GSA news & information

VOLUME 3, NUMBER 6

JUNE 1981

Report of the Committee on Research Grants

To the Council and Membership of the Geological Society of America:

The Committee on Research Grants, consisting of Emile A. Pessagno, Robin Brett, NSF conferee, and Walter Alvarez, Chairman, met at Society headquarters in Boulder, Colorado, on April 21 and 22, 1980. The meeting was overshadowed by the death of its new member Robert K. Fahnestock as a result of a light plane accident the day before the meeting. Because Fahnestock died indirectly as a result of serving on the committee, and because he was a distinguished scientist, the committee felt that it would be appropriate for GSA to honor his memory by designating, each year, the best of the research grant applicants in his field, geomorphology and sediment transport, as the recipient of a Robert K. Fahnestock Award. This person would be chosen in the same way that the recipient of the Stearns Award is presently selected. The committee found that Dr. Fahnestock had given his highest rating, an A+, to one applicant, James A. Pizzuto, who submitted a proposal on fluvial geomorphology. The committee recommended that the Council establish this award, and that it be given this first year to Mr. Pizzuto, the one student who particularly impressed Ken Fahnestock during his service on the Research Grants Committee. Subsequently, the Council approved this recommendation.

The committee had at its disposal $81,000, which included industrial donations, donations by past recipients and from dues statements check-offs, funds provided by the Society, and $1,000 from the Harold T. Stearns Fund.

The total number of applications (402) was almost double the number of last year and the overall quality remained high. Support was recommended for 192 or 48% of the total, with an average grant of $422. The committee was impressed by the increase in the proportion of female applicants this year. There were 94 applications from women this year and 52 in 1979. It seems very clear that there will be no lack of exceptional female geologists in the future. The distribution of supported projects among generalized fields is shown in Table 1.

TABLE 1.

	Requested	Funded
(1) Paleontology	32	15
(2) Sedimentology & Stratigraphy	104	31
(3) Structure & Tectonics	77	48
(4) Igneous & Metamorphic Petrology	93	53
(5) Economic Geology	35	14
(6) Quaternary Geology	33	20
(7) Geophysics	13	8
(8) Other	15	3

The committee voted to recommend three recipients for the 1980 Harold T. Stearns Fellowship Award for research on one or more aspects of the geology of the Pacific Islands and one of the circum-Pacific region. They are David L. Kimbrough, University of California, Santa Barbara, *Structure, petrology & geochronology of Baja California ophiolitic terranes, Vizcaino Peninsula & Cedros Island;* Kristian E. Meisling, California Institute of Technology, Pasadena, *Neotectonics of the north frontal fault system of the San Bernardino Mountains, southern California;* Richard G. Stanley, University of California, Santa Cruz, *Oligocene and early Miocene sedimentation and tectonics in the Santa Cruz Mountains, central California.*

The committee singled out eighteen young scientists and their proposals for special mention in the belief that

(continued next page)

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they should be brought to the attention of the Council and to the membership of the Society:

Lung Sang Chan, University of California, Berkeley
Karen Kluger Cohen, University of Pittsburgh, Pennsylvania
Cynthia Ann Evans, Scripps Institution of Oceanography, La Jolla
John Joseph Flynn, Columbia University, New York
Christopher J. Hale, University of Toronto, Canada
Robert Hershler, Johns Hopkins University, Baltimore, Maryland
Marie D. Jackson, Johns Hopkins University, Baltimore, Maryland
John W. King, University of Minnesota, Minneapolis
Linda A. Kovach, Johns Hopkins University, Baltimore, Maryland
Frederick W. Kunzinger, Old Dominion University, Norfolk, Virginia
Judy A. Massare, Johns Hopkins University, Baltimore, Maryland
Charles Merguerian, Columbia University & Lamont-Doherty, New York
James E. Pizzuto, University of Minnesota, Minneapolis
Luis A. Sanchez-Barreda, University of Texas, Austin
Diane R. Smith, Rice University, Houston, Texas
Kim S. Stemen, Ohio State University, Columbus, Ohio
Robert B. P. Stevens, Boston College, Newton, Massachusetts
David B. Weishampl, University of Pennsylvania, Philadelphia

Contributions of $2,000 were received from both Marathon and Mobil Oil Corporations in support of the research grants program. Nine promising young earth scientists were partially supported by these funds.

The committee believes the GSA research grant program represents one of the most effective scientific funding mechanisms in the country, yielding an enormous return for the relatively small amount of money expended. If the impact of the program is not to decline further with inflation, the level of funding must increase. This year the committee could easily have awarded to worthy projects at least $20,000 more than was available.

Respectfully submitted,
Walter Alvarez, Chairman; *Emile A. Pessagno, Jr.;*
Robin Brett, Conferee

1980 RESEARCH GRANTS SUMMARY OF COMMITTEE RECOMMENDATIONS

	Number of Applicants	Requested by Applicants	Recommended for Support
CATEGORY I (Recommended for support)			
M.S. Student applicants	83	$ 70,259	$ 29,624
Ph.D. Student applicants	109	119,802	51,376
Subtotal	192	$190,061	$ 81,000
CATEGORY II (Alternates)			
M.S. Student applicants	4	$ 5,072	
Ph.D. Student applicants	8	9,808	
Subtotal	12	$ 14,880	
CATEGORY III (not recommended for support)			
M.S. Student applicants	120	$124,552	
Ph.D. Student applicants	66	75,096	
Post Ph.D. applicants	12	15,658	
Subtotal	198	$215,306	
GRAND TOTAL	402	$420,247	$ 81,000
COUNCIL ACTION			
Support all Category I projects	192		$ 81,000
Funding declined (cancellations)	(7)		(2,625)
Funding returned from prior years			(1,748)
Alternates awarded	7		3,500
YEAR END TOTAL	192		$ 80,127

Short-term lectureships in Near East-South Asia available in 1982

Ten awards of six weeks to four months, beginning between February 1982 and September 1982 (but during a regular academic term of the host country), are offered without restrictions as to field to enable established American professionals and members of college and university faculties to teach in one or more Near Eastern and South Asian countries. Grantees are expected to carry out a substantive teaching and/or consulting program in the country of assignment. Applicants must be U.S. citizens and have postdoctoral college or university teaching experience or have established professional reputations.

Grant terms include roundtrip economy-class air travel for the grantee and a per diem of $75 plus a temporary living allowance, the total not to exceed $125 per day.

Participating countries are not yet determined, but the following countries have been included in previous years: Algeria, Bangladesh, Egypt, Jordan, Lebanon, Morocco, Nepal, Pakistan, Sri Lanka, Saudi Arabia, Sudan, Syria, Tunisia, Yemen.

Additional information and application forms are available from the Council for International Exchange of Scholars, Attention: Near East/South Asia Short-Term Program, Eleven Dupont Circle, Washington, D.C. 20036. Telephone (202) 833-4981.

Applications due July 1, 1981.

In June *Geology*

1. Controls on source and depth of emplacement of granitic magma, by D. W. Hyndman.
2. Kennebunk glacial advance: A reappraisal, by G. W. Smith
3. Ancestral head of Wilmington Canyon, by B. A. McGregor
4. Joint spacing as a method of locating faults, by H. A. Pohn
5. Carbon isotopes as indicators of dispersal patterns in Devonian-Mississippian shales of the Appalachian Basin, by J. B. Maynard
6. Gulf Stream: Reconstruction of Cenozoic flow patterns over the Blake Plateau, by P. R. Pinet, P. Popenoe, D. F. Nelligan
7. Temperatures within subglacial debris—A gap in our knowledge, by J. Menzies
8. Paleozoic continental-margin sedimentation in east-central Alaska, by M. W. Payne, C. W. Allison
9. Joints, microfractures, and the formation of solution cleavage in limestone, by P. A. Geiser, S. Sansone

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Prepared from contributions from the staff and membership by John C. Frye, Executive Director; James R. Clark, Production Manager; and June Thomas and Ann H. Fogel, Production Assistants.

WHY AUTHORS SHOULD USE THIS YEAR'S ABSTRACT FORM

For the Annual Meetings

GSA now is accepting abstracts for annual meetings only on the current year's form. To understand why, it is important to realize that these forms serve two purposes. First, the author-prepared abstract is used for actual paste-up for printing. This eliminates typesetting of the abstracts for the *Abstracts with Programs,* reducing costs and errors. Image quality is important and format requirements tend to change. Second, the abstract form provides data which are used to determine trends and develop on-going statistics. The criteria for these data are subject to frequent change.

