



GSA news & information

SUPPLEMENT TO GEOLOGY MAGAZINE

POSSIBLE NEW DUES OPTIONS

The Council needs your opinion on which of the dues options described on the next page you would prefer for 1976. A response box is provided for your convenience in replying.

Immediately following the announcement of the abrupt change in the dues structure last fall, many members wrote to the officers with suggestions, a prominent one being that additional options should be offered so that individual members could, in effect, "write their own tickets" as to what they would receive from the Society. As a result of these suggestions, the Council instructed the staff to make a study of possible additional options and their approximate costs to the individual. The following outlines a series of possible dues and publications packages. It is urgently requested that every member study these carefully and make his or her wishes known for the guidance of the Council at its May meeting. For your convenience in responding, there is a check-list box at the end of this discussion that can be marked, torn out, and mailed to headquarters. Letters with full discussion are welcome also, from those who wish to spend some extra time.

As background to the following discussions, a brief review of the financial position of the Society is in order, even though it will be repetitious to many of you. During several previous years, the Society had been spending income from the endowment at a rate in excess of 2/3 million dollars per year. This income was derived from dividends, interest, and capital gains, and served to subsidize reduced dues for Student Associates, cover costs of research grants, subsidize by approximately \$20 per year the distribution of publications to individual members, and provide funds for new and needed programs initiated by Council action, such as the employment interview and information service. Unfortunately, two opposing trends took sharp turns during 1974. Everyone is aware of the increased inflating cost of almost everything (cost of paper increased at an even faster rate). Most are also aware of the sharp downward movement in the stock market during the year. This latter trend placed the investment portfolio of the Society's endowment in a capital-loss position and therefore precluded income from capital gains. By the terms

of the Penrose bequest, the corpus of the endowment cannot be invaded. During the same year, the income from interest and dividends also declined a small amount. It was this combination of circumstances that demanded sudden action during the fall of 1974. Looking toward the future, inflation is expected to continue and there will probably be no appreciable recovery in income from the endowment.

In constructing the following possible dues options, it has been assumed that income from the endowment will continue to be adequate to subsidize the greatly reduced rates for students, provide for research grants, cover the set-up costs of the employment service, the headquarters overhead costs of Penrose conferences (but no direct costs), and cover at least part of the cost of the Council and committees. However, they do not provide for subsidy of publications to Fellows and Members, who would be paying at cost for the preparation, publication, and distribution of the items they receive.

It should be remembered that there are certain basic costs of membership that are essentially fixed and are not related to the volume of publications received. These basic costs include processing of membership files and dues statements, ballots, the Society's per-member dues to AGI, external auditing, and the portion of headquarters overhead not chargeable to publications and other specific programs.

One more point should be mentioned. In the suggestions from the membership to the officers, a recurring item was the desire for an option that excluded *Geology* magazine, and also a desire for a package deal on the five section *Abstracts with Programs* volumes. Possibilities in both directions are included.

The only membership preference poll available so far is the response to the two options on the 1975 dues statement. At the time of writing, with more than 1/2 of the membership heard from, the choice for 1975 is running slightly more than 50% among Fellows and Members for the high option, and among students more than 60% for the high option.

OPTION A

Basic membership in the Society. This option would provide for monthly mailing of the news and information section you are now reading (without *Geology* magazine and without separates from the *Bulletin*). Ballots and any other mailings to the entire membership would be received.
Tentatively priced at \$18 per year.

OPTION B

Monthly mailing of the news and information section, without *Geology* magazine but with the privilege of ordering 24 separate articles per year from the *Bulletin*, with *Abstracts with Programs* for the national meeting and for one section of your choice. Ballots and any other mailings to the entire membership would be received.
Tentatively priced at \$28 per year.

OPTION C

(Much the same as the low option for 1975.) Monthly mailing of *Geology* magazine with the news and information section, with the privilege of ordering up to 36 separate articles from the *Bulletin* during the year, with *Abstracts with Programs* for the national meeting and for one section of your choice. Ballots and any other mailings to the entire membership would be received.
Tentatively priced at \$34 per year.

OPTION D

Monthly mailing of the news and information section (without *Geology* magazine); with all 12 issues of the *Bulletin*, with *Abstracts with Programs* for the national meeting and for one section of your choice. Ballots and any other mailings to the entire membership would be received.
Tentatively priced at \$44 per year.

OPTION E

(Much the same as the high option for 1975.) Monthly mailing of *Geology* magazine with the news and information section, with all 12 issues of the *Bulletin*, with *Abstracts with Programs* for the national meeting and for one section of your choice. Ballots and any other mailings to the entire membership would be received.
Tentatively priced at \$49 per year.

SUPPLEMENTAL OPTION F

Available to any member selecting Options B through E. A package order of the five *Abstracts with Programs* for sections not included with the general option, at 70 percent of the list price for the group of five.

SUPPLEMENTAL OPTION G

The *Yearbook*, containing the complete membership list, constitution and bylaws, division affiliates, officers, and committee membership.
Tentatively priced at \$3.

Optional membership in any of the Society's divisions can, of course, be added to any of the options listed above. **STUDENTS.** Dues for Student Associates in Options A through E would be priced at 60 percent of the regular dues for Fellows and Members.

BOOK PUBLICATIONS. As usual, one copy of all books and maps published by the Society will be available to all members at a 20-percent discount.

Please give us your opinions for guidance at the May Council meeting as soon as possible, either by returning the box below or by a more explanatory letter.

PLEASE CUT OUT AND MAIL TO HEADQUARTERS BEFORE THE END OF APRIL.

DUES OPTION PREFERENCE

The options that will be offered will be determined by the Council, and will depend in part on the response to this questionnaire.

Please check the option, based on the above descriptions, which you would most likely select if they were all available.

A B C D E

Would you likely subscribe to Supplemental Option F? Yes No

Would you likely subscribe to Supplemental Option G? Yes No

I am a Fellow Member Student

Name (optional) _____

THIS IS NOT A COMMITMENT TO SUBSCRIBE
NOR A COMMITMENT FOR GSA TO OFFER THESE EXACT PRICES.

