancy), meals, and guidebook. Limit: 24.

4. Late Silurian-Early Devonian Sedimentary Facies and Biotas from the Southern North American Craton (Tennessee). April 7-9. Sponsored by the *Paleontological Society*. Thomas Broadhead, Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-6002, E-mail: broadhea@utkvx.utk.edu; and Mike Gibson, University of Tennessee, Martin.

Invertebrate biotas across the Silurian-Devonian boundary, biotic interactions, organic buildups, and taphonomy. Cost: \$100, including transportation, two nights lodging (double occupancy), and guidebook. Limit: 20.

5. Stratigraphic and Structural Relations in the Western Blue Ridge of Tennessee and North Carolina. April 8-9. Mark W. Carter, Robert D. Hatcher Jr., Steven Martin, and Don Geddes, Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-2366, E-mail: bobmap@utkvx.utk.edu.

Late Proterozoic(?)—early Paleozoic Laurentian margin stratigraphy across western Blue Ridge frontal thrust sheets in southeastern Tennessee. Cost: \$125, including transportation, two nights lodging (double occupancy), two lunches, one dinner, and guidebook. Limit: 24.

Southeastern continued on p. 17

6. The Grandfather Mountain Formation (Neoproterozoic) of Northwestern North Carolina: Clast Provenance and Architecture of Five Coarsening-Upward Sequences. April 8-9. Michael Neton, Geological and Environmental Services (GES) Inc., 701 Cherokee Boulevard, Suite G, Chattanooga, TN 37405-3303, (615) 756-8020; and Loren Raymond, Department of Geology, Appalachian State University, Boone, NC 28608.

Spectacular exposures highlighting possible source rocks of the Grandfather Mountain Formation. To our knowledge, many of these outcrops have never been viewed on any previous Grandfather Mountain window field trips. Cost: \$100, including transportation, two nights lodging (double occupancy), two lunches and one dinner, and guidebook. Limit: 27.

7. Understanding the Evolution and Sequence Stratigraphy of a Cambrian Platform Carbonate Succession, Southern Appalachians. April 8. Sponsored by SEPM. Kenneth R. Walker, Srinivasan Krishnan, and Bosiljka Glumac, Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-6017, E-mail: kwalker@freddy.gg.utk.edu.

Depositional environments and sequence stratigraphy of carbonate units, each representing a carbonate platform, to show how the platforms evolved, prograded, and finally were drowned by deeper water deposits. Cost: \$40, including transportation and guidebook. Limit: 24.

8. Coal Geology in Kentucky and West Virginia. April 8-9. James Hower and Cortland Eble, Center for Applied Energy Research, 3572 Iron Works Pike, Lexington, KY 40511-8433, (606) 257-0261.

Petrography, palynology, and coal origins in the Breathitt Formation. Cost: \$130, including transportation, two nights lodging (double occupancy), all meals except Friday dinner, and guidebook. Limit: 30.

9. East Tennessee Geology for K-12 Earth Science Teachers. April 8. Cosponsored by NAGT and the GSA Southeastern Section Education Committee. Don W. Byerly, Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-6007, E-mail: byerly@utkvx.utk.edu.

Mineral and fossil collecting in the Sweetwater Mining District, as well as photogenic stops that illustrate the classic stratigraphy and structure of East Tennessee, to provide teachers with opportunities to collect classroom materials and to interact with other teachers. Cost: \$18, including transportation. Limit: 25.

GUEST ACTIVITIES

The Knoxville area offers the Knoxville Museum of Art, the University of Tennessee McClung Museum, the American Museum of Science and Energy in Oak Ridge, the Museum of Appalachia, the Knoxville Zoo, the Candy Factory and Victorian Houses, the East Tennessee Historical Center/Custom House, Ijams Nature Center, and various cultural and sports events at the University of Tennessee. The two organized guest activities are listed below. *Guests are strongly encouraged to preregister for these activities, as they will be canceled if there is not sufficient interest.* Fees for canceled trips will be refunded after the meeting. Guests must be preregistered for the Thursday trip, but may sign up for the Friday trip

on Thursday before 10:00 a.m. (if space permits) at the registration desk in the Hilton lobby.

1. Pigeon Forge. Thursday, April 6. East Tennessee's outlet mecca, including Red Roof Mall, lunch at the Applewood Restaurant (and winery), and Five Oak Outlet Mall. Cost: \$23, including travel, guide, and lunch. Limit: 45.

2. Museum of Appalachia. Friday, April 7. Tennessee's pioneer culture and mountain-folk heritage: log cabin village, picnic lunch, and Craft and Antique Shop. Cost: \$25, including travel, guide, admission to museum, and box lunch. Limit: 45.

PUBLICATIONS

A limited number of the *Abstracts with Programs* publication for the meeting will be available at on-site registration. To guarantee a copy for on-site pickup, please order one when you preregister. Advance-copy purchases made through GSA Membership or Publication Sales require prepayment and will be mailed approximately

three weeks prior to the meeting. Refunds for duplicate orders will not be made.

Field trip guidebooks for trips 1, 2, 3, 5, 6, and 7 will be bound together as a volume of *University of Tennessee Studies in Geology*. The guidebook for trip 4 will be published as a separate issue of *Studies in Geology*, and the guidebook for trip 8 will be published by the Kentucky Geological Survey. Field trip participants will receive guidebooks as part of their registration fee, but other conference participants may order the multi-trip guidebook as part of their preregistration for pickup on-site, and a limited number of guidebooks will be on sale (\$10) at the on-site registration area. After the meeting, guidebooks (except for trip 8) may be purchased through the Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410.

STUDENT TRAVEL GRANTS

Limited funds for support of travel expenses for students presenting papers

at the meeting are available from the GSA Southeastern Section. For information, contact Michael J. Neilson, Department of Geology, University of Alabama, Birmingham, AL 35294, (205) 934-5102. Travel grant requests must be post-marked not later than March 6, 1995.

OTHER INFORMATION

For detailed information concerning the technical programs, contact Robert D. Hatcher Jr., Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-2238, fax (615) 974-2368, E-mail: bobmap@utkvx.utk.edu. For other questions and suggestions, contact the local program chair, Harry Y. McSween, Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410, (615) 974-5498, fax (615) 974-2368, E-mail: mcsween@utkvx.utk.edu ■

Preregistration Form

GSA Southeastern Section

Preregistration deadline is March 3, 1995. Knoxville, TN • April 6-7, 1995

Please print clearly. Copy for your records.

Name (last) _____ (first name/nickname as it should appear on badge)

Employer/University (affiliation as it should appear on badge) _____

Employer/University mailing address for Employer/University above _____

City _____ State _____ ZIP Code _____

Country (other than USA) _____ Business Phone _____ Fax _____ Home Phone _____

Spouse/Guest Name (last) _____ (first name/nickname as it should appear on badge)

City/State _____ Country _____

Please inform us by March 3 of any special considerations that you or your guest require.

I will need special considerations. Please call me.

Circle member affiliation (to qualify for registration member discount*):

(A) GSA
(B) SEPM
(C) PS
(D) NAGT

PREREGISTRATION Required for participating in all activities.	Rate	Qty	Amount
Professional Member* (circle affiliation above)	(01) \$55 <input type="checkbox"/>	1	\$ _____
Professional Nonmember	(03) \$60 <input type="checkbox"/>	1	\$ _____
Student Member* (circle affiliation above)	(05) \$15 <input type="checkbox"/>	1	\$ _____
Student Nonmember	(07) \$17 <input type="checkbox"/>	1	\$ _____
K-12 Earth Science Teacher	(42) \$15 <input type="checkbox"/>	1	\$ _____
Guest (per guest listed above)	(09) \$10 <input type="checkbox"/>	_____	\$ _____

*Member fee applies to any professional or Student Member of GSA or Associated Societies listed above. Discount does not apply to guest registrants.

