



# GSA news & information

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## First minority scholars selected for 1975-1976

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Six minority majors in the geological sciences have already been selected by the American Geological Institute to receive scholarships for the academic year 1975-1976. The scholarships, authorized by the AGI Executive Committee, will go to students selected by the Advisory Committee to the AGI Minority Participation Program based on academic excellence and probable future success, with amounts ranging from \$500 to \$2,000 based on need.

Six AGI Member Societies (American Geophysical Union, Geological Society of America, National Association of Geology Teachers, Seismological Society of America, Society of Economic Geologists, and Society of Economic Paleontologists and Mineralogists) and two companies (American Metal Climax Foundation, Inc., and Marathon Oil Company) have, as of March 10, 1975, contributed or pledged support for academic grants-in-aid next year. Many individuals have also contributed to the program, either through Member Societies or directly to the AGI.

The first six students to receive scholarships next fall are *Edward C. Blaise, Jr.*, a black geology senior at Louisiana State University; *Floyd Gray*, a black geology senior at the University of California, Santa Cruz, selected as the National Association of Geology Teachers Scholar; *Edward Jimenez*, a Puerto Rican geology senior at Colorado State University; *Anthony G. Johnson*, a black senior at Brother Martin High School, New Orleans; *Wilbert L. Mathews*, a black geology senior at the University of Kansas; and *A. Roland Mora*, a Latin-American geology graduate student at the University of California, Los Angeles.

The Advisory Committee to the AGI Minority Participation Program expects to select up to 20 more minority scholars at its meeting at GSA headquarters May 22 and 23. Contributions to the minority fund are deductible for income tax purposes.

— *L. C. Pakiser*, Chairman  
Ad Hoc Committee on Minority Group Members  
in the Earth Sciences

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## Penrose Conference: Lithosphere-Asthenosphere Boundary

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A Penrose Conference on "The Lithosphere-Asthenosphere Boundary" will be convened by Thomas H. Jordan and William S. Fyfe at the Kiandra Lodge, Vail, Colorado, November 16-21, 1975.

Many definitions of the lithosphere-asthenosphere boundary exist, based on various geodetic, seismological, petrological, and rheological data or phenomena. This ambiguity has resulted in confusion and misinterpretation on the part of students of Earth dynamics.

The purpose of this Penrose Conference is to bring together investigators from the many disciplines that provide information on the lithosphere and asthenosphere and to focus attention on the problems concerning the nature and configuration of the lithosphere-asthenosphere boundary that are critical in modern studies of Earth dynamics.

A registration fee of \$250 will cover accommodations at the Kiandra Lodge in Vail, all meals, and other conference costs. Attendance will be limited to approximately 70 participants.

To apply, write to Thomas H. Jordan, Department of Geological and Geophysical Sciences, Guyot Hall, Princeton University, Princeton, New Jersey 08540.

Deadline for application is September 1, 1975.

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## Penrose Conference: Geodynamics of Continental Interiors

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A GSA Penrose Conference on "Geodynamics of Continental Interiors" will be held at the Town and Country Hotel, San Diego, California, December 14-19, 1975. Conveners are Charles F. Kahle and Edmund F. Pawlowicz, Department of Geology, Bowling Green State University, Bowling Green, Ohio 43403 (phone: 419-372-2886).

Purpose of the conference will be to explore, coordinate, and synthesize knowledge and ideas about the structure and evolution of continental interiors within the framework of several hypotheses of global tectonics.

Attendance will be limited to 70-80 persons. Cost is expected to be \$250-\$300, including all meals, lodging, and registration. Those interested in further information or in applying should contact the conveners. Deadline for applications is October 1, 1975.

# News of the Coal Geology Division

## DIVISION ACTIVITIES PLANNED FOR SALT LAKE CITY MEETING

### Technical program

Plans for the annual meeting in Salt Lake City now include a field trip to central Utah, a half-day symposium complementing this trip, two half-day technical sessions of volunteered papers, and a luncheon-business meeting. Note that the luncheon this year will include both a speaker and the presentation of the second biennial Gilbert H. Cady Award for outstanding contribution to the field of coal geology.

### Field trip and symposium

(Field trip: October 17-19, 1975, Western Book Cliffs, Castle Valley and Salina Canyon)

Participants will convene at Provo, Utah, Thursday evening October 16. The route of the trip will follow Highway 50 eastward through Spanish Fork Canyon over Soldier Summit to Price River Canyon and to Wellington-Sunnyside area in the western Book Cliffs; then southwestward through Castle Valley along the Book Cliffs to I-70 and thence westward across a series of faults to the Salina Canyon and return to Salt Lake City. Many miles of continuously exposed Mesaverde (Upper Cretaceous) sandstones, shales,

and coal seams above steep cliffs of Mancos Shale (Upper Cretaceous) will be examined, and special stops will be made at one mine and several fossil plant, algal, and invertebrate beds. Lower Tertiary lake and plains sections will also be examined.

There are four basic goals during the field trip, some of which will be amplified in the post-field trip symposium on "Some Geologic Aspects of Coal Accumulation, Exploration, and Mining in the North-western Colorado Plateau." The effect of regional and local tectonic activity and later mining-induced structural changes on coal quality, resource mapping, and minability will be examined in the Sunnyside area. The characteristics of transgressive-regressive coastal sedimentation, and the interdigitation of marine beds and coastal freshwater swamps and associated sediments, will be observed and discussed in the Price River-Spring Canyon area. The third area of emphasis will be on an ancient river system and the sequence of sedimentary changes which will be observed beginning with near-offshore sites through beaches and coastal marshes to fluvial-deltaic facies and the character and identification of coals or organic detritus at these sites. A continuing area of emphasis throughout the trip will be the application of the study of fossil plants, both megascopic and microscopical size, to interpretation of environments of deposition.

### Please cut out and mail to

A. D. Cohen, 1975 Program Chairman/Coal Division, GSA/U.S. Geological Survey/956 National Center/Reston, Virginia 22092

1. I (do) (do not) plan to participate in the Utah field trip.
2. I suggest the following paper(s) for inclusion in the Technical Sessions or the Symposium at Salt Lake City:

By \_\_\_\_\_ Address \_\_\_\_\_

By \_\_\_\_\_ Address \_\_\_\_\_

Your address \_\_\_\_\_

Signature \_\_\_\_\_

# The Geological Society of America

# Annual Report for 1974

## Part 1. November 1974 Council Actions

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 first part of the series.