Publications

Papers on environmental monitoring sought for *Geology*

Environmental monitoring is the means of measuring how much, and how rapidly, our physical environment is being changed. The Committee on Environment and Public Policy has responded to a quickened interest in environmental monitoring by inviting short papers on this theme for publication in *Geology*. These papers provide examples of easy ways to monitor environmental changes in a variety of landscapes. By now, four kinds of monitoring have been described in *Geology*: Impact of Mining Gravel from Urban Stream Beds in the Southwestern United States (v. 2, p. 171-174); Channel Changes (v. 2, p. 271-272); Monitoring the Coastal Environment (v. 2, p. 385-388); and Reoccupying Unmarked Camera Stations for Geological Observations (v. 2, p. 469-471). Quite obviously, the list of additional topics on monitoring, each appropriate to a set of geologic processes or a circumstance of man's involvement with nature, is very large. For example, as mentioned at the outset of this series of papers, procedures are needed "to document the collapse of bluffs, shifting shorelines, wind erosion, pollutants in water supplies, heights of floods, and losses in the aesthetic worth of landscapes," among many other kinds of geologic change. Further contributions on the general theme of environmental monitoring are invited and encouraged. These may be sent to Harold E. Malde, U.S. Geological Survey, Federal Center, Denver, Colorado 80225, who is acting as general editor of this series. When a representative group of papers on environmental monitoring has been published, reprinting of these papers together in a handy workbook may be possible. Meanwhile, as the individual papers become available in the pages of *Geology*, the Committee on Environment and Public Policy hopes that such examples of environmental monitoring will be increasingly applied. In this way, a growing body of useful environmental data would soon become available.

Science editor sought

The Geological Society of America is seeking candidates for science editor for the Society to commence work about January 1, 1976. Bennie Troxel, science editor since July 1971, is resigning effective that date so that he can continue his geologic research and other interests.

Applications and inquiries should be directed to the executive director, John C. Frye, at the Geological Society of America, 3300 Penrose Place, Boulder, Colorado 80301. Confidentiality of inquiries is assured.

Members' book orders, a reminder

All GSA members are reminded to consult their October 1, 1974, price increase flyers when sending in any book orders. If you did not receive a flyer, they are available upon request from the Publication Sales Department of GSA.

All members in good standing may purchase Society publications at a discount of 20 percent from our listed prices. Please note it is up to the individual to take his or her 20 percent discount before sending checks or money orders. These discounts are subject to the following conditions: (1) Only one copy of any title may be purchased at the 20-percent discount. Extra copies may be purchased at list price. (2) The discount privilege is not transferable; all orders must be placed by members on their stationery or on GSA order forms. (3) The 20 percent member discount applies only to GSA's own publications, not to other publishers' works which we may offer for sale. (4) The 20 percent discount applies only to GSA's books and maps; it does not apply to periodicals (*Bulletin*, *Bibliography*, *Abstracts*, and *Geology*).

If your *Bulletin* is damaged in the mail . . .

Future issues of the *Bulletin* will be mailed without wrappers (unless they contain a foldout illustration) to all recipients in the United States and Canada. Should you receive a damaged copy, please tear off the cover that contains the mailing label and sent it to Membership Department, Geological Society of America, 3300 Penrose Place, Boulder, Colorado 80301, together with a brief note regarding the type of damage. A replacement copy will be sent to you immediately.

Recipients of damaged copies of *Geology* should do the same.

Authors asked to heed manuscript requirements

Authors of papers submitted to GSA for consideration for publication are reminded to heed GSA style requirements closely. Be sure that manuscripts are neat, with adequate margins, and that references and all typewritten material (quoted information, footnotes, figure captions, abstracts) are typed double spaced. Because illegible copies of photographs cannot be reviewed, the manuscript will not be sent out for review until two reviewable copies are received.

Each author can help speed up the review and processing of manuscripts by heeding the instructions noted in each issue of the *Bulletin*. More detailed instructions are stated in a pamphlet available from the editor.

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(Section W—Atmospheric & Hydrospheric Sciences)

(continued on next page)

Member of all committees of the Council. He may designate a member from the Council to represent him.

GSA committees & representatives, cont'd

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Paul L. Hilpman (July 1, 1973—June 30, 1976)

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GSA REPRESENTATIVE TO U.S. NATIONAL COMMITTEE ON GEOLOGY

Richard H. Jahns (September 1971—Spring 1975)

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Bruce R. Clark (September 1973 through 1976 USNCORM Symposium)

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Richard H. Jahns

Thanks for nominations

From several hard-working committees, the officers, and the headquarters staff, a "thank you" and acknowledgment to all members who have submitted nominations of individuals for offices, committee membership, medals, and awards. They have been most helpful, and all have been carefully considered by the appropriate committee.

Unfortunately, in some cases, the individual nomination was not acknowledged. This in no way implies that it was not appreciated nor given due consideration by the committee. In the future, all such nominations that come to headquarters will be individually acknowledged when they are sent on to the appropriate committee.

We would like to remind the membership again that when a nomination is sent in for the Committee on Nominations, Committee on Committees, Penrose Medal, Day Medal, and Honorary Fellows Subcommittees, justification for the nominations must be included. The committee members do not always know the people who have been suggested, and it is very difficult for them to search out the justification material. They cannot do justice to the nomination if back-up material of some sort is not included.

GeoRef Data Base

The GeoRef Data Base contains citations of world-wide geoscience literature—serials, symposia, theses—collected by the American Geological Institute. Each citation is represented by a unit record, containing up to 14 different categories of descriptive information. Many of these categories are searchable through SDC. They include *title*: complete English title of the document; *Original title*: original foreign language title, if any, of the document; *author(s)*: both personal authors and group authors (associations, survey groups, government agencies); *symposium*: title of symposium, if any; *source reference*: abbreviated journal title, volume, issue, and page numbers for journal articles, publisher or other availability information for monographic material, type of illustration; *title annotation*: key words, key word phrases, or cross-references to supplement information in other categories; *descriptors*: searchable terms selected by indexers to describe the subject and geographic content of the source document; *language*: two-letter abbreviation for the language of the original document; *journal coden*: five-character ASTM coden representing the title of the primary journal in which the article appears.