With regard to image quality, in 1980, as in previous years, GSA received hundreds of abstracts typed on photo-copies of old forms, some dating back ten years. Apparently, many organizations vigorously guard that "last copy" of the abstract form they have in the file and photocopy it for use year after year. Unfortunately, when abstract forms are photocopied, the nonreproducing blue lines which define the limits of the abstract usually reproduce in black, complicating the work of paste-up. In addition, the photocopies are often on lightweight paper which allows bleed-through of the hot wax used to cement the abstract to the printing layout. These problems can necessitate retyping of the abstract and a charge to the author.

Those old copies are badly out of date with regard to format requirements, creating additional problems, and even more out of date with regard to the peripheral data requested *about* the abstract.

Recent examples of the peripheral data problem include changes such as the one on the 1980 form asking authors to indicate a preference as to which of the associated societies should review the abstract. This year, that requirement was dropped and a new clarification was added limiting to one the number of abstracts an author may personally present. Almost every year the category list (of subdisciplines) changes slightly, and of course the abstract deadline changes every year. All such changes must be reflected on the form to be fair to authors and to facilitate the fastest possible processing of abstracts.

Seemingly minor changes, in format or peripheral data, grow in significance with each passing year. The form that was only one year out of date in 1979 is now badly outdated. If we were to continue to accept abstracts on those old forms, we would be creating more and more inconveniences for authors, including unwelcome author charges for retyping, and we would realize a growing amount of remedial work at GSA.

Realizing that the new policy calls for wide distribution of new forms, this year GSA began the routine of sending packets of forms and first announcements to the geology departments at 550 colleges and universities, to several USGS locations, to all State Geologists' offices, to a healthy list of commercial and industrial organizations, to the GSA divisions and sections, to all symposia organizers, to all GSA campus representatives, and to those individuals and organizations that requested forms during the previous year. Requests coming in this year for forms are nearly always filled the same day.

In 1980 GSA computerized abstract processing with the result that labor costs were reduced substantially while at the same time we were able to provide additional service to the authors, such as the immediate acknowledgment of receipt we now send and much prompter advice on acceptance and rejection. By 1982 we expect that the complete technical program section of *Abstracts with Programs* will be typeset automatically from the computer records.

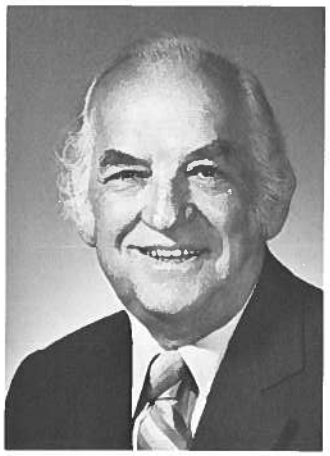
Annual Meeting ABSTRACT DEADLINE: June 5

CENTENNIAL NEWS

Evolution of a logo

The D-NAG logo has been subtly changing. The first version (shown below) adapted the idea of an ellipse with "Decade of North American Geology" above, submitted by Gerald Meyer of the USGS, by substituting a silhouette of North America for Pangaea with North America highlighted and moving the dates for the Decade inside the ellipse. The printing of the D-NAG brochure, mailed to all members in early April, showed the attractiveness of adding an outer ellipse. However, before this could even be created in a black and white version, a telephone call from Richard Williams, Jr., of the USGS, pointed out that Iceland had been left out of the silhouette. The addition of Iceland brought about a slight clockwise rotation of the entire silhouette. Unless other modifications are proposed and accepted, the logo as shown above will appear on all of the publications attributed to the Decade of North American Geology. We hope others view the evolutionary changes as improvements.

GSA FOUNDATION BOARD OF TRUSTEES



Caswell Silver, *Chairman*

I was born June 25, 1916, in New York City. After receiving both B.S. and M.S. degrees in geology at the University of New Mexico, my early career was spent in the San Juan Basin of northwest New Mexico with Florance Drilling Company. I was the first to recognize the basin-wide distribution of natural gas which was to develop into the second largest field discovered so far in the United States, and beginning in 1950, I published a number of articles on the San Juan Basin. In 1951, at the first annual meeting of the Rocky Mountain Section of the AAPG, I gave a paper suggesting the presence of a large regional stratigraphic trap possibility in the Gallup sandstone and outlined a general area 10 miles wide and 50 miles long in which it could be found. The Bisti oil field, 2 miles wide and 40 miles long, was found within the outlined area in 1957 after 30 dryholes.

Moving from Albuquerque to Denver in 1959, I soon converted Sundance Oil Company, of which I had been president since 1955, from a small company having one producing royalty in the Ashley Valley Field near Vernal, Utah, to exploring the Denver basin. In 1964, after four years of indifferent success in which Sundance income had grown from $20,000 to $35,000 a year, I initiated one of the first subsurface geologic mapping programs in which computers were employed to analyze electric well logs for porosity, water saturation, and fluid salinity using the Humble and Archie formulas. This was done under my supervision as a joint research effort with Marathon Oil Company research center in Littleton, Colorado. Out of this came an understanding of the controls and distribution for oil and gas occurrence in the Denver basin and the discovery of a number of fields that increased Sundance's yearly oil and gas sales to $1,500,000 a year by 1969 and thence led the company into opening an exploration office in Calgary, Alberta, in September 1970.

Out of my experience in the various Cretaceous oil and gas fields of the Rocky Mountain basins, principally the San Juan and Denver basins, I formulated the geologic principles that were so successfully employed in the Alberta syncline in Canada. Ideas contained in my 1973 publication "Entrapment of petroleum in isolated porous bodies" bred a philosophy of exploration that made Sundance Oil Canada, Ltd., the most successful exploration company in Canada in the decade of the 1970s and built the company to its present size of having a discounted present worth of more than one billion dollars.

Presently I am chief executive officer and chairman of the Board of Directors of the Sundance Oil Company. I am a Fellow of the Geological Society of America and the American Association for Advancement of Science and a member of the American Association of Petroleum Geologists, the Society of Economic Geologists, and various local geological societies—RMAG, WGS, and CIPG.

Robert Fuchs, *Vice-Chairman*

Bob Fuchs started his geological career at Cornell University. His master's degree was obtained from the University of Illinois, following which he began work as a junior geologist for Mobil Oil. During 13 years with this major oil company, he served in a variety of exploration positions world-wide.

In 1965, Bob left Mobil to work for a research company in the Washington, D.C., area, and shortly thereafter he founded a computer business. This company was sold three years later, at which time he joined forces with two businessmen to form Intercontinental Oil Corporation. This is now a public company located in Denver that is engaged in oil, gas, and uranium exploration and production.

In 1971, Bob founded Geosystems Corporation and is currently its president. Geosystems is a natural resources company that has successfully married geological expertise to investment management concepts. As a result, Geosystems and its partners participate in a broad spectrum of investments in natural resources, from geothermal through petroleum to coal gasification and gold.

In the Geological Society of America, Bob has been very active in financial affairs since the early 1970s and has chaired the Committee on Investments since 1977. He has fulfilled a similar role for the American Association of Petroleum Geologists and is also the incoming president of the AAPG's Energy Minerals Division.

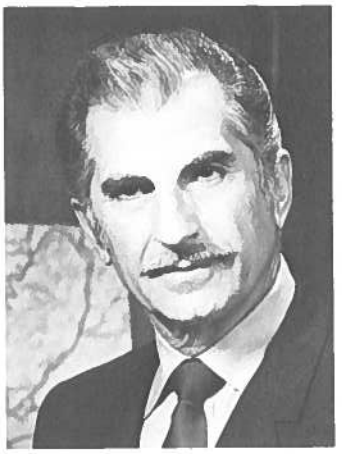
While working in Venezuela in 1955, Bob met and married Josephine Servello. They now reside in Westport, Connecticut, where both are elected officials in local government. The Fuchs have two sons—Edward, who is employed by Mobil Oil Corp., and Robert, who is a senior in chemical engineering at Cornell.

Michel T. Halbouty's career as an earth scientist spans five decades in the fields of petroleum geology and petroleum engineering, from 1931 when he began to work in his chosen fields, through today as an independent geological consultant and oil and gas producer and operator in Houston. A graduate of Texas A&M University, he holds bachelor's and master's degrees in both geology and petroleum engineering and professional geological engineering and doctor of engineering degrees (HC) from Montana College of Mineral Science and Technology.

Over the years he has continued to research and learn techniques and concepts of advanced oil and gas exploration, production, and development. The newest of these concepts is the use of remote sensing from spacecraft to enhance the overall global petroleum exploration effort. Halbouty has contributed several books and over 200 scientific articles to the literature of petroleum geology and petroleum engineering.