- 1 Adopted as the report of the Council the *Annual Report for 1973* that was submitted to the annual corporate meeting as required by the bylaws.
- 2 Approved a "break-even" budget for 1975, based on certain changes in Society policy.
- 3 Revised Article VI, Section 2, *Annual Dues*, of the bylaws to accommodate changes in the dues structure.
- 4 Discussed a basic dues option—with the opportunity to subscribe to the Society's publications desired.
- 5 Discussed economies in force or planned throughout headquarters.
- 6 Suspended for one year the establishment of a Fair Rental for Capital Plan for financing Society expenses.
- 7 Rescinded for one year the May 1974 Council action changing the Society's fiscal year.
- 8 Ratified the Miami Beach national meeting budget as amended.
- 9 Appropriated funds to cover a deficit in the Penrose Medal Fund for 1974.
- 10 Modified the Section financial resolution concerning check-signing and other money-handling functions.
- 11 Received a progress report concerning the Society's auditing firm.
- 12 Selected the dates of May 11-12, 1975, for the spring meeting of the Council to be held in Boulder, Colorado.
- 13 Voted to change the title of the Society's chief staff officer to Executive Director.
- 14 Voted to shift, as soon as it can be implemented, the national meeting days from arrival on Sunday and departure on Wednesday to arrival on Thursday and departure on Sunday to take advantage of lower hotel room rates.
- 15 Authorized the inspection of Portland, Oregon, as a possible national meeting site.
- 16 Accepted the resignation of John C. Reed, Jr., as general chairman of the 1976 national meeting in Denver and appointed R. Dana Russell in his place.
- 17 Assigned GSA national officers to attend section annual meetings during 1975.
- 18 Increased the maximum permitted registration fee for the North-Central Section's joint meeting with the Geological Association of Canada and the Mineralogical Association of Canada, May 15-17, 1975.
- 19 Discussed the items covered during the section officers' meeting in Miami Beach, November 18, 1974.
- 20 Voted to ask the management boards of divisions not now charging dues to consider such action.
- 21 Approved the revised bylaws of the Quaternary Geology and Geomorphology Division concerning the J. Hoover Mackin Grant.
- 22 Accepted reports from GSA section, divisions, and representatives to non-GSA groups.
- 23 Ratified the 1975 Committee on Committees slate.
- 24 Selected members for the 1975 committees and as Society representatives.
- 25 Appointed an ad hoc Committee on the Scheduling of Committee and Council Meetings.
- 26 Approved the recommendations of the Publications Committee to
  - a. Set the abstracts deadline for the Salt Lake City national meeting at July 1, 1975.
  - b. Effective with 1976, set the abstracts deadline for the national meeting at 18 weeks before the meeting date.
  - c. Establish a numbered series of maps and charts.
  - d. Establish a numbered miscellaneous publications series on microform.
- 27 Established a GSA depository for back-up material for the *Bulletin* and other GSA publications, charts, tables, and the like.
- 28 Discussed *Geology* magazine.
- 29 Expressed interest in the Geodynamics Program and the JOIDES Group and, when appropriate, in holding symposia and publishing certain syntheses.

(continued on page 252)

## Annual Report for 1974 (continued)

- 30 Discussed Bennie W. Troxel's resignation at the end of 1975 and his replacement as head of the Publications Department.
- 31 Advanced 37 Members to Fellowship and ratified the election of 345 candidates to membership in the Society.
- 32 Empowered the Committee on Environment and Public Policy to prepare four information papers a year and to prepare a proposal to NSF to cover the costs of production and distribution.
- 33 Discussed the status of the GSA research grant program.
- 34 Directed that the unrestricted monetary gift from the Mobil Oil Corporation be added to the funds available for research grants in 1975.
- 35 Noted with appreciation the fund-raising efforts of George deVries Klein for support of the GSA research grants program.
- 36 Reduced the 1975 research grants appropriation from \$75,000 to \$50,000.
- 37 Ordered that the rules governing the Penrose Research Grants be applied to the Harold T. Stearns Research Grant Fellowships.
- 38 Approved five Penrose Conferences for 1975.
- 39 Approved a financial resolution concerning the direct costs of headquarters personnel involved in Penrose Conferences.
- 40 Accepted the resignation of Alfred G. Fischer as chairman and member of the Ad Hoc Committee on the Treatise and appointed J. Tom Dutro, Jr., as chairman and Edwin B. Eckel as member.
- 41 Established a permanent GSA-Treatise Advisory Committee; dissolved the Ad Hoc Committee on the Treatise.
- 42 Voted a financial contribution of \$20,000 to support the Treatise for 1975 and to discuss the Treatise allocation annually.
- 43 Named Julian R. Goldsmith as GSA's member on the AGI Governing Board.
- 44 Voted to continue the minority fund check-off on the dues statement.
- 45 Established an ad hoc Headquarters Advisory Art Committee.
- 46 Approved establishment of liaison with the Earthquake Engineering Research Institute.
- 47 Noted the formation of the National Association of Groundwater Officials.
- 48 Approved a meeting called between the Executive Committee and the presidents of the associated societies set for January 15, 1975, in Boulder, Colorado.
- 49 Accepted on behalf of the Society a gift of miserite from Charles Milton.
- 50 Modified the retirement resolution for GSA personnel.
- 51 Voted to permit the staff to purchase with their own funds voluntary 24-hour accident insurance for themselves and their families.
- 52 Adopted a resolution of thanks concerning the Miami Beach meetings.
- 53 Adopted a resolution of thanks to the retiring officers, councilors, and committee chairmen.
- 54 Established priorities of financial commitments made by the Council.
- 55 Took other minor actions, records of which are on file at headquarters.

## Letters

Dear Sirs:

I have received a copy of Roger Cuffey's December 13 letter to you and wish to support his position with regards to making available increased opportunities for GSA members and members of affiliate organizations to exchange information on current work. It seems to me that all Dr. Cuffey's points are valid, but I am particularly concerned that meetings of geologists within a region are to be narrowed in scope to include only papers directly involved with that region. In most fields of geology—such as my own, paleontology—there is much research on materials from outside the researcher's region and along general principles and theory that are of interest to others within the researcher's geographic region. This work deserves an aural audience even if the researcher cannot afford to travel across country to attend national meetings. For many geologists there is no travel subsidy; at Appalachian State University it is less than \$100 per year. Travel to national meetings is possible for our faculty only for the single man with no children to support or for others only when the meetings happen to be close by.

Beyond the scope of Dr. Cuffey's letter, however, I am concerned that regional meetings, at least in the southeast, be revitalized. This past year there were but two good papers that I heard. Otherwise the papers were poorly delivered (some unbelievably so) or lacking in content. Each speaker should receive instructions on minimum content and on quality of illustrations and delivery, perhaps similar to but smaller than the packet distributed to speakers by AAPG-SEPM.

Sincerely,  
*Frank K. McKinney*  
Appalachian State University  
Boone, North Carolina 28608

# Publications

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## New geologic map of United States published by USGS; entirely new compilation

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Publication of a new geologic map of the United States (exclusive of Alaska and Hawaii) was announced February 18, 1975, by the U.S. Geological Survey, Department of the Interior.

The wall-size (48 x 110-inch) multicolored map includes a legend that shows more than 150 readily identifiable geologic units. Published at a scale of 1:2,500,000 (1 inch equals about 40 miles), the map is an entirely new compilation, and supersedes a previous map published in 1932.

A companion to the new map is a 40-page supplementary report to assist the user in interpreting the map. The report describes the historical antecedents of the map, the sources from which the map was compiled, and the classification and representation of rock units and structures.

The map is marked by a variety of vivid colors, with each color representing a different rock unit and its geologic age. The flat-lying formations of the Midwestern States are portrayed in reds, purples, and blues; the Great Plains and the Coastal Plains in greens and yellows, as contrasted with the confused and disordered formations of the Appalachian Mountains in the east, and the Cordilleran Mountains that form the western third of the country. Along the Pacific Coast, the map lays out accurately the trace of the San Andreas fault and other faults which extend northwestward through the length of California, and, although the geology of the sea bottoms which adjoin the country is not represented, their topography is shown by bathymetric contours in meters.

