



GSA news & information

G.S.A. ARCHIVES

VOLUME 5, NUMBER 6

JUNE 1983

Membership Committee Prepares Recommendations for Council

by Faith Rogers

Fellowship nominations and membership recruitment topped the agenda for the GSA Membership Committee at its 1983 spring meeting. The six-member committee, Chairman William A. Thomas (University of Alabama), Aureal T. Cross (Michigan State University), Henri E. Gaudette (University of New Hampshire), Marcus E. Milling (ARCO, Dallas), Eric W. Mountjoy (McGill University), and Patrick K. Sutherland (University of Oklahoma), met at GSA headquarters in Boulder, Colorado, on March 27.

Selection of Fellows

A new system for nominating GSA members for Fellowship had been approved by the Council at the 1982 Annual Meeting in New Orleans (see accompanying story, *New Nomination Procedure Emphasizes Honor of Fellowship*). Nominations using the revised form, which had been made available to current Fellows when 1983 dues statements were sent and was also published in February 1983 *GSA News & Information*, are now coming in, and the Membership Committee finds that the new procedure makes at least part of their work more efficient. The committee

votes on Fellowship nominations, as well as applications for Membership, and presents results to the Council, which has the final say.

How the Committee Works

The Membership Committee conducts most of its business by mail and has a one-day meeting in Boulder in the spring and a short get-together at the GSA annual meeting in the fall. New Member and Student Associate applications (629 and 954, respectively, in 1982) are reviewed by the committee throughout the year. Lists of approved applicants go to the Council for final ratification at its spring and fall meetings. Member and Student Associate applications are straightforward: applicants must either have a bachelor's degree in geology or a related science or equivalent training through practical experience, or have active connection with geology through employment, or be a student enrolled in a geology or related science program. Fellowship nominations, however, require consideration of the nominees' contributions to the science. The Membership Committee may

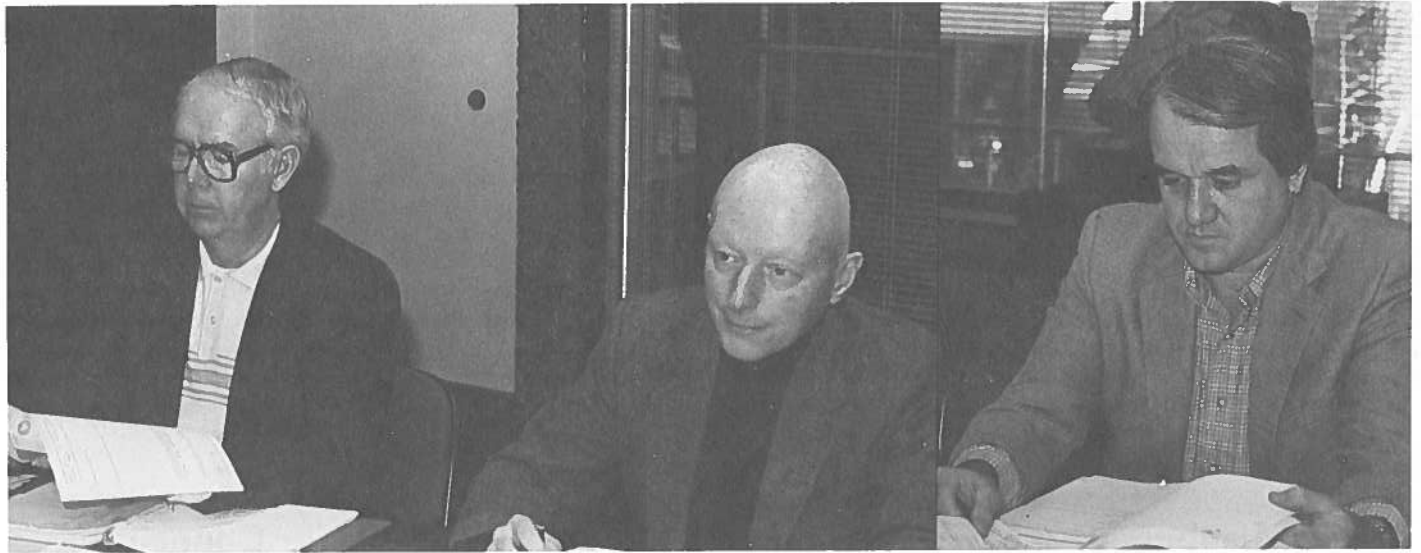
(continued on p. 86)



Henri Gaudette (1983-1985)



Chairman William A. Thomas (1981-1983)



Patrick Sutherland (1982–1983), left, and Eric Mountjoy (1982–1984)

Marcus Milling (1983–1985)

Membership Committee (continued from p. 85)

approve a Fellowship nomination by mail ballot or may decide to hold a nomination for discussion at the committee's spring meeting, when the final recommendation to the Council is prepared.

Guidance for Council

Preparing recommendations for the May Council meeting, the Membership Committee this year considered simplifying the Member application form—"We suggested revisions that would streamline the process," Chairman Bill Thomas said. The group also discussed ways to recruit new members and possibilities for additional membership benefits. Statistics provided by GSA's Membership Department keep the committee up-to-date: in 1982, the Society gained 1,586 Members, Student Associates, and Honorary Fellows, bringing total GSA membership to 13,386, despite the loss of 972 members who resigned or died or were dropped from the rolls for nonpayment of dues.

Results of a survey of a sample of GSA members and nonmembers by a public relations firm suggest that even members are not knowledgeable about GSA. The Membership Committee made a list of specific ways to remedy this situation, to present to the Council as part of the committee report.

Slots to Fill

The Membership Committee will need replacements for Bill Thomas and Patrick Sutherland when their terms end this year. If you want to nominate someone for the committee for 1984-1986, contact William A. Thomas, Department of Geology, University of Alabama, Tuscaloosa, AL 35486; (205) 348-5095.



Aureal Cross (1982–1984)

**American Institute of Hydrology
Offers Registration**

The American Institute of Hydrology (AIH), a nonprofit organization, offers registration of hydrologists and hydrogeologists. Each Member admitted to AIH is certified as a Professional Hydrologist or Professional Hydrogeologist. Information forms are available from A. Zaporozec, General Secretary, AIH, University of Wisconsin, 1815 University Avenue, Madison, WI 53706; (608) 262-3385.

GSA News & Information

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CENTENNIAL NEWS

by Allison R. (Pete) Palmer

DNAG Synthesis Volume on *Precambrian: Conterminous U.S. Organized*

The organizational workshop for the DNAG synthesis volume on the Precambrian of the conterminous United States was held in Denver, Colorado, on February 26 and 27, 1983. Twenty-six participants contributed to the development of the outline presented below. As with the

other synthesis volumes, the chapter leaders may involve additional contributors in preparation of the best possible synthesis of the current state of knowledge about the U.S. Precambrian. Publication of this volume is expected in 1986.