He is an outspoken optimist about the future of the world-energy economy and puts into action what he believes by telling others, applying his knowledge to the existing problems, and offering solutions. As chairman of President Reagan's Energy Policy Advisory Task Force and later as leader of the Transition Team on Energy, he has given much of his time and expertise to help ensure the economic energy stability of our country.

He is a staunch supporter of the geological sciences and contributes his time, as well as financial support, to increased excellence in geological research, education, and applications.



Michel T. Halbouty

John C. Maxwell

I was born in Xenia, Ohio, in the opening year of the "War to End All Wars," and was educated successively at DePauw University, University of Minnesota, the Texas Company (as jug hustler on a seismic crew), Sun Oil Company (as a geologist and geophysicist), and Princeton University. Work with Harry Hess and Taylor Tom at Princeton began a lifelong interest in the origin and complexities of mountain systems, particularly those which are still actively forming. My students and I have worked in the Caribbean area from the Virgin Islands to Venezuela, in the Appalachians, the northern Rocky Mountains, the Mediterranean from Spain to Turkey, the northern California Coast Ranges, and the Klamath Mountains. Over the years I have been honored by election to the Council and presidency of the Geological Society of America and the presidency of the American Geological Institute. Currently, as the knees become more arthritic, my scientific efforts are largely vicarious, but none the less exciting, as a member, and now chairman of the U.S. Geodynamics Committee and a member and vice-chairman of the Board of the UNESCO-IUGS-sponsored International Geological Correlation Programme. The University of Texas at Austin provides a stimulating environment and the necessary financial means to permit these activities.

Hollis D. Hedberg was born in 1903 in the small Swedish farm community of Falun, Kansas, and brought up to work by the side of his father on their homesteaded wheat farm. He obtained his B.A. degree, Phi Beta Kappa, from the University of Kansas in 1926, his M.S. from Cornell in 1927, and his Ph.D. from Stanford in 1937. He joined Gulf Oil Corporation in 1928 as a geologist in Venezuela, later (in the U.S.) became chief geologist, and then vice-president in charge of exploration. In 1969, he became professor of geology at Princeton University.

He has received many and varied recognitions for his years of service in the geological profession. In 1941, he received the Medalla de Honor de la Instruccion Publica from Venezuela; in 1963, the Sidney Powers Medal of the AAPG and the Distinguished Service Award of the University of Kansas; in 1969, the Certificate of Appreciation from the National Petroleum Council for his work on the Council's Committee on Petroleum Resources under the Ocean Floor; in 1972, the President's Award of the AAPG for his paper on continental margins; in 1973, the Mark Clark Thompson Medal of the National Academy of Sciences and the Human Needs Award of the AAPG; in 1975, the Distinguished Achievement Award of the Offshore Technology Conference and the Wollaston Medal of the Geological Society of London; in 1977, a Doctorate *honoris causa* from the University of Uppsala in Sweden for his twenty-five years of work in bringing together a consensus on stratigraphic classification which culminated in the publication of the International Stratigraphic Guide; and in 1980, the Penrose Medal of the Geological Society of America.

Hedberg is a member of the National Academy of Sciences and of many of the geological societies, including honorary membership in scientific societies in England, Sweden, and Denmark. He was president of the Geological Society of America in 1960 and president of the American Geological Institute in 1962-1963.

He has published more than 150 scientific papers on compaction of sediments, stratigraphy and stratigraphic classification, petroleum geology and the origin of petroleum, ocean boundaries and the law of the sea, and many other subjects.

Hollis D. Hedberg

1981 ANNUAL MEETING

NOVEMBER 2–5

CINCINNATI, the Queen City, founded on seven hills overlooking the Ohio River, is an excellent site for the November meeting. It is also the site of the inception of GSA—back in 1881. A city with a pronounced Southern exposure, Cincinnatians are gracious with strangers, and best of all, for travelers inclined to gauge a city by the quality and diversity of culinary offerings, its restaurants compare favorably with cities many times larger. We recommend the convenient location of the convention center and hotels and moderate costs for food and lodging.

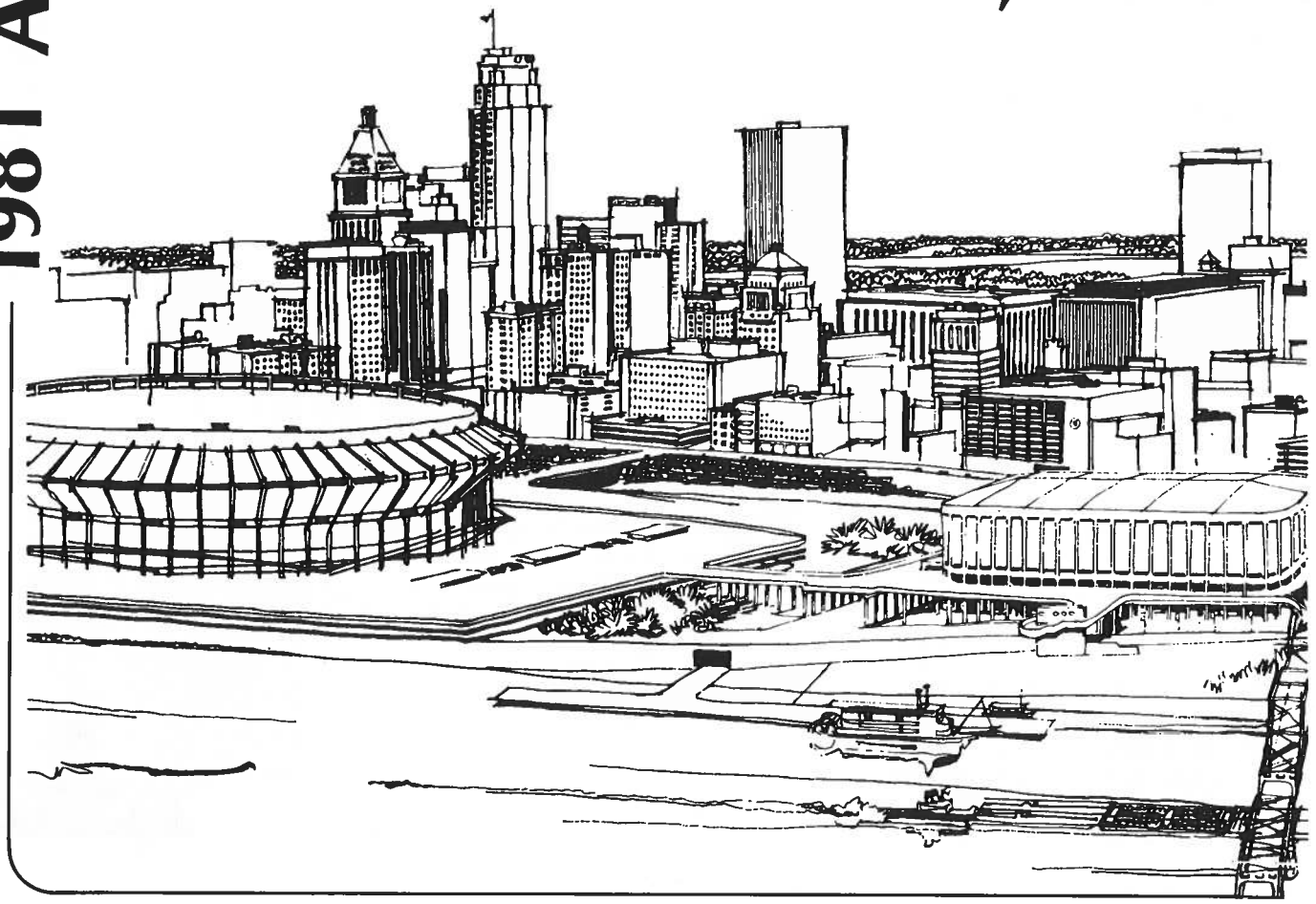
The Local Committee has initiated an enticing series of events that will round out the more sedate technical program.

Welcoming Party, November 1. Cincinnati Union Terminal is the location for the Sunday night opening reception. Beverages will be available on the rotunda and concourse levels. Browsing through stores and snacking at food stands is encouraged—a good pastime while seeing friends. This will be a cut above the usual hotel ballroom atmosphere.

Oktoberfest, November 3. Plan for a great evening of music and dance from biergartens to opera amid the tradition of German foods and icy beer steins. It will be in Cincinnati's grand old Music Hall. Unlimited free beer will be included in the ticket price.