The map was produced during five years of research and compilation by USGS geologists Philip B. King and Helen M. Beikman, of the Survey's Menlo Park, California, office, who summarized data from hundreds of geologists and scores of Federal and State agencies as well as educational and scientific institutions.

The map, "Geologic Map of the United States, 1974," is available for purchase through the mail at \$5 per copy from the following U.S. Geological Survey Distribution Branches: 1200 South Eads St., Arlington, Virginia 22202; and Federal Center, Building 41, Denver, Colorado 80225. (Prepayment is required, and remittances should be sent by check or money order payable to the U.S. Geological Survey.) Copies may also be purchased over the counter from the following USGS Public Inquiries Offices: 7638 Federal Building,

300 N. Los Angeles St., Los Angeles, California; 504 Custom House, 555 Battery St., San Francisco, California; 1012 Federal Building, 1961 Stout St., Denver, Colorado; 8102 Federal Building, 125 South State St., Salt Lake City, Utah; 1C45, 1100 Commerce St., Dallas, Texas; 678 U.S. Court House, West 920 Riverside Ave., Spokane, Washington; 108 Skyline Building, 508 Second Ave., Anchorage, Alaska; 1028 GSA Building, 19th and F Streets, N.W., Washington, D.C.; and 1C402 National Center, Reston, Virginia.

The companion report, "Explanatory Text to Accompany the Geologic Map of the United States," is published as USGS Professional Paper 901, and may be purchased over the counter for \$1.25 per copy at USGS Public Inquiries Offices listed above, and through the mail from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, to whom remittances should be sent by check or money order.

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## USGS now selling its books

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On April 1, 1975, the U.S. Geological Survey, in addition to selling its maps, began selling its books through the mails as a newly authorized agent of the Superintendent of Documents, U.S. Government Printing Office, thus increasing the availability of earth science information to the scientific community.

Direct-mail book sales by the Geological Survey, supplementing the Superintendent of Documents sales in Washington, D.C., will be a new, featured service of the Survey outlet. The service will provide faster filling of orders for all current issues of Survey reports, and it will provide a means of obtaining certain reports that are considered out of print (and therefore not stocked) by the Superintendent of Documents.

Those interested in ordering USGS book reports through the mail should order by series and number (such as Professional Paper 813-C) and complete title.

Send order, accompanied by check or money order payable to the U.S. Geological Survey, to the Branch of Distribution, U.S. Geological Survey, 1200 South Eads Street, Arlington, Virginia 22202. Inquiries concerning the new program may be sent to the U.S. Geological Survey, Reston, Virginia 22092.

# Publications

## **"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 262). If you are not eligible for ordering *Bulletin* separates, the coupon will nevertheless be honored for the mini-catalog.

## **Why we're fussy about quality of typing on abstracts**

After your abstract has been accepted for publication in the Abstracts with Programs volume, it is checked for correct format specifications and quality of type. If incorrect format or typing which will not reproduce satisfactorily necessitates retyping at GSA headquarters, a charge of \$15 will be imposed. This charge can be avoided by following the instructions that accompany each set of abstract forms.

The abstract form is designed to accommodate 250 words in a standard typeface. The original abstract, as you submitted it, is reduced to 72% of its original size (this article has been reduced at 72%). Because of this reduction factor, it is important that your abstract is typed in a typeface that is large enough and clean enough to be legible. A black carbon ribbon used with an electric typewriter produces the clearest, easiest-to-read copy (you are reading a sample of it now).

Here are some reasons why abstracts will be retyped:

Too small a typeface will be too small to read after reduction.

A ribbon that has a blue or gray tint to it will not reproduce well.

A cloth ribbon (even a new one) will print dark and smudgy.

Dirty typewriter keys will result in clogged letters (g's, o's, e's) that will become more exaggerated after reduction.

## **Memorial preprints available on request**

Separate preprints of GSA memorials to the persons listed below are now available, upon request, until supplies are exhausted. Authors of the memorials are listed in parentheses.

John Willis AMBROSE (Raymond A. Price), Orville L. BANDY (William H. Easton), Hugh Hamilton BEACH (Conrad O. Hage), Byron Nelson COOPER (W. D. Lowry), Armand John EARDLEY (William Lee Stokes), George E. EKBLAW (H. B. Willman and W. Calhoun Smith), Harold C. ELLIOTT (Willard E. Cox), Charles Edgar ERDMANN (William T. Pecora), Maurice EWING (J. Lamar Worzel), Aurelius Sydney FURCRON (Jesse H. Auvil, Jr.), Mary Welleck GARRETSON (Charles H. Behre, Jr.), Louis Caryl GRATON (Donald H. McLaughlin), John Charles HAZZARD (William H. Easton and William R. Moran), Donnel Foster HEWETT (Richard H. Jahns), Claude William HIBBARD (John Andrew Wilson), George William HOLMES (Eugene C. Robertson and John H. Moss), Charles George JOHNSON (Frank C. Whitmore, Jr.), William Drumm JOHNSTON, Jr. (John Van N. Dorr II, Islwyn Winwaeloc JONES (W. B. Skidmore), William J. McMANNIS (John Montagne), Wolfgang Werner E. MAHRHOLZ (Konrad B. Krauskopf), Frank B. NOTE-STEIN (C. William Saville), Edward H. RAINWATER (R. J. Le Blanc), Roger F. RHOADES (Charles S. Content), Erich Maren SCHLAIKJER (Warren L. Taylor), Lloyd M. SCOFIELD (Ralph W. Marsden), Harold T. U. SMITH (Robert L. Nichols), Erwin C. STUMM (Kenneth K. Landes), George David SWINGLE (William D. Hardeman), C. E. TILLEY (Felix Chayes), Edward Leffingwell TROXELL (Charles D. Campbell), Dart WANTLAND (Malcolm Logan), David M. S. WATSON (Everett C. Olson), Bradford WILLARD (J. Donald Ryan), Merton Y. WILLIAMS (V. J. Okulitch and H. V. Warren), Roy Arthur WILSON (Hollis D. Hedberg), Paul WOLDSTEDT (Roland Brinkmann), and James C. WRIGHT (Walter S. White).

Stock has been depleted on memorials to Eliot Blackwelder, Harry Hammond Hess, Hisashi Kuno, Frederic Henry Lahee, Hugh Dinsmore Miser, Walter Harry Newhouse, William T. Pecora, Herbert Harold Read, Harold Rollin Wanless, and Chester Keeler Wentworth.

Memorials are also available through our bound volumes. Volumes I and II are \$4 each; Volume III is \$6.

Members will continue to be informed as new preprints become available.

# Membership

## Function of Committee on Membership and Membership Benefits described

The Committee on Membership and Membership Benefits consists of six members. Two are elected each year from among the general membership to serve three-year terms. The chairman of the committee is appointed by the Council and is usually one of the two senior members.

The functions of the committee come under two broad categories of responsibility: first, the election of candidates to various categories of membership; second, the evaluation of various forms of member benefits and subsequent recommendations to the Council. Much of the business of the committee is conducted by mail. Two formal meetings are held each year prior to Council meetings, and reports are submitted to the Council.

