GSA news & information

SUPPLEMENT TO GEOLOGY MAGAZINE

1975 research grants awarded

At its March meeting, the 1975 Committee on Research Grants reviewed 320 applications and recommended 95 of them to the Council for financial support. Three grants were awarded to senior investigators and 92 to people working toward advanced degrees. The total amount awarded was $62,430 with grants ranging from $250 to $1,300 each. These funds consist of $50,000 from the Council from the endowment fund, $11,500 from contributions from industry, and $900 income from the Harold T. Stearns Fellowship Fund.

The committee voted to recommend Thomas R. Bultman, Yale University, to be the first recipient of the Harold T. Stearns Award for research on one or more aspects of the geology of the circum-Pacific region. Mr. Bultman's project in Alaska is titled "The Stratigraphic and Structural Evolution of a Mesozoic Behind-the-Arc Basin."

The Penrose Grants Fund was augmented by $11,500 in generous gifts to the Society from eight oil companies: Mobil Oil Corporation, Ashland Oil, Inc., Gulf Oil Foundation, Texaco, Inc., Marathon Oil Company, Chevron Oil Field Research Company, Union Oil Company, and Shell Development Company. Sixteen promising young earth scientists whose projects fall in the general range of the interest of the donors were chosen as recipients of these gifts.

The Committee singled out six young scientists and their outstanding proposals to be brought to the attention of the membership of the Society. These are

- *Rodey Batiza,* Scripps Institute of Oceanography, "Geochemical evolution of oceanic central volcanoes near constructional plate margins"
- *Ian James Duncan,* University of British Columbia, "An experimental and field study of cordierite geobarometry"
- *Frederick B. Keller,* Yale University, "Precambrian sedimentology and structural chronology of a portion of the Tennessee Blue Ridge"
- *David Ronald Kobluk,* McMaster University, "The accuracy and reliability of coral growth bands in determining coral growth rates"
- *Daniel E. Lawson,* University of Illinois at Urbana-Champaign, "Alaskan valley glaciers: Sediment transport and deposition within the terminus region"
- *Jason Saleeby,* University of California at Santa Barbara, "Structure, petrology and geochronology of the mafic-ultramafic complex in the western Sierra Nevada foothills between the Kings and Tule Rivers, California"

Application forms and detailed instructions for 1976 grants will be sent, upon request, by the Executive Director, GSA, 3300 Penrose Place, Boulder, Colorado 80301.

New illustration manual needed?

A proposal has come into Society headquarters for the cooperative development of a handbook for the production of slides and other illustrative materials that might be used at scientific meetings of the Society.

Through the years, there have been several items published as aids to slide and illustration preparation. It would be helpful to headquarters if members could let us know their feeling of need for a new handbook with a new approach designed to serve this need.

Confusion still exists about Geotimes

We have learned from AGI headquarters that there still exists some confusion about the status of *Geotimes*. They continue to get change-of-address notices from members of member societies who have not subscribed to *Geotimes* and therefore are not getting the magazine.

To remind you of the present status, although GSA continues to pay its dues of $2 per member to AGI, this no longer brings a subscription to *Geotimes*. Any member of the Society may subscribe to *Geotimes* at the member discount price of $6 per year in contrast to the nonmember subscription price of $9.

Subscriptions to *Geotimes* have been received at AGI headquarters at the predicted rate which, it is hoped, will assure the continued existence of the magazine.

PRELIMINARY ANNOUNCEMENT AND CALL FOR PAPERS

SOUTHEASTERN SECTION, 25th ANNUAL MEETING *JOINTLY WITH* NORTHEASTERN SECTION, 11th ANNUAL MEETING

Arlington, Virginia, March 22-29, 1976

SPONSORED BY The U.S. Geological Survey The Geological Society of Washington The Maryland Geological Survey
The Virginia Geological Survey Department of Geology, University of Maryland
Department of Earth and Planetary Sciences, Johns Hopkins University
Department of Geological Sciences, Virginia Polytechnic Institute and State University
Department of Geology, George Washington University Department of Geology, Howard University

The NORTHEASTERN and SOUTHEASTERN SECTIONS of the Geological Society of America will meet jointly March 22-29, 1976, at the Stouffer's National Center Inn, Arlington, Virginia, together with some of their associated societies.

REGULAR TECHNICAL SESSIONS will be held on Thursday, Friday, and Saturday, March 25-27.

SYMPOSIA (chairmen in parentheses) will include ***Southern Appalachian Geology*** (John C. Reed, Jr., and Robert D. Hatcher, Jr.), ***Northern Appalachian Geology*** (David S. Harwood), ***Economic Geology of the Appalachians*** (Helmuth Wedow, Jr., and Frank G. Lesure), ***Paleontology of the Appalachians; including Paleontologic Data Bearing on the Existence of a Proto-Atlantic Ocean*** (Joseph E. Hazel), ***Nuclear Reactor Siting*** (James F. Davis), and ***Geology of the Atlantic Continental Margin*** (Robert R. Jordan).

FIELD TRIPS will include ***Piedmont Geology of the Fredericksburg, Virginia, Area and Vicinity:*** Louis Pavlides; two days; pre- or post-meeting (same trip offered twice); limited to 42. ***Coastal Plain Geology of Chesapeake Bay and Vicinity:*** J. P. Owens, C. S. Denny, R. B. Mixon, and J. P. Minard; three days; post-meeting; limited to 140. ***Cross Section of the Blue Ridge Anticlinorium in Northern Virginia:*** G. H. Espenshade and J. W. Clarke; one day; post-meeting; limited to 41. ***Platform and Off-Platform Carbonates, Central Appalachians:*** Juergen Reinhardt and L. A. Hardie; two days; pre-meeting; limited to 41. ***Geology of the Baltimore Gneiss and the Glenarm Series in the Vicinity of Baltimore, Maryland:*** William Crowley; one day; post-meeting; limited to 42. ***Carboniferous Stratigraphy of Southwestern Virginia and Southern West Virginia:*** K. J. Englund and others; two days; post-meeting; limited to 40.

SHORT COURSES will include ***Spindle Stage Techniques:*** F. D. Bloss, S. J. Louisnathan, and Ed Wolfe; three days; pre-meeting; limited to 20. ***Geology of Plate Tectonics:*** J. F. Dewey, Kevin Burke, and Harold Williams; two days; pre-meeting; limited to 40. ***Advances and Concepts in Environmental Geology:*** A. J. Froelich and J. N. Van Driel; three days with field trip; pre-meeting; limited to 40. ***Geochronology and Isotope Geology for Geologists:*** A. K. Sinha, T. E. Krogh, T. W. Stern, and John Sutter; two days; pre-meeting; limited to 40. ***Geophysical Methods Applied to Geologic Problems in the Appalachians:*** M. F. Kane, H. D. Ackermann; A.A.R. Zohdy, W. F. Hanna, and D. L. Daniels; three days; pre-meeting; limited to 25. ***Geophysics for Geologists:*** Isidore Zietz and G. P. Eaton; two days; pre-meeting; limited to 25.