GUEST PROGRAM			
1. Pigeon Forge	April 6	(20) \$ 23	_____ \$ _____
2. Museum of Appalachia	April 7	(21) \$ 25	_____ \$ _____

PUBLICATIONS			
<i>Abstracts with Programs</i>	(301)	\$ 10	_____ \$ _____
Field Trip Guidebook for Trips 1, 2, 3, 5, 6, 7 for on-site pickup.	(200)	\$ 10	_____ \$ _____

(Published as *UT Studies in Geology*. Field trip participants automatically receive guidebooks.)

FIELD TRIPS			
1. Geology and Hydrology of Oak Ridge Reservation	April 5	(101) \$ 30	1 \$ _____
2. Deformation and Emplacement of the Rabun Granite	April 4-5	(102) \$ 180	1 \$ _____
3. Waulsortian Bioherms of Maury and Fort Payne Formations	April 8-9	(103) \$ 120	1 \$ _____
4. Silurian-Devonian Sedimentary Facies and Biotas	April 7-9	(104) \$ 100	1 \$ _____
5. Stratigraphic and Structural Relations in Blue Ridge	April 8-9	(105) \$ 125	1 \$ _____
6. Grandfather Mountain Formation: Clast Provenance	April 8-9	(106) \$ 100	1 \$ _____
7. Evolution, Sequence Stratigraphy of Cambrian Carbonates	April 8	(107) \$ 40	1 \$ _____
8. Coal Geology in Kentucky and West Virginia	April 8-9	(108) \$ 130	1 \$ _____
9. East Tennessee Geology for K-12 Teachers	April 8	(109) \$ 18	1 \$ _____

TOTAL FEES \$ _____

Remit in U.S. funds payable to: 1995 GSA Southeastern Section Meeting
(All preregistrations must be prepaid. Purchase Orders not accepted.)

Payment by (check one): Check American Express VISA MasterCard

Card Number _____

Signature _____ Expires _____

**MAIL TO: GSA SOUTHEASTERN SECTION MEETING,
P.O. BOX 9140, BOULDER, CO 80301**

FOR OFFICE USE

A _____ V _____ M _____

CK# _____

DR _____ CR _____

Bal. A/R _____

1233-12440 _____

Ref. A/P 2006 _____

Refund ck# _____

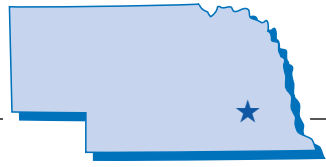
Final Announcement

NORTH-CENTRAL SECTION, GSA 29th Annual Meeting

and

SOUTH-CENTRAL SECTION, GSA 29th Annual Meeting

Lincoln, Nebraska
April 27–28, 1995



The North-Central and South-Central Sections of the Geological Society of America will meet in the Nebraska Center for Continuing Education and the East Campus Student Union on the East Campus of the University of Nebraska-Lincoln in Lincoln, Nebraska. The meeting will be hosted by the Conservation and Survey Division (Nebraska Geological Survey), the Department of Geology, and the University of Nebraska State Museum of the University of Nebraska-Lincoln, the Geography and Geology Department of the University of Nebraska at Omaha, the Nebraska Geological Society, the Omaha office of Woodward-Clyde Consultants, the Department of Geology of Kansas State University, and the Texas Section of the National Association of Geology Teachers. Societies that will meet in conjunction with the combined section meeting include the Pander Society; North-Central and South-Central Sections of the Paleontological Society, Texas; Mid-Continent and Central Sections of NAGT; Great Lakes and Midcontinent Sections of SEPM (Society for Sedimentary Geology); and the Geology Division of the Council on Undergraduate Research.

ACCESSIBILITY FOR REGISTRANTS WITH SPECIAL NEEDS

GSA is committed to making the Annual Meeting accessible to all people interested in attending. All meeting rooms are handicapped accessible. Many local hotels and motels have rooms available for visitors with special needs. Registration and housing information is detailed in this final announcement. If you need any auxiliary aids or services because of a disability, check the appropriate box on the registration form. If you have suggestions or need further information, contact Tami Krull, GSA headquarters. Please let us know your needs by March 24.

The University of Nebraska-Lincoln is a smoke-free campus. Smoking is not allowed in any building on the campus, including the meeting and hotel rooms at the Nebraska Center for Continuing Education, or in any University vehicle.

LOCATION

Lincoln, Nebraska, is about midway between Chicago, Illinois, and Denver, Colorado, on I-80. It is near the western border of the dissected till plain of the Central Lowland physiographic province of Thornbury. Bedrock topography is mostly covered by Pliocene and younger glacial, fluvial, and eolian deposits, which have been eroded to the point that morainal topography is not obvious. The population of the city is about 192,000, and the student enrollment at the University of Nebraska-Lincoln is about 24,000. The weather in late April is variable and frequently rainy.

REGISTRATION

Preregistration Deadline:
March 24, 1995

If you preregister, you will not have to wait in long registration lines to pick up materials in Lincoln because badges will be mailed within two weeks prior to the meeting. Save yourself time and money—preregister today!

1. There is a savings in fees if you register by the preregistration deadline!

Advance registration is suggested for many of the special activities because of participation limits. Use the preregistration form provided in this announcement.

2. Badges must be worn for access to ALL activities, 7:30 a.m. Thursday through 11:00 a.m. Friday.

3. Registration discounts are given to both GSA and Associated Societies listed on the preregistration form. Please indicate your affiliation(s) to register using the member rates.

4. Full payment MUST accompany registration. Unpaid purchase orders are NOT accepted as valid registration. Charge cards are accepted as indicated on the preregistration form. If using a charge card, please recheck the card number given. Errors will delay your registration. The confirmation card will be your receipt for charge-card payments. No other receipt will be sent.

5. Register one professional or student per form. Copy the form for your records.

6. Guest registration is required for those attending guest activities, technical sessions, or the exhibit hall. Guest registrants MUST be accompanied by either a registered professional or student. A guest is defined as a nongeologist spouse or friend of a professional or student registrant.

7. Students and K-12 Teachers must show a CURRENT ID in order to obtain these rates. Students or teachers not having a current ID when registering on site will be required to pay the professional fee.

8. Due to the mailing of badges, it is imperative that ALL preregistrations are RECEIVED by the preregistration deadline of March 24. All registrations received after March 24 will be held for

on-site processing, and charged the on-site rates.

Cancellations, Changes, and Refunds. All requests for registration additions, changes, and cancellations must be made in writing and received at the GSA Meetings Department by March 31, 1995. Faxes will be accepted. NO REFUNDS WILL BE MADE ON CANCELLATIONS RECEIVED AFTER MARCH 31, 1995. Refunds will be mailed after the meeting, and fees paid by credit card will be credited according to the card number on the preregistration form. NO refunds will be given for on-site registration and ticket sales.

ON-SITE REGISTRATION SCHEDULE

Wednesday, April 26

Nebraska Center—5:00 p.m.–9:00 p.m.

Thursday, April 27

Nebraska Center—7:30 a.m.–5:00 p.m.

Friday, April 28

Nebraska Center—7:30 a.m.–11:30 a.m.

STUDENT PAPERS AND TRAVEL ASSISTANCE

The North-Central Section of GSA will award \$75 for each of the eight papers judged best whose principal author and presenter is a graduate or undergraduate student. Abstracts submitted for these awards should be indicated on the abstract form. In addition, awards of up to \$200 for travel assistance may be made to students who are members of the North-Central Section of GSA as of January 1, 1995. To be eligible for a travel grant, the student must present a paper (oral or poster) of which he or she is sole or co-author. For applications for travel assistance awards, contact the General Chair, R. F. Diffendal Jr., Nebraska Geological Survey, 113 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-7546. Applications must be received by **February 15, 1995**.