Precambrian of the Conterminous United States

- I. Introduction—J. C. Reed, Jr.
- II. Lake Superior Region
 - A. Introduction—P. K. Sims, G. B. Morey, Z. E. Peterman
 - B. Geophysical Characteristics—V. W. Chandler
 - C. Archean Craton and Associated Archean Rocks
 - 1. Greenstone-Granite Terrane—D. L. Southwick
 - 2. Gneiss Terrane—R. L. Bauer, G. R. Himmelberg
 - 3. Interrelationship between Greenstone-Granite and Gneiss Terranes—D. L. Southwick, P. K. Sims
 - D. Penokean Orogen and Related Epicratonic Rocks
 - 1. Early Proterozoic Epicratonic Rocks—G. B. Morey
 - 2. Wisconsin Magmatic Zone—P. K. Sims, K. J. Schulz, Z. E. Peterman, W. R. Van Schmus
 - 3. Tectonic evolution—P. K. Sims, G. B. Morey, D. K. Larue, K. J. Schulz, Z. E. Peterman, W. R. Van Schmus
 - E. Intracratonic Igneous and Sedimentary Rocks
 - 1. 1.76 Ga Rhyolite-Granite—E. I. Smith
 - 2. Platform Quartzite—R. W. Ojakangas
 - 3. Anorogenic Batholithic Rocks (Wolf River Batholith)—J. L. Anderson
 - 4. Midcontinent Rift System—P. W. Weiblen
 - F. Mineral Resources—M. G. Mudrey, Jr.
 - G. Tectonostratigraphic Evolution and Problems—K. Sims, G. B. Morey, Z. E. Peterman
 - H. Subsurface Extensions of Exposed Precambrian Rocks—P. K. Sims, Z. E. Peterman
- III. Wyoming Province—R. S. Houston, K. E. Karlstrom, G. L. Snyder, Z. E. Peterman
 - A. Introduction
 - B. Archean Rocks
 - 1. Gneissic Terrane
 - 2. Greenstone Belts
 - 3. Metasedimentary and Metavolcanic Succession of Miogeoclinal Affinity
 - 4. Archean Igneous Rocks
 - 5. Mafic Dikes Cutting Archean Rocks
 - C. Proterozoic Metasedimentary Successions on Archean Basement
 - D. Cheyenne Belt
 - E. Proterozoic Rocks South of the Cheyenne Belt with No Known Archean Basement
 - F. Proterozoic Igneous Rocks
 - G. Subsurface Extensions
 - H. Regional Structure, Including Involvement in Phanerozoic Deformations
 - I. Summary of Geochronology
 - J. Relation to Canadian Shield
 - K. Crustal Structure and Concepts of Geologic Evolution
 - L. Mineral Resources
- IV. Transcontinental Proterozoic Province
 - A. Introduction—L. T. Silver
- B. Regional Summaries
 - 1. Southwestern U.S.—L. T. Silver
 - 2. New Mexico—J. M. Robertson
 - 3. Colorado—O. Tweto
 - 4. Northern Midcontinent—W. R. Van Schmus
 - 5. Southern Midcontinent—M. E. Bickford, Jr.
 - 6. Eastern Midcontinent—E. G. Lidiak
- C. General Synthesis—L. T. Silver, J. M. Robertson, O. Tweto, W. R. Van Schmus, M. E. Bickford, Jr., E. G. Lidiak
 - 1. Nature of Boundaries
 - 2. Major Internal Terranes
 - 3. Midcontinent Rift System
 - 4. Other Suites and Events
 - 5. Sedimentary Record and Intervals without Record
 - 6. Geochemical and Geophysical Character of the Crust
 - 7. Mineral Resources
 - 8. Implications for Continental Evolution
- V. Proterozoic Rocks East and Southeast of the Grenville Front
 - A. Introduction and Overview—D. W. Rankin
 - B. Adirondack Massif—J. M. McLelland
 - C. Subsurface Grenville-age Rocks between the Adirondack Massif and the Black Warrior Basin—E. G. Lidiak
 - D. Western Extensions of Grenville-age Rocks: Texas—S. Mosher
 - E. Proterozoic North American Rocks of the Appalachian Orogen—D. W. Rankin, N. M. Ratcliffe
 - F. Proterozoic Rocks of Accreted Terranes—R. Goldsmith, D. T. Secor, Jr.
 - G. Mineral Resources—D. W. Rankin, R. Goldsmith, E. G. Lidiak, J. M. McLelland, S. Mosher, D. T. Secor, Jr.
 - H. Synthesis and Problems—D. W. Rankin, R. Goldsmith, E. G. Lidiak, J. M. McLelland, S. Mosher, D. T. Secor, Jr.
- VI. Precambrian Rocks of the Northern Rocky Mountains and the Basin and Range Province
 - A. Overview—M. W. Reynolds
 - B. Basement—M. W. Reynolds
 - C. Middle Proterozoic Rocks—M. W. Reynolds, D. P. Elston, J. E. Harrison, C. A. Wallace, L. A. Wright
 - D. Late Proterozoic Rocks—P. K. Link, J. H. Stewart, L. A. Wright, M. W. Reynolds, D. P. Elston, J. E. Harrison
 - E. Tectonics—M. W. Reynolds
 - F. Paleobiology—M. W. Reynolds
 - G. Problems in Correlations—D. P. Elston, J. E. Harrison, P. K. Link, M. W. Reynolds, J. H. Stewart, L. A. Wright
 - H. Mineral Resources—J. E. Harrison, D. P. Elston, P. K. Link, M. W. Reynolds, J. H. Stewart, L. A. Wright
 - I. Summary and Problems To Be Solved—M. W. Reynolds
- VII. Discussion and Synthesis—J. C. Reed, Jr., R. S. Houston, D. W. Rankin, M. W. Reynolds, L. T. Silver, P. K. Sims

New Nomination Procedure Emphasizes Honor of GSA Fellowship

"A Member of the Geological Society of America is advanced to Fellowship in recognition of significant contribution to the science of geology," according to the Criteria for Election to Fellowship, and as of October 1982 that process is begun by a Nominating Sponsor.

It's the first significant change in the process since the Society's founding in 1888. Originally, every member of the Society (about 100 in 1888) was a Fellow. It wasn't until 1948 that the GSA Council established a Member category, open to anyone with a bachelor's degree in geology or related science and who was working or studying in that field.

Nominating Sponsor

With the new procedure, a Nominating Sponsor initiates a nomination and identifies two other GSA Fellows who are familiar with the nominee's qualifications and have agreed to sponsor the nomination. The Nominating Sponsor sends the nomination to GSA's Membership Department, which then sends sponsor's evaluation forms to the two Fellows listed on the Nominating Sponsor's form and a request to the nominee for a vita.

Criteria

Significant contribution to the science of geology is the main criterion for election to Fellowship. Nominees must have at least eight years of professional experience in geology or related fields (graduate study can constitute a maximum of three years of the eight). Examples of significant contribution include publication of the results of geologic research, practical application of geologic knowledge in government or industry, teaching geology students, administering geological programs, promoting public awareness

of geology, leadership in professional organizations, and editorial and bibliographic activities. However, as stated in the criteria, "The opportunities available to Members of the Geological Society of America to make a contribution to the science of geology are as diverse as geologists and indeed as geology itself. Therefore, a nominee may present to the Committee on Membership activities which do not fit into any of the ordinarily prescribed categories."

Evaluation of Nominations

Fellowship nominations and supporting data are sent to each Membership Committee member, who returns a vote to GSA headquarters. Nominations with at least five affirmative votes (the Membership Committee has six members) go immediately into a list to be presented to the Council for decision at its spring or fall meeting. Nominations with fewer than five affirmative votes are held for discussion by the Membership Committee at its spring meeting. The committee may decide at that time to accept, reject, or table a nomination. About 100 new Fellows are elected each year.

Committee Asks Fellows to Nominate

"We are trying to identify GSA Members who should become Fellows," Membership Committee Chairman William A. Thomas said, "and we're asking Fellows to assist us in continuing to honor those who deserve this recognition." The Nominating Sponsor form is in the February 1983 issue of *News & Information*. If you need a Nominating Sponsor form, write to Membership Department, Geological Society of America, P.O. Box 9140, Boulder, CO 80301, or phone (303) 447-2020.

GSA Special Paper 191

*Tectonic Studies in the Talladega and Carolina
Slate Belts, Southern Appalachian Orogen*

Edited by Denny N. Beane, William Black, Stephen A. Kish, and James F. Tull

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Going to Indianapolis for the 1983 Annual Meeting?

GSA/Viking Airline Reservation System

The Geological Society of America has designated Viking Travel, Ltd. of Boulder, Colorado, as the sole airline reservation agent for the 1983 Annual Meeting in Indianapolis.