SPOUSES' ACTIVITIES will include (1) a one-day trip to antique shops in New Market, Maryland; (2) a one-day tour of mansions and historic homes in the Washington-Northern Virginia-Southern Maryland areas; and (3) a one-day tour of Washington, D.C.

CALL FOR PAPERS. Papers are invited for presentation at the technical sessions. Most papers will be allowed 15 minutes for presentation and 5 minutes for discussion. ***Deadline for abstracts is November 3, 1975.*** Abstracts are limited to 250 words.

ABSTRACT FORMS that *must* be used may be obtained from

Abstracts Secretary
Geological Society of America
3300 Penrose Place
Boulder, Colorado 80301
(303) 447-2020 *or*

Michael W. Higgins
U.S. Geological Survey
928 National Center
Reston, Virginia 22092
(703) 860-6503

ABSTRACTS SHOULD BE SENT TO

Michael W. Higgins
U.S. Geological Survey
928 National Center
Reston, Virginia 22092
(703) 860-6503

Send one original and two copies.

AWARDS will be given for the best student papers in the categories of undergraduate, master's candidate, and Ph.D. candidate. Each award will be for $50 and a year's free student membership in GSA.

PROJECTION EQUIPMENT for 2" x 2" (35-mm) slides only will be available, with two screens per meeting room.

THE GSA EMPLOYMENT INTERVIEW SERVICE will be available for both employees and employers. Notification that you wish to participate should be made no later than January 15, 1976. The earlier we are aware of your intended participation, the better we can serve you. To announce your participation or for further information write to

Joan Heckman, Membership Assistant
Geological Society of America
3300 Penrose Place
Boulder, Colorado 80301
(303) 447-2020

DETAILED INFORMATION concerning registration, motel accommodations, and other activities will appear in the News & Information section of a later issue of **Geology** and as a part of the **Abstracts with Programs for 1976** for the two sections.

EXHIBIT SPACE will be available near the sessions in the main motel. Rental costs will be $200 for commercial exhibits and $50 for educational exhibits. For additional information write to

Jack Medlin
U.S. Geological Survey
956 National Center
Reston, Virginia 22092 *or*

Fred Handy
Geological Society of America
3300 Penrose Place
Boulder, Colorado 80301
(303) 447-2020

ADDITIONAL INFORMATION, REQUESTS, OR SUGGESTIONS should be directed to

Michael W. Higgins
U.S. Geological Survey
928 National Center
Reston, Virginia 22092
(703) 860-6503 *or*

Norman L. Hatch, Jr.
U.S. Geological Survey
926-A National Center
Reston, Virginia 22092
(703) 860-6404

The Geological Society of America

Annual Report for 1974

Part 2. Reports of the Committee on Research Grants and the Executive Secretary

Report of the Committee on Research Grants

To the Council and Membership of The Geological Society of America, Inc.:

The Committee on Research Grants, consisting of George deVries Klein, Anthony J. Naldrett, William E. Benson, conferee, and David B. Slemmons, Chairman, met in Boulder at Society headquarters on March 10 and 11, 1974.

The committee was very pleased with the increase to $100,000 for the Research Grants Fund, which made it possible to increase the number of grants awarded, and although it was possible to increase the average dollar amount of the grants, the increase was lower than the amount of inflation. Of the 249 applications considered, 138 were recommended for support at an average level of $735 per supported proposal. The total amount requested was $228,255 and the total recommended for support was $101,522. The increase in funds permitted the committee to increase the percentage of applications supported to 55 percent.

During 1974, the Council accepted a gift from Dr. Harold T. Stearns and approved the establishment of a Harold T. Stearns Fellowship Fund. The income from the fund will be used to award periodically a grant in support of research on one or more aspects of the geology of the circum-Pacific region. This fellowship fund is distinct from the GSA Penrose Research Grants and is restricted in its use to the particular region. The awardee will be selected by the Research Grants Committee.

The committee welcomed receipt of $1,500 in additional funds made available by the Council from donations received by the Society. Grants from these additional funds were assigned to proposals appropriate to the geological interest of the donor, who will be properly acknowledged by the grantees.

A major concern was expressed by the committee in view of a potential reduction in the Research Grants Fund due to the financial problems of the Society. These problems will lead to a reduction in funding available for research grants, and the committee felt that efforts should be made to appeal to additional sources of funds in industrial fields of geology.

The review process continued to work well, and no changes are suggested.

Respectfully submitted,
George deVries Klein
Anthony J. Naldrett
William E. Benson, Conferee
David B. Slemmons, Chairman

SUMMARY OF COMMITTEE RECOMMENDATIONS AND COUNCIL ACTIONS
1974 RESEARCH GRANTS

	Applicants	Requested by applicants	Recommended
Committee recommendations			
Category I (recommended for support)			
Senior investigators	7	$ 5,996	$ 4,550
Doctoral candidates	131	118,192	96,972
Subtotal	138	$124,188	$101,522
Category II (not recommended for support)			
Senior investigators	33	$ 41,977	
Doctoral candidates	78	62,090	
Subtotal	111	$104,067	
GRAND TOTAL	249	$228,255	$101,522
Council action			
Support all Category I projects	138	$124,188	$101,522
Approved applications withdrawn later	(6)	(4,882)	(4,325)
Alternates awarded	6	6,800	3,050
	138	$126,106	$100,247
Reduction resulting from refunds made by grantees			$ 1,376
			$ 98,871

The **Annual Report for 1974**, rather than being printed and distributed separately, will appear this year in the News & Information section in segmented form. This is the second part of the series.

Report of the Executive Secretary

To the Council and Membership of
The Geological Society of America, Inc.:

The Executive Secretary's report for 1973 closed with an optimistic statement: "I believe I am turning over a healthy, going, concern to my successor." Going? Yes, unquestionably GSA kept going, and growing, in 1974, and it is certain to keep going in the future. But healthy? Well, not exactly. Financial storm clouds that were gathering even in 1973 took ominous form early in 1974 and reached what we all hope was a climactic storm that year.

GSA's financial problems were primarily caused, of course, by rampant inflation, accompanied by an increasingly severe recession in the nation's economy.

(continued on page 316)

Internally, these problems were exacerbated by the fact that the Society had been living beyond its means for some time. Better accounting reporting than had ever been available before showed this fact clearly. So long as current, realized capital gains were available to bridge the gap between outgo and other income, GSA remained in the black despite ever-increasing costs of periodical publications distributed to the membership. When available current capital gains diminished in the investment climate of late 1973 and all of 1974, the Society's only alternative was to dip into "stored" capital gains generated in prior years by the Penrose Endowment, and to retrench our outgo severely.