The South-Central Section of GSA will award \$200, \$100, and \$50 for the three best oral student papers and \$200 for the best student poster given at the meetings. Awards for outstanding papers will be based on quality of research and effectiveness of presentation. To be eligible, the abstract must list only student authors who are members of the South-Central Section as of January 1, 1995, and must identify the abstract clearly as a student paper.

In addition, awards for travel will be made to students who are presenting a paper (oral or poster). For further information, contact Page C. Twiss, Department of Geology, Kansas State University, Manhattan, KS 66506-3201, (913) 532-6724, fax 913-532-5159, E-mail: pctwiss@ksuvm.bitnet. Applications for travel assistance must be received by **February 15, 1995**.

SPOUSE AND GUEST ACTIVITIES

The coordinator for Spouse and Guest Activities is Mary Anne Holmes. Questions regarding the activities described below can be addressed to her at (402) 472-5211.

University of Nebraska Intercollegiate Athletics Department.

Tour the facilities that have helped make Nebraska student athletes some of the best in the country in both athletics and scholarship. Thursday, April 27, 10:00 a.m. Cost: \$10, including transportation, guides, and admittance fee.

University of Nebraska State Museum. Visit one of the country's major natural history museums, noted for its dioramas of Nebraska vertebrate life and displays of fossils. Thursday,

April 27, 2:00 p.m. Cost: \$10, including transportation, guides, and admittance fee.

Nebraska State Capitol. Visit a structure designated as one of the world's architectural masterpieces. Friday, April 28, 10:00 a.m. Cost: \$10, including transportation, guides, and admittance fee.

Animal Science Building, East Campus. Tour this state-of-the-art research facility and learn about studies of meat animals. Thursday, April 27, 9:00 a.m. Free to registrants, spouses, and guests.

SPECIAL EVENTS

PLEASE NOTE: All meals described below will include meat and meatless entrees.

The **Welcoming Reception** will be held Wednesday evening April 26, in the Nebraska Center for Continuing Education from 7:00 to 9:00 p.m. Badges are to be worn for admittance. The room is to be determined. The **Annual Banquet** will be held on Thursday evening, April 27, in Elephant Hall on the University of Nebraska City Campus, preceded by a social hour beginning at 6:00 p.m. Stanley A. Schumm, Colorado State University, will speak on "The Variability of Large Alluvial Rivers: Implications for Geological Interpretation." Van service to and from Elephant Hall and the Nebraska Center will be available for participants. Banquet cost: \$25.

Breakfasts for persons interested in geology and public policy and for the GSA South-Central Section Education Committee are planned for April 27. Cost: \$10.

The **North-Central Section Management Board Breakfast and Business Meeting** will be on Thursday, April 27, in the Nebraska Center at 7:00 a.m.

A **Joint Luncheon** for the Great Lakes and Midcontinent Sections of SEPM, the North-Central and South-Central Sections of the Paleontological Society, and the Pander Society will be on Thursday, April 27, in the Nebraska Center. Cost: \$15. The **Association for Women Geoscientists** will hold a breakfast and talk on mentoring relationships on Friday, April 28, in the Nebraska Center. Cost: \$10.

The **GSA Campus Representatives breakfast** will be held on April 28 at the Nebraska Center. Cost: \$4.

The **GSA South-Central Section Management Board Business Meeting** will be held on April 26 at 4:30 p.m. in the Nebraska Center.

The **South-Central Section Annual Business Meeting** will be held on Thursday, April 27, following the last session of the day, at about 5:00 p.m. in the Nebraska Center.

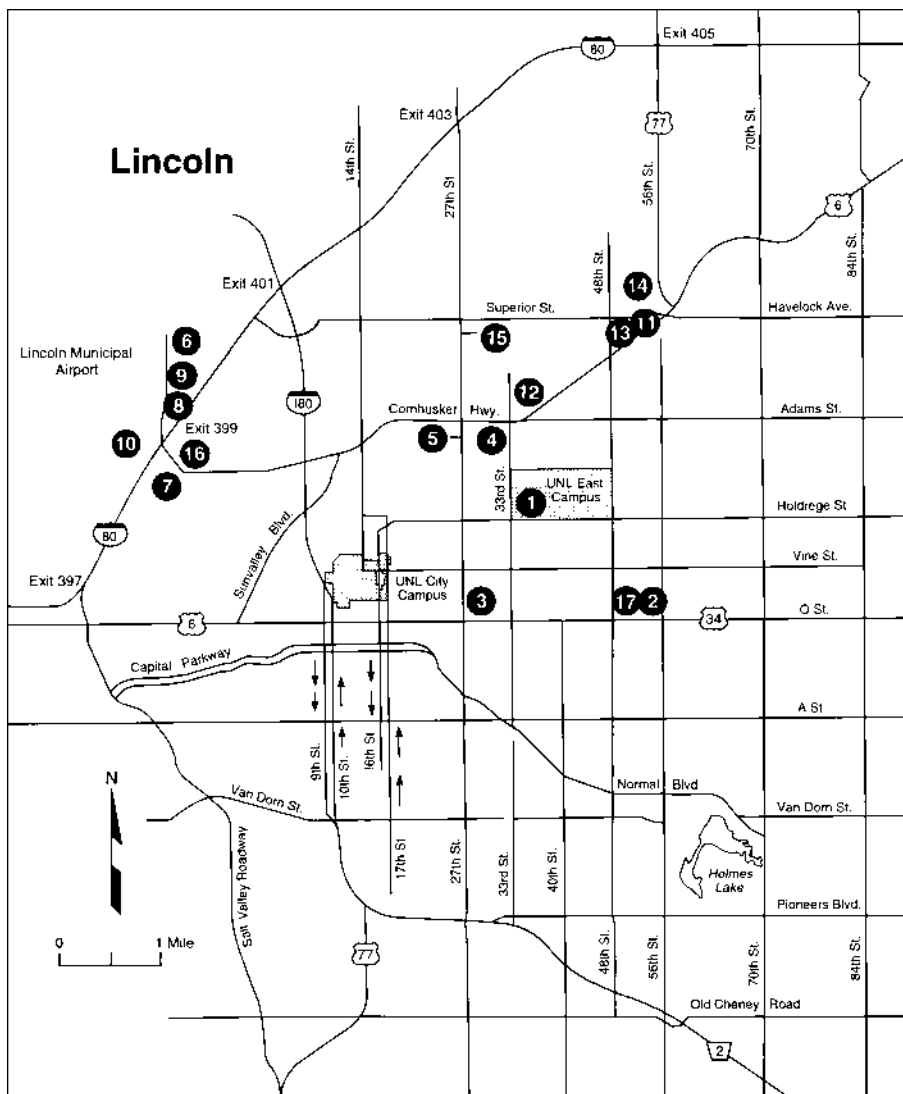
The **Texas and Midcontinent Sections of NAGT** will hold technical sessions and a business meeting during Thursday and Friday, April 27 and 28, in the Nebraska Center.

The **Central Section of NAGT and the GSA North-Central Section Education Committee** will host a luncheon at noon on April 28 in the Nebraska Center. Cost: \$10.00.

An **Open House Tour** of the University of Nebraska State Museum invertebrate fossil collections will be held from 12:00 to 1:30 p.m. in Nebraska Hall on the City Campus of the University of Nebraska-Lincoln on April 28.

An informal meeting of student members of **Sigma Gamma Epsilon** chapters will be held at 12:00 noon in

North-Central-South-Central
continued on p. 19



North-Central-South-Central
continued from p. 18

the lobby of the Nebraska Center on Friday, April 28.

ACCOMMODATIONS

Blocks of rooms have been reserved at several area motels (numbers correspond to those on map). S—single; D—double; R—restaurant; RN—restaurant nearby; H—rooms for handicapped; NS—non-smoking rooms available; SH—shuttle bus from airport to and from motel. Add 9.5% sales tax to rates.