Viking will make arrangements for attendees, regardless of point-of-departure, and guarantees that you will receive the least expensive airfare available from your departure city.

You are encouraged to make your airline reservation through the GSA/Viking toll-free "hotline" number: **(800) 525-0368**.

Procedures

1. Call Viking toll-free at (800) 525-0368, or from within Colorado at (303) 449-6983. Call Monday through Friday, 8:30 a.m. to 5:30 p.m. Mountain time.
2. Identify yourself as attending the GSA Indianapolis Annual Meeting and request a reservation from your departure city.
3. The Viking agent will immediately confirm your reservations, and quote you the applicable group-fare or deep-discount fare.
4. Payment options are:
 - a. Check payable to Viking Travel, Ltd.
 - b. Major credit card.
 - c. Invoice to your firm.

5. Delivery will be via first-class mail. You will receive your tickets at least two weeks prior to departure. Payment or credit card authorization is required before mailing.
6. Your reservation will be monitored to take advantage of any fare reductions that may occur between the time of booking the reservation and the ticketing date. In the event of a fare increase, your reservation will be ticketed at the previously confirmed lower fare.

That's all there is to it!

The GSA/Viking Airline Reservation System was designed to assure you of confirmed, discounted reservations to the meeting in Indianapolis. Because Viking has arranged special GSA fares on several major airlines, we encourage you to make your reservation through Viking.

Call today to assure the best flight schedule and fare for you!



75th Anniversary Symposium of the Paleontological Society Scheduled for 1983 GSA Annual Meeting

In honor of the 75th Anniversary of the Paleontological Society, one of GSA's associated societies, a day-long symposium on *Frontiers in Paleontology* will be held in Indianapolis during the GSA annual meeting, Oct. 31-Nov. 3, 1983. The symposium will focus on new discoveries, methodological advances, modern controversy, theory, and conceptual innovation in paleobiology and closely allied disciplines. Scientists from diverse fields and age groups will participate, and opposing viewpoints have been encouraged on controversial issues.

Among topics chosen for presentation are origin and early evolution of Metazoa; environments of special preservation; rates

and patterns of evolution; community evolution; chemopaleontology; functional morphology; extinctions and their role in evolution; unique habitats and biotas; biological oceanography; basin analysis through fossils; new research in micropaleontology; the evolution of diversity; coevolution and symbioses in the fossil record; high-resolution event and biological stratigraphy; paleo-behavior; and evolution of continental ecosystems. This is one of the most dynamic times in the history of paleontology, and the symposium is designed to provide a cross section of exciting research.

Specimens and Papers Crowding You Out of Office and Home?

Two institutions have asked GSA to help them obtain rock and mineral specimens and other geology-related material.

School Needs Course Material

Science-oriented Eleanor Roosevelt Senior High School, for which students must apply and compete academically to be admitted, needs rock and mineral specimens, fossils, slides, maps, and other items of geologic interest. The school requires that students take two science courses in each of their junior and senior years. The geology course, first offered in 1979, this year attracted almost 100% of the school's enrollment. The school needs large display and investigative specimens for use in this course. For more information, contact George H. Strachan, Eleanor Roosevelt Senior High School, 7601 Hanover Parkway, Greenbelt, MD 20770; (301) 345-7500.

Historical Documents Sought

The Western History Research Center in Laramie, Wyoming, is collecting materials pertaining to the history and development of economic geology from the 1800s on. The center's 65,000 ft² of storage space and 18-member staff accommodate and catalogue diaries, photographs, maps, manuscript geological reports, reprints, books, articles, field notes, etc. Donors of material to the center include Henry R. Aldrich, Gilbert H. Cady, Edwin D. McKee, V. E. McKelvey, A. A. Meyerhoff, Midwest Oil, Standard Oil, and Western Oil and Gas, among almost 200 individuals and companies. For more information, contact Gene M. Gressley, Western History Research Center, Box 3334, Laramie, WY 82071; (307) 776-4114.

Journal of Metamorphic Geology

Half price
to members of the
Geological Society of America

Editors

Dr Michael Brown, *Department of Geology & Physical Sciences,
Oxford Polytechnic, Headington, Oxford OX3 0BP, UK*

Professor Timothy P. Loomis, *Department of Geosciences,
The University of Arizona, Tucson, Arizona 85721, USA*

Professor R.H. Vernon, *School of Earth Sciences, Macquarie University,
North Ryde, New South Wales 2113, Australia*

Aims and Scope

This new journal brings together research on all aspects of metamorphic geology from a wide range of specialisms and will appeal to workers in the fields of metamorphic petrology, mineral deposits geology and other related fields in geology.

The scope of the journal extends over the whole range of metamorphic studies from the scale of the individual crystal to that of the lithospheric plate, including the properties of metamorphic minerals, the theoretical and experimental study of metamorphic reactions, the geochemistry of metamorphic rocks (including isotope geochemistry and fluid inclusion studies), microstructural studies of metamorphic rocks, deformation in relation to metamorphism, regional studies of metamorphic terrains (including geochemistry and geophysics), the environment of formation of metamorphic rocks, and economic aspects of metamorphic terrains (including the metamorphism of mineral deposits).

Volume 1, Number 1, March 1983

Pre-Alpine eclogites in the Pennine Basement of the Eastern Alps *G.T.R. Droop*

A corundum and sapphirine paragenesis from the Limpopo Mobile Belt, southern Africa *P.C. Horrocks*

Crustal growth in south-eastern Australia — evidence from lower crustal eclogitic and granulitic xenoliths
S.Y. Wass and J.D. Hollis

Peristerite compositions in quartzofeldspathic schists, Franz Josef-Fox Glacier area, New Zealand
R. Grapes and M. Otsuki

A tectonic model for the metamorphic evolution of the Basal Gneiss Complex, Western South Norway
S.J. Cuthbert, M.A. Harvey and D.A. Carswell

Research workers in the field of metamorphic geology are invited to submit material for publication in the journal direct to one of the editors, from whom detailed 'Notes to Contributors' may be obtained on request.

Subscription Information

Journal of Metamorphic Geology is published quarterly and the subscription rate for 1983 is \$97.50. Members of the *Geological Society of America* are entitled to subscribe at half price, \$48.75, by applying direct to the publishers.

Order Form

Please tick the appropriate box and return to **Blackwell Scientific Publications, P.O. Box 88, Oxford, England**

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First Rocky Mountain Coal Scholarships Awarded

The Rocky Mountain Coal Scholarship Committee has selected two recipients for the first scholarships jointly awarded by the Symposium on the Geology of Rocky Mountain Coal and the Coal Geology Division of GSA.

First Place

A first-place scholarship of \$1,000 was awarded to Kathleen McKenzie of Vancouver, British Columbia. McKenzie is a Master's candidate at the University of British Columbia. Her thesis is titled "The Sedimentology and Stratigraphy of the Late Jurassic to Cretaceous Coal Measures Within the Southern Portion of the Bowser Basin, British Columbia"; her thesis area is in the Intermontane belt of British Columbia.

Second Place

A second-place scholarship of \$500 was awarded to Carrie Manfrino of Boulder, Colorado. Manfrino is a Master's candidate at Colorado School of Mines. Her thesis is titled "Stratigraphy and Palynology of the Upper Cretaceous Fruitland Formation Near Durango, Colorado"; her thesis area contains the thick, high-ash Carbonero coal bed.

Area of Study

The Rocky Mountain Coal Scholarship Program was established to further interest and research into coal within the Rocky Mountain and northern Great Plains coal provinces by providing scholarship funds for field and laboratory expenses, books, and tuition. Funding for the program comes from surplus money accumulated by the Symposium on the Geology of Rocky Mountain Coal. These funds have been invested in the Geological Society of America Foundation, and the interest now forms the basis of the scholarship. There is, however, no assurance of the amount of funds or that funds will be available every year.