The Society's economic distress became apparent early in the year and required a rapidly increasing proportion of the management's attention throughout 1974. At the Council's direction, economic retrenchment became the watchword, with changes in investment policy, additional economies in operations, increased dues, and reductions in the mass of publications for members. It is to be hoped that all these steps will again place the Society on a sound financial footing, but much depends on national and world economic recovery and on other events that are beyond GSA's control.

Positive accomplishments during 1974 included a total of eight outstanding Penrose Conferences, the highly productive yearly meeting of each of the six sections, active growth and impact of the five specialized discipline divisions, and the outstanding annual meeting at Miami Beach. One of the best-attended—and best-run—annual meetings ever, it was perhaps most notable for two unrelated but significant developments. One of the these was the full flowering of an employment interview system operated by the Society; the other was the opportunity for more scientists than ever before to present their research results in person. Despite restrictions on the number of papers and symposia to be presented in open session, a significant net increase was accomplished by introduction of the poster session concept. For poster sessions, authors could not only publish their abstracts, but could show the graphic representations of their work to specially interested audiences over far longer periods than the usual 10- to 15-minute exposure permitted for orally presented papers. With suitable modifications based on experience, employment services, Penrose Conferences, and poster sessions seem to be among the most promising future growth areas for the Society.

The Society continued to play a leading part in development of the science, and of its practitioners, in diverse ways. It distributed approximately $100,000 in grants to support research by 138 recipients, almost all of them graduate students. It also supported the AGI Minority Program, and took the first promising steps toward publication of objective, unbiased "position papers" on various facets of environmental-natural resource problems.

In the publications area, which to many represents the heart of the Society's ongoing activities, two relatively unpublicized steps were taken that bid fair to have more lasting impact than will the actions having to do with pricing and distribution of publications, rise in dues, and like matters. One of these was adoption of a policy that will assure the health of the *Treatise* project until income from the generous bequest of Raymond C. Moore (who died during the year) becomes available for its support. The other step was the completion of an agreement with AGI that should remedy most of the long-standing financial and management problems of GeoRef, the source of the material published in GSA's *Bibliography and Index of Geology*. The health of both these indispensable research tools thus seems to be assured.

Edwin B. Eckel
Executive Secretary

Addendum

As an addendum to the foregoing excellent report prepared by Ed Eckel, I will add a few paragraphs to complete the Executive Secretary's report for the remainder of the year 1974.

Unfortunately, the financial problems described by Mr. Eckel have not gone away, but rather have intensified during the remainder of the year. This situation has prompted the Council to authorize a canvass of the entire membership, soliciting member preference as to which of the Society's publications the membership is willing to support, assuming a dues level that provides for Society operation on a "pay-as-you-go" basis.

Two new revenue-producing publication series were authorized by the Council with the objective of simultaneously reducing publication costs and making scientific material more readily available. These are a series of maps and charts and a series of publications in microform. This move permits the discontinuance of expensive map supplements in the *Bulletin* but assures their ready availability. The microform series is a means of publishing, at a fraction of the cost of printing in book form, many important specialized items of limited demand. Otherwise, such data could not be available to the scientific community at a reasonable cost in today's economic climate.

We are looking forward to the strong growth and sound financial development of the Society with the full realization that the endowment income will probably never again be capable of substantially subsidizing its periodical publications distributed to the membership as has been the case over the last several years.

Executive Director

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Annual Report for 1974 (continued)

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John L. Wray

R. F. Yerkes

Robert E. Zartman
E-an Zen

Annual Report for 1974 (continued)

Publications

The following publications were issued by the Society during 1974, totaling 20,354 pages: 12 issues of the monthly *Bulletin* with Matthews separate; 12 issues of *Geology; Abstracts with Programs* for meetings of the Cordilleran, Rocky Mountain, North-Central, South-Central, Northeastern, and Southeastern Sections of the Society; *1973 Annual Report of Officers and Committees;* 4 Memoirs; 7 Special Papers; *Yearbook for 1974; Bibliography and Index of Geology,* Volume 38 (12 issues); cumulative volumes of the *Bibliography and Index of Geology,* Volume 37; Newsletters—*The Geologist* with 2 environmental supplements, *The Engineering Geologist, the Quaternary Geologist and Geomorphologist, The Hydrogeologist,* and *The Coal Geologist; Engineering Geology Case Histories No. 10; Memorials,* Volume III (1970); Reprints—*Treatise,* Part C (2 volumes), Memoirs 123 and 131, Special Papers 126 and 136, Rubey *Bulletin* separate, and *Engineering Geology Case Histories #6-#10;* memorials preprints; and miscellaneous publications such as *Council Rules, Policies, and Procedures; GSA Headquarters Guidebook; AESE Blueline* (newsletters of the Association of Earth Science Editors); *GeoRef Symposia Bibliographies* (9) for the annual meeting in Miami; and *GeoRef Guide to Indexing.* Maps issued: Tectonic Map of China, Baja California, Bahamas Plateau, Age of the Ocean Basins, and Bering Shelf.

Committee on Committees seeks nominations

The Committee on Committees requests help from all members. Its sole purpose is to look for talent to serve GSA as members of committees and as representatives to other organizations.

The committee will meet later this summer and will choose at least two nominees for each open position to present to the Council at its October meeting in Salt Lake City. Individual Councilors may add other names to the lists for consideration. The entire Council will then select appointees for all positions, thus completing the process of bringing new blood into Society affairs.

The 1975 Committee on Committees is made up of the following people: William R. Muehlberger, Chairman, Don L. Eicher, Alan M. Goodwin, George A. Thompson, and Karl A. Waage.

This group is broadly based, both geographically and in disciplines, but its members cannot possibly know all the GSA members who are potential candidates for serving the Society. You can help them immensely by volunteering yourself or by suggesting names of others you think should be considered for the openings.

To ensure thorough consideration of your candidates, *please attach a note explaining the special qualifications of your candidates for particular jobs.* Please be sure that your candidates are members of the Society.

Listed below are the GSA committees and organizations to which GSA has representatives that will have vacancies to be filled at the Salt Lake City Council meeting. (Duties of the committee members are described in the manual *Council Rules, Policies, and Procedures.*)

Budget
Environment and Public Policy
Headquarters Advisory
Penrose Medal
Day Medal
National Medal of Science
Investments
Membership
Penrose Conferences
Publications
Research Grants
Joint Technical Program Committee

GSA representatives to
American Association for the Advancement of Science
  Section E (Geology and Geography)
  Section W (Atmospheric and Hydrospheric Sciences)
American Committee on Stratigraphic Nomenclature

MSA to sponsor short course in Salt Lake City

The Mineralogical Society of America will sponsor a Short Course on Feldspar Mineralogy on October 17–19, 1975, immediately preceding the annual meeting of the Geological Society of America in Salt Lake City, Utah.