For retrospective searches, write or phone the GeoRef Search Editor, American Geological Institute, 5202 Leesburg Pike, Falls Church, Virginia 22041. The telephone number is 703-379-2480.

Meet GeoRef

CITATION LISTS AT \$2.75 EACH

Geochemistry of some environmental problems, 1973-74
Man, fossil [in the Americas], 1967-1974
Sedimentary processes on the Atlantic continental margin of North America, 1968-1974
Basalt in ocean basins, 1972-1974
Submarine canyons, 1967-1974
Carbonate sediments, 1973-1974
Peat, 1970-1974
Permafrost, 1972-1974
Caribbean region, 1972-1974

Dates following titles indicate publication dates of the literature cited. Each bibliography is a booklet 5 and 3/8 by 8 and 1/2 inches.

The search strategy was made using Boolean logic (and, or, and not relationships). Some of the citations are inevitably irrelevant and are marked to indicate their irrelevancy.

Supplies are limited. Get your order in now! Prices are net (membership discount does not apply). Postage charge is waived when payment accompanies an order.

ALSO FOR SALE:

GeoRef's guide to indexing. This guide, prepared by GeoRef Information Services of the American Geological Institute, is used by the GeoRef editors for selecting index terms and arranging them into the three-level index entries found in the printed products made from the GeoRef data base. *GeoRef's Guide to Indexing* is the result of a long history of revisions and alterations made on a basic concept developed at the U.S. Geological Survey many years ago. Changes have resulted from several factors: changes in geologic concepts and terminology, changes in the general thrust of information purposes toward more facile retrieval, and changes in terms of cross-referencing. This guide reflects current usage at the GeoRef Information Services of AGI and is continuously being revised. It provides the best guide to the indexing used in the *Bibliography and Index of Geology*. 95 p., \$3.

Here's a *GET-ACQUAINTED OFFER* you and your geology librarian cannot afford to pass up—a cost of \$2.75 each for nine off-line bibliographic citation lists generated by GeoRef. Similar searches on the GeoRef Data Base cost \$75 each, plus 15 cents a citation.

Nine searches, based on symposia presented at the 1974 national GSA meeting, were drawn from the GeoRef Data Base through the Interactive Retrieval Service of System Development Corporation (SDC). These off-line bibliographic citation lists are:

Please send to:

NAME _____
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Payment enclosed Please bill me

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Return order form to

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 3300 Penrose Place,
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QUANTITY	TITLE	PRICE EACH	TOTAL
	Geochemistry of some environmental problems	\$2.75	
	Man, fossil (in the Americas)	\$2.75	
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	Submarine canyons	\$2.75	
	Carbonate sediments	\$2.75	
	Peat	\$2.75	
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	Caribbean region	\$2.75	
	GeoRef's Guide to Indexing	\$3.00	
	Tax if applicable*		
	TOTAL		

* Residents of Colorado please add 3% state sales tax. Residents of Denver metro area please add 3 1/2% state and local taxes. Residents of Boulder please add 5 1/2% state and local taxes.

Penrose Conferences

Regional geophysics and tectonics of the intermountain west

A GSA Penrose Conference on "Regional Geophysics and Tectonics of the Intermountain West" will be held in Alta, Utah, September 7-12, 1975. Conveners are Robert B. Smith, Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah 84112, and Don R. Mabey and Gordon P. Eaton, U.S. Geological Survey, Federal Center, Denver, Colorado 80225.

Area of interest: The Intermountain West, with emphasis on the transition zone from the Basin and Range province to the Colorado Plateau and Middle Rocky Mountains provinces, the eastern Snake River Plain, and Yellowstone National Park.

Purpose: To examine Cenozoic tectonics and interpretations of regional geophysical data of the Intermountain West, in light of the general theory of plate tectonics. The Intermountain West represents an area of Late Mesozoic to Early Cenozoic compressional tectonism, followed by Late Cenozoic volcanism, uplift, and normal faulting. The region is characterized geophysically by high heat flow, active seismicity, a thin crust, and low upper-mantle velocities. Subduction, intraplate boundary effects, vertical uplift, and mantle spreading have all been proposed as plausible mechanisms to explain the Cenozoic tectonics of this anomalous region. We propose to bring together geophysicists and geologists to focus on interdisciplinary geologic problems of the Intermountain West, and to establish interpretive constraints. Renewed exploration for minerals, petroleum, and geothermal resources in the Intermountain region indicates strong industrial interests. Accordingly, we will stress discussions of the tectonic theories as applied to exploration models. Primary emphasis will be on regional geophysical data, regional tectonics, and petrology. An important goal will be informal discussions among earth scientists concerned with interpretations of regional geophysical data as they relate to regional structural patterns and possible tectonic mechanisms. Discussions will include adequacy of theoretical mechanisms to account for observed geologic and geophysical features, relations between surface geology and crustal models, and relative crustal motions. Correlations will be made with grossly similar regions elsewhere: the Rio Grande Valley, East African rifts, Baikal rift, Rhine graben.

Field trip: Along Wasatch front, preceding conference, optional at additional fee. There will be no publication of the conference proceedings except for a news report. Attendance implies agreement that ideas and data will be regarded as privileged.

Attendance limit: 70. Fee about \$250 covering meals, lodging, and transportation to and from the Salt Lake City airport. To apply, write to the conveners briefly stating field of special interest, knowledge related to conference topic, and subjects with which you are conversant. *Application deadline is May 1, 1975.*

Relationship of magmatic sulfides to differentiated mafic plutons

A Penrose Conference on the "Relationship of Magmatic Sulfides to Differentiated Mafic Plutons" will be held in September 1975 in northeastern Minnesota at the site of the Duluth Gabbro Complex. The conference is intended to bring people working on the field and laboratory aspects of magmatic sulfide deposits from around the world together with those studying mafic plutons and the differentiation of basaltic magma. The conference will last five days, with three days devoted to discussions of field and laboratory aspects of mafic plutons and magmatic sulfides, and two days of field trips in the Duluth Complex to examine various aspects of its general constitution, magmatic differentiation, and associated sulfide deposits. The cost is expected to be in the \$250-\$300 range; this will include lodging, meals, registration, and the field trips. The attendance will be limited to 50-70 persons. The exact dates, place, and cost of the conference will be announced as soon as information is available. Those interested in further information, or in applying to attend, should contact the convener, Bill Bonnicksen, Department of Geological Sciences, Kimball Hall, Cornell University, Ithaca, New York 14853 (607-256-3461), *before June 15, 1974.*

July 1, 1975, is deadline for abstracts for national meeting

The deadline for abstracts for the national meeting of GSA and associated societies at Salt Lake City, Utah, is July 1, 1975. Abstracts for oral and poster presentations and discussion papers must be submitted on a standard form which can be obtained from the Abstracts Secretary, GSA, 3300 Penrose Place, Boulder, Colorado 80301.