1. **Nebraska Center Hotel:** 33rd and Holdrege, (402) 472-3435, S\$53/D\$60 (R, RN, H, NS only). Rate includes continental breakfast.
 2. **Villager Motor Inn** (Best Western): 5200 "O" St., (402) 464-9111, S\$45/D\$45 (R, RN, H, NS, SH).
 3. **Great Plains Motel:** 2732 "O" St., (402) 476-3253, S\$28/D\$34 (RN, NS).
 4. **Guesthouse Inn:** 3245 Cornhusker Hwy., (402) 466-2341, S\$30/D\$36 (RN, NS).
 5. **Cornhusker Super 8:** 2545 Cornhusker Hwy., (402) 467-4488, S\$35/D\$42 (RN, H, NS).
 6. **Best Western Airport:** (402) 475-9541, S\$43/D\$45 (R, RN, NS, SH).
 7. **Econo Airport Lodge:** (402) 474-1311, S\$25/D\$31 (R, RN, NS).
 8. **Days Inn:** (402) 475-3616, S\$40/D\$45 (RN, NS, SH).
 9. **Holiday Inn Airport:** (402) 475-4971, S\$49/D\$4 (R, RN, NS, SH).
 10. **Motel 6:** (402) 475-3211, S\$26/D\$32 (RN, H, NS).
 11. **Holiday Inn Northeast:** 5250 Cornhusker Highway, (402) 464-3171, S\$49/D\$49 (R, NS, SH).
- Other motels with rooms not blocked:
12. **Kings Inn:** (402) 466-2324.
 13. **Starlite Motel:** (402) 466-1902.
 14. **Econo Lodge Northeast:** (402) 464-5971.
 15. **Fairfield Inn:** (402) 476-6000.
 15. **Comfort Suites:** (402) 476-8080.
 16. **Inn 4 Less:** (402) 475-4511.
 17. **Sleepy Hollow Motel:** (402) 464-3166.

To make reservations, telephone the hotel or motel directly and indicate that you are attending the 1995 GSA meeting. Please stay at the Nebraska Center Hotel if possible, because the cost to the sections for meeting rooms will be reduced if rooms in the hotel are used. Please call the hotel or motels early, because many of the special rates are on a space-available basis and are guaranteed only up to a month before the meeting.

A very limited number of rooms are available in a residence hall on the City Campus **for students only**. Rates per night are S\$16/D\$22 plus tax. Contact Joey Kramer, housing administrator, at (402) 472-3561 for information. Students using these facilities will be required to show a valid student identification card from their college or university before they can register.

MEALS

There are restaurants both on and off campus. Lincoln has many fine restaurants including those serving Italian, Mexican, Vietnamese, Chinese, Greek, Thai, and Indian cuisine. A list of these will be available on-site at the information table.

TRANSPORTATION

The University of Nebraska-Lincoln East Campus is a short distance from I-80, U.S. Routes 6, 34, and 77, and Nebraska Highway 2 in Lincoln, Nebraska. Lincoln is served by United Airlines and Airlink through Chicago and Denver, Continental Connection from Denver, TWA through St. Louis, Northwest Airlink through Minneapolis, and US Air Express through Kansas City. Amtrak trains stop at Lincoln, as do Greyhound buses. Taxi service from the airport and train and bus stations to the Nebraska Center costs about \$10.

If you are certain that you will be coming to the meeting and plan to travel to Lincoln by plane, train, or bus, book your tickets as early as possible to get the best rates. Have your travel agent then watch for fare reductions as they become available later. If you register for one of the postmeeting

field trips that start and end in Lincoln, you may be able to take advantage of the lower airfares for staying over on Saturday. Check with the trip leader to make sure the trip is open, to verify the trip dates, and to confirm the probable return time before making reservations.

Free parking is available for up to 300 automobiles of registered meeting participants at the Nebraska Center. Additional parking is available on nearby residential streets. Maps showing parking locations will be available on-site at the information table.

TECHNICAL PROGRAM

Any questions about the technical program can be directed to David Loope, Department of Geology, University of Nebraska-Lincoln, Lincoln, NE 68588-0340, (402) 472-2647, E-mail: dloope@unlinfo.unl.edu, fax 402-472-4917.

Symposia

The following symposia have been organized. Authors are encouraged to contact the individual symposium organizers for information.

1. **Cyclic Sedimentation in Carboniferous and Permian Strata of North America: Sequence Stratigraphy, Biostratigraphy, and Paleogeology.** Darwin R. Boardman II and Arthur Cleaves, School of Geology, Oklahoma State University, Stillwater, OK 74078-0451, (405) 744-5315, fax 405-744-7841.
2. **Geoarchaeological Research in Fluvial and Aeolian Depositional Environments.** Rolfe Mandel, 1730 SW High St., Topeka, KS 66604-3121, (913) 235-1647.
3. **Quaternary Eolian Deposits of the Plains: Loess, Sand, and Ash.** E. Arthur Bettis III, Iowa DNR, Geological Survey Bureau, 123 N. Capitol St., Iowa City, IA 52242-1319, (319) 335-1590, E-mail: abettis@gsbthpo.uiowa.edu; James B. Swinehart, 113 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-7529, E-mail: jbs@unlinfo.unl.edu, fax 402-472-2410; and Brian Carter, Department of Agronomy, Oklahoma State University, Stillwater, OK 74078, (405) 744-6414.
4. **Remote Sensing and GIS for Water-Quality Assessment.** Donald Rundquist, 113 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-7536, fax 402-472-2410.
5. **Perspectives on Urban Geology: Principles, Educational Needs, and Case Studies.** Sponsored by the Institute for Environmental Education. Perry Wigley, 113 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-3471, fax 402-472-2410, E-mail: pwigley@unlinfo.unl.edu; Priscilla Grew, 302 Adm, University of Nebraska-Lincoln, Lincoln, NE 68588-0433, (402) 472-3123; and William Wayne, Department of Geology, University of Nebraska-Lincoln, Lincoln, NE 68588-0340.
6. **College- and University-Related Earth Science Educational Activities.** Robert Pinker, Johnson County Community College, 12345 College at Quivira, Overland Park, KS 66210-1299, (913) 469-3894; and David Gosselin, 113 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-8919, fax 402-472-2410, E-mail: gosselin@unlinfo.unl.edu.
7. **Ogallala Group and Younger Neogene Geology, Great Plains.** R. F. Diffendal Jr., 113 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-7546,