The lecturers will be Richard A. Yund, Brown University; David B. Stewart, U.S. Geological Survey; Paul H. Ribbe, Virginia Polytechnic Institute and State University; and Joseph V. Smith, University of Chicago. Lecture notes will be published prior to the Short Course and will later be made available by MSA at a nominal price.

The short course will have a limited enrollment. Registration details will be given in the News & Information section of the August issue of *Geology*. For further information, write to Paul H. Ribbe, Department of Geological Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061 (telephone: 703-951-6880).

GSA establishes supplementary data depository

To facilitate the storage and prompt retrieval of supplementary material such as certain tabular data, location information, and descriptive information, the Geological Society of America has established a depository at the headquarters office.

Supplementary material for each article is given a number which is identified by a footnote in the article together with a statement on how to obtain the data from the Society. If the stored material is not too bulky, it will usually be provided at no charge. For large quantities of material, a charge for reproducing it may be hade.

The Society plans to provide all of the material stored each year on microfiche for those who wish to maintain the data for easy access. The Society also is considering ways to provide the supplementary data when an order is received for separate articles for which supplementary material is deposited.

The material to be stored must be provided in neatly-typed, clearly legible form for reproduction. It will not be edited or otherwise altered by the GSA staff.

Second announcement—annual meeting

A multiple-page insert containing detailed information about the annual meeting will appear in the News & Information section of the August issue of *Geology*. In addition to preregistration forms, the insert will contain forms for making reservations for housing, field trips, annual dinner, and spouses' activities. Additional copies of the insert are available from Annual Meeting Department Secretary
Geological Society of America
3300 Penrose Place
Boulder, Colorado 80301.

Group travel arranged for 25th IGC

Arrangements have been made for group travel to the 25th International Geological Congress in Sydney, Australia, August 16-25, 1976.

The American Geological Institute, on behalf of the U.S. National Committee on Geology, has officially appointed Conventions Unlimited, Inc., as the co-ordinating agent for the travel of U.S. delegates to the Congress.

Conventions Unlimited, Inc., is developing a travel program to utilize the services of Pan American World Airways, the only U.S. flag carrier presently serving Australia, and Qantas, the Australian International Airlines. They will arrange and confirm all group travel arrangements for participants to and from the Congress, as well as handling arrangements on an individual basis.

A full-color brochure describing the travel program in detail is available from Conventions Unlimited, Inc., 2011 Eye Street, N.W., Suite 702, Washington, D.C. 20006.

Letters

One of the functions of the News & Information section is to stimulate discussion among members about the operation of the Society. As space permits, we will publish letters from the membership that reveal problem areas and suggest corrective changes in policies and procedures. Obviously, not all letters that come to headquarters can be published. Our hope is that we will be able to select a few on a wide range of subjects and, on occasion, to publish letters responding to previously published letters. No letter will be published without the specific permission of the writer.

[*To John C. Frye, Executive Director, GSA*]

. . . May I suggest an option which may not have been considered. The publication of micro-fiche or micro-cards of the abstracts of all section meetings would be a relatively easy, and perhaps less expensive, method of publication than the bulky copies of the abstracts now made. If costs are much lower, these might be furnished to total membership. Likewise, for those desiring it, perhaps micro-fiche or cards of the monthly bulletin might be made available. Obviously, micro-readers would have to be available to those who desired this type of publication. Reasonably priced readers are available on the market. Perhaps even less expensive readers could be designed and sold. It would be of interest to know the membership's reaction to this option.

A complete volume of bulletins could be stored in minimal space. At year's end, an index could also be published in the same format which would be more comprehensive and readily usable for the reader. This would especially be so if each article published were required to have key words listed. GSA, Economic Geology, and others in earth science are somewhat remiss in not requiring this key word system. The use of such would expedite the literature search as well as broaden the reader audience who might be interested in the articles if a quick index search were available.

. . .

Sincerely,
Paul Dean Proctor, Professor of Geology
and Geological Engineering
University of Missouri—Rolla

1976 AAAS national meeting

GSA headquarters has received an invitation from the AAAS for any of our members to attend, and, if they wish, to participate in the AAAS national meeting to be held in Boston February 18-24, 1976.

Interested persons are urged to contact Dr. Sheldon Judson, Department of Geological and Geophysical Sciences, Princeton University, Princeton, New Jersey 08540, GSA's Section E representative; or Dr. Bruce B. Hanshaw, USGS, 431 National Center, Reston, Virginia 22092, GSA's Section W representative, as soon as possible with program suggestions.

Publications

Microform Publications series initiated

The first document in the Society's new Microform Publications series will soon be published. It is entitled "Environmental Geology: A Selected Bibliography," by Vivian Hall. The document will be on four microfiches enclosed in an envelope. The bibliography contains more than 4,200 references divided into 8 categories, with an author index. Original 8½ x 11 in. typewritten copy of 328 manuscript pages was photographed and reduced on microfiche. The microfiches are standard 98-frame fiches for use on 24x readers.

The new Microform Publications series is being initiated to provide an additional outlet for scientific data published by the Society. It is intended to supplement the Special Papers and Memoirs as well as be an outlet for data that might not otherwise be published by the Society but is worthy of publication. It should result in the publication of data much more rapidly and at substantially lower costs than conventional book form.

The Society no longer contemplates the publication in book form of symposia volumes beyond those for which it has a commitment to publish. Instead, it hopes to provide microfiches of symposia or other special sessions of its meetings at the time of the meeting, thus providing the data while they are new. This can be accomplished if the symposium leaders or convenors can provide peer-reviewed text to the Society at least two months before the meeting at which the session will be held.

Beyond the need for peer review, the Society has few restrictions as yet on material for consideration. Manuscripts should ordinarily be submitted to the Society in the same form as all other manuscripts. After they have been sent out for peer review, they most likely will need revision. We plan to note specific GSA style requirements on a copy of the manuscript that is returned to the author. Once the author returns acceptable, clean typescript, it will be processed for reproduction on microfiche.

In addition to releasing peer-reviewed, original papers in the series, the Society is also considering the prerelease of selected Special Papers and Memoirs in printed and microfiche form; reprints on microfiche of collections of selected subjects from the *Bulletin*, *Geology*, or book articles; and reprints of out-of-print Special Papers and Memoirs. We also plan to provide microfiches of annual cumulations of material from the GSA depository of supplementary data for published articles.

A study is also being made to put all *Abstracts with Programs* on microfiche, in addition to providing printed copies. Under consideration also is the possibility of publishing synopses of lengthy reports in *Geology* and providing full text on microfiche in the Microform Publications series.

Material published in journals or other media, especially foreign, that are largely inaccessible to general readership and guidebooks or other material provided only in limited quantity might also be candidates for the series.