One of the major tasks of the committee is the handling of fellowship matters. The entire Society membership has been polled several times on interest in maintaining this category of membership as a rank of distinction in the profession. Results of these polls have conclusively indicated that the majority of the Society's members wish to retain the distinction, and they have also indicated that this committee should be responsible for maintaining high standards for election to fellowship. Therefore, the committee seeks ways to obtain qualified member candidates to nominate to the rank of Fellow. This is done annually by sending each Councilor a list of members for review to determine those who have distinguished themselves in the science, by including announcements in the Society newsletters urging members to initiate their own candidacy or to nominate deserving colleagues, and by canvassing faculty members in the academic community to nominate qualified colleagues and former students.

On request, headquarters will mail appropriate forms for fellowship nominations either to sponsors or prospective candidates. Once the completed forms have been returned and processed, they are forwarded to members of the committee for review, and each member of the committee makes an objective evaluation of each candidate's qualifications on the basis of the information on the nomination forms. The majority of the nominations submitted are approved by the committee for recommendation to election to fellowship by the Council. Some are judged premature, however, and some are rejected because of insufficient evidence of qualification. Many times this lack of evidence arises from inadequate information provided by the candidate's

sponsors or insufficient vita and bibliographic material from the candidate.

The committee also receives monthly lists of all new Member and Student Associate applicants for review and approval. The committee devises methods of recruiting new members to ensure the continued vitality of the Society. It operates on the philosophy that the new geologists of today will be the leaders of the science and the Society tomorrow. One of the best methods of recruitment has been to provide membership information and application forms to geology departments at academic institutions each year.

The committee also approves all requests for reinstatement of membership or remission of dues for those members who become physically disabled or who reside in countries that do not have a currency exchange with the United States.

In the area of member benefits, the committee has recommended such changes as discount dues rates for couples who are members and simplified means of reinstating membership with original status and year of affiliation retained. The committee has also reviewed the desirability of sponsoring group insurance plans through the Society and has recommended reduced age and affiliation requirements for dues exemptions for retired members and temporary exemptions from dues for those serving in the armed forces below the rank of noncommissioned officer.

### Necrology

Frank E. Byrne, Green Bay, Wisconsin; Frank C. Calkins, Menlo Park, California; Earl C. Cockrum, Denver, Colorado; Durham Forrest, Hempstead, New York; John W. Funkhouser, Chester, Virginia; David T. Griggs, Los Angeles, California; Steven J. Lewis, Redford, Virginia; George Moses Knebel, Austin, Texas; Samuel Howell Knight, Laramie, Wyoming; Davis Mortimer Lapham, Harrisburg, Pennsylvania; Gerald R. McCarthy, Chapel Hill, North Carolina; Daniel G. Moye, Victoria, Australia; George V. Mueller, Montreal, Quebec, Canada; Stephen O. Orajaka, Nsukka, Nigeria; Alexander Stoyanow, Los Angeles, California.

1976

## SECTION MEETINGS

Papers for all section meetings of the Geological Society of America are invited from GSA Fellows, Members, Student Associates, and nonmembers. Accepted abstracts will be published in the appropriate issue of *Abstracts with Programs*, which will be distributed as a formal publication prior to the section meeting. Depending on limitations set by the individual sections, any author may submit as many abstracts as he or she wishes; however, no more than two from any author or coauthor will be accepted for publication.

Abstracts will be selected on the basis of geologic significance, amount of new information, broad interest, and relevance to the section's geographic coverage.

If you are not a member of GSA or not a member of the section for which the abstract is submitted, you will be asked to indicate this on the abstract form so that you will receive the *Abstracts with Programs* book in which your abstract appears.

GSA members automatically receive a copy of *Abstracts with Programs* for the section in which they reside (unless the individual member has requested otherwise).

Abstracts, which are limited to 250 words, must be submitted camera-ready on official GSA forms that may be obtained from Local Committee officers listed on the opposite page or

Abstracts Secretary  
Geological Society of America  
3300 Penrose Place  
Boulder, Colorado 80301.

If the typing of the original copy will not reproduce satisfactorily, accepted abstracts will be retyped at GSA headquarters; the senior author will be charged \$15. There will be no opportunity for authors to review or revise the retyped material. Abstracts submitted on other than the GSA form will be returned without consideration for the meeting.

Please note abstract deadlines.

Acceptance or rejection of abstracts will be based on the abstracts as submitted by the author. There will be no opportunity to revise or withdraw them. Final decisions on acceptance or rejection of abstracts are the responsibility of the Program Committee.

**POSTER SESSIONS.** Some sections will have space for poster sessions during their 1976 meetings. It will be necessary to submit the usual 250-word abstract explaining the material on display. Even though a formal paper is not read, the abstract is printed in *Abstracts with Programs* for formal citation. Decisions on whether papers are accepted for oral presentations or poster sessions will be made by the Program Committee. The authors, however, may indicate their preference if they so desire.

**STUDENT PAPERS** are welcomed and encouraged. Some sections give a Best Student Paper award. To be considered for the award, the paper must be by an individual author and it must be identified as being a student paper.

**ALL SLIDES** must be 2" x 2" and of a thickness that will fit comfortably in a standard carousel projection magazine. Slides should be designed for easy reading on 10-foot-wide screens by viewers who are as far away as 70 feet. Overhead projectors and chalkboards will be available on request.

**DETAILED INFORMATION** for registration, housing, field trips, short courses, ladies' activities, welcoming parties, business meetings and luncheons, annual dinners, and the like will be announced in future issues of the News & Information section as well as being included in the appropriate issues of *Abstracts with Programs*.

**AN EMPLOYMENT INTERVIEW SERVICE** for both employers and employees will be available at some section meetings during 1976. More information will be announced in the News & Information section as it becomes available.

**EXHIBIT SPACE** will be available during some section meetings for commercial, industrial, and academic organizations, as well as state and federal agencies. For further information, please write or call Local Committee officers listed on the opposite page or

Annual Meeting Manager  
Geological Society of America  
3300 Penrose Place  
Boulder, Colorado 80301.



# Announcements and Call for Papers

## South-Central

Rice University  
Houston, Texas  
February 26-27, 1976

**ABSTRACT DEADLINE: October 10, 1975**

Please submit completed abstracts to  
John A. S. Adams, *Program Committee Chairman*  
Department of Geology  
Rice University  
P.O. Box 1892  
Houston, Texas 77001  
(713) 528-4141, ext. 443

## Northeastern

Stouffer's National Center Inn  
Arlington, Virginia  
March 25-27, 1976

**ABSTRACT DEADLINE: November 3, 1975**

Please submit completed abstracts to  
Norman L. Hatch, Jr., *Local Committee Chairman*  
U.S. Geological Survey  
926-A National Center  
Reston, Virginia 22092  
(703) 860-6404  
*This will be a joint meeting with the Southeastern Section.*

## Southeastern

Stouffer's National Center Inn  
Arlington, Virginia  
March 25-27, 1976

**ABSTRACT DEADLINE: November 3, 1975**

Please submit completed abstracts to  
Michael W. Higgins, *Local Committee Chairman*  
U.S. Geological Survey  
928 National Center  
Reston, Virginia 22092  
(703) 860-6503  
*This will be a joint meeting with the Northeastern Section.*

## Cordilleran

Washington State University  
Pullman, Washington  
April 5-7, 1976

**ABSTRACT DEADLINE: November 3, 1975**

Please submit completed abstracts to  
J. W. Mills, *Program Committee Chairman*  
Department of Geology  
Washington State University  
Pullman, Washington 99163  
(509) 335-3009