Abstracts and discussion papers will be reproduced for the Abstracts with Programs by offset printing from plates made from the typed copy submitted on the abstract form. If inferior quality of the original copy of accepted abstracts or discussion papers makes retyping necessary at GSA headquarters, the senior author will be charged \$15.

There will be no opportunity for authors to review or revise the retyped material.

News of the Quaternary Geology & Geomorphology Division

Election results

In the division elections which were completed October 15, 1974, the following were elected officers for 1974-75: *Robert L. Nichols*, Chairman; *Laurence H. Lattman*, First Vice-Chairman; *William C. Bradley*, Second Vice-Chairman; *Don J. Easterbrook*, Secretary.

Elected to two-year terms on the Division Panel (1974-76) were *W. Hilton Johnson*, *Kenneth L. Pierce*, and *John W. Hawley*. Completing the second year of their terms (1973-75) will be *John T. Andrews*, *William B. Bull*, and *Joseph H. Hartshorn*.

Mackin Grant awarded to Louis D. Carter

The Mackin Fund has now grown to the point of making possible an annual grant for research in geomorphology. According to recent changes in procedures approved by the Management Board and the GSA Council and ratified at the annual business meeting, the division is now solely responsible for administering the grants without going through the Committee on Research Grants.

The 1974 winner of the Mackin Grant is *Louis D. Carter* for a research project in Baja, California. The award was announced at the annual business meeting in Miami and the following read by Chairman *D. R. Crandell*:

"On behalf of the Quaternary Geology and Geomorphology Division of the Geological Society of America, I am pleased to inform you that you have been awarded the J. Hoover Mackin Research Grant for your studies of the terraces of Sierra Mayor. This grant honors a remarkably versatile and thoughtful geologist whose professional competence and personal warmth were greatly respected and admired by all who knew him. For more than three decades Hoover Mackin stimulated and guided countless students at two major universities. Although renowned as a teacher, he was also an outstanding field geologist, whose scientific contributions have greatly increased our understanding of a variety of geologic subjects. J. Hoover Mackin's memory can be honored in no better way than to provide financial support to a student, like yourself, who is engaged in geological research. Congratulations and good luck!"

Ruhe wins Kirk Bryan Award

Robert V. Ruhe was presented the 1974 Kirk Bryan Award at the annual business meeting of the division in Miami for his paper "Quaternary Landscapes in Iowa." The citation for the award was read by *George W. White*. The citation and response will be published in the News & Information section of a forthcoming issue of *Geology*.

Division dues assessment proposed

The division has been informed by the GSA Council that if we wish to continue to operate the division as we have in the past, and possibly expand its activities, collection of annual dues will be necessary to defray costs of a newsletter mailing to affiliates, and other expenses. (The Engineering Geology Division has been assessing its members \$2 annual dues for several years.) This change is made necessary by inflationary costs. It requires a change in the bylaws and an affirmative vote by the voting members of the division. The Management Board has approved the following: "To charge \$2 annual dues in order to cover costs of continuing the division newsletter and other division activities."

The bylaws of the division allow for collection of annual dues upon approval of the Management Board and the membership. Therefore, the next ballot will contain a proposal to collect annual dues. The alternative to the collection of dues would be to communicate with members of the division only at the annual business meeting at the national meetings. The News & Information insert in *Geology* that goes to all the membership can be used for division items of interest to the entire Society membership, citations and responses for awards, announcements of officers, and so on, but not for news of restricted interest or announcements of meetings not sponsored by GSA.

Paleoecology Conference

Immediately preceding the joint meeting of the Geological Association of Canada, the Mineralogical Association of Canada, and the North-Central Section of the Geological Society of America to be held at the University of Waterloo, May 15-17, 1975, the Department of Earth Sciences, University of Waterloo, Waterloo, Ontario, will host a field trip on the theme of Quaternary Nonmarine Paleocology May 12-14, 1975.

The purpose of the Paleocology Conference is to acquaint Pleistocene workers with some of the problems of using different fossil groups in the interpretation of Quaternary nonmarine sequences. The conference will involve key speakers who will outline the advantages and (or) disadvantages of a particular faunal or floral group, and these will be followed by selected papers describing specific studies.

A one-day field trip to the Sangamon (Eemian/Ipswichian) interglacial deposits of the Don Valley Brickyard, and the Scarborough (early Wisconsinan/Weichselian/Devensian) sequences of the Scarborough Bluffs, Toronto, will be held May 14. Accommodation for the field trip will be limited, and participants will be accepted on a first-come, first-served basis.

Quaternary sessions will also be held during the main GAC/MAC/NCGSA conference, and a second field trip on Huron ice lobe stratigraphy will be held May 18-19.

GSA's Employment Matching Service

The Society provides an employment matching service as an aid to geoscientists and employers of geoscientists. This service is a clearing house to put employers in touch with applicants within specialized fields of expertise. The Society also has sponsored an employment interview service through the local committees at national annual meetings since 1969. At its 1973 spring meeting, the Council recommended that these services be managed through the headquarters staff and that they be offered on a year-round basis. A brief summary of the functions of both services is given below in order to familiarize the membership with these programs and to encourage more participation.

Year-Round Employment Matching Service

This program operates throughout the year to supply requesting employers with lists of applicants whose qualifications match specific job requirements as they are related to fields of expertise, experience, and educational background. Employers participating in this program review copies of relevant applications and resumes and then contact those applicants in whom they are interested.