The Society receives many useful suggestions about its various programs—may we have your suggestions for our Microfiche Publications series? The science editor would also welcome submission of material for consideration in the series.

Persons and organizations who wish to receive Microform Publications on a standing-order basis may do so by writing to Publication Sales Department, Geological Society of America, 3300 Penrose Place, Boulder, Colorado 80301. —*B. W. Troxel*

"Mini-Catalog" of GSA publications available

An eight-page "Mini-Catalog" listing current prices of all GSA publications now in print is just off the press. Items are listed numerically by series, giving title, author(s) or editor(s), year of publication, and price. An order blank is printed on the last page of the catalog.

All members and student associates are reminded that they may purchase one copy of each GSA publication at 20 percent discount off list prices. Such orders must be personal orders placed directly with the Society in order to earn the member discount. Discounts are not given on institutional orders.

If you would like a copy of the mini-catalog, please check the special box provided on the coupon that is used for ordering *Bulletin* separates (see page 324). If you are not eligible for ordering *Bulletin* separates, the coupon will nevertheless be honored for the mini-catalog.

Necrology

Francis Cameron, Stanford, California; **John G. Douglas,** Axford, Mississippi; **Horacio J. Harrington,** Buenos Aires, Argentina; **Francis M. Van Tuyl,** Lakewood, Colorado; **Edward H. Watson,** Bryn Mawr, Pennsylvania; **Max G. White,** Arlington, Virginia.

June BULLETIN briefs

Brief summaries of articles in the June 1975 GSA Bulletin *are provided on the following pages to aid members who chose the lower dues option to select* Bulletin *separates of their choice. The Document Number of each article is repeated on the coupon and mailing label in this section.*

☐ 50601—Glacier-Flow Patterns and the Origin of Late Wisconsinan Till in the Southern Rocky Mountain Trench, British Columbia. *John J. Clague, Department of Geological Sciences, University of British Columbia, Vancouver, British Columbia, V6T 1W5, Canada (present address: Geological Survey of Canada, 100 West Pender Street, Vancouver, British Columbia V6B 1R8, Canada).* (11 p., 10 figs., 1 tbl.)

Late Wisconsinan glacier-flow patterns and till genesis in the southern Rocky Mountain Trench, British Columbia, have been determined through a study of glacial landforms, till fabric, and till composition.

A major shift in the pattern of glacier flow occurred near the end of glaciation; tributary glaciers coalescent with the trunk glacier in the Rocky Mountain Trench receded, and side valleys were invaded by the trunk glacier. Final recession of the trunk glacier occurred with no major halts and without stagnation of the terminus.

Till associated with drumlins in the Rocky Mountain Trench accumulated by lodgement of particles due to subglacial pressure melting against a planar substratum. Fabric results from the lower part of the *younger* till sheet suggest either complex patterns of ice flow similar to those at junctions of many modern valley glaciers, or mass movement of supraglacial till associated with an interstadial interval within the late Wisconsinan glaciation. Till composition reflects a south- to southeast-flowing trunk glacier augmented by coalescent tributary glaciers.

Most pebbles and fine-grained sand in the tills of the Rocky Mountain Trench are of local origin. Local constituents decrease in relative amounts away from the mouths of tributary valleys whence they are derived. These decreasing gradients result largely from progressive deposition and dilution.

Compositional differences in till are pronounced off tributary valleys but become less distinct in a down-glacier direction. This probably results from laterial mixing of sediment due to shifts in the zone of coalescence of trunk and tributary glaciers with changes in relative ice flux from the two.

☐ 50602—Layered Series of the Wichita Complex, Oklahoma. *Nancy Scofield, Department of Geology and Geological Engineering, Michigan Technological University, Houghton, Michigan 49931.* (5 p., 5 figs., 1 tbl.)

The core of the Wichita Mountains of Oklahoma is a layered igneous intrusive mass composed of plagioclase cumulates, predominantly anorthosite, with some olivine-bearing anorthosite, gabbro, and olivine gabbro. Some chemical trends in the rocks indicate that cryptic layering is present but is the reverse of that found in most mafic layered intrusions. The anomalous position of highly calcic plagioclase near the top of the intrusion, inferred from field relations, coupled with possible reverse cryptic layering, suggests a separation of anorthosite by flotation or rafting of plagioclase.

☐ 50603—Generalized Facies Models for Resedimented Conglomerates of Turbidite Association. *Roger G. Walker, Department of Geology, McMaster University, Hamilton, Ontario L8S 4M1, Canada.* (12 p., 10 figs., 3 tbls.)

Descriptive features that contribute to models of resedimented (deep-water turbidite association) conglomerates are the presence or absence of a preferred clast fabric, stratification, and inverse and (or) normal graded bedding.

One model is characterized by the presence of both inverse and normal grading and the absence of stratification (inversely to normally graded model). A preferred fabric is present in about one-half of the examples studied. As the clast size becomes smaller, this model passes into a graded-stratified model, characterized by the absence of inverse grading and the presence of normal grading and stratification. Most examples exhibit a preferred clast fabric. A third model is characterized by the absence of normal and inverse grading and by stratification (disorganized-bed model). Few examples contain a preferred fabric.

Where present, the preferred fabric consists normally of long (a) axes parallel to flow and dipping upstream. This indicates direct deposition from dispersion without rolling on the bed. In examples with prominent stratification, however, it is postulated that the fabric changes to long (a) axes transverse to flow with intermediate (b) axes dipping upstream. This would indicate bed-load rolling and would allow use of standard bed-load formulae for calculation of rates of emplacement.

In basin analysis, the disorganized-bed model is probably characteristic of the feeder channels or canyons. The

inversely to normally graded model reflects flow on a relatively steep slope, but nevertheless downstream from the disorganized-bed model. As the slopes flatten out in midfan areas, the inversely to normally graded model passes into the graded-stratified model.

☐ 50604—Seismic Geyser and Its Bearing on the Origin and Evolution of Geysers and Hot Springs of Yellowstone National Park. *George D. Marler, Thornton, Idaho 83453; Donald E. White, U.S. Geological Survey, Menlo Park, California 94025.* (11 p., 8 figs.)

The major Hebgen Lake earthquake on August 17, 1959, profoundly affected the hot springs and geysers of Yellowstone National Park. The epicenter of this earthquake was about 48 km northwest of Upper Geyser Basin, and its magnitude was 7.1 on the Richter scale. No earthquake of closely comparable intensity had previously jarred the geyser basins in historic time. By the day after the earthquake, at least 289 springs in the geyser basins of the Firehole River had erupted as geysers; of these, 160 were springs with no previous record of eruption.

New hot ground soon developed in some places, some new fractures developed locally into fumaroles, and a few of these evolved into hot springs or geysers.