Coal research pertaining to the coals in the states or provinces of Arizona, Alberta, British Columbia, Colorado, Idaho, Montana, New Mexico, North Dakota, Utah, Saskatchewan, South Dakota, and Wyoming is considered for support. Applicants for the scholarship must be currently enrolled in a graduate



Kathleen McKenzie



Carrie Manfrino

program (M.S. or Ph.D.) at a private or state college or university. The main theme of an applicant's research must be an aspect of coal research, and the research must pertain to coal in the states or provinces listed above (the institution where the research is being conducted need not be in the listed states or provinces). Although the applicant must be involved in coal research, he or she need not be a geology major.

Application and Award

Scholarship applications can be obtained from the Geological Society of America, P.O. Box 9140, Boulder, CO 80301. Deadline for applications is February 1.

A committee composed of two ad hoc members of the Symposium on the Geology of Rocky Mountain Coal and two GSA Coal Geology Division members screens applications and selects the most appropriate proposal by May 1. At the time of selection, scholarship monies are transferred directly to the grantee by the GSA Foundation. When the scholarship winner's research is complete, he or she submits one copy of his or her thesis to the Secretary of the GSA Coal Geology Division.



North American members should report address changes 6 weeks in advance; all others, 3 months in advance.

Member Number _____
 Name _____
 New Address _____

 City _____
 State _____ Zip _____
 Country _____
 Effective Date of Change _____

Former Address—Attach Mailing Label

Penrose Conference on Multistage Mantle Processes Slated

A GSA Penrose Conference "Processes and Products of Multistage Melting and Metasomatism in the Mantle," cosponsored by the U.S. Geological Survey, will be held in spring 1984 at a central Arizona location. The conveners are Jane E. Pike, U.S. Geological Survey, Fred A. Frey, Massachusetts Institute of Technology, Arthur L. Boettcher, University of California, Los Angeles, and Frank M. Richter, University of Chicago.

Interest in multistage mantle processes has increased in the last decade as evidence for a heterogeneous mantle has accumulated from field, petrological, geochemical, and geophysical sources. Geophysical evidence for structural heterogeneity in the mantle has been collected worldwide for many years; more recent chemical and isotopic data indicate the existence of long-lived chemical mantle heterogeneities. Concepts about the nature and origin of these heterogeneities are varied. Among them are multistage melting, differentiation, and wall-rock reaction processes observed in textures and compositions of mantle xenoliths, and "mantle reservoirs," which explain the isotopic variations discovered in lavas that probably were derived from melting of mantle parent material. Such concepts increasingly have superseded simpler models of a stratified mantle produced by batch partial melting.

The purpose of the conference is to bring together petrologists, experimentalists, geophysicists, geochemists, and modelers of various disciplines to communicate about the current state of their research into mantle heterogeneities and the processes that create them. Among the problems identified by the conveners for discussion are the following: What is the source of metasomatic fluids, and where do the fractionated liquids that result from the crystallization of cumulates reside? Can metasomatic processes and the compositions of metasomatic fluid be studied experimentally? What constraints are there on the physical behavior of melts in the mantle? What are the characteristics of melt migration? Can mixing models that explain isotopic heterogeneities in oceanic basalts also explain isotopic disequilibrium in mantle xenoliths? How do old structural and chemical heterogeneities persist in a convecting mantle? What are the implications of multistage processes to the attainment of equilibrium in parent mantle rocks, and does this relate to the calibration of mantle geothermometers and geobarometers? In discussion, participants will have an opportunity to identify fruitful

lines of enquiry and gaps that should be filled and to examine the potential of multidisciplinary investigations.

Proposed sessions will address the petrology and geochemistry of mantle material that has been modified by multistage events, geochemical evidence of multistage mantle processes from the study of lavas, experimentally determined evidence of the geochemistry of mantle metasomatic fluids, geophysics of melt processes and melt migration, and evolution of chemical heterogeneities in a convecting mantle.

The conference is scheduled tentatively for 5 days in March or April 1984. The registration fee is expected to be \$400 per person, including food, lodging, and a one-day field trip to the San Carlos, Arizona, mantle xenolith locality, which has produced petrological and geochemical evidence of mantle metasomatic processes. Attendance is limited to 80 participants. Applications should be sent to Jane E. Pike, U.S. Geological Survey, 345 Middlefield Rd., MS 75, Menlo Park, CA 94025, to be received no later than October 31, 1983. Applicants should include a brief description of the topics they wish to present or their reason for attending the conference. Some money will be available to support the attendance of a small number of interested students.

Other Penrose Conferences Scheduled

September 5-9, 1983

Blueschists and Related Eclogites

Bellingham, Washington

Conveners: Edwin H. Brown, Department of Geology, Western Washington University, Bellingham, WA 98225; Bernard W. Evans, Robert B. Forbes, and Peter Misch, Department of Geological Sciences, University of Washington, Seattle, WA 98195

October 2-7, 1983

Cretaceous Climates

Florissant, Colorado

Conveners: Eric J. Barron, National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307; William W. Hay and Erle G. Kauffman, University of Colorado, Boulder, CO 80309

January, 1984

The West African Connection

Riviera, France

Conveners: John Rodgers, Department of Geology and Geophysics, Yale University, New Haven, CT 06520; Xavier T. Le Pichon, Paris University, 52 Rue Marillac, Trosly-Breuil, Cuise La Motte 60350, France; Jean Sougy, Marseilles University, St. Jerome Faculty of Science, Marseilles, CEDEX 13, France

Late June, 1984

Melanges of the Appalachian Orogen

Stephenville, Newfoundland

Conveners: Harold Williams, Department of Earth Sciences, Memorial University of Newfoundland, St. John's, Newfoundland A1B 3X5, Canada; Nicholas Rast, Department of Geology, University of Kentucky, Lexington, KY 40506; Brenna E. Lorenz, Department of Earth Sciences, Memorial University of Newfoundland, St. John's, Newfoundland A1B 3X5, Canada



THE
GEOLOGICAL SOCIETY
OF AMERICA

APPLICATION FOR PARTICIPATION IN A PENROSE CONFERENCE

Title of Penrose Conference _____

Your name and title _____

Organization _____

Mailing address _____
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Telephone number _____
Area Code Number

Field of interest _____

Please state briefly what your interest and experience have been with regard to the conference topic.

MEETINGS

1983

24th U.S. Symposium on Rock Mechanics, "Rock Mechanics: Theory—Experiment—Practice," June 20-23, 1983, College Station, Texas, U.S.A.. Information: Earl R. Hoskins, Dept. of Geophysics, Texas A&M University, College Station, TX 77843; (713) 845-1371.

International Symposium on Two Phase Gas-Liquid Flow in Pipes, August 8-9, 1983, Cuernavaca, Mexico. Information: A. Gutiérrez or R. Aldave (731) 438-11, ext. 3338 or 2234; Telex INELME-017-8351, or Shakespeare 6, Apartado Postal 5-849-5620, Mexico 5, D.F., or Interior Internado Palmira, Apartado Postal 475, Cuernavaca, Morelos, México.

Oceans '83, August 29-September 1, 1983, San Francisco. Information: Oceans '83, P.O. Box 70970, Sunnyvale, CA 94086; (408) 742-3104.

Second International Surface Mining and Quarrying Symposium, October 4-6, 1983, Bristol, England. Information: Conference Officer, Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, England; telephone 01-580 3802; Telex 261410.

North American Cartographic Information Society, annual meeting, October 20-22, 1983, Milwaukee, Wisconsin. General Information: Donald Daidone, Newman Library, Virginia Tech, Blacksburg, VA 24061; (703) 961-6308. Proposals: Ron Bolton, NOAA/NOS, 8060 - 13th Street, Silver Spring, MD 20910; (301) 427-7650.