Annual Dinner, November 4. As part of the GSA Annual Dinner, Frank Press, incoming president of the National Academy of Science, will address us. We are counting on his background in Washington, D.C., to give us a special perspective. Everyone is welcome to attend this after-dinner address.

CINCINNATI, OHIO



Amphibole short course will precede the Cincinnati Annual Meeting

The Mineralogical Society of America will sponsor a Short Course on Amphiboles and Other Hydrous Pyriboles before the 1981 MSA/GSA Annual Meeting in Cincinnati, Ohio. The Short Course will be held at a conference center near Erlanger, Kentucky, from October 29 (evening) to November 1 (noon). It will include an intensive review of the crystal chemistry, spectroscopy, phase equilibria, igneous and metamorphic petrology, and subsolidus behavior of amphiboles, as well as discussions of the mineralogy and geology of amphibole asbestos and wide-chain pyriboles. The outstanding lecturers who have been selected for this course will also participate in the preparation of Volume 8 of the MSA Reviews in Mineralogy series. For further information, write to **Amphibole Short Course, Mineralogical Society of America, 2000 Florida Avenue, N.W., Washington, D.C. 20009.**

1981 ANNUAL MEETING COMMITTEE

General Chairman	Warren Huff	University of Cincinnati
Co-Chairman/Treasurer	Malcolm Annis	University of Cincinnati
Field Trips	Lois Campbell	University of Kentucky
	Thomas Roberts	University of Kentucky
Guest Program	Terry & Marie Huizing	Emery Industries Inc.
Publicity	Robert McWilliams	Miami University, Ohio
Science Theatre	Napoleon Bryant	Xavier University
Student Assistants	Kees DeJong	University of Cincinnati
Technical Program	Norman Hester	Consolidated Resources of America, Inc.
	Martin Noger	Kentucky Geological Survey
Technical Services	Raman Singh	Northern Kentucky University
Transportation	David Lienhart	U.S. Army Corps of Engineers

Reduce . . . and Enjoy

For the sake of economy in a year of cutbacks, we suggest the following ways to save in '81 while enjoying the annual meeting:

1. Preregister.
2. Prepurchase the *Abstracts with Programs.*
3. Arrange a carpool. For Surveys— how about a vanpool?
4. Book your excursion airfare NOW while still available. It usually costs nothing to cancel. Check with a travel agent; services are free.
5. Register for a hotel room in August when the housing forms first become available. This will help assure your first choice.
6. Walk or use the free shuttle. Try to arrange four persons to a cab when traveling to and from the airport or use the airport bus.
7. Reminder, weekday prices at most restaurants are less than those on weekends. (Many of the best restaurants are closed Sunday anyway!)

We are doing our best to hold the expenses of putting on a meeting to a reasonable minimum. We predict the registration fee will not be increased for 1981—a bargain compared to the general inflation rate.

About 2/3 of meeting attendees preregister. Note on your calendar: Register for the GSA meeting by **OCTOBER 2.** Refunds are permitted until **October 15.**

We look forward to meeting with you. See you in Cincinnati!

Call for proposals for the Centennial Symposium: 1982 Annual Meeting—New Orleans

The Council of the Society has authorized the designation of a featured Centennial Symposium for each annual meeting during the decade of the 1980s. This symposium will be a part of the Centennial Program and of the Decade of North American Geology. The President of the Society will make the final selection from suggestions and proposals made by the Program Review Committee, the Council, divisions, sections, and the membership at large. Proposals are being accepted for the 1982 meeting in New Orleans.

The featured symposium should focus on pacesetting trends and current breakthroughs in research having broad interdisciplinary impact on the science of geology.

Suggestions and proposals of titles and subjects should be sent **before October 2, 1981,** to

A. R. Palmer, Centennial Science Program Coordinator
Geological Society of America
P.O. Box 9140
Boulder, CO 80301

Annual Meeting Field Trips—
See Next Page

FIELD TRIPS

The Cincinnati area has a long history of attracting geologists because of its abundantly fossiliferous strata and its position on the crest of the Cincinnati Arch. Within easy reach are karst features, coal-producing regions, glacial sediments, Paleozoic rocks from Ordovician through Permian age, as well as shores of large lakes. Within reasonable distances, the Appalachians and the Ozarks are also accessible.

For further information concerning any field trip, contact either **Lois J. Campbell, Chairman, or Thomas Roberts, Co-Chairman, Department of Geology, University of Kentucky, Lexington, KY 40506 (606) 257-3758.** Unless otherwise indicated, all trips originate and terminate in Cincinnati.

Premeeting

1. **Upper Ordovician (Richmondian) Stratigraphy and Paleoecology of Southeastern Indiana and Southwestern Ohio (1 day).** John K. Pope, Roy H. Reinhart, and Wayne D. Martin, Miami Univ., Oxford, OH; and Helen B. Hay, Earlham College, Richmond, IN.
2. **Stratigraphy of Devonian and Lower Mississippian Agglutinate Foraminifera of Northwestern Kentucky and Southern Indiana (2 days. Origin. Louisville, KY).** James E. Conkin, Univ. of Louisville; and Barbara M. Conkin, Jefferson Community College, Louisville, KY.
3. **Chattanooga Shale—Potential Source of Oil, Gas, and Heavy Metals (3 days. Origin. Chattanooga, TN).** Roy C. Kepferle, USGS, Cincinnati, OH; and John B. Roen, USGS, Reston, VA.
4. **Mississippian-Pennsylvanian Boundary in the Central Part of the Appalachian Basin (4 days. Origin. Princeton, WV).** Kenneth J. Englund and Thomas W. Henry, USGS, Reston, VA; John C. Horne, Colorado School of Mines; and Frank R. Ettensohn and John C. Ferm, Univ. of Kentucky. (Mississippian-Pennsylvanian Boundary Group, SEPM.)
5. **Geohydrology of the Ohio River Alluvial Aquifer (1 day).** Donald S. Mull and Robert J. Faust, USGS, Water Res. Div. Louisville, KY.
6. **The Serpent Mound Cryptoexplosion Structure, Southwestern Ohio (1 day. Same trip as postmeeting 16).** Stephen P. Reidel, Rockwell Hanford Operations, Research Dept., Richland, WA; and Frank L. Koucky, College of Wooster, Wooster, OH.
7. **Coastal Geomorphology and Geology of the Ohio Shore of Lake Erie (2 days. Origin. Cleveland, OH).** C. H. Carter, D. E. Guy, Jr., and J. A. Fuller, Ohio Geological Survey, Lake Erie Section, Sandusky, OH.
8. **Hydrogeology of the Mammoth Cave Region, Kentucky (4 days).** James F. Quinlan, National Park Service, Mammoth Cave, KY; and Ralph Ewers, Cumberland Karst Research Lab., Stab, KY.
9. **Quaternary Deposits of Southern Ohio (3 days).** R. P. Goldthwait, Ohio State Univ.; D. P. Stewart, Miami Univ.; D. A. Franzi, Syracuse Univ.; and Michael J. Quinn, Shell Oil Co., New Orleans, LA.
10. **Stratigraphical and Structural Geology of the Hot Springs Traverse, Tennessee-North Carolina (3 days. Origin. and Term.: Knoxville, TN. Hdqs: Newport, TN).** Nicholas Rast and James C. Bolton, Univ. of Kentucky.