One fracture evolved into a fumarole and then into a geyser, now named "Seismic," that erupted to heights of 12 to 15 m and explosively excavated a jagged-walled vent more than 12 m in maximum diameter and more than 6 m deep. Major eruptions ceased in 1971 when a small satellite crater formed and then assumed dominance.

The formation and evolution of Seismic Geyser provide the keys for understanding the origin of the craters and vents of other geysers and probably also the large smooth-walled nongeysering pools and springs.

Earthquakes, largely localized just outside the Yellowstone caldera, result in violent shaking of the large high-temperature convection systems of the geyser basins. New fractures form in the self-sealed shallow parts of these systems where high-temperature water is confined at pressures much above hydrostatic. As old fractures and permeable channels become sealed by precipitation of hydrothermal minerals, new channels are provided by the periodic seismic activity.

Our explanations for the origin of geyser and hot spring vents apply specifically to the geyser basins of Yellowstone Park, where near-surface fluid pressure gradients are commonly 10 to 50 percent above the hydrostatic gradient, and temperature gradients and thermal energy available for explosive eruption are correspondingly high. The same general explanations seem likely to account for the origin of geyser tubes and hot-spring vents in other less favored areas where pressures and maximum temperatures are limited by hydrostatic pressures, probably with little or no overpressure being involved.

☐ 50605—K-Ar Apparent Ages, Peninsular Ranges Batholith, Southern California and Baja California. *Daniel Krummenacher, R. Gordon Gastil, Jonathan Bushee, and Joan Doupont, Department of Geology, San Diego State University, San Diego, California 92115 (present addresses: Bushee, Department of Geology, Northern Kentucky State College, Covington, Kentucky 41011; Doupont, Lawrence Livermore Laboratory, Livermore, California 94550).* (9 p., 5 figs., 3 tbls.)

More than 200 K-Ar apparent ages determined from minerals from the Peninsular Ranges batholith of southern California and northern Baja California show in general a progressive decrease from about 120 m.y. in the southwestern part of the batholith to less than 70 m.y. in the northeastern part. The gradients for biotite and hornblende ages can be represented by contours of equal ages. Both concordant and discordant hornblende-biotite pairs and minerals, from a variety of plutonic and metamorphic rock types, share in the apparent-age gradient. Ages for hornblende average 5 m.y. older than the ages for coexistent biotite. Isotopic U-Pb and Pb-α measurements on zircon indicate ages greater than those calculated from K/Ar ratios of hornblende or biotite. It is believed that in the Peninsular Ranges province, the U-Pb ages for zircon approximate the ages of emplacement, whereas concordant K-Ar ages may or may not approximate the ages of emplacement, depending on the depth of emplacement and the rate of uplift and denudation.

☐ 50606—Geophysical Interpretation of Crustal Structure along the Southeastern Coast of Norway and Skagerrak. *Ivar B. Ramberg and Scott B. Smithson, Department of Geology, University of Wyoming, Laramie, Wyoming 82071 (permanent address, Ramberg: Institutt for Geologi, University of Oslo, Oslo, Norway).* (6 p., 5 figs.)

Seismic, magnetic, and geologic data are used to provide constraints on gravity models of the crust from southeast-

ern Norway into the Skagerrak. Seismic data indicate that the Moho rises from more than 39 km under central Norway to approximately 30 km under the Skagerrak and that a basin with about 5 to 6 km of sediments in it is present in the Skagerrak. Magnetic data show a maximum depth of 6 km to the magnetic basement in the sedimentary basin, and characteristic magnetic anomalies are found over basement rocks along the coast and under the Skagerrak. The Great Friction Breccia fault zone, separating migmatitic and supracrustal rocks along the southeast coast, is a major tectonic feature on land. Bouguer gravity anomalies increase from slightly negative values northwest of the breccia zone to as high as +50 mgal along the coast and offshore. Major features of this interpretation are the following: (A) recognizable supracrustal rocks are more mafic than underlying mobilized migmatites, (B) a probable crustal low-velocity zone is formed by the above compositional inversion, (C) intrusive granite in the supracrustal rocks may be formed by anatexis and diapiric uprise of migmatite, (D) the Great Friction Breccia fault zone is a major tectonic feature, and (E) continuation of the Oslo graben and associated igneous rocks under the Skagerrak seems likely.

☐ 50607—Reconnaissance Geophysical Survey of the Caroline Basin. *Dewey R. Bracey, U.S. Naval Oceanographic Office, Washington, D.C. 20373.* (10 p., 7 figs.)

On the basis of the results of reconnaissance seismic reflection and magnetic surveys of the region, the Caroline Basin is interpreted as having been created by two phases of sea-floor spreading. The first phase, beginning prior to 42 m.y. B.P., accreted crust from an east-northeast-striking spreading center for at least 17 m.y. until the spreading axis was ingested into the northward-dipping subduction zone south of the West Caroline Ridge about 25 m.y. B.P. The possibility exists that the Eauripik-New Guinea Rise was formed on the southern limb of this spreading center by a mantle plume operative during this period.

The second phase of sea-floor spreading, beginning prior to 18 m.y. B.P., was located in the northwest corner of the pre-existing basin. This spreading axis was oriented west-northwest and persisted for at least 4.3 m.y., until about 13.7 m.y. B.P. This spreading axis was probably responsible for formation of the Northwest Caroline Basin fracture zone, which separates its southern terminus from the older basin crust, and for the reactivation of the western part of the defunct West Caroline Ridge subduction zones.

Major segments of the basin margin are interpreted as subduction zones, ranging from inactive to possibly incipient.

☐ 50608—Precambrian Evolution of the Spanish Peaks Area, Montana. *Edgar W. Spencer and Samuel J. Kozak, Department of Geology, Washington and Lee University, Lexington, Virginia 24450.* (8 p., 6 figs., 2 tbls.)

Precambrian crystalline rocks in the Spanish Peaks area of southwestern Montana are composed primarily of granitic and amphibolitic gneiss, quartzite, and amphibolite. Sillimanite gneiss, ultrabasic intrusive rocks, marble, and post-Precambrian basalt are also present. Almandine-amphibolite metamorphic facies and sillimanite-almandine-orthoclase subfacies are widely distributed in the area.

Two major Precambrian orogenic events followed accumulation of a thick sedimentary sequence. An early Precambrian orogenic deformation produced isoclinal folds, folded pegmatites, and amphibolite boudins. These structural features were deformed in a second orogeny, which was characterized by large, open, northeast-trending folds that developed under metamorphic conditions favorable for ductile deformation and a second generation of pegmatites. Cross folding and flexure of the second-generation folds and development of kinks accompanied or followed the second orogeny. Mafic dikes and sills were emplaced following the second orogenic event and subsequently metamorphosed. They cut across the second-generation folds. Quartz veins, felsic porphyry dikes, and basalt dikes cut all earlier structures.