Eastern Oil Shale Symposium, November 13-16, 1983, Lexington, Kentucky. Information: Connie Blakemore, Conference Coordinator, University of Kentucky Institute for Mining

& Minerals Research, P.O. Box 13015, Lexington, KY 40512; (606) 252-5535.

1984

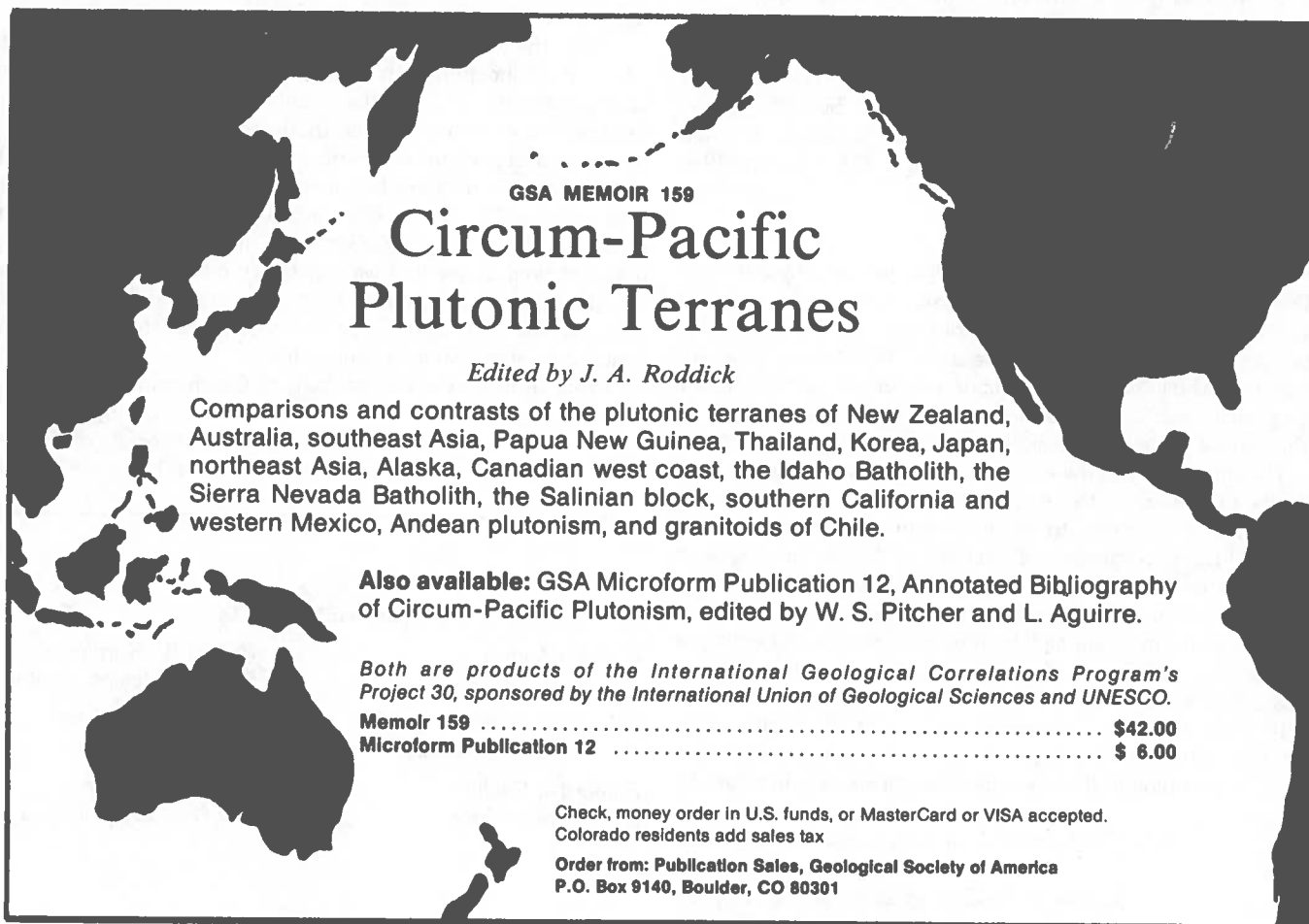
International Congress on Applied Mineralogy in the Mineral Industry, February 22-25, 1984, Los Angeles, California. Information: Organizing Chairman, P.O. Box 310, Danbury, CT 06810.

International Conference on Geomembranes, June 20-24, 1984, Denver, Colorado. For abstract (deadline July 15, 1983) and paper guidelines, request a copy of Bulletin #1 from International Conference on Geomembranes, c/o IFAI, 345 Cedar Building, Suite 450, St. Paul, MN 55101; (612) 222-2508; TWX 910-563-3622. Information: Gretchen Artig (612) 222-2508.

25th U.S. Symposium on Rock Mechanics, "Rock Mechanics in Protection and Productivity," June 25-27, 1984, Northwestern University, Evanston, Illinois. Information: Charles H. Dowding, Department of Civil Engineering, Northwestern University, Evanston, IL 60201; (312) 492-7270.

20th Annual American Water Resources Association Conference and Symposium, August 13-16, 1984, Washington, D.C. Information: Arlene Dietz, Corps of Engineers, Institute for Water Resources, Casey Bldg., Fort Belvoir, VA 22060; (202) 325-6768.

Reagents in the Minerals Industry, September 18-22, 1984, Rome. Abstracts (in English, 200-300 words; deadline July 1, 1983) and information: Secretary, Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, England.



GSA MEMOIR 159

Circum-Pacific Plutonic Terranes

Edited by J. A. Roddick

Comparisons and contrasts of the plutonic terranes of New Zealand, Australia, southeast Asia, Papua New Guinea, Thailand, Korea, Japan, northeast Asia, Alaska, Canadian west coast, the Idaho Batholith, the Sierra Nevada Batholith, the Salinian block, southern California and western Mexico, Andean plutonism, and granitoids of Chile.

Also available: GSA Microform Publication 12, Annotated Bibliography of Circum-Pacific Plutonism, edited by W. S. Pitcher and L. Aguirre.

Both are products of the International Geological Correlations Program's Project 30, sponsored by the International Union of Geological Sciences and UNESCO.

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25 years ago . . .

"The Canadian Shield has been divided into geological provinces and subprovinces on various bases. Van Hise and Leith in their discussion of correlation called the regions northwest and south of Lake Superior the northern and southern subprovinces. The writer proposed the names Timiskaming and Grenville for two additional subprovinces in the southeastern part of the shield and suggested that serial names such as Keewatin and Timiskaming be restricted to the subprovince in which they were originally proposed because: (1) much of the geological mapping in these regions had been lithological rather than structural and (2) geographical and geological barriers prevented direct correlation between them. The above-named subprovinces include most of the Precambrian parts of the St. Lawrence basin and therefore together can appropriately be called St. Lawrence province. In 1939 and 1941 the writer pointed out that the Canadian Shield is divided naturally into five regions or provinces in which the relationships of formations because of their proximity to one another can be determined in greater detail than is possible for regions separated by wide stretches of water, by Paleozoic or later sediments, or by belts of complex gneisses.

"Gill attempted to divide the Canadian Shield into provinces using the structural trends of formations as a standard, and J. T. Wilson proposed a division of the shield based on physico-chemical age determinations which he believes support the hypothesis that the shield has grown by successively younger mountain building from its core outward. More recently Gill stated objections to widespread correlation that in part at least are the same as those cited by the writer in 1918. In the present state of knowledge the division of the Canadian Shield into provinces based on structural trends or scattered physico-chemical age determination is speculative."

From "Precambrian Classification and Correlation in the Canadian Shield" by M. E. Wilson
Bulletin of the Geological Society of America
v. 69, p. 757-774, June 1958

50 years ago . . .