Annual Meeting Employment Interview Service

Separate from the year-round employment matching service, the Society offers an annual meeting employment interview service in conjunction with the national meeting and some section annual meetings. Employers participating in this service are sent computer printouts of applicant listings by specialty which also includes a brief summary of each applicant's qualifications. The Society also makes interview space available at the meetings for in-person contact between employers and job seekers.

Applicants attending those annual meetings at which the service is provided may look through books listing positions available and sign up for interviews with employers who are in attendance. Employers contact those applicants listed on the computer printouts in whom they are interested, either for further information by mail or to set up interviews during the meeting. GSA makes no guarantee of contact by an employer.

We also maintain a file on minority-group status to aid employers in complying with affirmative-action programs. Information in this file is obtained from applicants on a voluntary basis only, and is released to employers if they specifically request this kind of information.

Standard forms for both job applicants and requesting employers are provided by the Society. Applicants must also prepare a one-page typewritten resume to

be submitted with the application. The applicant fee is \$7.50 for a six-month registration. Employers utilizing the year-round service pay \$10 per applicant search, plus 50 cents per page for all reproduced documents. Employers registering for the annual meeting service pay a minimum of \$30 for a computer printout of applicant listings in up to three specialties. From four to six specialty listings of applicants are \$5 each. More than six listings—or the entire applicant listing by specialty—is \$60.

The requisite forms may be obtained from Joan Heckman, Membership Assistant at headquarters, by specifying the service in which you wish to participate and whether you are an employer or an applicant.

You may find the following statistics regarding the employment service of interest. A total of 108 employers participated in the annual meeting employment service connected with the Miami Beach meeting, and 51 of these conducted in-person interviews in GSA facilities. Over 500 applicants registered with the service; 85 at the meeting. Two hundred thirty-eight applicants attended the meeting, and 130 of these had from one to five prescheduled interviews with interested employers.

The year-round service began in July 1974 with 37 applicants and 17 requesting employers. Our active files now include more than 200 applicants, and we fill three to five employer requests for applicant searches weekly.

Slides recovered at Miami Beach meeting

The Annual Meeting Department at GSA headquarters is holding a group of slides from the 1974 national meeting in Miami Beach, Florida. These slides were turned in to us at the end of the meeting and have not been claimed.

Each slide has a red dot in the lower left corner. One slide, evidently the final slide of the series, is as follows: "A tip of the hat to: The National Science Foundation and the Stanford University Research Development Fund for financial support, and to Standard Oil of California for use of their computational facilities without which this study would not have been possible."

If you believe these slides belong to you, please write to the Annual Meeting Department, Geological Society of America, 3300 Penrose Place, Boulder, Colorado 80301.

Applications invited for Fulbright-Hays awards

Applications will be accepted this spring for more than 550 university lecturing and advanced research awards during 1976-77 in more than 75 countries under the senior Fulbright-Hays program, the Council for International Exchange of Scholars announced recently. Specialists in geology who are U.S. citizens and have a doctorate or college teaching experience are invited to indicate their interest in an award by completing a simple registration form, available on request from the Senior Fulbright-Hays Program, 2101 Constitution Avenue N.W., Washington, D.C. 20418. Registrants will be sent a detailed announcement of the 1976-77 program in April. July 1, 1975, is the deadline for applying for research awards and it is also the suggested date for filing for lectureships.

Each year Fulbright-Hays agencies abroad forward to the Council for International Exchange of Scholars applications of senior foreign scholars who are interested in remunerative appointments for lecturing and postdoctoral research at American colleges or universities for temporary periods. The scholars are eligible for Fulbright-Hays travel grants if arrangements are confirmed for remunerative appointments.

The Council would be pleased to receive at any time information regarding appointments available at American educational institutions for foreign scholars for temporary periods of three months to one year. A directory of senior Fulbright-Hays foreign scholars who are in the United States this academic year is available on request to the Council. A number of these scholars would welcome invitations to give lectures or to participate in special conferences under the sponsorship of academic institutions and educational organizations.

Meeting of Associacao Brasileira de Metais

GSA headquarters has received an invitation from Associacao Brasileira de Metais for any of our members to attend, and, if they wish, to present a paper at their next meeting in Rio de Janeiro, Brazil, from June 29 to July 4, 1975. Correspondence should be addressed to Eng. Emilio Wainer, President—Organizing Committee, Pca. Cel. Fernando Prestes 110, CEP 01124, C.P. 30.148, Sao Paulo, Brazil.

Geotimes—An explanation

Although this explanatory note is not needed by most, a few letters have come to headquarters indicating that at least a few members do not understand the relation of GSA to AGI and to the magazine *Geotimes*.

The American Geological Institute is a federation of the scientific and professional societies and associations in the earth sciences. It is organized in such a way that organizations—not individuals—are members. As a member society, GSA pays annual dues of \$2 each for each of our Fellows and Members. This was never a subscription to *Geotimes*, but was, and still is, our proportionate dues to the federation for GSA.

The AGI, for many years, has sent *Geotimes* to all members of the member societies, but their Board decided last year to stop the automatic distribution and put the magazine on an individual subscription basis. However, members of member societies now receive a one-third discount on the price if they individually subscribe.

GSA initiates depository system

The Society has initiated a depository for storage of supplemental data. These data include information such as extensive chemical analyses, descriptions of rocks or detailed stratigraphic sections, laboratory procedures, and similar data. It is especially necessary to store the data if they are likely to be useful to only a few of the readers of the article.

The Society will maintain the information at headquarters and provide single copies upon request. Arrangements can be made to obtain multiple copies, and the feasibility of offering subscriptions for depository material is being studied.

Record number of manuscripts received

Once again, the Society has received a record number of manuscripts to consider for publication. At the close of the year 1974, a total of 652 manuscripts had been submitted for review and possible publication in the *Bulletin* and *Geology* or as Special Papers or Memoirs. Each manuscript must be handled several times between its receipt and its ultimate acceptance for publication or rejection. We got behind for a while between Thanksgiving and the new year, but it looks as if we have nearly caught up now. If your manuscript was delayed during that interval, we apologize.