Alternate correlation of thermal events whose ages have been determined radiometrically at 2.6, 1.9, and 1.6 b.y. with metamorphic and structural events are made as follows:

Amphibolitization of unfolded dikes and sills: I, 1.9 b.y.; II, 1.6 b.y.

Open, subhorizontal folds: I, 2.6 b.y.; II, 1.9 b.y.

Isoclinal folds: I, age uncertain; II, 2.6 b.y.

☐ 50609—Experimental Origin of Transform Faults and Straight Spreading-Center Segments. *J. W. O'Bryan, R. Cohen, and W. N. Gilliland, Department of Geology, Rutgers University, Newark, New Jersey 07102.* (4 p., 9 figs.)

Experimental work based on a combination of the wax model of Oldenburg and Brune and the tennis ball experiment of Cox suggests a possible origin of the orthogonal mid-ocean system of ridge and transform faults. Various cuts were made in a crust formed by cooling on the surface of a pan of melted wax, and portions of the crust were rotated about a pole of rotation while other portions remained stationary. New thin crust formed in the gap between the rotated portions of the initial crust. The new crust is characterized by a medial spreading center offset by arcuate fractures concentric about the pole of rotation. At slow spreading rates (nearer the pole of rotation), the shape of the spreading center is distinctly zigzag, and concentric fractures are lacking. The straight sections of the zigzag possibly originate as shears. At fast spreading rates (farther from the pole of rotation), the zigzag becomes typically orthogonal with straight segments offset by concentric fractures.

We propose that the oceanic ridge systems originate as zigzag spreading centers in the asthenosphere or at the base of the lithosphere and then evolve into orthogonal systems that are propagated upward.

☐ 50610—Ophiolite in Southeast Asia. *Charles S. Hutchison, Department of Geology, University of Malaya, Kuala Lumpur, Malaysia.* (10 p., 3 figs., 1 tbl.)

No fewer than 20 belts of mafic-ultramafic assemblages have been named "ophiolite" in the complex Southeast Asia region of Sundaland. Fewer than one-half of these can be confidently classified as ophiolite. The only well-documented complete ophiolite, with continuous conformable sections from mantle harzburgite through gabbro to

spilite, occurs in northeast Borneo and the neighboring Philippine Islands. It contains a record of oceanic lithospheric history from Jurassic to Tertiary and has a Miocene emplacement age. All other ophiolite belts of the region are either incomplete or dismembered. The Sundaland region probably has examples of several types of emplacement mechanism and emplacement ages ranging from early Paleozoic to Cenozoic.

☐ 50611—Crustal Structure of the Texas Gulf Coastal Plain. *G. R. Keller, Department of Geology, University of Kentucky, Lexington, Kentucky 40506; D. H. Shurbet, Seismological Observatory, Texas Tech University, Lubbock, Texas 79409.* (4 p., 4 figs., 1 tbl.)

In order to obtain new information about deep crustal structure in the Texas Gulf Coast region, tripartite arrays of long-period vertical seismographs were deployed to observe Rayleigh wave dispersion. Additional gravity measurements were also made and combined with those of a previous study to produce four detailed gravity profiles crossing the study area. Interpretation of the Rayleigh wave dispersion data and the gravity data together suggests a crustal structure consisting of a Paleozoic subduction zone and orogen buried beneath thick accumulations of Mesozoic and Cenozoic sedimentary rocks.

☐ 50612—Terrestrial Heat Flow along the Rio Grande Rift, New Mexico and Southern Colorado. *Marshall Reiter, C. L. Edwards, Harold Hartman, and Charles Weidman, New Mexico Institute of Mining and Technology, Socorro, New Mexico 87801 (present address, Hartman: Texaco Inc., Tulsa, Oklahoma 74102).* (8 p., 4 figs., 1 tbl.)

From heat-flow data obtained in New Mexico and southern Colorado, we recognize (1) a major geothermal anomaly with heat-flow values greater than 2.5 HFU (heat-flow unit, $\mu cal/cm^2/sec$) coincident with the western part of the Rio Grande rift, (2) a complex heat-flow pattern in the eastern Colorado Plateau with values of 1.5 HFU and less, apparently associated with major structural basins, and values of 2.0 HFU and greater, apparently associated with some intrusions and perhaps major uplifts, (3) a regional increase in heat-flow values from 1.5 to 2.0 HFU to values greater than 2.5 HFU in southwestern New Mexico, which may be coincident with the north-trending geothermal transition zone between the Colorado Plateau and the Basin and Range provinces.

☐ 50613—Granitic Plutonism and Metamorphism, Eastern Alaska Range, Alaska. *Donald H. Richter, U.S. Geological Survey, 1209 Orca Street, Anchorage, Alaska 99501; Marvin A. Lanphere, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025; Neal A. Matson, Jr., U.S. Geological Survey, 1209 Orca Street, Anchorage, Alaska 99501.* (11 p., 6 figs., 2 tbls.)

Plutonic rocks in the eastern Alaska Range were emplaced in Late Pennsylvanian time (282 to 285 m.y. B.P.) and during two distinct intervals in Cretaceous time (105 to 117 and 89 to 94 m.y. B.P.). Development of a large plutonic-metamorphic complex, consisting of diorite and quartz diorite intimately associated with banded gneiss and other metamorphic rocks, apparently occurred during Late Triassic to Middle Jurassic time (163 to 199 m.y. B.P.). A smaller plutonic-metamorphic complex is Miocene in age (17 m.y.).

The younger Cretaceous plutons are recognized only in the regionally metamorphosed Devonian and older terrane north of the Denali fault. Plutons of the older Cretaceous and Pennsylvanian events are restricted to Pennsylvanian and younger terrane south of the Denali fault and are associated with coeval volcanic rock assemblages. The major plutonic-metamorphic complex is also restricted to the terrane south of the Denali fault and may relate to collapse of an upper Paleozoic volcanic arc in Triassic time followed by syntectonic magmatism in Jurassic time. The Miocene plutonic-metamorphic complex may reflect the time of initial movement along the Denali fault.

Porphyry copper deposits are associated with the Cretaceous plutons south of the Denali fault. The source of the copper may be subjacent copper-rich basalt flows (Nikolai Greenstone) of Triassic age.

☐ 50614—Structural Evolution of the Honduras Continental Margin and the Sea Floor South of the Western Cayman Trough. *Paul R. Pinet, Department of Geology, University of Georgia, Athens, Georgia 30602.* (9 p., 11 figs.)