## North-Central

Western Michigan University  
Kalamazoo, Michigan  
April 28-May 1, 1976

**ABSTRACT DEADLINE: December 15, 1975**

Please submit completed abstracts to  
W. Thomas Straw, *Program Committee Chairman*  
Department of Geology  
Western Michigan University  
Kalamazoo, Michigan 49001  
(616) 383-1775

## Rocky Mountain

University of New Mexico  
Albuquerque, New Mexico  
Technical Sessions: May 20-21, 1976  
Field Trips: May 19, 22-23, 1976

**ABSTRACT DEADLINE: December 29, 1975**

Please submit completed abstracts to  
Lee A. Woodward, *Local Committee Chairman*  
Department of Geology  
University of New Mexico  
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# Reviews

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## EARTH SCIENCE IN THE PUBLIC SERVICE USGS Professional Paper 921 / Washington, D.C., 1974, 73 pages, \$2.15

Professional Paper No. 1 was published in 1902. In the years since, more than 900 have been issued on subjects as diverse as Data of Geochemistry, Larger Foraminifera of the Palau Islands, Lignite of North Dakota, Forests of Oregon, Origin of Colemanite, Principles of Underfit Streams, Crystallization History of Lunar Basalt. Yet, for all this apparent diversity, these papers have had a common denominator—virtually all are by Survey authors and each contributes to the sum of geological knowledge. PP 921, "Earth Science in the Public Service," stands unique among its 920 predecessors in that not one of the 15 papers is by a Survey author, nor does it report any field, laboratory, or theoretical investigations, or advances in knowledge; nevertheless it does, in more subtle and sophisticated ways, advance the cause of geology.

PP 921 brings together papers presented during the dedication ceremonies, in July 1974, for the new USGS headquarters (the John Wesley Powell Building) in Reston, Virginia. Essentially, it reports a symposium on "Earth Science in Public Service." The contributions, as listed on the cover, are from Canada Department of Energy, Mines and Resources [Charles H. Smith], Council on Environmental Quality, Executive Office of the President [Beatrice E. Willard]; Dartmouth College, Department of Earth Sciences [Charles L. Drake]; Environmental Research Institute of Michigan [George J. Zissis]; Illinois State Geological Survey [John C. Frye]; Johns Hopkins University, Department of Geography and Environmental Engineering [M. Gordon Wolman]; Massachusetts Institute of Technology, Department of Earth and Planetary Sciences [Frank Press]; Office of Senator Paul J. Fannin [Joseph S. Jenckes]; Pennsylvania State University, Department of Mineral Economics [John D. Ridge]; Resources for the Future, Inc. [Joseph L. Fisher]; Syracuse University, Department of Geology [Daniel F. Merriam]; U.S. Department of Commerce, National Oceanographic and Atmospheric Administration [Robert M. White]; U.S. Department of the Interior: Assistant Secretary for Fish and Wildlife and Parks [Nathaniel P. Reed], and Geological Survey [V. E. McKelvey]; University of Oklahoma, Science and Public Policy Program [Don E. Kash]; Virginia Division of Mineral Resources [James L. Calver].

These constitute a somewhat curious miscellany. It gives an impression of a symposium perhaps put together rather hastily from the readiest and nearest sources—an impression that is in no way dispelled by one speaker who comments that "I first knew about this symposium a couple of days ago . . .". Yet at the same time some contributions have obviously been

thoughtfully prepared and documented. Dan Merriam's 7-page article, for example, cites 49 references. Two-thirds of the papers include no citations. Most of the papers are short—the majority are around 3,000 words. The longest (Wolman's) is nearly 6,000 words; the shortest (Jenckes'), less than 1,800. Surprisingly, in view of Powell's notable contributions to and concerns for the land "West of the 100th Meridian," and in a symposium dedicating a building in his honor, there is nothing from the Rocky Mountain region, the Pacific Coast states, Alaska, or Hawaii—regions from which have come so many contributions to the advancement of geology. But if these comments are viewed by any as "bad news" (they are not so intended!), then here is "the good news."

PP 921 contains much that will warm the hearts of all geologists; that will stimulate ideas for improved applications of the science; and that will provide food for thought for legislators and other public servants. Following brief welcoming remarks by Vincent McKelvey, Director of the USGS, Charles Smith of Canada presents the lead-off paper. In it he includes a paragraph to which anyone who has participated in the vicissitudes and triumphs of the AGI or any geologist "seeking identity" will respond with a rousing cheer. He says: "It is unfortunately necessary to remind the uninitiated continually that geology means the 'study of the earth'; it is a respected name with a long and honorable history and is not a specialized subdivision of the term 'earth sciences.' Geology is an integrating science, created directly from man's observation of natural phenomena and his effort to understand them and make use of them, and it is based upon many basic sciences and common sense." Smith goes on to emphasize, as do many of the following speakers, the need for basic data, the need for making such information available before decisions are required, and the need for continued maintenance and improvement of data. Joseph Fisher, in the following paper, addresses the energy problem, pointing to the key role of geology, and raising the question as to whether we should have "open information regarding energy—or privilege and secrecy." John Ridge, as do others, cites the pioneering study of Griffiths on the benefits that could accrue from a systematic drilling program on a continent-wide basis. Gordon Wolman, in reviewing the history of water policy, pays tribute to Powell's plans for the arid lands of the west, noting that "vision and public interest coincide for only a brief moment." Wolman goes on to discuss not only quantity but also quality of water, bringing in global considerations, and decrying the lack of data, particu-

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larly in the development of energy resources. He concludes that *"The ability to take advantage of the political moment, or the awakened public consciousness, by virtue of a disaster or an election may determine the extent to which these fleeting moments of interest are well used in the slow business of improving the ability of the public and its representatives to make wise decisions about the future."*

Beatrice Willard, although hers is one of the shortest papers, nevertheless demonstrates the breadth and the depth of thinking within the Council on Environmental Quality. She emphasizes, among other things, the need to recognize functional limits, carrying capacity, and stress points in the environment, as well as the importance of geologic data in seeking to achieve a balance between population and resource use. Don Kash, in one of the most thoughtful and at the same time most provocative papers, points out that "value preferences have nonrational and non-empirical roots and generally cannot be changed by facts or more information." He urges a change in the traditional adversary relationship between government and industry. All parties now need to recognize that resource information should be a public commodity—needed because "planning, resource allocation, and follow-on regulation are inseparable elements."

Daniel Merriam provides a masterly summary of the several methods of resource-data storage and retrieval currently in use by various government agencies, followed by a stimulating discussion on the "Philosophy of Search." James Calver, president of the Association of American State Geologists, whose state in recent years has been one of the most successful in cooperating with the USGS toward completion of its topographic atlas, offers some constructive criticism aiming at still better products. For example, all boundaries of public use areas (such as National Forests) should be more clearly identified. Charles Drake, who has chaired the Geodynamics Project for the United States, presents a succinct summary of that far-reaching effort in international cooperation. He notes that almost 200 years ago Benjamin Franklin had "anticipated the Geodynamics Project and the plate-tectonics model that has caused a revolution in geologic thought during the last decade." George Zissis also emphasizes the importance of international cooperation in his paper on remote-sensing and its promise for resource assessment on a global basis, while raising the question of how resources should be shared. The world's wealth, he cogently argues, "is the world itself." Robert White has some amusing, some pessimistic, some encouraging, some discouraging comment on inter-agency coordination while including critical and constructive thoughts on the procedures involved. He concludes that inter-agency coordination is something like marriage, "it is, in fact, a phenomenon more enduring than a great

many marriages. It will be with us until death us do part. There is no alternative but to make it work." "Amen," responds this reviewer.