- fax 402-472-2410, E-mail: rfd@unlinfo.unl.edu.
8. **Chemical Dispersions in Hydrologic Systems.** Sambhud Chaudhuri, Department of Geology, Kansas State University, Manhattan, KS 66506-3201, (913) 532-6724, fax 913-532-5159, E-mail: ksuncsc@ksuvm.bitnet.
 9. **Geology of the Garbage Heap: Waste Sites and Waste Siting.** Sanford S. Kaplan, Department of Geology, University of Nebraska-Lincoln, Lincoln, NE 68588-0340, (402) 472-6213, E-mail: skaplan@unlinfo.unl.edu; and Page C. Twiss, Kansas State University, Manhattan, KS 66506-3201, (913) 532-6724, E-mail: pctwiss@ksuvm.bitnet.
 10. **Great Plains Neogene Tectonism.** George W. Shurr, Department of Earth Sciences, St. Cloud State University, St. Cloud, MN 56301-4498, (612) 255-2009 or (612) 253-7810.
 11. **Occurrence, Transport, and Transformation of Pesticides and Nutrients in Surface and Ground Waters.** Mary Exner Spalding, Conservation and Survey Division, 113 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-7547, E-mail: mspalding@unlinfo.unl.edu, fax 402-472-2410.
 12. **Genesis and Morphology of Paleosols.** Mark Kuzila, Conservation and Survey Division, 113 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-7537, E-mail: mkuzila@unlinfo.unl.edu, fax 402-472-2410.
 13. **Cretaceous Rocks of the Mid-continent.** David K. Watkins, Department of Geology, University of Nebraska-Lincoln, Lincoln, NE 68588-0340, (402) 472-2648, E-mail: dwatkins@unlinfo.unl.edu, fax 402-472-4917; and Richard Hammond, South Dakota Department of Water and Natural Resources, Division of Geological Survey, Vermillion, SD 57069-2390, (605) 677-6162.
 14. **Environmental Regulations and the Regulated Community: Impacts and Responses.** Hugh Stirts, U.S. Army Corps of Engineers, Omaha District, Attn. CEMIRO-ED-EE, 215 N. 17th St., Omaha, NE 68102-4978, (402) 221-7164; and David Henni, Dames and Moore, Omaha.
 15. **Catastrophic Floods.** John F. Shroder Jr., and Kevin Cornwell, Department of Geography and Geology, University of Nebraska at Omaha, Omaha, NE 68182-0199, (402) 554-2662.
 16. **Depositional Environments, Lithostratigraphy, and Biostratigraphy of the White River and Arikaree Groups.** Hannan E. LaGarry, University of Nebraska State Museum, W436 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0549, (402) 472-2657; Dennis O. Terry, Department of Geology, University of Nebraska-Lincoln, Lincoln, NE 68588-0340, (402) 472-2604, E-mail: dterry@unlinfo.unl.edu, fax 402-472-8949; and Robert M. Hunt Jr., University of Nebraska State Museum, University of Nebraska-Lincoln, Lincoln, NE 68588-0549.
 17. **Interpreting Animal Behavior from the Fossil Record.** Loren Babcock, Department of Geology, Ohio State University, Columbus, OH 43210, (614) 292-0358, E-mail: lbabcock@orton.mps.ohio-state.edu, fax 614-292-1496.
 18. **Sedimentary Rhythmites: Origins and Implications.** Allen W. Archer, Department of Geology, Kansas State University, Manhattan, KS 66506, (913) 532-6724, E-mail: aarcher@

North-Central-South-Central
continued on p. 20

North-Central-South-Central
continued from p. 19

ksumv.bitnet; and Erik P. Kvale, Indiana Geological Survey, Indiana University, Bloomington, IN 47405.

19. **Antarctic Paleoclimates and Paleoenvironments.** David Harwood, Department of Geology, University of Nebraska-Lincoln, Lincoln, NE 68588-0340, (402) 472-2648, E-mail: dharwood@unlinfo.unl.edu.

20. **Problems in Continental Scientific Drilling.** M. Charles Gilbert, School of Geology and Geophysics, University of Oklahoma, Norman, OK 73019-0628, (405) 325-4424, E-mail: mcgilbert@geoadm.gcn.uoknor.edu, fax 405-325-3140; and Kenneth Windom, Department of Earth and Atmospheric Sciences, Iowa State University, Ames, IA 50011.

FORUM

1. K-12 Earth Science Education Forum: Opportunities, Chal-

enges, and Benefits for the Geoscience Community. David Gosselin (address given in Theme Session, this page).

WORKSHOP

The GSA **Institute for Environmental Education** will sponsor an all-day workshop on public information and education techniques on Saturday, April 29. The workshop will provide attendees with insights and information on how to deal with all forms of media. See the IEE article on p. 9 of this issue for additional information.

THEME SESSION

Modern and Ancient Lake Environments of the Northern Great Plains. David C. Gosselin, 113 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-8919, E-mail: gosselin@unlinfo.unl.edu, fax 402-472-2410; and William M. Last, Department of Geo-

logical Sciences, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2, (204) 474-8361, E-mail: mlast@ccm.umanitoba.ca, fax 204-261-7581.

POSTER SESSIONS

We strongly encourage students and professional members to take advantage of this highly effective means of communication. Please indicate Poster Session on the GSA Abstract Form. Each poster booth will provide three 4' x 4' white boards arranged at table height. Poster sessions will be located in the area near the exhibits and will be available for viewing for one-half day. Authors will be expected to be present at their poster displays at least half of the time allotted for presentation of the displays.

The **Geology Division of the Council on Undergraduate Research** will sponsor a poster session on geological research by undergraduate students. We urge undergraduates to participate in this event.

PROJECTION EQUIPMENT

Two standard 35 mm carousel projectors for 2" x 2" slides and one overhead projector for transparencies will be provided in each meeting room. Please bring your own loaded carousel trays identified with speaker's name, session, and speaker number to your session room before the start of the session. A speaker-ready room equipped with projectors will be available for review and practice in the library.

SHORT COURSE

1. **Field and Laboratory Techniques for Vertebrate Fossils: A Primer for Geologists.** Gregory Brown, chief preparator, Division of Vertebrate Paleontology, University of Nebraska State Museum, W-436 Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0514, (402) 472-2657, fax 402-472-8949, E-mail: gbrown@unlinfo.unl.edu. Though relatively uncommon, vertebrate fossils may be found occasionally by geologists in the field, and such finds may be vitally important to vertebrate paleontologists. This workshop will demonstrate the fundamental techniques for collecting vertebrate fossils and the essential data that should accompany each specimen. Laboratory preparation and conservation principles will be presented by the museum staff on Friday, April 28, at 1:00 p.m. in Research Collections, W-436 Nebraska Hall, University of Nebraska-Lincoln. Limit: 15. Cost: \$40.

FIELD TRIPS

The field trip coordinator is Roger Pabian, Conservation and Survey Division, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-7564, fax 402-472-2410, E-mail: rpabian@unlinfo.unl.edu. All trips begin and end at the Nebraska Center except for the trip to Manhattan, Kansas. Preregistration for field trips is recommended because of logistical limitations. All field trip participants must also register for the meeting. Further information will be sent to participants at a later date. Trip members should be prepared for inclement weather and muddy walking conditions. If a trip must be canceled for logistical reasons, a full refund will be issued after the meeting. Be aware of cancellation penalties imposed by the airlines. Plan alternatives in advance should the trip you are registered for be canceled. Contact the field trip leaders for detailed descriptions of each trip.

Premeeting

1. **Late Pennsylvanian and Early Permian Biostratigraphy and Paleocology in Richardson and Pawnee Counties, Nebraska.** Roger K. Pabian, Conservation and Survey Division, University of Nebraska-Lincoln, Lincoln, NE 68588-0517, (402) 472-7564, fax 402-472-2410, E-mail: rpabian@unlinfo.unl.edu; and Darwin R. Boardman II, 105 Noble Research Center, School of Geology, Oklahoma State University, Stillwater, OK 74078. Cyclic deposits in southeastern Nebraska showing both marine and continental facies, including eolian deposits, paleosols, channel sands, lagoonal or estuarine sediments and nearshore and offshore marine sections. Wednesday, April 26. Cost: \$35, including guidebooks, box lunch, snacks, and transportation. Limit: 25.

2. **Late Quaternary Fluvial and Eolian Sediments: Loup River Basin and the Nebraska Sand**

North-Central-South-Central
continued on p. 21

Preregistration Form

GSA North-Central and South-Central Sections
Lincoln, Nebraska • April 27-28, 1995

Preregistration deadline is March 24, 1995

Please print clearly. Copy for your records.

Name (last) _____ (first name/nickname as it should appear on badge) _____

Employer/University (affiliation as it should appear on badge) _____

Employer/University mailing address for Employer/University above _____

City _____ State _____ ZIP Code _____

Country (other than USA) _____ Business Phone _____ Fax _____ Home Phone _____

★ Spouse/Guest Name (last) _____ ★ (first name/nickname as it should appear on badge) _____

★ City/State _____ ★ Country _____

Please inform us by March 24 of any special considerations that you or your guest require.

I will need special considerations. Please call me.