The interpretation of 2,500 km of seismic-reflection profiles and its synthesis with the results of previous work reveal a four-stage development for the Honduras continental margin since late Mesozoic time. Late Cretaceous–early Eocene orogenesis deformed basement rocks and preorogenic units off Honduras. Following subsidence during middle Tertiary time, two postorogenic units blanketed the eroded preorogenic rocks, creating a distinct angular unconformity. The widespread distribution and uniform thickness of the postorogenic sediments suggest deposition during a tectonically quiescent period. Pliocene time marked the onset of block-faulting activity which fragmented the crust into irregular ridges and basins in northern Central America and along the Honduras continental margin and the western Cayman Trough. The continental shelf and slope of Honduras have been prograding since the Miocene Epoch; turbidites are now filling the proximal fault basins off the shore of Honduras.

Assuming that regional tectonism and continental margin development are relatable to lithospheric plate interactions, the deformed preorogenic units are interpreted as having been buckled by convergent plate motions during Late Cretaceous–early Eocene time. Plate slippage may have lapsed during middle Tertiary time, as inferred from the nature of the postorogenic units. This phase of plate passivism was terminated during Pliocene time by block-faulting activity, which presumably represents the resumption of plate motions along the Cayman Trough that have persisted to the present in the northwestern Caribbean.

☐ 50615—Late Cenozoic Paleo-Oceanography of the Ross Sea, Antarctica. *Richard H. Fillon, Graduate School of Oceanography, University of Rhode Island, Kingston, Rhode Island 02881 (present address: Atlantic Geoscience Centre, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada).* (7 p., 3 figs.)

Paleomagnetic, radiolarian, and foraminiferal studies of piston cores from the Ross Sea, Antarctica, reveal the

existence of a widespread disconformity separating sediments of Gauss age (t > 2.4 m.y.) from a thin discontinuous layer of Brunhes sediments (t < 0.7 m.y.). Climatic cooling, expansion of the Ross Ice Shelf, and the resultant increased circulation of bottom water in late Gauss or early Matuyama time probably caused the extensive erosion and (or) nondeposition responsible for the disconformity. Ross Ice Shelf expansion may also have caused a reduction in the number of outlet glaciers discharging debris-laden ice directly into the sea resulting in the observed decrease in glacial-marine sediment deposition since the Gauss. Increased circulation under an expanded ice shelf and an associated increase in the concentration of dissolved carbon dioxide is implied by a late Gauss-early Matuyama rise from >1,800 to <350 m in the calcium-carbonate compensation depth within the Ross Sea. The distribution of reworked Gauss-age fossils in Brunhes deposits in submarine channels on the Ross Sea Shelf and continental slope and on the nearby abyssal plain further indicates that substantial amounts of resuspended sediment have been transported out of the Ross Sea by bottom currents during the Brunhes.

☐ 50616—Fluid Precipitates in Rocks from the Earth's Mantle. *H. W. Green, Department of Geology, University of California, Davis, California 95616; S. V. Radcliffe, Department of Metallurgy and Materials Science, Case Western Reserve University, Cleveland, Ohio 44106.* (7 p., 4 figs.)

Xenoliths of rocks from the Earth's mantle are commonly included in alkalic basalt and kimberlite diatremes. The xenoliths, many of them highly deformed by plastic flow, consist primarily of olivine and pyroxene and may be derived from depths as great as the seismic low-velocity zone. Large numbers of very small bubbles of CO_2-rich fluid are within the major phases. The combined techniques of optical and high-voltage electron petrography demonstrate that the smallest bubbles, many of them below optical resolution, are attached to crystal defects induced by deformation and exsolution and to grain boundaries. It is concluded that formation of the smallest bubbles precedes incorporation of the xenoliths into the host magma and occurs by solid-state precipitation on the deformation and exsolution features. The bubbles then collect on migrating grain boundaries during syntectonic recrystallization.

The occurrence of bubble formation before xenolith incorporation into the magma strengthens previous suggestions that the tectonite xenoliths may be the magma source rock or residuum and that the asthenosphere is not partially melted. Furthermore, since the presence of analogous "bubble structure" in ceramics and metals is known to weaken significantly the high-temperature creep resistance of such materials, it appears likely that the mode of flow in mantle rocks may be influenced similarly.

☐ 50617—Mineralogic Composition of Sand-Sized Sediment on the Outer Margin off the Mid-Atlantic States: Assessment of the Influence of the Ancestral Hudson and Other Fluvial Systems. *Gilbert Kelling, Department of Geology and Oceanography, University of Wales, Swansea, Wales SA2 8PP; Harrison Sheng and Daniel Jean Stanley, Division of Sedimentology, Smithsonian Institution, Washington, D.C. 20560.* (10 p., 4 figs., 1 tbl.)

The mineralogic composition of surface and core sand samples from the outer shelf, slope, and rise between Hudson and Norfolk Canyons has been determined to evaluate the relative contributions of major drainage areas lying to the north and west. The observed mineralogic uniformity in space and time is largely attributable to the fact that the principal fluvial supply to this sector during the Pleistocene and Holocene Epochs was through river systems, all of which drain some part of a large and geologically variable glaciated region. Further complications in distinguishing specific sources probably result from the extensive migration of the Hudson River across the subaerially exposed continental shelf during various Pleistocene low sea-level stands, which produced considerable homogenizing of shelf sediment prior to its downslope transfer onto the continental rise.

Trends of the major light and heavy mineral groups on this outer continental margin show that the ancestral Hudson probably extended at least to the head of Baltimore Canyon. The distribution of a distinctive variety of the mineral axinite suggests that the Hudson may have exerted its influence some 140 km farther to the south than previously postulated.

Vertical time-related changes in the mineral assemblages in slope and rise cores show a broadly similar pattern throughout the region. The marked compositional variation of sand with depth in cores from the lower rise is best explained by fluctuations in materials transported from adjacent shelf sources downslope to the southeast (lateral input and transport model) rather than by significant long-term dispersal parallel to isobaths (contour current transport model).

☐ 50618—Amazon Cone: Morphology, Sediments, Age, and Growth Pattern. *John E. Damuth and Naresh Kumar, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964.* (16 p., 10 figs.)

The morphology, sediment distribution, and growth pattern of the Amazon cone are similar to those of other deep-sea fans; its sediment, at least during the late Quaternary Period, was deposited in response to glacial-interglacial cycles, and its age of formation is estimated to be middle to late Miocene.

Sedimentation on the Amazon cone, at least during Quaternary time, has been climatically controlled. During high sea-level stands, terrigenous sediment is trapped on the inner continental shelf, and only pelagic sediment is deposited on the cone. During low sea-level stands, the Amazon River discharges terrigenous sediment into the Amazon Submarine Canyon, from where it is easily transported to the cone by gravity-controlled sediment flows. Wisconsin sedimentation rates on the cone were in excess of 30 cm/10^3 yr.

Average sedimentation rates for the Pleistocene Epoch, based on the extrapolated age (2.2 m.y.) of a prominent acoustic reflector within the cone, range from 50 to 115 cm/10^3 yr. The Amazon cone began to form about 8 to 15 m.y. B.P. and is thus about one-tenth the age of the Equatorial Atlantic.