Membership

122 new Members elected

ALKER, JULIUS
ANDERSEN, RICHARD LEWYN
BADRY, ANN M.
BARSS, DAVID L.
BENSON, DON G., JR.
BIRKENMAJER, KRZYSZTOF L.
BLOUNT, ALICE M.
BRAUTIGAM, GERALD L.
BRIZUELA, LUIS R.
BROOKE, ROBERT C., JR.
BROWN, JOHN F.
BURDETTE, MYRON S.
BUTLER, JOHN C.
CRUZ QUINONES, HECTOR M.
DANEKER, THOMAS M.
DAVIS, JOSEPH R.
DEBOO, PHILI B.
DETMAN, DOUGLAS T.
DEYAMPERT, LUCIUS D.
DONEGAN, BEN
DYER, JAMES R.
DZIEDZIC, JOSEPH M., JR.
EDWARDS, IAN N.
EFFRAMIAN, MANOUCHEHR
EICHLER, GARY E.
EISBACHER, GERHARD H.
ELIFAS, JOEDO D.
ESCOVAR, RICARDO
EWING, RODNEY C.
FANKHAUSER, ROBERT E.
FENTON, MARK M.

FRAZIER, ELIZABETH L.
GARRISON, RONALD L.
GILLAM, MARY L.
GRAY, LINWOOD H.
GRAYSON, ROBERT C., JR.
HICKS, HENRY T., JR.
HILLAIRES-MARCEL, CLAUDE
HOLBERGER, RICHARD L.
HOSTETTER, MARK
HOWAT, WADE E.
HUNTSBERGER, DAVID V.
ISAACSON, PETER EDWIN
JACKSON, ROSCOE G., II
JACOBS, STEPHEN E.
JOHNSON, ALLEN H.
JOHNSON, JAMES F.
JONES, RICHARD WARREN
JONES, STEVEN D.
JUDGE, SUSAN J.
KEYES, SCOTT W.
KHAN, FARRUKH Z.
KOO, JA H.
KORNACKI, ALAN S.
KOUSSA, ABDALLAH A.
KRAJEWSKI, JOHN L.
LAMARRE, ALBERT L.
LANGENKAMP, DAVID
LAWRENCE, JAMES R.
LEAGUE, LARRY D.
LEPLEY, LARRY K.
LILES, V. E.

LUETHE, RONALD D.
MACMILLAN, LOGAN T.
MARSH, PETER P.
MARTINEZ, MAXIMILIANO A.
MATULAC, ARTHURO P.
MCLEAN, STEVEN A.
MERRILL, WILLIAM R.
MILLER, GERALD A.
MILLER, ROBERT E.
MILNER, SAM
MIYASHIRO, AKIHO
MORE, SYVER W.
MORRIS, HENRY M.
MORRIS, RICHARD N.
MORSE, CAROLINE M.
MULMOLLAND, JAMES W.
NAQVI, ANWAR A.
NIELSON, RUSSELL L.
OLIVEIRA, ALVIMIR A.
PEDERSON, DARRYL T.
PINCOMB, ARTHUR C.
PLATT, JEREMY B.
POLKOWSKI, GEORGE R.
PREWITT, CHARLES T.
PURCELL, CHARLES W., JR.
RAINES, GARY L.
RAMBERG, IVAR B.
RAMEY, HENRY J., JR.
REDMAN, EARL C.
REUTER, GREGORY J.

REVETTA, FRANK A.
ROCKWELL, CHARLES
ROTH, PETER H.
ROWLANDS, DAVID
RUDSER, RALPH J.
SA-FERNANDES, LUIZ ANIBAL T.
SEELEY, MARC W.
SEMET, MICHEL P.
SHEARIN, K. KAY
SINGH, JOGINDER
SMITH, MORLAND E.
SMITH, ROBERT C.
SMITH, THOMAS E.
SNYDER, FRANK S.
SOPER, DONALD A.
SPIRAKIS, CHARLES S.
STELLAVATO, JOSEPH N.
STOLLE, JAMES M.
SWIDERSKI, THEODORE J.
TEDFORD, FREDERICK J.
VEROSUB, KENNETH L.
VESPUCCI, PAUL D.
WACHTER, JACK P.
WATKINS, JEFFREY A.
WEBER, LAWRENCE C.
WILLIAMS, DAVID A.
WILLIS, MICHAEL W.
WOLF, FREDERICK G.
WRIGHT, NANCY A.
YARDLEY, BRUCE W. D.

174 Student Associates join Society

AGEE, JEFF
ALIABADI, NASSROLLAH
ALLISON, DENNIS A.
ANDERSON, JAMES R.
AUBUT, ALAN J.
BAGBY, WILLIAM C.
BALDRIDGE, WARREN S.
BARNARD, ROBERT S.
BAUM, KEN C., JR.
BEHENSKY, JAMES F., JR.
BERG, RICHARD C.
BERTRAND, CHRISTOPHER
BLANCHARD, DAVID C.
BLAUVELT, ROBERT P.
BODEN, KIP K.
BRADY, KEITH B. C.
BREWER, WAYNE M.
BROHL, HELEN A.
BROWN, STEPHEN P.
BROWN, WILLIAM D.
BUCHHOLZ, PAUL E.
BURTCHEL, PETER
CANELON, GUSTAVO A.
CARR, ROYCE P.
CARROLL, THOMAS E.
CARVER, CHERI L.
CHARPENTIER, RONALD R.
CISLER, RICHARD E.
CITRON, GARY P.
CLARK, EDWARD M., JR.
CLAYTON, CLIFFORD M.
COLLINS, BENJAMIN I.
CONNELLY, WILLIAM R.
COREA, WILLIAM C.
CORPORON, JOE R.
CROSBY, GERRIT L.
CUTLER, SHERWOOD T.
DIXON, JAMES B.
DOLAN, JOHN D.
DONALDSON, JOAN E.
DOUGHERT, ABOURHMAN K.
DURFEE, DANIEL
DYMAN, THADDEUS S.
EHRENBERG, STEPHEN N.