John Frye, in his discussion of land use, gets help from Willa Cather in illustrating the striking contrast in attitudes toward and use of the land on the part of the Indian and of the white man. He pleads for multiple-sequential use of the land and states that *"We can no longer afford whimsical or emotional decisions, or decisions based on vicious self-interest. Earth scientists must use all the developing and advanced technology available to furnish our public administrators with the needed data. In turn, governmental bodies must support the acquisition of the needed data—at Federal, State, and local levels—by encouragement and funding, and they must heed the data available to them in their formulation of public policies."* At this point, Joseph Jenckes, on behalf of Governor Williams of Arizona, presented a plaque and paid tribute to Major Powell's far-sighted efforts in the then Territory of Arizona. Next, Nathaniel Reed takes a hard look into the problems of interdisciplinary approach, noting that "the real crises of overpopulation and overconsumption of finite materials, of food, and of declining energy reserves will be with us from now on. If light is to penetrate the darkness, if change is going to occur speedily to keep us on an even keel, then some old dogs must learn new tricks."

By now the reader may have noticed that the sequence of presentations has followed a more logical order than the alphabetic-by-institution list of contributors on the cover of PP 921. Thus, although Canada provided the lead-off in both sequences, Frank Press of MIT is the anchor-man in the symposium—most appropriately, since his topic of hazards-reduction is uppermost today in the minds of so many, and since the phenomena concerned have done so much to unite the interests of geologists with those of John Q. Citizen. Press outlines a well-considered program; then asks some searching questions: "How does one sell preventive medicine for a future affliction to agencies beleaguered with current illnesses?" And, "Does anyone doubt that we would have a program similar to the one I have described after the next magnitude 8 earthquake in a western State?" Such questions, perhaps for the present, can only be answered by asking another (it was the title of a talk given a few years ago by Preston Cloud before the Cordilleran Section, GSA): "Is there intelligent life on earth?"

Anyone who reads PP 921 will have a basis for a somewhat optimistic answer to that last question. What the United States—and the world—need, therefore, are more people to read and heed PP 921!

Ian Campbell  
California Academy of Sciences  
San Francisco, California

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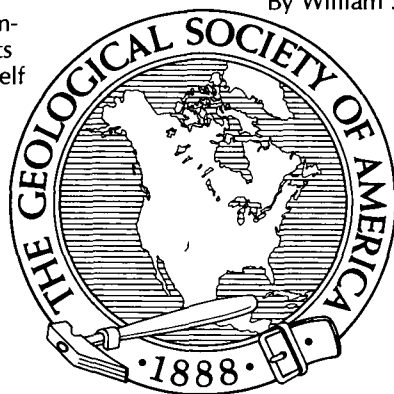
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# May BULLETIN briefs

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□ 50501—Channels on Mars. Robert P. Sharp, Michael C. Malin, Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91109. (17 p., 23 figs., 2 tbls.)

By showing that parts of equatorial and mid-latitude Mars have a variety of channels and channel-like forms, Mariner 9 photographs provide a basis for speculations concerning surface processes, crustal events, climatological environment, and evolutionary history.

Some large outflow channels display characteristics suggesting scour and plucking by torrential floods similar to the Spokane and Bonneville events of western United States. Other channels with dendritic tributaries suggest runoff fed by seepage and headward growth and enlargement by sapping.

Some Martian channels and channel-like forms were probably created or initiated by endogenic processes such as faulting, subsidence, volcanism, fracturing, and crustal extension; others may be due to wind or lava erosion, but the features and relationships of many channels are best accounted for by fluvial action.

Reconciliation of fluvial erosion and the current hostile Martian environment may be possible if the channels are as old as 3 b.y. Such an age is suggested by recent re-evaluations of meteoroidal flux impacting Mars, Moon, and Earth and the chronology of lunar maria. A residual

primitive atmosphere possibly congenial to running water on Mars may have permitted fluvial erosion 3 to 3.5 b.y. ago. Haphazard scattering of channels and the likelihood of seepage and sapping suggest that water was supplied to the Martian surface from the lithosphere, not the atmosphere.

□ 50502—Quaternary Sedimentation on the Amazon Continental Margin: A Model. John D. Milliman, Colin P. Summerhayes, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543, Henyo T. Barretto, Petroleo Brasileiro S. A. (PETROBRAS), Rio de Janeiro, Brasil. (5 p., 5 figs.)

Sedimentation on the Amazon continental margin occurred in two distinct patterns during the Quaternary Period. During interglacials, when sea level was high, most of the sediment contributed by the Amazon River was deposited near the river mouth, then transported northwest along the innermost shelf by longshore currents. Apparently, little Amazon sediment escaped the nearshore environment. As sea level fell in response to glacial advance, the sedimentation pattern remained roughly similar, resulting in construction of an extensive prograding shoreline. Once the sea fell more than -60 to -80 m relative to present sea level, however, most Amazon sediment was channeled directly to the deep sea. Shoreline accretion stopped, but prograded sediments were preserved as a mud wedge that presently occupies the inner shelf seaward of the Amazon River.

The accumulation of large quantities of arkosic sands throughout the western Equatorial Atlantic deep sea during Pleistocene glacial epochs appears to have been derived mostly from the Andes Mountains via the Amazon River.

□ 50503—Zeolitic Diagenesis in Oligocene Volcanic Sediments, Trans-Pecos Texas. Anthony W. Walton, Department of Geology, Vanderbilt University, Nashville, Tennessee 37235. (10 p., 6 figs., 3 tbls.)

Volcanic sedimentary rocks of the Vieja Group of Trans-Pecos Texas contain zeolite, montmorillonite, and silica minerals that formed during diagenesis in an open hydrologic system. Volcanic glass shards dissolved in ground water to provide constituents for authigenic minerals. Diagenetic mineral zones, from top to bottom, are (1) montmorillonite-opal-glass, (2a) montmorillonite-opal-clinoptilolite, (2b) montmorillonite-quartz-clinoptilolite, (3a) montmorillonite-quartz-analcime, and (3b) analcime quartz. During diagenesis, the original vitroclastic texture of volcanic sediment was preserved. Montmorillonite formed coatings on glass shards that preserved their outline during replacement by clinoptilolite. Clay or clinoptilolite cement fill much of the remaining intergranular space. Analcime replaced both pseudomorphs of shards and interstitial cement that first formed as clinoptilolite. All authigenic minerals formed at low temperature and low pressure at burial depths no greater than a few hundred meters. Rocks in each zone were buried less deeply, and boundaries between zones are stratigraphically higher in the northeastern than in the southwestern part of the area. Distribution of clinoptilolite and analcime was controlled locally by permeability of the host rocks. Diagenesis converted sediment with an original composition similar to that of rhyolite into rock composed of Na<sub>2</sub>O, CaO, Al<sub>2</sub>O<sub>3</sub>, and SiO<sub>2</sub>, but relatively depleted in K<sub>2</sub>O. Field evidence shows that diagenesis occurred in early Oligocene time, but zeolite minerals began to form only after a critical thickness of a few hundred meters of sediment had accumulated.