Circle member affiliation (to qualify for registration discount):

(A) GSA Member # _____

(B) NAGT (C) PS (D) Pander Soc. _____

(E) SEPM (F) SVP _____

	Rate	Qty	Amount
Professional Member (circle affiliation above)	(01) \$ 45 <input type="checkbox"/>	1	\$ _____
Professional Nonmember	(03) \$ 50 <input type="checkbox"/>	1	\$ _____
Student Member (circle affiliation above)	(05) \$ 15 <input type="checkbox"/>	1	\$ _____
Student Nonmember	(07) \$ 20 <input type="checkbox"/>	1	\$ _____
Teacher (K-12)	(42) \$ 10 <input type="checkbox"/>	1	\$ _____
Guest/Spouse (per guest listed above)	(09) \$ 10 <input type="checkbox"/>	1	\$ _____
GUEST ACTIVITIES			
Tour of Animal Science	April 27 (20) FREE	_____	\$ _____
Tour of Athletic Facilities	April 27 (21) \$ 10	_____	\$ _____
Museum Tour	April 27 (22) \$ 10	_____	\$ _____
State Capitol Tour	April 28 (23) \$ 10	_____	\$ _____
SPECIAL EVENTS			
Geology and Public Policy Breakfast	April 27 (60) \$ 10	_____	\$ _____
GSA South-Central Education Committee Breakfast	April 27 (61) \$ 10	_____	\$ _____
Annual Banquet	_____	_____	\$ _____
Check entree preference <input type="checkbox"/> meat (62) <input type="checkbox"/> meatless (63)	April 27 \$ 25	_____	\$ _____
Combined Paleo Society/Pander Society, SEPM Lunch	April 27 (64) \$ 15	_____	\$ _____
GSA Campus Representatives, Breakfast	April 28 (65) \$ 4	_____	\$ _____
AWG Breakfast	April 28 (66) \$ 10	_____	\$ _____
Central Sec. of NAGT and GSA NC Sec. Education Comm. Lunch	April 28 (67) \$ 10	_____	\$ _____
SHORT COURSE			
Field/Lab Techniques for Vertebrate Fossils	April 28 (150) \$ 40	_____	\$ _____
FIELD TRIPS			
Premeeting			
1. Late Pennsylvanian/Early Permian Biostratigraphy	April 26 (101) \$ 35	_____	\$ _____
2. Late Quaternary Fluvial & Eolian Sediments	April 25-26 (102) \$125	_____	\$ _____
3. Quaternary and Engineering Geology, Lincoln Area	April 26 (103) \$ 40	_____	\$ _____
4. White River Group Revisited	April 24-26 (104) \$165	_____	\$ _____
Postmeeting			
5. Ashfall Fossil Beds	April 29 (105) \$ 35	_____	\$ _____
6. Geology of Ogallala/High Plains Regional Aquifer	April 29-May 2 (106) \$175	_____	\$ _____
7. Late Quaternary Landscape Evolution	April 29 (107) \$ 40	_____	\$ _____
8. Contaminant Occurrence, Offutt Air Force Base	April 29 (108) \$ 35	_____	\$ _____
9. Permian Strata in Manhattan, Kansas, Area	April 29-30 (109) \$ 30	_____	\$ _____
10. Crow Creek Member, Pierre Shale	April 28-30 (110) \$ 80	_____	\$ _____
11. Upper Pennsylvanian Paleosols	April 29 (111) \$ 35	_____	\$ _____
Abstracts with Programs (for on-site pickup)	(301) \$ 10	1	\$ _____
TOTAL FEES			\$ _____

Remit in U.S. funds payable to: **GSA North-Central Section Meeting**
(All preregistrations must be prepaid. Purchase Orders not accepted.)

Payment by (check one):
 Check American Express VISA MasterCard

Card Number _____

Signature _____ Expiration Date _____

MAIL TO: GSA NC/SC SECTION MEETING, P.O. BOX 9140, BOULDER, CO 80301-9140, FAX 303-447-1133

FOR OFFICE USE

A _____ D _____ V _____ M _____

CK# _____

DR _____ CR _____

Bal. A/R _____

1233-12450 _____

Ref. A/P 2006 _____

Refund Check # _____

Approval _____

L/s during different times of the year over the 1989–1992 period.

Effects of Geothermal Development. WRIR 91-4052 discusses several options for geothermal development and ranks them according to the level of risk to the Yellowstone thermal springs. As stated in the report, the safest options include (1) surface diversion of the flow of La Duke Hot Spring, (2) use of down-hole heat exchangers in wells, and (3) well production from only the existing Church Universal and Triumphant (CUT) geothermal well. We noted that more risk is involved with the use of additional geothermal wells anywhere in the Corwin Springs area unless such wells obtain production mainly from the capture of natural thermal-water discharge and the reservoir drawdown in the development area remains small. We acknowledged that a small level of drawdown beneath Yellowstone cannot be avoided even when producing only from the CUT well, which is located less than 3 km from the boundary of Yellowstone National Park. If the accepted goal is to prevent any hydrologic change beneath Yellowstone, we would agree that no well production should be allowed at such distances outside the park. However, we stand by the WRIR 91-4052 conclusion that use of development options 1–3 noted above would pose no discernible risk to Yellowstone's thermal springs, even if this is viewed by Friedman as constituting a "resource-development bias."

PERSPECTIVE 5: Rebuttal to Sorey et al.

Irving Friedman

Sorey and his coauthors state that Cl, Br, B, Li, and the water isotopes are conservative constituents and are not altered by passage through the aquifer. This may be true for hydrogen, but it is definitely not true for oxygen. There is extensive literature, including a study of Mammoth Hot Springs, devoted to the changes in $\delta^{18}\text{O}$ of water that reacts with carbonates and silicates in reservoir rocks. I question whether any of the listed species is truly conservative under all circumstances. WRIR 91-4052 (chapter F) admits that the concentration of many of these "conservative" constituents are affected by water-rock interactions.

The determination of the "true" concentration of helium in well Y-10 was not properly discussed in WRIR 91-4052. In Perspective 4, Sorey, Kharaka, and Evans state that, in order to correct for suspected degassing of the water sample just prior to collection, the assumption was made that original Ar concentration in both Y-10 and the Church Universal and Triumphant (CUT) well was similar because Ar in both was derived from atmospheric saturation. Because the measured Ar concentration of the Y-10 sample was about 1/3 that in the CUT well, Sorey et al. calculated a 20 \times reduction in the He concentration of Y-10 due to degassing.

The $^{36}\text{Ar}/^{40}\text{Ar}$ ratio in the gas sample derived from Y-10 is very different

from that from the CUT well. Therefore, their assumption that the water from the two sites, before degassing, contained the same argon concentration derived by atmospheric saturation is very questionable.

In a description of the Y-10 well, White et al. (1975) stated, "Because of high wellhead water pressures, the depth of first exsolution may be as low as 170 ft." There is no evidence that the sample described by Kharaka et al. (1990) from a depth of 53 m (173.9 ft), using a down-hole sampler, actually degassed before collection.

For these reasons, I find Sorey, Evans, and Kharaka's assumption of He loss prior to collection suspect. My argument relative to the importance of the difference in the $^4\text{He}/^3\text{He}$ ratios between the Y-10 and CUT wells still stands.

I concede that improvements in the analytical technique for the analysis of sulfate in water, made after my discussion of the errors of analysis was written, now makes it possible to reduce the analytical error from 0.4 ppm to 0.2 ppm. This will allow the contribution of sub-bottom springs under the Yellowstone River to be monitored for a somewhat longer part of the year than the six weeks stated in Perspective 3. This represents a small decrease in the risk associated with the recommended "safe" withdrawal of 60 L/s from wells in the La Duke–Bear Creek area.

Sorey, Kharaka, and Evans admit to the existence of connections in the

geologically recent past between Mammoth and the La Duke area. The possible present-day hydrologic connection between Mammoth Hot Springs and the Corwin Springs Known Geothermal Resource Area cannot be ruled out in spite of the claims by Sorey et al. to the contrary.