EINARSON, GEORGE W.
ELLIS, EUGENE G.
ERB, EDWARD E., JR.
EVANS, WILLIAM E.
FAUCHIER, DENNIS R.
FECHNER, STEVEN F.
FINK, JOHN W.
FITHIAN, PATRICIA A.
FITZSIMMONS, GARY C.
FRANCO, GRASSO
FREEMAN, ROY W.
FRIEDMAN, DANIELLE S.
GAMBER, JAMES M.
GABALDO, M. VIRGINIA
GARIFAL, LINDA
GAUTIER, DONALD L.
GILLESPIE, JIMMIE D.
GODLEWSKI, DAVID W.
GOLNAZARIANS, ROBIN
GORDON, ARTHUR J.
GRAY, JOHN H.
HABERMANN, RAY E.
HALL, CHARLENE R.
HARDIMAN, ANDREW L.
HARNED, DOUGLAS A.
HENKE, EILEEN M.
HENRY, DARRELL J.
HERRICK, LAURA K.
HEUTMAKER, DUANE L.
HIGGS, PAUL N.
HOLLAND, JAMES L.
HORNBECK, JAMES M.
HOSTETTLER, JOHN E., III
IRVIN, LYNNE E.
JONES, DOUGLAS S.
KANEHIRO, BRIAN Y.
KASTEN, JAMES A.
KEMPNER, WILLIAM C.
KING, JAMES M.
KNAPP, RICHARD M.
KOZA, DOUGLAS M.
KRUMHARDT, ANDREA P.
KUCSMA, PAUL J.
KUEHN, CARL A.

KYLE, PHILIP R.
LANTZY, RONALD J.
LAOSEBIKAN, SAMUEL O.
LA POINTE, PAUL R.
LARKO, THOMAS S.
LEATHERMAN, STEPHEN P.
LEINEN, MARGARET S.
LISTER, LONNIE
LOPEZ, JOHN A.
MCCLURE, ROBERT K.
MCCONAUGHY, CHRIS E.
MCCURRY, MICHAEL O.
METZ, RANDALL T.
MINCK, ROBERT J.
MOCHIZUKI, GEORGE S., JR.
MYERS, ROBERT G.
NELSON, STEPHEN A.
NEUBERT, NANCY E.
PALMER, JOHN E.
PAP, DORA M.
PARCHMAN, MARK A.
PARKS, WILLIAM SCOTT, JR.
PERKINS, WAYNE F.
PETERSEN, CHERYL L.
PETERSEN, LAWRENCE E.
PILATZKE, RICHARD H.
PONTIGO, FELIPE A., JR.
PROST, GARY L.
PUCK, LAWRENCE S.
PYRON, ARTHUR J.
REITER, DAVID E.
REPPE, CALVIN C.
REYMOND, WILLIAM C.
RIDLEY, KEVIN J. D.
ROBISON, MARY S.
ROLOFF, JEFFERY N.
SALEM, MOSTAFA J.
SANCHEZ, CHARLOTTE M.
SANDERS, MARK C.
SAVELY, CARL D.
SCHEIHING, MARK H.
SCHIANO, LORRAINE
SCHLUETER, ELIZABETH A.

SCHNEIDER, ROBERT R.
SCHUMACHER, JOHN C.
SCHURER, VICTORIA C.
SHEARER, DAVID L.
SHERVEM, RUSSELL L., JR.
SHORE, JESSE P.
SILVERMAN, JAY N.
SIMERKA, DAVID L.
SKERLEC, GRANT M.
STANLEY, RICHARD G.
STEINBERG, ROGER T.
STELLAS, MICHAEL J.
STIERMAN, DONALD J.
STORK, ALLEN L.
STRATMAN, JOEL M.
STRINGER, GARY L.
STRUHSACKER, ERIC M.
SUTTON, MICHAEL B.
SWEENEY, JERRY J.
TAYLOR, FREDERICK W.
TAYLOR, JAMES R.
THOMPSON, DAVID K.
THORNTON, EDWARD C.
THURMOND, CAROL J.
UNDERWOOD, WILLIAM D.
UPHAM, GREGORY A.
VAN ALLEN, BRUCE R.
VANDERLEY, WILLIAM
WALBERG, NEAL G.
WALLACE, STEPHEN D.
WATSON, LEE R.
WEAVER, STEPHEN G.
WELLS, ROBERT A.
WERMIEL, DAN E.
WHETSTONE, KENNETH N.
WHITE, HOWARD J.
WICKER, RUSSELL A.
WILBER, ROBERT J.
WILLIAMS, DAVID S.
WILSON, FREDERIC H.
WOJNIAK, WAYNE S.
WORTHINGTON, JUNE B.
YILMAZ, PINAR O.

March BULLETIN briefs

Brief summaries of articles in the March 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 on the last page of this section.

□ 50301—Himalayan-Bengal Model for Flysch Dispersal in the Appalachian-Ouachita System. *Stephan A. Graham, William R. Dickinson, Raymond V. Ingersoll, Geology Department, Stanford University, Stanford, California 94305.* (14 p., 6 figs.)

The relation of the modern Bengal subsea fan to the Cenozoic Himalayan suture belt and the analogous relation of the Carboniferous Ouachita flysch to a presumed Paleozoic Appalachian suture belt suggest a guiding principle of synorogenic sedimentation. Most sediment shed from orogenic highlands formed by continental collisions pours longitudinally through deltaic complexes into remnant ocean basins as turbidites that are subsequently deformed and incorporated into the orogenic belts as collision sutures lengthen.

India first encountered a southern Eurasian subduction zone near the end of Paleocene time. Northward movement of India since Oligocene time choked the subduction zone, stifled the associated magmatic arc, and created a suture complex of deformed Cretaceous flysch and younger Tertiary molasse. Strata derived from the resulting orogen include continental clastic wedges shed southward toward India and voluminous turbidites fed longitudinally through the Ganges-Brahmaputra Delta into the Bay of Bengal. The eastern flank of the Bengal subsea fan is being subducted now beneath the still-active eastern extension of the subduction zone.

The sequential, north-to-south welding of Europe and Africa to North America formed the complex Appalachian-Caledonide-Mauritanide suture belt, from which Taconic, Acadian, and Alleghanian

clastic wedges were shed toward the North American craton. Turbidites of the Carboniferous Ouachita flysch were fed longitudinally, as sediment supplied through the Alleghanian clastic wedge, into a remnant ocean basin lying south of North America. The Ouachita system was then thrust northward across the continental edge during arc-continent collision that progressed from east to west.