Postmeeting

11. **Paleoenvironmental Interpretation of the Middle Ordovician High Bridge Group in Central Kentucky (1 day).** Gary L. Kuhnhenn, Eastern Kentucky Univ., Richmond, KY; George Grabowski, Rice Univ., Houston, TX.
12. **Stratigraphy, Sedimentology, and Paleoecology of the Cincinnatian Series (Upper Ordovician) in the Vicinity of Cincinnati, Ohio (2 days).** D. L. Meyer, W. A. Pryor, and R. C. Tobin, Univ. of Cincinnati; R. G. Osgood, College of Wooster, Wooster, OH; and W. B. Harrison, Western Michigan Univ., Kalamazoo, MI.
13. **Early Mississippian Deltaic Sedimentation in Central and Northeastern Ohio (3 days. Term. Cleveland, OH).** R. A. Heimlich and A. H. Coogan, Kent State Univ., Kent, OH; R. J. Malcuit and K. B. Bork, Denison Univ., Granville, OH; and T. L. Lewis, Cleveland State Univ.
14. **Coals and Coal-Bearing Strata of Southeastern Kentucky (4 days).** James C. Cobb, Norman C. Hester, and Donald R. Chestnut, Kentucky Geological Survey; and James C. Hower, Inst. for Mining and Minerals Research, Univ. of Kentucky (Coal Geology Division).
15. **Precambrian Geology and Mineralization, the St. Francois Mountains, Southeastern Missouri (3 days. Origin. and Term.: St. Louis, MO. Hdqs: Flat River, MO).** Eva B. Kisvarsanyi and Arthur W. Hebrank, Missouri Geological Survey, Rolla, MO; and Richard F. Ryan, Pilot Knob Pellet Co., Ironton, MO.
16. **The Serpent Mound Cryptoexplosion Structure, Southwestern Ohio (1 day. Same trip as 6).** Stephen P. Reidel, Rockwell International, Geoscience Group, Richland, WA; and Frank L. Koucky, College of Wooster, Wooster, OH.
17. **Geoarchaeology of the Flint-Mammoth Cave System and the Green River Valley, Western Kentucky (2 days).** Julie Stein, Univ. of Washington; Patty Jo Watson, Washington Univ. in St. Louis; and William B. White, Penn State Univ. (Archaeological Geology Division).
18. **Engineering Geology of Cincinnati (1 day).** Robert W. Fleming, USGS, Denver, CO; Arvid M. Johnson, Univ. of Cincinnati; and James E. Hough, Consulting Geol., Cincinnati. (Engineering Geology Division)
19. **Structure and Stratigraphy of the Pine Mountain Thrust Sheet (2 days. Term.: Knoxville, TN).** T. Dennis Coskren, Univ. of Kentucky.

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THE GEOLOGICAL SOCIETY OF AMERICA

UPDATE

Announcing 22nd U.S. Symposium on Rock Mechanics

The 22nd U.S. Symposium on Rock Mechanics will be presented this year at the Massachusetts Institute of Technology from June 29 to July 2, 1981.

Designed for mining, civil, and petroleum engineers; geophysicists; and rock physicists, the conference will present papers and discussions concerning energy, mineral extraction, civil construction, and waste disposal.

Both the research and applications areas will be examined in concurrent sessions in each of the following topic areas: heat and fluid flow, fragmentation and fracture propagation, deformation of rock masses, and site characterization. State-of-the-art papers in each of these areas will commence the symposium.

In addition, a special plenary session will address the transfer of technology from research to practice through paper presentations and then panel discussions between session chairmen, state-of-the-art speakers, and the audience.

Field trips will be conducted through Boston's Massachusetts Bay Transportation Authority's Red Line extension tunnel, as well as through the Seabrook Nuclear Power Station cooling water tunnel.

For additional information, contact the Seminar Office at (617) 253-7461.

FIRST ANNOUNCEMENT AND CALL FOR PAPERS

FIRST ANNUAL CONFERENCE ON THE MANAGEMENT, ANALYSIS AND DISPLAY OF GEOSCIENCE DATA

January 27-29, 1982
Colorado School of Mines
Golden, Colorado

Mathematical Geologists of the United States

The conference will provide a forum for geoscientists, mathematicians, statisticians, and computer scientists to discuss progress in theoretical and applied approaches. The program will include invited review papers on the following topics:

- General
- Advances in geostatistics
- Developments in geomathematics
- Computer applications
- Computer graphics
- Database management

Contributed papers are invited on any of these topics. Suggestions or contributions on other, related topics will also be considered by the organizing committee. Those wishing to submit an abstract should send a tentative title of their paper to: Richard B. McCammon, U.S. Geological Survey, National Center 920, Reston, VA 22092. The deadline for receiving this information is **August 15, 1981.**

Impact of Richards's Equation: Semi-Centennial Session

In 1931, L. A. Richards proposed an equation for transient flow of water in partially saturated soils (Capillary conduction of liquids through porous mediums: Physics, 1, 318–333, November 1931). In modern notation this equation is

$$\nabla \cdot \frac{k k_r(p)}{\mu} (\rho g \nabla z + \nabla p) = \frac{d\theta}{dp} \frac{\partial p}{\partial t} ,$$

where k is intrinsic permeability, k_r is the relative permeability as a function of capillary pressure, ρ is fluid density, g is acceleration due to gravity, z is elevation above datum, p is fluid pressure, θ is volumetric moisture content, and t is time. Richards's equation can be considered as the forerunner of modern analysis of transient fluid flow in porous media, used in such earth-science disciplines as hydrogeology, soil science, soil mechanics, and petroleum engineering. Fifty years after the publication of Richards's equation it is worthwhile to step back and reassess its impact, its validity and limitations, its extensions and applications.

Accordingly, a day-long special session entitled, "Impact of Richards's Equation: A Semi-Centennial Session," is being organized by the Hydrology Section of the American Geophysical Union, during the annual fall meeting, San Francisco, December 7–11, 1981. The session will consist of invited as well as contributed papers dealing with theoretical aspects, laboratory studies, field applications, and mathematical solutions. Those who desire to contribute presentations are requested to send an abstract in standard AGU format no later than July 1, 1981, to T. N. Narasimhan. Authors of accepted abstracts will be notified by August 1, 1981. For further details, contact anyone listed below. The session is being co-sponsored by appropriate sections of the American Society of Civil Engineers, the Hydrogeology Division of the Geological Society of America, the Soil Science Society of America, and the American Society of Agricultural Engineers.

Jacob Rubin
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U.S. Geological Survey
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(415) 323-8111, ext. 2141

T. N. Narasimhan
Chairman of Special Session
Earth Sciences Division
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Berkeley, CA 94720
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University of California
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Memorial Preprints Ready For Free Distribution

The following memorial preprints are now available for distribution, free of charge, by writing to GSA, P.O. Box 9140, Boulder, CO 80301:

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Calendar of Penrose Conferences for 1981–1982

April 28-May 2, 1981
SIGNIFICANCE & PETROGENESIS OF MYLONITIC ROCKS
Harbor Island Sheraton, San Diego, CA

Conveners: **Arthur W. Snoke,** Department of Geology, University of South Carolina, Columbia, SC 29208; **Victoria Todd,** U.S. Geological Survey, Scripps Institution of Oceanography, La Jolla, CA 92093; **Jan A. Tullis,** Department of Geological Sciences, Brown University, Providence, RI 02912

May 10-15, 1981
TIMING OF OROGENIC ACTIVITY IN THE APPALACHIAN-CALEDONIAN SYSTEM
Ann Jordan Lodge, Alexander City, AL

Conveners: **William A. Thomas,** Department of Geology & Geography, University of Alabama, University, AL 35486; **James F. Tull,** Department of Geology & Geography, University of Alabama, University, AL 35486

September 6-14, 1981
CONTROLS OF PLATFORM EVOLUTION
Hotel Europa-Palace, Isle of Capri in Naples Bay, Italy

Conveners: **James Lee Wilson,** Department of Geological Sciences, The University of Michigan, 1006 C. C. Little Building, Ann Arbor, MI 48109; **Bruno D'Argenio,** Geological Institute, University of Naples, 10 Largo San Marcellino, 80138 Napoli, Italia

April 11-16, 1982
THE ANTARCTIC PLATE: A GLOBAL PERSPECTIVE
Skyland Lodge, Shenandoah National Park, Virginia

Conveners: **Ian W. D. Dalziel,** Lamont-Doherty Geological Observatory, Columbia University, Palisades, NY 10964; **David H. Elliott,** Institute of Polar Studies, The Ohio State University, Columbus, OH 43210

September, 1982
THE SONOMA OROGENY AND PERMIAN TO TRIASSIC TECTONISM IN WESTERN NORTH AMERICA
Winnemucca, NV

Conveners: **John H. Stewart,** U.S. Geological Survey, Mail Stop 26, 345 Middlefield Road, Menlo Park, CA 94025; **Hubert Gabrielse,** Geological Survey of Canada, 100 West Pender Street, Vancouver, BC V6B 1R8 Canada; **Walter S. Snyder,** Lamont-Doherty Geological Observatory, Columbia University, Palisades, NY 10964

First or second week of October 1982
MODELS OF DIAGENESIS IN CLASTIC RESERVOIRS
Santa Barbara, CA

Conveners: **James R. Wood, Jr.,** Chevron Oil Field Research Company, 3282 Beach Boulevard, La Habra, CA 90631; **James R. Boles,** Department of Geological Sciences, University of California, Santa Barbara, Goleta, CA 93106; **Ian E. Hutcheon,** c/o James R. Wood, Jr., Chevron Oil Field Research Company, 3282 Beach Boulevard, La Habra, CA 90631

Call for symposia for combined Northeastern-Southeastern Section meeting, March 1982

A variety of symposia are being organized for the combined NE-SE GSA meeting in Washington, D.C., March 25–27, 1982. This notice is both a call for additional symposia and an announcement by conveners of sessions being organized.