Discussions by Molnia (Perspective 1 [GSA Today, December 1994]) and Sorey, Kharaka, and Evans (Perspective 2) of the legal aspects (the takings issue) of protection of the geothermal resources of the park are not relevant to the issue of the *risk associated with development*. The legality of protection is a public issue to be decided by Congress, not the USGS.

My original argument that WRIR 91-4052 presented a resource-development bias still stands, and my plea for careful examination of the evidence regarding possible environmental damage due to resource development to a unique and fragile environment such as Yellowstone National Park is still appropriate.

REFERENCES CITED

Kharaka, Y. K., Mariner, R. H., Ambats, G., Evans, W. C., White, L. D., Bullen, T. D., and Kennedy, B. M., 1990, Origins of water and solutes in and north of the Norris-Mammoth corridor, Yellowstone National Park: Geothermal Resources Council Transactions, v. 14, p. 705–714.

White, D. E., Fournier, R. O., Muffler, L. J. P., and Truesdell, A. H., 1975, Physical results of research drilling in thermal areas of Yellowstone National Park, Wyoming: U.S. Geological Survey Professional Paper 892, 70 p. ■

North-Central-South-Central continued from p. 20

Hills. James B. Swinehart, Conservation and Survey Division, University of Nebraska–Lincoln, Lincoln, NE 68588-0517, (402) 472-7529, fax 402-472-2410, E-mail: jbs@unlinfo.unl.edu; David May, Department of Geography, University of Northern Iowa, Cedar Falls, IA 50613, (319) 273-2772, fax 319-273-7103; and David Loope, Department of Geology, University of Nebraska–Lincoln, Lincoln, NE 68588-0340, (402) 472-2647.

Exposures of five fills beneath loess-mantled and fluvial terraces, a spectacular canal cut with Pliocene to Holocene units, the largest sand sea in the Western Hemisphere, interdune peat with eolian sand sheet interbeds, and a boiling artesian sand spring. Tuesday and Wednesday, April 25 and 26. Cost: \$125, including transportation, one night lodging, two lunches, and guidebook. Limit: 35.

3. Quaternary and Engineering Geology of the Lincoln, Nebraska, Area. William J. Wayne, Department of Geology, University of Nebraska–Lincoln, Lincoln, NE 68588-0340, (402) 472-2663 or (402) 472-2601.

Significance of recognizing the Quaternary materials around Lincoln and the history of their deposition in evaluating slope movements, foundation stability, and flooding. Wednesday, April 26. Cost: \$40 including guidebook, box lunches, refreshments, and transportation. Limit: 36.

4. The White River Group Revisited: Vertebrate Trackways, Ecosystems, and Lithostratigraphic Revision, Redefinition, and Redescription. Dennis O. Terry Jr., Hannan E. LaGarry, and W. Brantly Wells, Department of Geology, 214 Bessey Hall, University of Nebraska–Lincoln, Lincoln, NE 68588-0340, (402) 472-2663.

Spectacular exposures of vertebrate trackways within an Oligocene fluvial

system and the basis for a major reinterpretation of lithostratigraphic units, boundaries, and depositional environments. Monday–Wednesday, April 24–26. Cost: \$165, including transportation, guidebook, two continental breakfasts, three lunches, and two nights at hotel. Note: Participants should prepare for temperatures ranging from 32 to 70 °F and either rain, sun, or snow. There will be some hiking over difficult terrain. Limit: 30.

Postmeeting

5. Ashfall Fossil Beds. M. R. Voorhies, University of Nebraska State Museum, W436 Nebraska Hall, University of Nebraska–Lincoln, Lincoln, NE 68588-0514, office (402) 472-2654, home (402) 435-7148.

A unique accumulation of vertebrate fossils preserved in a volcanic ash bed in the Ogallala Group (Miocene) in northeastern Nebraska, including rhinos, horses, camels, and birds. Saturday, April 29. Cost: \$38, including transportation, lunch, guidebook. Limit: 55.

6. Geology of the Ogallala–High Plains Regional Aquifer System in Nebraska. R. F. Diffendal Jr., Conservation and Survey Division, University of Nebraska–Lincoln, Lincoln, NE 68588-0517, (402) 472-7546, E-mail: rfd@unlinfo.unl.edu.

The several formations of the Ogallala, Ashfall Park, Pliocene fluvial deposits, Nebraska Sandhills, Quaternary valley fills, springs, waterfalls, and several of the major rivers of Nebraska. Saturday–Tuesday, April 29–May 2. Cost: \$175, including transportation by van, three nights lodging (double occupancy), park admittance fee, and guidebook. Limit: 10.

7. Late Quaternary Landscape Evolution and Stratigraphy in Eastern Nebraska. Rolfe Mandel, 1730 SW High St., Topeka, KS 66604-3121, (913) 235-1647; and E. Arthur Bettis III, Iowa DNR, Geological Survey Bureau, University of Iowa, Iowa City, IA 52240, (319) 335-1578.

The Holocene alluvial stratigraphy of streams in eastern Nebraska, late Quaternary loess deposits and associated paleosols, new age determinations on the Gilman Canyon Formation and overlying Peoria Loess, and alluvial deposits beneath the loess mantle. Saturday, April 29. Cost: \$40, including transportation, guidebook, box lunch, and refreshments. Limit: 55.

8. Hydrostratigraphic Control of Contaminant Occurrence and Transport, Offutt Air Force Base, Nebraska. Bob Goodwin, Denny Jorgenson, and Terry Thonen, Woodward-Clyde, 101 S. 108th St., Omaha, NE 68154, (402) 334-8181.

Results of contaminant characterization studies, mostly for volatile organic compounds, in soils and ground water of four hydrostratigraphic units: upland glacial, Pleistocene terrace, and two separate alluvial units. Saturday, April 29. Cost: \$35, including transportation, box lunch, and entrance fee for a guided tour of the Strategic Air Command Museum. Limit: 25.

9. Permian Strata in the Manhattan, Kansas, Area: Implications for Climatic and Eustatic Controls. Allen Archer, Keith Miller, Page Twiss, and Ronald West, Department of Geology, Kansas State University, Manhattan, KS 66506, (913) 532-6724.

Lower Permian rocks in the spillways of Milford and Tuttle Creek Reservoirs exposed by the 1993 flood. Saturday and Sunday, April 29 and 30. Cost: \$30, including local transportation, guidebook, and open-file reports; *not* including room, meals, or transportation to and from Manhattan. Limit: 50.

10. The Crow Creek Member, Pierre Shale (Upper Cretaceous) of Southeast South Dakota and Northeast Nebraska: Impact Tsunamiite or Basal Transgressive Deposit? Raymond R. Anderson and Brian J. Witzke, Iowa DNR, Geological Survey Bureau, 109 Towbridge Hall, University of Iowa, Iowa City, IA

52242-1319, (319) 335-1575, fax 319-335-2754, E-mail: raymond-anderson@uiowa.edu; Richard H. Hammond, South Dakota Geological Survey, Science Center—Campus West, University of South Dakota, Vermillion, SD 57069, (605) 624-6162; David K. Watkins, Department of Geology, University of Nebraska–Lincoln, Lincoln, NE 68588-0340.

Crow Creek Member (marl), Upper Cretaceous Pierre Shale: a transgressive unit above a regional unconformity or an impact-induced tsunamite triggered by the Manson impact structure? Friday–Sunday, April 28–30. Cost: \$80, including transportation and guidebook; *not* including lodging, two dinners, or breakfast. Limit: 25.

11. Upper Pennsylvanian Paleosols in the Platte and Missouri Valleys, Southeastern Nebraska.

R. M. Joeckel, Department of Geological Sciences, 306 G&G Building, University of Tennessee–Knoxville, Knoxville, TN 37919-1410, (615) 974-2366.