"Have we, in the method of multiple working hypotheses, applied with the aid of rigorous analysis, something which will guide us unflinchingly to the discovery of truth? We are compelled to answer this question in the negative. No device, however perfect, can wholly deprive the human intellect of its capacity for making mistakes. De Leon searched in vain for the fountain of youth. Can we hope for a magical fountain of truth?"

"The most for which we may reasonably hope is by correct methods of research to reduce the chances of error to a minimum, and to raise to its maximum the probability of discovering the real causes and relations of things. This we have done, so far as lies within our power, when we are accurate in observing facts, careful in classifying them, cautious in generalizing from them, fertile in inventing hypotheses, ingenious and impartial in testing their validity, skillful in securing their confirmation or revision, and judicial in formulating ultimate interpretations.

"Multiple working hypotheses as a method, employed in connection with critical analysis as an instrument of precision, offer us, in my opinion, the best guarantee of success in scientific research."

From "Role of Analysis in Scientific Investigation"
by Douglas Johnson
Bulletin of the Geological Society of America
v. 44, p. 461-494, June 30, 1933

75 years ago . . .

"Mr. Brögger, from his exhaustive studies in the Norwegian pegmatites, reaches the conclusion that the minerals of the thorite-orangite group, including urano-thorite, crystallize in his first phase of vein formation, that of "magmatic consolidation with the cooperation of pneumatolytic processes." In the second phase, or the "principal phase of pneumatolytic minerals," galena crystallizes out. He has observed galena in so many pegmatites that he considers it superfluous to enumerate them. Now, every one who has had much to do with minerals knows how impure most of them are; how prone to include much more than traces of whatever foreign substances may be present. Brögger's observations show that lead compounds must be soluble in the menstruum from which uraniferous minerals crystallize and indicate the probability that lead may be occluded in them as an impurity, the amount of which may vary from crystal to crystal.

"In view of these facts, the proportion of helium in uranium minerals would perhaps afford a better basis than the lead content for estimates of their age. If Sir William Ramsay's determination of the life of radium is correct, Mr. Rutherford's helium estimate of the age of fergusonite, referred to above, would reduce to 66 million years, which seems not geologically impossible. But I find no convincing evidence that the law of decay is so simple as is assumed. Under the conditions in which uranium compounds are stable, λ must necessarily reduce to zero. It is in the highest degree improbable that λ is a discontinuous function, and it is to the same degree probable that the law of decay fails like Boyle's law, or that λ varies with circumstances such as may have environed a mineral in a pegmatite, even though heat alone or pressure alone may be without effect upon radioactivity.

"On the whole, then, the surface temperature gradients, taken in connection with the age of the earth as determined stratigraphically, or from the sodium content of the ocean, or from my theory of a cooling earth, do not indicate that the excess of temperature within the earth is due to any large measure to radioactivity. Something like a tenth of the gradient, however, may perhaps be due to this cause—a question which a more discriminating study of gradients will answer, at least in part. It does not seem to me that geologists can possibly accept the ages of minerals as determined from the uranium-helium or the uranium-lead ratios, which do not seem consistent and are far longer than stratigraphers could admit."

From "Relations of Radioactivity to Cosmogony and Geology"
by George F. Becker
Bulletin of the Geological Society of America
v. 19, p. 113-146, June 18, 1908

IN MEMORIAM

E. Philip Andrews
Boulder, Colorado

Jules Braunstein
New Orleans, Louisiana

Edward J. Buehler
Buffalo, New York

Robert W. Karpinski
San Luis Obispo, California

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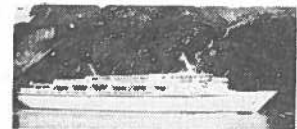


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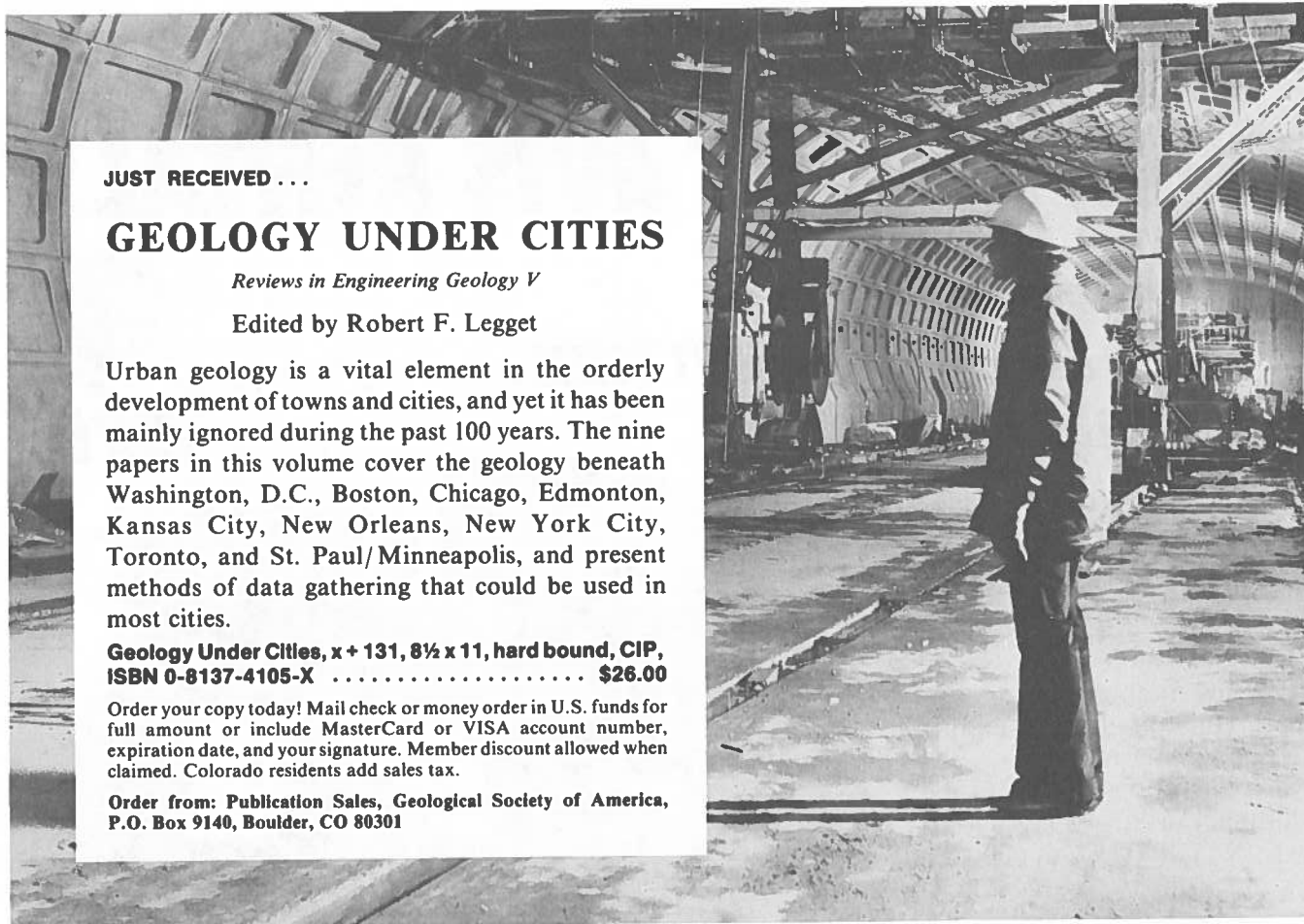


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NGDC Offers Site Summary Information from the Deep Sea Drilling Project

In cooperation with the Deep Sea Drilling Project (DSDP) office, a set of worldwide summary drilling and geologic information for legs 1-87 of the DSDP is being made available through the National Geophysical Data Center (NGDC). This update is current through the year 1982, and information for new legs will be available periodically.