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50504—Rome and Coosa Faults in Northwest Georgia. *Thomas L. Kesler, P.O. Box 308, Rome, Georgia 30161.* (7 p., 4 figs., 1 tbl.)

The geologic structure of northwest Georgia lacks the longitudinal regularity of that in east Tennessee. The main elements in this difference in structural style are the Rome and Coosa thrust faults and associated folds. The Rome thrust plane has been folded near Rome, Georgia; farther northeast, the fault straightens and merges with the Beaver Valley thrust of east Tennessee.

Southeast of the sinuous trace of the Rome, the Coosa fault trends northeast to Resaca, Georgia, overlapping the south-trending thrust formed by merging of the Saltville and Knoxville faults. From Resaca, the Coosa trends northeastward along a topographic lineament, truncating the north end of a broad synclinal structure in which occurs the northwest-trending Folsom fault. Northeast of the truncation of the syncline, the Coosa fault merges with the Camp Ground fault, which has cut off the east limb of the Chatsworth syncline and is interpreted to merge with the Great Smoky fault.

50505—Correlation of Finite Strain from Both Reduction Bodies and Preferred Orientation of Mica in Slate from Wales. *Terry E. Tullis, Department of Geology and Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California 90024* (Present address: *Department of Geological Sciences, Brown University, Providence, Rhode Island 02912*), *Dennis S. Wood, Department of Geology, University of Illinois, Urbana, Illinois 61801.* (7 p., 7 figs.)

Finite strain measurements obtained from formerly spherical natural strain indicators in slate are compared to the degree of preferred orientation of mica, as revealed by x-ray pole figure goniometry. The pole figures obtained for (002) are

elongated point maxima normal to the slaty cleavage; the short axes of these elongate maxima trend toward the direction of the linear "grain" in the plane of cleavage. The deformation ellipsoid has its shortest axis precisely perpendicular to the cleavage and its longest axis parallel to the linear grain in the cleavage. The geometric relations are consistent with a model proposed by March that assumes passive rotation of tabular markers and thereby allows strains to be predicted from observed preferred orientations and vice versa. The measured deformation ellipsoids reveal a compressional strain across the plane of cleavage of 63 percent, 66 percent, and 68 percent. The corresponding concentrations of poles to (002) predicted by the March model from these strains are 20.6, 25.6, and 31.6 times uniform, respectively, whereas pole concentrations of 16.3, 17.9, and 18.3 times uniform were measured. Hence the measured strains are more than adequate to account for the formation of the observed preferred orientations by a mechanism of rotation. Quantitative preferred orientation studies may enable both the magnitudes and directions of the principal finite strains to be estimated in deformed micaceous rocks that do not contain independent indicators of strain.

50506—Development of Chemical Remanent Magnetization during Early Stages of Red-Bed Formation in Late Cenozoic Sediments, Baja California. *Edwin E. Larson, Theodore R. Walker, Department of Geological Sciences, University of Colorado, Boulder, Colorado 80302.* (12 p., 17 figs.)

Petrographic, rock magnetic, and paleomagnetic studies of fine-grained red sediments of late Cenozoic age in Baja

California show that the sediments have variably acquired chemical remanent magnetization (CRM) overprints that have obscured the original magnetization. The chemical remanence is carried predominantly by hematite, goethite, and a Mn-Ba compound, herein called "hydropsilomelane" — that occur as pigments and as concretions. Remanence directions generally associated with each mineral are goethite, reverse; hydropsilomelane, normal; and hematite, normal of reverse. Some samples possess a remanence that is strong and normal or strong and reverse; these generally contain only one of the authigenic minerals in abundance. Many samples, however, are weak in intensity and random in direction. When such samples are split into parts and measured, it is generally found that each part is strongly magnetized but that some parts are normal and others are reverse in direction. In such cases, the magnetization of the whole sample is resultant of the multiple components that are generally carried by two or more of the authigenic minerals.

The following conclusions can be drawn concerning the acquisition of CRM in the Baja California deposits. (1) The sediments contain chemically unstable iron- and manganese-bearing minerals, such as hornblende and biotite, that are susceptible to postdepositional alteration, and they have provided the parent material for the authigenic magnetic minerals. (2) Authigenic magnetic minerals, growing from

# May BULLETIN briefs

crystallites, generally acquired a remanence that was parallel to the Earth's field when they surpassed the critical grain size. (3) The rate of CRM acquisition has not been uniform in these sediments, probably because the processes of alteration and formation of authigenic magnetic minerals depend on an interplay of highly variable factors such as the chemistry of the interstitial water, hydraulic gradients, and mineralogy of the sediments. (4) Complex variability in acquisition of CRM has led to a remanence stratigraphy that bears little discernible correlation with the geomagnetic field at the time of deposition.

□ 50507—Sediments and Structure of the Japan Sea. *William J. Ludwig, Robert E. Houtz, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964, Sadanori Murachi, National Science Museum, Ueno Park, Tokyo, Japan.* (14 p., 9 figs., 1 tbl.)

Seismic reflection (profiler) traverses of the Japan Basin, Yamato Basin, and intervening Yamato Ridge reveal horizontally stratified sediments over weakly stratified sediments. In each basin, the sediments decrease in thickness outward from a center.

Wide-angle reflection and refraction data from 65 sonobuoy stations give velocities in the sediments that range from 1.6 to 3.2 km/sec. Smooth oceanic basement has two refracting layers, 3.5

and 5.8 km/sec; rough oceanic basement is typified by the 5.8 km/sec velocity alone.

The Japan Basin and Yamato Basin are underlain by oceanic crust which in turn is covered by sediments (and volcanics?) that have built a shallower sea floor than that in the western North Pacific basin. Yamato Ridge appears to be mainly a pile of volcanics resting on an oceanic layer at normal depth. The crust of Yamato Basin may also have been modified to the extent that it has a thicker than normal layer 3 and a low-velocity mantle.

□ 50508—Comparative Anatomy of Marine and Freshwater Algal Reefs, Bermuda and Central New York. *Walter E. Dean, Department of Geology, Syracuse University, Syracuse, New York 13210, Jane R. Eggleston, Department of Geology, Syracuse University, Syracuse, New York 13210 (Present Address: West Virginia Geological Survey, Box 879, Morgantown, West Virginia 26505).* (12 p., 20 figs., 5 tbls.)

The cup reefs of Bermuda and the reefs of Green Lake, Fayetteville, New York, and other central New York lakes are similar in form and growth pattern. Algae are major contributors to growth.

The cup reefs grow near the margin of the Bermuda platform and rise 2 to 10 m from a coral floor to the intertidal zone. They are composed principally of encrusting calcareous red (coralline) algae and colonial vermetid gastropods. The material composing the reefs is primarily high-Mg calcite with lesser amounts of aragonite.

The algal reefs in Green Lake grow as lobate, overhanging ledges that protrude 2 to 8 m into the lake. The ledges extend from lake level to a depth of approximately 12 m. These reefs are composed of low-Mg calcite algal sediment and cement.

In Green Lake, the main sediment producer is the calcareous alga *Chara*, which is analogous to the calcareous alga *Liagora valida* on the cup reefs. In the quiet waters of Green Lake, surface growth of the reef occurs by trapping and binding of sediment by blue-green algae and mosses, and later cementation is by precipitated calcium carbonate. In the cup reefs, trapping and binding is primarily confined to protected cavities, and surface growth in the agitated water is mainly by encrusting calcareous algae. In both environments, cementation continues inside cavities by precipitation of calcium carbonate.