Paleosols in the Kansas City, Lansing, Douglas, and Shawnee Groups of the Upper Pennsylvanian in southeastern Nebraska which have important implications in the interpretation of Missourian–Virgilian eustasy, tectonics, and paleoclimate. Saturday, April 29. Cost: \$35, including transportation, lunch, guidebook. Limit: 25.

EXHIBITS

Exhibits of educational and commercial organizations will be on display in the Nebraska Center near the symposia, technical, and poster sessions. Exhibits will be open Thursday 8:00 a.m.–5:00 p.m., and Friday 8:00 a.m.–11:00 a.m. The exhibits coordinator is George Engelmann, Department of Geography and Geology, University of Nebraska at Omaha, Omaha, NE 68182-1099, (402) 554-2662, fax 402-554-3518. ■

Coal Division Offers Medlin Award

The Coal Geology Division of the Geological Society of America announces the availability of the Antoinette Lierman Medlin Scholarship in Coal Geology for the 1995–1996 academic year. The scholarships provide full-time students who are involved in research in coal geology (origin, occurrence, geologic characteristics, or economic implications of coal and associated rocks) with financial support for their project for one year.

Scholarship funding can be used for field or laboratory expenses, sample analyses, instrumentation, supplies, or other expenses essential to the successful completion of the research project. Approximately \$1500 will be available for the 1995–1996 scholarship award. In addition, the recipient of the scholarship may be provided with a stipend to present results of the research at the 1996 GSA Annual Meeting. For the academic year 1995–1996, the Coal Geology Division is also offering a field study award of \$500.

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

Interested students should submit five copies of the following: (1) a covering letter indicating which award(s) is (are) sought; (2) a concise statement of objectives and methods, and a statement of how the scholarship funds will be used to enhance the project. The proposal would be no more than five (5) double-spaced pages in length, including references; (3) a letter of recommendation from the student's immediate advisor which includes a statement of financial need and the amount and nature of other available funding for the research project.

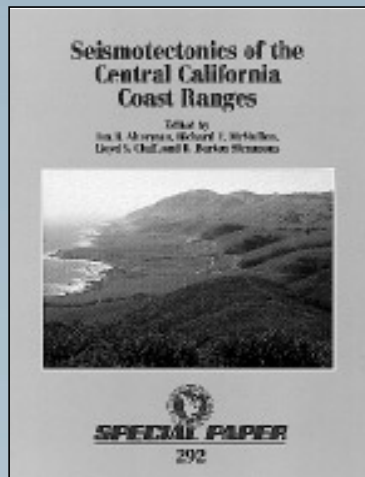
Send the material to:

Sharon S. Crowley
Chairman, A. Lierman Medlin
Scholarship Committee
U.S. Geological Survey
MS 956 National Center
Reston, VA 22092
Phone: (703)648-6453

The proposal and letter of recommendation must arrive no later than February 15, 1995. Applicants will be notified of the Scholarship Committee's decision by April 1, 1995.

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

SPECIAL PAPERS

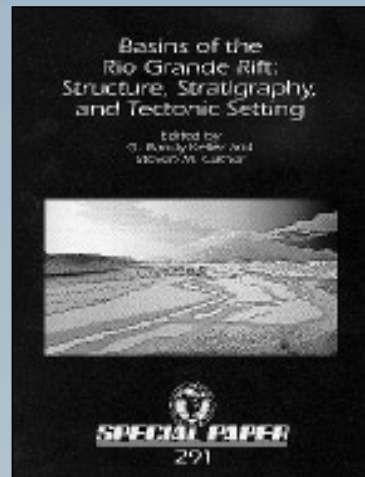


Seismotectonics of the Central California Coast Ranges

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. It includes among the several techniques and topics soil science, paleoseismological analysis, calculations of Quaternary marine terrace uplift rates, structural and field stress analyses, geophysical instrumentation, and estimating slip rates on Holocene faults. The studies and conclusions are relevant to academic directions of research, industry, and government agencies responsible for protecting the health and safety of the public.

SPE292, 246 p., w/ 3 loose inserts, paperback, indexed, ISBN 0-8137-2292-6, \$67.00

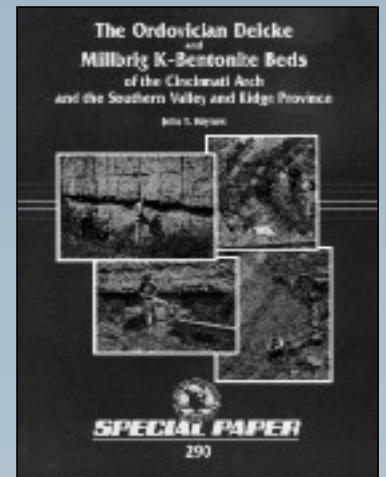


Basins of the Rio Grande Rift: Structure, Stratigraphy, and Tectonic Setting

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. There are contributions from most of the research groups now working on this topic. 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. The geographic coverage is also broad because the entire length of the rift is treated, as are several flanking features. The emphasis of the volume is on bettering our understanding of the nature and extent of the rift and of the timing of events during its evolution.

SPE291, 316 p., paperback, indexed, ISBN 0-8137-2291-8, \$72.50



The Ordovician Deicke and Millbrig K-Bentonite Beds of the Cincinnati 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. Because of their persistence across several facies changes in the southern Appalachians, the Deicke and Millbrig are ideal for observing the effects of varying burial conditions on a compositionally uniform stratum. This lateral persistence makes them ideal marker beds for stratigraphic purposes as well, and the latter part of the text is devoted to a discussion of the regional litho- and biostratigraphic significance of these two beds.

SPE290, 84 p., paperback, ISBN 0-8137-2290-X, \$32.00



The Geological Society of America
Publication Sales, P.O. Box 9140, Boulder, CO 80301, 303-447-2020
1-800-472-1988, fax 303-447-1133



GSA JOURNALS ON COMPACT DISC

A CD-ROM publication of the Geological Society of America. Published since 1992, each annual disc contains an entire year of articles from *GSA Bulletin*, *Geology*, and *GSA Today*, plus the current year's *GSA Data Repository*, and a *Retrospective Electronic Index* to GSA's journal articles published since 1972.

Users can search the full ASCII text of all articles, or view, print, or export from them. Scanned, graphical page-images of all articles are also included, linked to the ASCII text; users can view or print these. High-resolution versions of all b&w and color photographs are provided, linked to the ASCII text, to overcome the low quality of these photos on the scanned pages. Starting in 1995, publication frequency changes to twice-annually and new technology greatly improves the photos on the scanned pages. The Data Repository, and any inserts, are available only as scanned images without ASCII text.

GSA Journals on CD is available for both DOS and Macintosh as follows:

■ JCD001. 2-year, 2-CD introductory package (1992 & 1993), 6,000+ pgs. Available immediately. Net price: GSA Members \$99, all others \$125.

■ JCD004. 1-year, 1-CD (1994), 3,000+ pgs. Available February, 1995. Net price: GSA Members \$99, all others \$125.

■ JCD005. 1-year, 2-CDs (1995), 3,000+ pgs. First six-month-CD available July 1995; complete annual CD available February 1996. Net price: GSA Members \$89, all others \$125. This edition available in Windows version, also.

UNSURE? A free demonstration diskette is available for DOS-based PCs showing in detail the operation of the CD — screens, menus, graphics, with many descriptive comments. Call or write for a copy.

1-800-472-1988
303-447-2020; fax 303-447-1133

Indicate DOS or Macintosh platform when ordering.

JOIN THE DIGITAL REVOLUTION WITH GSA!

ISSN 1052-5173

The Geological Society of America
3300 Penrose Place
P.O. Box 9140
Boulder, CO 80301

SECOND CLASS
Postage Paid
at Boulder, Colorado
and at additional mailing offices