"Grenville terranes of the Appalachians" will cover a wide spectrum of topics concerning the Grenville province of eastern North America. A symposium volume will be published for which manuscripts are due by **July 1, 1981**. Symposium speakers will primarily be selected from contributors to the volume. Interested persons should contact Mervin J. Bartholomew, VDMR Office c/o Department of Geological Sciences; VPI&SU, Blacksburg, VA 24061. Telephone (703) 961-7647 (or leave messages at 961-6894 or 961-6027).

"Weathering and soil genesis in the eastern U.S." will cover topics of interest to soil scientists, geomorphologists, and Quaternary geologists. Recent studies in the Atlantic and Gulf Coastal Plains, the Appalachian Piedmont, and the Mid-Continent focusing on the processes of soil genesis, rates of soil genesis, and relationships of soils to geomorphology and climate. Interested persons should contact Milan J. Pavich or Helaine W. Markewich, U.S. Geological Survey, 926 National Center, Reston, VA 22092. Telephone (703) 860-6421.

Additional symposia being developed include "Hazardous waste problems in the eastern U.S., "Environmental geology: Case histories," "Paleogeography of the Cambro-Ordovician shelf." Individuals interested in organizing additional symposia or aiding conveners of symposia mentioned above please contact Juergen Reinhardt, Program Chairman, 1982 NE-SE GSA, U.S. Geological Survey 928 National Center, Reston, VA 22092. Telephone (703) 860-6595.

NEW GSA PUBLICATIONS

Geologic cross section of the central Oregon continental margin

MC-28J—By P. S. Snavely, Jr., H. C. Wagner, and D. L. Lander. 1980. In color, 34'' × 40''. Scale, 1:250,000. With 8-page text ..... Folded: $10.00; rolled: $11.50

The geologic cross section of the central Oregon continental margin (near latitude 45°N) extends 130 km westward from the Coast Range to the abyssal plain and serves to illustrate that both compressional and extensional forces have operated during Cenozoic time. The geologic data used to construct the cross section are from detailed onshore geologic mapping, from subsurface information in the Standard-Union Nautilus No. 1 offshore test well and in Deep Sea Drilling Project (DSDP) sites 174 and 175, and from the interpretation of 24-channel and high-resolution seismic reflection profiles and magnetic and gravity data.

An important feature shown beneath the inner shelf on the cross section is a deep marginal basin which contains more than 7,000 m of Cenozoic sedimentary and volcanic rocks that accumulated on a lower to middle Eocene oceanic crust. The western margin of this basin is interpreted as being bounded by a transcurrent fault which juxtaposed a thick sequence of lower Eocene graywackes on the west against the oceanic crust on the east. A linear magnetic anomaly with a steep gradient marks the contact between the graywackes and volcanic rocks along the transcurrent fault. Based upon subsurface information from five deep offshore test wells drilled south of the cross section, a dextral separation of about 200 km is required along this fault in late middle to early late Eocene time.

The outer continental shelf and upper slope are presumed to be underlain by an upper Oligocene to middle Miocene melange wedge similar to the tectonically complex Hoh assemblage along the west side of the Olympic Mountains. In Pleistocene time, the melange wedge and overlying Pliocene(?) strata are inferred to have been uplifted during several compressive episodes along a series of eastward-dipping imbricate thrust faults. The Pliocene(?) strata are considered to be trench deposits which form the lower part of the sedimentary sequence beneath the lower slope and abyssal plain.

The lower continental slope is underlain by a folded and faulted sequence of Pliocene and Pleistocene abyssal strata. Compressive deformation of these strata is inferred to result from thrusting and folding of upper plate strata in the zone that lies at the base of the slope.

Beneath the abyssal plain at the western end of the cross section, upper Tertiary and Pleistocene strata have a thickness of about 3,500 m. These strata rest on an oceanic crust that produces a magnetic anomaly, which correlates with Anomaly 5, indicating a late Miocene age. On the seismic record, the upper surface of this oceanic crust appears to dip gently eastward beneath the base of the upper slope.

The present Oregon continental margin is interpreted to be part of an upper plate above a low-angle, east-dipping megathrust along which the Pacific plate is underthrusting the North American plate. Major zones of vertical crustal movements in the upper plate, resulting from this underthrusting, have a pattern of (1) uplift and associated compression along the continental slope and outer shelf as indicated by broad folds and by an imbricate set of landward-dipping thrust faults, (2) subsidence in the marginal basin on the inner shelf, and (3) uplift in the Coast Range. These zones of vertical deformation appear to trend approximately parallel to the present locus of underthrusting at the base of the slope.

Geologic cross sections from Patton Ridge to the Mojave Desert, across the Los Angeles Basin, Southern California

MC-28K—J. C. Crowell, L. C. Beyer, Shawn Biehler, P. L. Ehlig, E. A. Hall, Arne Junger, and J. C. Vedder. 1980. In color, 26'' × 37''. Scale 1:250,000. Explanation on map ..... Folded: $7.50; rolled: $9.00

The cross section extends northeastward from the deep Pacific Ocean with thin oceanic crust, across the complex southern California Borderland, and onshore across the Los Angeles Basin and the San Gabriel Mountains to within the Mojave Desert. The Borderland region, from the Patton Escarpment to the margins of the Cortes Bank, is underlain by Upper Cretaceous and older metamorphic rocks probably related to the Franciscan Formation farther north in the California Coast Ranges. Similar basement underlies the region from the San Clemente Ridge to the vicinity of the Newport-Inglewood zone of folds and faults. The Cortes and Tanner Bank areas, in contrast, consist of Upper Cretaceous and younger sedimentary rocks overlying basement of unknown character. Northeast of the Newport-Inglewood zone, the basement consists of sialic gneissic, granitic, and schistose rocks ranging from Precambrian to late Mesozoic in age. The deformed Vincent Thrust system, of Late Cretaceous(?) age, lies within this region and places gneissic and granitic rocks on top of schist of probable Mesozoic age.

Upper Cenozoic sedimentary strata, now deformed and displaced by major fault systems, were deposited in several basins. Faults shown on the cross-section include major strike-slip faults, such as the San Andreas, and thrust faults, such as the Vincent and Sierra Madre. Deformation accompanying sedimentation characterizes the region and has proceeded intermittently during both Mesozoic and Cenozoic times.

Roster is open to all women geoscientists

The Women Geoscientists Committee of the American Geological Institute is currently revising its *Roster of Women in the Geoscience Professions.* The second edition, published in 1978, contained the names, addresses, and specialties of over 800 women geoscientists. We hope the third edition, scheduled for publication in late 1981, will enlarge on this and reflect the increasing participation of women in the earth sciences. The roster is open to all professional women employed in any aspect of the geosciences. Upon completion, the roster will be available to interested individuals, societies, and institutions. Data forms for submission may be obtained from Women Geoscientists Committee, AGI, 5205 Leesburg Pike, Falls Church, VA 22041.

MAY BULLETIN BRIEFS

Article Summaries

• Geology and petrology of some polymetamorphosed amphibolites and associated rocks in northeastern Taiwan: Summary.

J. G. Liou, Department of Geology, Stanford University, Stanford, California 94305; W. G. Ernst, Department of Earth and Space Sciences, University of California, Los Angeles, California 90024; Diane E. Moore, U.S. Geological Survey, Menlo Park, California 94025 (2 figs.)

• Characteristics and origin of Egyptian Younger Granites: Summary.

Jeffrey K. Greenberg, Wisconsin Geological Survey, 1815 University Avenue, Madison, Wisconsin 53706. (11 figs., 3 tables)

• Stratigraphy and age of the Chumstick and Wenatchee Formations: Tertiary fluvial and lacustrine rocks, Chiwaukum graben, Washington: Summary.

Randall L. Gresens, Department of Geological Sciences, University of Washington, Seattle, Washington 98195; Charles W. Naeser, U.S. Geological Survey, Denver, Colorado 80225; John T. Whetten, Department of Geological Sciences, University of Washington, Seattle, Washington 98195, and U.S. Geological Survey, Seattle, Washington 98105 (present address: MS 570, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). (3 figs.)

Articles Complete in the May Issue of Part I

• Structure and petrology of pelitic schists in the Fremont Peak pendant, northern Gabilan Range, California.