This file is a summary compiled from other, more detailed DSDP data bases and published information. It contains inventory information such as leg, hole, geographic location, water depth, penetration, metres recovered, and coring method or downhole measurements taken. The file also includes basic geologic information such as physiographic features on which the site is located, type of crust, depth to basement, geologic age, brief description of sediment lithology, and igneous rock description.

The DSDP site summary file is available on one magnetic tape for \$100. A listing of the format of the data base as well as a translation of all codes used in the file are also provided. Unless otherwise specified, tapes are 9-track, 1600 bpi, unblocked (294 characters—1 logical record—per block) ASCII. Address inquiries to National Geophysical Data Center, NOAA Code E/GC3, 325 Broadway, Boulder, CO 80303; (303) 497-6338 (FTS: 320-6338).

For further information on the actual compilation of the site summary file, or for information regarding other data files available from the DSDP, contact Data Manager, Deep Sea Drilling Project, University of California-San Diego (A031), La Jolla, CA 92093; (619) 452-3526 (FTS: 895-5496).

Bedrock Geologic Map of Wisconsin Is Published

A new 1:1,000,000-scale, colored bedrock geologic map of Wisconsin has recently been released by the Wisconsin Geological and Natural History Survey. The map, prepared by M. G. Mudrey, Jr., B. A. Brown, and J. K. Greenberg, is the result of a renewed effort in regional geologic mapping and improvement in geophysical data. The new map subdivides the Precambrian and Phanerozoic to an equivalent stratigraphic level, whereas the approximately 20 geologic maps of Wisconsin prepared since 1851 have emphasized subdivisions of either the Precambrian or the Phanerozoic, but not both.

The principal new map information is the subdivision of the Precambrian. By correlating aeromagnetic and gravity data with rock exposures and subsurface data, extrapolation has been made into areas of few bedrock exposures. Mapping has delineated the relative ages of most units. Distribution of principal Paleozoic units is emphasized, including major subdivisions of the Ordovician clastic and carbonate rocks. Known localities of small Paleozoic outliers are shown, as well as known localities of the Cretaceous(?) Windrow Formation.

The map is available from M.A.P.S., Wisconsin Geological and Natural History Survey, 1815 University Avenue, Madison, Wisconsin 53705-4096 for \$6.00 plus \$1.75 for postage and handling. A limited number of maps printed on tear-proof, water-proof, plasticized stock are available for \$20.00 plus \$1.75 postage and handling.

New National Petroleum Reserve Data for Alaska Available

The National Geophysical Data Center has received a considerable amount of new data from the National Petroleum Reserve in Alaska, sent by the U.S. Geological Survey for dissemination to the public. These data are of immediate substantial interest to industry groups involved in exploration and research for oil and gas in northern Alaska and in bidding on the lease sales there. The sets have been released since publication of the NPRA catalog last year and therefore do not appear in it. They are

- TGY-0300, Four seismic and well data reports (1980-82)
- TGY-0301, The geological significance of compaction gradient plots of wells in NPRA, 25 p., 27 pl.
- TGY-0302, Report on an integrated interpretation of seismic and well data pertaining to the Barrow gas fields and the Avak disturbed zone, 24 p., 9 pl.
- TGY-0303, Report on interpretation of seismic data pertaining to Mesozoic strata in the Cape Simpson region, NPRA, 28 p., 13 pl.
- TGY-0304, Report on analysis and reinterpretation of seismic and well data pertaining to Jurassic sandstone prospects in the northern part of NPRA, 31 p., 20 pl.
- TGZ-0170, NPRA Final Report, 1974-1981. Final report of the entire USGS exploration program; a new presentation with updated maps and interpretations, using most recent geophysical data; 3 volumes: 130 p. text, 71 pl. (maps, scale 1:500,000), 132 figs.
- TGZ-0160, 1981 Exploration Program— Geophysical and Geological Report; 2 volumes: Interpretation Report, 71 p., 74 pl. (maps), 10 figs.; Field Reports, 400 p., 19 tables

- TGY-0210, Geochemistry data from five wells—Phase III. Data from analyses of test well cores; includes some updated material from Phases I and II
- TGY-0105, Digitized logs from six new wells—1981; in Schlumberger LISLOG format (9-track, 1600 bpi), two magnetic tapes
- TGR-0230, Final gravity and magnetic report (1974-81). Final report of the USGS exploration program updated with most recent geophysical data; data organized by provinces; 2 volumes: 57 p., 20 maps, 28 figs.; gravity base stations data, 413 p., plus 33 p. text and tables
- TGX-0172, Regional depth—Seismic horizon sections. Final segment of earlier data set: Regional geophysical data and compressed sections (82-TGB-08); 20 profiles, scale 1:125,000, correlated with regional compressed sections

Most of these data sets are available in blackline or sepia paper and sepia plastic. Also, NGDC now has a new format called the Executive Boxed Set, for use as a permanent office reference; the Final Report, 1981 report, and Gravity and Magnetics report are available in this format.

These data may be ordered by telephone or by mail from National Geophysical Data Center, NOAA, Code E/GC12, 325 Broadway, Boulder, CO 80303; (303) 497-6541 or 6826.

NSF Division of Earth Sciences Sets Fund for Major Research Equipment

The Division of Earth Sciences of the National Science Foundation will consider proposals for purchase of major research equipment, renovation and upgrading of existing equipment, and for the development of new instruments that will extend current research capabilities. Research in the earth sciences has developed increased needs for specialized equipment, including analytical instrumentation, experimental apparatus, and dedicated equipment for field studies and for computation and data processing, that commonly is too expensive and of too broad potential use to be adequately justified by a regular research proposal.

Equipment proposals will be accepted from colleges, universities, and other institutions in the United States with formal research programs in the areas supported by the NSF Division of Earth Sciences. Proposals may involve individual scientists or groups; proposals for major items of specialized equipment whose use will be shared are encouraged. Proposals to upgrade existing equipment to state-of-the-art capability are also encouraged. Equipment that is dedicated to an individual scientist's research will normally be considered as part of a regular research proposal and should be justified by the research being proposed.

The NSF welcomes proposals on behalf of qualified scientists and engineers, and strongly encourages women and minorities to compete fully in this equipment program.

The standard NSF grant provisions will apply to awards made from this program. Address inquiries to Earth Sciences Equipment, Division of Earth Sciences, NSF, Washington, DC 20550; (202) 357-7498.



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Special Publications

Collections of research papers and reviews, edited to produce overall reviews of the subject area; hard cover, page size 248 x 170 mm.

Caledonides of the British Isles—Reviewed (1979, 768 p., \$50). Sections on basement cover relations, tectonics, metamorphism, floras and faunas, stratigraphy and sedimentology, volcanism, and plutonism of this closely studied orogenic belt.

Thrust and Nappe Tectonics (1981, 539 p., \$65). Mechanics of thrusts and nappes, rock products of thrusting, thrust and nappe regimes of Caledonia, the Alps, Eurasia, and the Americas.

Trench and Forearc Geology (1982, 576 p., \$60). Japan, Central and South America, Aleutians, Asia, Australasia, Atlantic, Mediterranean, Iran, Pakistan, California; orogenic belts—facies, petrology, models.

Others include *Phanerozoic Time Scale* (458 p., \$15); *The Fossil Record* (827 p., \$15); *Phanerozoic Time Scale* (supplement) (458 p., \$15); *Geological Background to Fossil Man* (585 p., \$40).