□ 50509—Chino Valley Formation (Cambrian?) in Northwestern Arizona. *Richard Hereford, U.S. Geological Survey, Center of Astrogeology, 601 East Cedar Avenue, Flagstaff, Arizona 86001.* (6 p., 4 figs., 3 tbls.)

A thin persistent unit (maximum thickness 13 m) of probably Cambrian age in the Chino Valley region consists of three laterally equivalent, mutually exclusive lithofacies. These are, from west to east, lithic sandstone, pebble to boulder conglomerate, and dolomite. The unit, named the Chino Valley Formation, is younger than middle Middle Cambrian and older than Devonian in age. A Late Cambrian age is probable, although no fossil evidence supports this conclusion.

The lithic sandstone and conglomerate facies were derived from two apparently active source areas and were probably deposited in shallow marine water. Uplift to the south or southwest of the area almost reversed the regionally westward-dipping Cambrian paleoslope and exposed sedimentary rocks to erosion. Sediment derived from this terrain formed the lithic sandstone facies. Synchronous movement initiated erosion of the Mazatzal Quartzite (Precambrian) from which the conglomerate facies was derived. The dolomite facies is inferred to have accumulated on a mud flat in the supratidal zone.

□ 50510—Magnetic and Petrologic Variations along the Galapagos Spreading Center and Their Relation to the Galapagos Melting Anomaly. Roger N. Anderson, *Marine Physical Laboratory of the Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California 92037* (Present address: Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964), David A. Clague, *Geological Research Division, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California 92037* (U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025), Kim D. Klitgord, *Marine Physical Laboratory of the Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California 92037*, Monte Marshall, *U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025*, Richard K. Nishimori, *Geological Research Division, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California 92037*. (12 p., 10 figs., 3 tbls.)

Magnetic anomalies with unusually large amplitudes are found along the Galapagos spreading center near the Galapagos Islands from long. 85° to 95° W. On either end of the Galapagos spreading center, however, normal amplitudes occur. Modeling of these magnetic anomalies, which were measured by both surface and deep-tow methods, indicates that the amplitude differences are probably caused by variations in the magnetic intensity of the rocks in the area. Tholeiitic basalt samples that were recovered from the ridge crests involved showed the expected variation in magnetic intensity.

Basalt samples from the ridge crests with normal-amplitude anomalies contained 9 percent total Fe (calculated as FeO) and 1 percent TiO<sub>2</sub>, whereas basalt samples from the ridge crests with large-magnetic amplitude contained 14 percent total Fe and 2 percent TiO<sub>2</sub>. Variations in MgO, CaO, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, and Al<sub>2</sub>O<sub>3</sub>, as well as in FeO and TiO<sub>2</sub>, are consistent with the theory of Fe enrichment by fractional crystallization as a mechanism for the formation along ridge crests of tholeiite with high magnetic intensity. This phenomenon may be related to the proximity of those ridge segments with large magnetic amplitudes to the Galapagos melting anomaly.

Furthermore, the transition from large magnetic amplitudes at the ridge crest near the Galapagos Islands to normal magnetic amplitudes on the flanks suggests that the Galapagos melting anomaly may have formed 3 to 4 m. y. ago.

□ 50511—Interaction of Meteoric Water with Magma: An Oxygen-Isotope Study of Ash-Flow Sheets from Southern Nevada. Peter W. Lipman, Irving Friedman, *U.S. Geological Survey, Federal Center, Denver, Colorado 80225*. (8 p., 4 figs., 4 tbls.)

Glassy rocks from compositionally zoned ash-flow sheets and cogenetic lava flows, erupted from the late Miocene Timber Mountain-Oasis Valley caldera complex, show systematic oxygen-isotope variations among all major phenocryst phases: quartz, sanidine, plagioclase, biotite, augite, and magnetite. Oxygen isotope compositions of each phenocryst phase become lighter in O<sup>18</sup> with decreasing age and are interpreted as indicating major interaction between meteoric ground water and batholithic-sized bodies of silicic magma prior to eruption. Each of the ash-flow sheets is compositionally zoned from silicic and phenocryst-poor at the base of more mafic and phenocryst-rich at the top; this pattern represents in inverse order the original compositional zonation in the magma chamber. The changing isotopic fractionations between phenocrysts also reflect crystallization temperatures that varied vertically over several kilometers in the differentiated magma. Posteruption oxidation and cooling effects have not significantly modified oxygen-isotope compositions of phenocrysts from glassy rocks.

□ 50512—Dasht-e Ba'ayaz Fault, Iran: Earthquake and Earlier Related Structures in Bed Rock. J. S. Tchalenko, *Department of Civil Engineering, Imperial College, London SW7 2AZ, England*, M. Berberian, *Geological Survey of Iran, P.O. Box 1964, Tehran, Iran*. (7 p., 10 figs.)

An 18-km long segment of bed rock of the Dasht-e Ba'ayaz earthquake fault was studied in detail to define the 1968 earthquake-related and earlier tectonic deformations. Ground displacements that accompanied the earthquake coincided precisely with the pre-existing east-trending fault trace. Maximum components of offset were 4 m left lateral and 1 m south side relatively down. The bedrock displacement occurred along new tension fractures that strike on average at 50°, as well as along reactivated pre-existing structures. Earlier tectonic deformation also produced tension fractures (post-Pliocene), conjugate shears (Pliocene), and tension joints (pre-Pliocene), and are all consistent with 47° to 55° tectonic

compression. The study covered three points: (1) the 40° to 45° angle measured between the major principal stress direction indicated by the earthquake fractures and the fault; (2) the apparent constancy of the stress field direction during the three early phases and the 1968 deformation; and (3) the "gap" and "anti-Riedel" structure shown by the overall fault trace, which, we suggest, are characteristic of situations of kinematic restraint and are associated with a nonuniformly propagating rupture.

□ 50513—Caledonian Nappe Sequence of Finnmark, Northern Norway, and the Timing of Orogenic Deformation and Metamorphism. B. A. Sturt, *Geologisk Institutt, avd. A, Joachim Friesesgt. 1, Bergen, Norway*, I. R. Pringle, *Department of Geophysics, Madingley Road, Cambridge, England*, D. Roberts, *Norges Geologiske Undersøkelse, Postboks 3006, Trondheim, Norway*. (9 p., 1 fig., 2 tbls.)

On the basis of regional, structural, and metamorphic studies combined with age determinations, it is demonstrated that the internal metamorphic fabrics of the main nappe sequence of Finnmark, northern Norway, developed during an Early Ordovician phase of the Caledonian orogeny (Grampian?); the cleavage development in the autochthon also belongs to this phase. The final mise-en-place of the thrust-nappe sequence, however, appears to belong to a later phase of Caledonian orogenic development, probably toward the end of the Silurian Period, as does the deformation and metamorphism of the Silurian sequence of Magerøy. The geochronological results also give information regarding the positioning of the lower boundaries to the Cambrian and Ordovician Systems.

□ 50514—Plate Tectonics and the Evolution of the Alpine System: Discussion and Reply.

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Reply: John F. Dewey, *Department of Geological Sciences, State University of New York, Albany, New York 12222*, W. C. Pitman III, W.B.F. Ryan, *Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964*, J. Bonnin, *Institut d'Astronomie et Geophysique, Meudon, Paris, France*.