David John, Geology Department, Stanford University, Stanford, California 94305 (present address: U.S. Geological Survey, M.S. 41, 345 Middlefield Road, Menlo Park, California 94025). (7 figs., 1 table). Supplementary data appear in *Part II.*

The Fremont Peak pendant is the largest of many small exposures of "Sur Series" metasedimentary rocks in the northern Gabilan Range along the eastern edge of the central Salinian block, California Coast Ranges. Two periods of folding and three periods of metamorphism were identified in pelitic schists. Early east-west–trending, isoclinal folding accompanied by sillimanite-grade metamorphism formed the dominant structural features. This dynamothermal event predated emplacement of middle Cretaceous (105- to 110-m.y.-old) granitic plutons.

Two later periods of thermal metamorphism, during emplacement of granitic plutons, locally reached garnet-cordierite grade with estimated maximum temperatures and pressures of about 710 °C (±50 °C) and 4.2 kb (±1 kb) and XH20 in the fluid phase of 0.40 to 0.75. The reaction forming garnet-cordierite assemblages (quartz + biotite + sillimanite = garnet + cordierite + K-feldspar + vapor) probably occurred over a temperature range of 50 °C or more due to the effect of minor components (Na, Ca, Mn, and Ti).

The structural and metamorphic sequence seen in the Fremont Peak pendant is very similar to those found in other exposures in the central Salinian block.

• A geologic reconnaissance of the Cycladic blueschist belt, Greece.

M. C. Blake, Jr., U.S. Geological Survey, Menlo Park, California 94025; Michel Bonneau, Jacques Geyssant, J. R. Kienast, Claude Lepvrier, Universite P. et M. Curie, Sciences de la Terre, 75230 Paris, Cedex 05, France; Henri Maluski, Universite des Sciences et Techniques du Languedoc, 34060 Montpelier Cedex, France; Dimitrios Papanikolaou, University of Athens, Department of Geology and Paleontology, 46, F. Roosevelt St., Athens, Greece. (3 figs.)

The Cycladic blueschist belt consists of two distinctive segments separated by a broad zone of superposed granitic and high-temperature metamorphic rocks. The northern segment contains early metamorphic fold axes and parallel glaucophane lineations that trend ~060° with a progressive increase in metamorphism toward the southeast. The southern segment contains similar fold axes and glaucophane lineations that trend ~010° with an apparent increase in metamorphism toward the northwest. Radiometric dating of metamorphic minerals from both segments give apparent ages of about 40 to 80 m.y.

These data suggest the existence of late Mesozoic or early Cenozoic subduction zones in the Aegean region that subsequently collided.

• Folds in firn.

Charles J. Waag, Department of Geology, Georgia State University, University Plaza, Atlanta, Georgia 30303, and Foundation for Glacier and Environmental Research, and Juneau Icefield Research Program, Seattle, Washington 98109. (8 figs.)

Folds in firn on glaciers of the Gilkey Trench, Alaska, have been observed during years of heavy snowfall and reduced ablation. The firn folds were formed by upbuckling and decollement resulting from intense lateral shortening within the underlying glacier ice. Trends of the firn fold axes were normal to the shortening direction (σ_1), and subparallel to foliations in the glacier ice and the ice-flow direction (σ_3). Extension crevasses normal to the fold trends were also common in the area of the firn folds. Peculiar parallelogram patterns formed by recrystallization of the lowermost centimetre of firn were exposed in the ablated cores of some

folds. The patterns were consistently oriented with respect to the firn fold axes and englacial structures, and they seem to reflect the same stress field.

• Comparison of sediment sound-velocity functions from conjugate margins.

Robert E. Houtz, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964. (2 figs., 1 table)

A comparison of velocity functions from 15 regions within the conjugate margins of the Norwegian-Greenland Sea, Southeast Indian Ocean, North Atlantic, and South Atlantic Ocean shows that velocity functions are not significantly different across most conjugate margins. One major exception is the segment from the Blake Plateau to New England in the western North Atlantic, and its counterpart in northwest Africa. Here the velocity gradients are consistently steeper on the African side compared with those on the North American side. The reason for this unexpected difference was sought in the geologic literature of the two margins. Published studies of these two margins show that although total subsidence and sediment thickness of each of the margins are about equal, the older beds (pre-Cenozoic) are much thicker on the African side. This fundamental difference in depositional history seems to be the major cause of the difference in velocity profiles. Possible differences in the distribution of salt along the margins of Africa and North America are not considered a likely source for the trans-Atlantic differences in the velocity functions. The North Atlantic data therefore illustrate that velocity increases more rapidly with depth in sections biased toward greater proportions of older beds; that is, sedimentation rates decrease as the basin ages. These studies also reveal that sound-velocity profiles are sensitive to the early conditions of deposition on passive margins.

• Deep Sea Drilling Project Leg 72: Southwest Atlantic paleocirculation and Rio Grande rise tectonics.

Peter F. Barker, Department of Geological Sciences, University of Birmingham, P.O. Box 363, Birmingham B15 2TT, United Kingdom; Richard L. Carlson, Department of Geophysics, Texas A&M University, College Station, Texas 77843; David A. Johnson, Department of Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543 (Co-Chief Scientists).

Pavel Cepek, Bundesanstalt fur Geowissenschaften und Rohstoffe, Postfach 510153, 3000 Hannover 51, Federal Republic of Germany; William Coulbourn, Deep Sea Drilling Project, A-031, Scripps Institution of Oceanography, La Jolla, California 92093; Luiz A. Gamboa, Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York 10964; Norman Hamilton, Department of Geology, University of Southampton, Southampton SO9 5NH, United Kingdom; Ubirajara Melo, Petrobras, Centro de Pesquisas e Desenvolvimento, Leopoldo a. Miguez de Mello [Cenpes], Cidade Universitaria, Quadra 7 Ilha do Fundao, CEP 21.910 Rio de Janeiro RJ, Brazil; Claude Pujol, Department de Geologie et Oceanographie, University of Bordeaux 1, 33405 Talence, France; Alexander N. Shor, Lamont-Doherty Geological Observatory, Palisades, New York 10964; Alexey E. Suzyumov, P. P. Shirshov, Institute of Oceanology, USSR Academy of Sciences, Kraiskov St. 23, Moscow, USSR; Leonard R. C. Tjalsma, Cities Service Technology Center, 4500 S. 129th E. Avenue, Tulsa, Oklahma; William H. Walton, Charles T. Main, Inc., Boston, Massachussetts 02199; Wolfgang Weiss, Bundesantalt für Geowissenschaften und Rohstoffe, Postfach 510153, 3000 Hannover 51, Federal Republic of Germany. (12 figs., 2 tables)

In order to investigate South Atlantic paleocirculation and the tectonic and sedimentary history of the Rio Grande rise, D/V *Glomar Challenger* occupied four sites during Deep Sea Drilling Project (DSDP) Leg 72: Site 515 in the Brazil basin, Site 516 near the crest of the Rio Grande rise, and Sites 517 and 518 on the lower western flank of the rise.

Site 515 recovered sediments deposited by Antarctic Bottom Water (AABW) entering the Brazil basin through the Vema channel. We penetrated 617 m of rapidly accumulated, terrigenous and siliceous muds and mudstones before encountering an unconformity spanning 20 to 25 m.y. between the late Oligocene and early Eocene. The hiatus brackets the time of the proposed onset of AABW flow in the southwestern Pacific at ~37 m.y.; however, evidence in the sediments at Site 515 suggests the presence of bottom-water circulation in the Brazil basin by early Eocene time.

Sites 517 and 518 recovered calcareous sediments deposited under the influence of AABW and North Atlantic Deep Water (NADW) within the Vema channel. At both sites, an increase in the abundance of the AABW indicator species *N. umbonifera* during the late Pliocene implies that AABW extended to significantly shallower depths at that time than it does today. Detailed carbonate analyses at Site 518 may extend the late Pleistocene climatic signal through the entire Pleistocene and perhaps into the Miocene.

At Site 516, near the crest of the Rio Grande rise, we penetrated 1,250 m of dominantly calcareous sediments and 21 m of basaltic basement rocks of Santonian-Coniacian age. With the exception of some minor hiatuses in the middle and late Miocene, sedimentation at this site was continuous for the past 80 m.y. Magneto-stratigraphic and bio-stratigraphic control is excellent, and the section may therefore be useful as a stratigraphic reference. The Cretaceous-Tertiary boundary was recovered intact and is directly comparable with the Italian Gubbio section. This interval may also provide some new evidence pertaining to the proposed association between mass extinctions and geochemical anomalies at the boundary.