Special Reports

The British Isles are a classic area for study of the historical development of stratigraphy and contain many internationally important reference sections. These reports contain detailed

correlation charts for the various systems, with explanations of the correlations. Attention is given to relationships with other parts of the world. The reports are typeset and are like journal parts, measuring 248 x 176 mm. Available numbers are 1, Silurian, 30 p., \$10; 2, Cambrian, 42 p., \$10; 3, Ordovician, 74 p., \$10; 4, Quaternary, 99 p., \$10; 6, Precambrian, 135 p., \$10; 7, Dinantian, 87 p., \$10; 8, Devonian, 110 p., \$10; 9, Cretaceous, 70 p., \$10; 10, Silesian, 81 p., \$10; 11, Stratigraphic Procedure, 18 p., \$3; 12, Tertiary, 72 p., \$10; 13, Triassic, 78 p., \$10; 14, Lower Jurassic, 73 p., \$12; 15, Middle and Upper Jurassic, 109 p., \$14.

Memoirs

Research publications; paperback, 305 x 240 mm. Examples are 4, *The Geology of Portuguese Timor* (80 p., \$12); 5, *Shallow-water Sedimentation as Illustrated by the Upper Devonian Baggy Beds* (94 p., \$12); 6, *Late Precambrian Glaciation in Scotland* (106 p., \$12).

Miscellaneous Papers

Paperback, printed from camera-ready copy, page size mostly 141 x 205 mm. Examples are 10, *Geological Directory of the British Isles* (109 p., \$10); 12, *Sources of Information on the Geology of E.E.C. Countries* (1980, 150 p., \$10); 14, *Computer Applications in Geology I and II* (1982, 284 p., \$15); 15, *Computer Applications in Geology III* (1982, 144 p., \$15).

William T. Pecora Award Nominations Sought

The National Aeronautics and Space Administration and the Department of the Interior are accepting nominations for the William T. Pecora Award.

The award is presented annually in recognition of outstanding contributions of individuals or groups toward the understanding of the earth by means of remote sensing. It was established in 1974 to honor the memory of William T. Pecora, former Director of the U.S. Geological Survey, and later, Under Secretary, Department of the Interior. Pecora, a GSA Fellow, was the motivating force behind the establishment of Earth Resource Sensing from space.

All individuals or groups working in the field of earth resource sensing are eligible for this award.

The award recognizes contributions of those in the scientific and technical community as well as those involved in the practical application of remote sensing. Consideration will be given to sustained or single contributions of major importance to the art or science of the understanding of the earth through observations made from space.

Nominations for the award may be made by any individual, scientific organization, or professional society, by letter (an original and seven copies) to the William T. Pecora Award Committee, Office of Personnel, Department of the Interior, Washington, D.C. 20240 or to the Incentive Awards Board, NB—45, National Aeronautics and Space Administration, Washington, D.C. 20546. A brief statement in support of the nomination is sufficient, but a more developed evaluation of the nominee is preferred. The deadline for nominations is July 15, 1983.

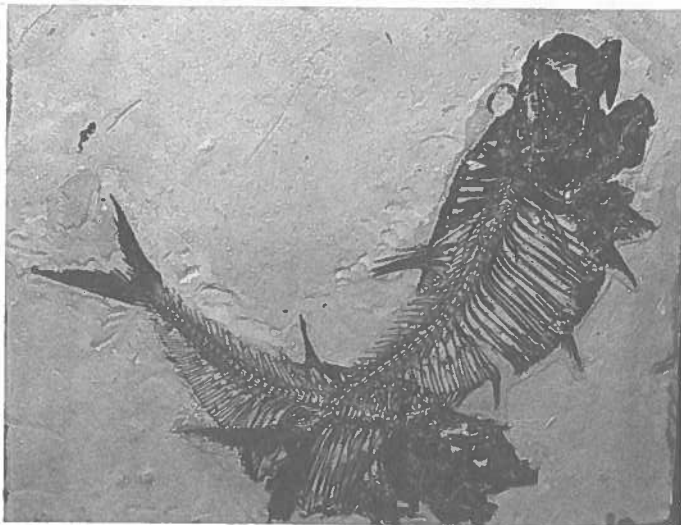
Awardees receive a framed citation signed by the NASA Administrator and the Secretary of the Interior, a plaque presented by the Administrator and the Secretary, and designation as a William T. Pecora Fellow.

People

GSA Fellow and Councilor **Bruce B. Hanshaw**, 52, a specialist in geo-chemistry and ground-water hydrology, has been named assistant director for research at the U.S. Geological Survey National Center, Reston, Virginia. Hanshaw succeeds GSA Member **Robert Wesson**, who has returned to a research position within the USGS. Hanshaw has been acting assistant director since January 1982. He will serve as the principal advisor to the USGS director on major research initiatives and program directions within the Survey's wide range of research activities.

Hanshaw has worked as an exploration geologist for the U.S. Atomic Energy Commission and as a research geologist in the private sector, developing new geochemical approaches to the search for oil and gas reserves. He joined the USGS in 1961 as a research geologist in the water resources division, where he worked on geochemical and isotopic hydrology in the United States, Brazil, and Mexico. He has served as an advisor and consultant on hydrology and geochemistry to many national and international committees, including the Committee on the International Hydrologic Decade, the International Atomic Energy Agency, the Defense Department, and the White House Office of Science and Technology.

SPECIMEN OF THE MONTH



One way to prepare herring: Take two armored herring (*Diplomystus dentatus*), sprinkle liberally with hot volcanic ash, leave in place for 55 m.y. (\pm a few million), and then meticulously remove the scales and overlying layers of rock, leaving the bones in relief.

Probably not very tasty, but this fossil from the Green River Formation of the Fossil Syncline Basin 19 km west of Kemmerer, Wyoming, is one of the many beautiful specimens you may view when you visit your Society's headquarters in Boulder, Colorado. The fossil fish were a gift to GSA from the Department of Geology, University of Wyoming, Laramie, through Paul O. McGrew.

NOW IN PRESS — MEMOIR 157

Tectonics and Stratigraphy of the Eastern Great Basin

Dedicated to Max D. Crittenden, Jr. and edited by David M. Miller, Victoria R. Todd, and Keith A. Howard, this volume represents a wide range of current studies of the eastern Great Basin region. The tectonic history of eastern Nevada, western Utah, and southern Idaho is examined in 19 topical papers covering diverse subjects of geology.

The chief subject is tectonics; the authors address tectonic problems by means of a variety of tools, such as structural analysis, stratigraphy, geochronology, and geophysics. To emphasize continuity of stratigraphy and structure, the papers are ordered geographically, beginning with the Wasatch front and progressing westward.

The Wasatch front, a discontinuous physiographic zone, has marked fundamental boundaries in every era since the Proterozoic. Near the Wasatch front, thick miogeoclinal strata of Proterozoic and Paleozoic age are thrust over thin cratonal sections along Mesozoic foreland thrusts of the Sevier orogenic belt. This same zone is the approximate eastern limit of pronounced Cenozoic crustal extension that is manifested as the Basin and Range province. The hinterland of the Sevier belt lies westward and northwestward of the Wasatch front, well within the Basin and Range province. In central Nevada the hinterland is superposed Paleozoic and Mesozoic orogenic belts. In parts of the Basin and Range province, Cenozoic extension—particularly where asso-

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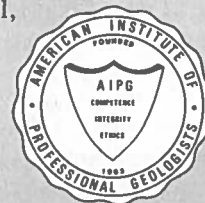
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ciated with metamorphic core complexes—was pronounced; it was accomplished by complex low- and high-angle faulting.

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INTERPRETATION OF WINDFLOW CHARACTERISTICS FROM EOLIAN LANDFORMS

Edited by Ronald W. Marrs and Kenneth E. Kolm

This collection of nine papers synthesizes research in which the traditional procedures and knowledge of stratigraphy, sedimentology, and geomorphology are combined with new remote sensing and statistical methods to decipher relationships between eolian processes and resulting landforms. The applications of this knowledge range from oil and gas exploration to locating and evaluating areas of high wind energy potential. More than 100 photos and line drawings.

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