The igneous basement rocks recovered at Site 516 are T-type Mid-Ocean Ridge Basalts (MORB), similar to those found on Iceland, and are unlike the alkalic basalts exposed on Tristan da Cunha. Their chemistry, together with the occurrence of shallow-water fossils in vein fillings, suggests that these basalts were erupted on an anomalously shallow part of the Mid-Atlantic Ridge. A Santonian-Coniacian age for basement is inferred from the age of the overlying sediments and is consistent with the identification of magnetic anomalies 33 and 34 on the rise to the east of the site.

The basal sediments and underlying volcanic basement recovered at Site 516 may provide constraints on the subsidence history of the Rio Grande rise. However, this history may have been complicated by a middle Eocene episode of tectonic and volcanic activity, as suggested by ash layers,

volcaniclastic sediments, and slump blocks in the mid-Eocene sediment section. The occurrence of reef debris in this interval implies that the uppermost part of the rise was very shallow and perhaps subaerial during this time.

• Late Cenozoic deformation in the forearc region: Matanuska Valley, Alaska.

Ronald L. Bruhn, Terry L. Pavlis, Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah 84112. (10 figs., 1 table)

Brittle deformation in the crust commonly occurs by simultaneous movements on multiple sets of faults. The principal shortening and extension directions in faulted rock can be determined using a deformation axis technique. This technique can also be applied in regions where earthquakes occur on faults of several different orientations if a representative sample of focal mechanism solutions is available. The shortening and extension directions are defined for only the last increment of deformation unless the deformation path is co-axial. In the latter case, the deformation axis orientations are valid for finite strains. No assumptions concerning the angular relationships between the fault planes and the stress or strain axes are required.

A period of extensive faulting occurred in the western Matunuska Valley, Alaska, during the Neogene. Deformation proceeded by simultaneous movements on three fault sets, the number required to accommodate a general, three-dimensional brittle deformation. The fault system consisted of two sets of northward-trending conjugate strike-slip faults and a set of east-northeast–trending reverse faults. North-northwestward crustal shortening was accompanied by lateral and vertical extension.

The geometry and displacements of mesoscopic faults in the interior of two large reverse fault zones indicated that cataclastic deformation during faulting occurred in a flattening strain field. The principal incremental shortening direction in both fault zones was oriented at a large angle to the fault strike, while the two extension axes were subparallel to the fault zone. The incremental strain axes were oriented in a manner consistent with reverse slip across the faults. Finite reverse slip across the two fault zones clearly occurred; this conclusion is based on evidence for stratigraphic separation.

The Matanuska Valley is located about 50 km above the subduction zone. The contemporary direction of horizontal principal shortening is predicted to be north-northwest based on the orientation of the Pacific–North American plate slip vector and the nature of ground displacements following the 1964 (M = 8.5) subduction zone earthquake. A deformation axis plot for focal mechanisms of earthquakes (Bhattercharaya and Biswas, 1979) at depths between 20 and 60 km in the area surrounding the Valley indicates north-northeast lateral and vertical shortening strains with west-northwest extension. The principal horizontal shortening directions in the regions immediately west of the Matanuska Valley trend west-northwest as indicated by the orientations of large folds and the displacement along a Holocene scarp of the Castle Mountain Fault system.

• Lower Ordovician through Lower Devonian cratonic margin rocks of the southern Great Basin.

Richard H. Miller, George A. Zilinsky, Allison Center, Department of Geological Sciences, San Diego State University, San Diego, California 92182 (3 figs.)

Lower and middle Paleozoic rocks in the southeastern Great Basin include thin sequences of gray, generally unfossiliferous, dolostones that were deposited in cratonic margin paleoenvironments. The recovery of age-diagnostic conodonts from a 295-m-thick section of Mountain Springs Formation indicates that Lower and lower Middle Ordovician, Upper Ordovician, and upper(?) Lower Devonian rocks occur in the section. Distinct disconformities provide evidence for a Middle Ordovician hiatus and a Silurian through Early Devonian hiatus. These cratonic sequence rocks are laterally replaced within 15 to 20 km to the west and northwest by thicker miogeoclinal rocks. The northeastward trend of this facies change provides a good marker where it intersects the south side of the Las Vegas shear zone; location of the same facies change on the north side of the shear indicates right-lateral separation of ~40 km.

• Rb-Sr and U-Pb geochronology and distribution of rock types in the Precambrian basement of Missouri and Kansas.

M. E. Bickford, K. L. Harrower, W. J. Hoppe, B. K. Nelson, and R. L. Nusbaum, Department of Geology, University of Kansas, Lawrence, Kansas 66045; John J. Thomas, Department of Geology, Skidmore College, Saratoga Springs, New York 12866. (26 figs., 1 table). Supplemental data in *Part II.*

Basement rocks in Kansas and Missouri are known largely from cores and cuttings from deep drilling. These rocks may be divided into a northern terrane, underlain by rocks consisting of abundant granite commonly showing cataclastic textures, and metavolcanic to metasedimentary rocks; and a southern terrane underlain almost exclusively by rhyolitic flows and ash-flow tuffs and epizonal granite plutons. The northern terrane is interrupted in central Kansas by mafic igneous rocks and flanking arkosic sedimentary rocks of the Central North American Rift System.

Data from 63 Rb-Sr whole-rock analyses yield ages ranging from 1,153 to 1,748 m.y., but these are considered to represent only the minimum ages of the rocks. Ages derived from U-Pb analyses of suites of cogenetic zircons from 22 rock samples indicate that some rocks of the northern terrane were formed 1,610 to 1,650 m.y. ago. These are apparently intruded by younger granite plutons formed 1,450 to 1,470 m.y. and 1,340 to 1,380 m.y. ago. Rocks of the southern terrane were formed 1,460 to 1,480 m.y. ago in the St. Francois Mountains terrane of southeastern Missouri and its buried equivalents but are about 1,380 m.y. old in southwestern Missouri and southern Kansas. Rocks of the Central North American Rift System in Kansas are assumed to be about 1,100 m.y. old by geophysical and drill-hole extension to their outcrop in the Lake Superior region where they have been dated.

Both the northern and southern terranes are notable

for the great abundance of granitic rocks and the scarcity of intermediate to mafic igneous rocks. Quartzite is the most abundant of granitic rocks and also the most abundant metamorphic rock. Although the decrease of ages from north to south in the mid-continent region suggests their sequential accretion at the edges of a pre-existing continent, the rock assemblages are not consistent with convergent plate margin suites of the Andean type. The great volumes of rhyolite and epizonal granite of the southern terrane may represent melting of thickened, somewhat older crust following accretion at the continental margin.

Major element chemical data are presented for basement rocks from Kansas, Oklahoma, and Texas, and these are compared with the compositions of similar rocks from the St. Francois Mountains. Names and locations are given for wells from which samples were obtained.

• Ice fabrics from a borehole at the top of the south dome, Barnes Ice Cap, Baffin Island.

Roger LeB. Hooke, Peter J. Hudleston, Department of Geology and Geophysics, University of Minnesota, Minneapolis, Minnesota 55455. (4 figs., 1 table)

Crystallographic fabrics from a bore hole at the top of the south dome of Barnes Ice Cap, Baffin Island, Canada, were studied. Fabric intensity in coarse ice increases with increasing depth and the pattern changes from an initial weakly oriented one to one involving two C-axis maxima within a small circle centered on the vertical. The two maxima are aligned in a plane in the direction of maximum horizontal extension; they are distinct at 180 m and then dominate the fabric until about 215 m; below this depth, the circular pattern dominates. Fine ice displays similar but more variable fabric patterns, complicated by the inheritance of a vertical single maximum from the initial state.

Measured surface strain rates suggest a coaxial deformation history intermediate between pure shear and uniaxial compression. Such stress configurations are known to lead to two-maximum and small-circle fabric patterns, respectively, on the basis of experiments and models involving plastic basal glide alone. With increasing strain, the angle between the two maxima, or the opening angle of the small circle, decreases in a similar manner in both the natural fabric diagrams and in the fabrics predicted by models of plastic glide. Both the two-maximum and the small-circle patterns are considered to be equivalent to the single maximum pattern found in ice subjected to simple shear. In all cases, the fabric becomes well defined at natural octahedral unit shears of about 1.0; and in all cases, the fabric development is largely controlled by basal glide.

• Threshold of critical power in streams.

Discussion: *David Alexander, Department of Geography, University College London, Gower Street, London WCIE 6BT, England.*

Reply: *William B. Bull, Department of Geosciences, University of Arizona, Tucson, Arizona 85721.*

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