□ 50302—Vegetation Record for the Last 20,000 Years from a Small Marsh on Lookout Mountain, Northwestern Georgia. *W. A. Watts, Department of Botany, Trinity College, Dublin, and Limnological Research Center, University of Minnesota, Minneapolis, Minnesota 55455.* (5 p., 3 figs.)

Three pollen zones are found in 1 m of sediment from a small marsh on Pigeon Mountain. The oldest, which begins at 19,520 yr B.P. and ends at 10,820 yr B.P., has pollen of pine, spruce, deciduous trees, and herbs, which implies that the plateau was not forested in full-glacial time but that tree pollen was transported to the site from valleys below the plateau. The second zone of late Pleistocene or early Holocene age implies a mesic forest in which beech was a common tree. The youngest zone has pollen of oak, chestnut, sweetgum, and blackgum, representing the modern somewhat xeric oak forest.

The site was a pond with water lilies and rooted and submerged aquatic plants at the time of zones P-1 and P-2. Subsequently, woody wet-ground plants (such as buttonbush, red maple, sweetgum, and willow) invaded the site and converted it into a marsh.

□ 50303—A Re-examination of the Regional Distribution of the Late Cenozoic Ore Deposits in the East Japan Arc. *Shunso Ishihara, Mineral Deposits Department, Geological Survey of Japan, Hisamoto 135, Takatsu-ku, Kawasaki, Japan, Toshio Igarashi, Mineral Deposits Department, Geological Survey of Japan, Tokyo Branch, Kawada-cho 8, Shinjuku-ku, Tokyo, Japan, Chikao Nishiwaki, Institute for International Mineral Resources Development, Fujinomiya, Shizuoka, Japan.* (3 p., 2 figs.)

In following the seismic discontinuity under the Japanese arcs, the distribution of the Quaternary sulfur deposits, the Pliocene-Miocene gold-silver deposits, and the Miocene Kuroko and vein-type deposits are re-examined. The sulfur deposits show remarkable concentration at the intersections between the discontinuity and the present volcanic front. The gold and silver deposits seem to follow transverse faults. The base metal deposits

are definitely related to the volcanic front of that age, and they seem to have some connection with the discontinuity.

□ 50304—Petrology of Basalt and Andesite of the Black Range, New Mexico. *R. V. Fodor, Department of Geology and Institute of Meteoritics, University of New Mexico, Albuquerque, New Mexico 87131.* (10 p., 7 figs., 5 tpls.)

The Black Range, southwestern New Mexico, on the margin of the Basin and Range physiographic province, consists mainly of Tertiary mafic, intermediate, and silicic lava flows, and silicic ash-flow tuff units.

Initial volcanism in early and middle Oligocene time was predominantly andesitic and was succeeded in late Oligocene and Miocene time by a suite of basalt, basaltic andesite, and andesite. The Oligocene andesite is interpreted as being derived from primary magma, whereas younger andesite is derived from differentiation from basaltic magma. Only basaltic volcanism occurred in Pliocene time. The change in volcanism from intermediate to mafic is similar to the general trends of middle Cenozoic volcanism in the western United States. Compositional changes may have been related to physical changes in a subduction regime beneath New Mexico and progressive devolatilization.

□ 50305—Analogous Evolution of the Burma Orogen and the Scottish Caledonides. *A.H.G. Mitchell, W. S. McKerrow, Department of Geology and Mineralogy, Parks Road, Oxford OX1 3PR, England.* (11 p., 8 figs., 2 tpls.)

Thick turbidite sequences derived from the Bengal Delta are accumulating on the floor of the Bay of Bengal. Eastward subduction has resulted in successive underthrusting with tectonic emplacement of the turbidites above the subduction zone to form the Indo-Burman Ranges of western Burma. The ranges are separated from the Eastern Highlands of Burma by the Central Lowlands.

In Scotland, the Upper Ordovician and Silurian turbidite sequences of the Southern Uplands are comparable to those of the Indo-Burman Ranges; the Midland Valley and the Grampian Highlands, respectively, are similar to the Central Lowlands and the Eastern Highlands.

The development of the Midland Valley and the Southern Uplands can be explained by analogy with the Burma orogen. Both orogens show a similar history of sedimentation, igneous activity, and deformation over a period of 100 m.y., but in Scotland, the equivalent events took place about 400 m.y. earlier than in Burma. There is no known

equivalent in Burma of the Early Ordovician Grampian orogeny in Scotland.

Our comparison suggests that mineralization similar to that in the Burman volcanic arc should be present in andesite of the Sidlaw anticline.

□ 50306—Stereographic Technique for Determination of Minor Fold Sense. *Gerald D. Prager, Department of Earth Sciences, Northeastern University, 360 Huntington Avenue, Boston, Massachusetts 02115.* (3 p., 3 figs.)

Stereographic projection permits accurate determination of minor fold sense in areas of structural complexity and provides a simple and flexible field method to supplement routine mapping methods through structural analysis.

□ 50307—Sedimentation in an Ancient Playa-Lake Complex: The Wilkins Peak Member of the Green River Formation of Wyoming. *Hans P. Eugster, Lawrence A. Hardie, Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland 21218.* (16 p., 19 figs.)

The Wilkins Peak Member of the Green River Formation of Wyoming contains seven rock units: (1) flat-pebble conglomerate, (2) limy sandstone, (3) mudstone, (4) oil shale, (5) trona-halite beds, (6) siliciclastic sandstone, and (7) volcanic tuff. Their respective subenvironments are (1) rapid transgression of a shallow lake, (2) lake shore oscillating over a mud flat, (3) playa mud flats, (4) shallow lake with occasional desiccation, (5) seasonally dry salt lake, (6) braided stream, and (7) not specific.

Subenvironment deposits are arranged in depositional cycles, the most complex of which begins with flat pebble conglomerate followed by oil shale passing gradually into mudstone which is capped by lime sandstone. Most cycles are simpler and belong to one of five types. Individual cycles have been correlated as far as 24 km.

The Wilkins Peak Member is thought to have been deposited in a playa-lake complex consisting of a shallow central playa lake surrounded by mud flats and fringed by alluvial fans. Evaporative concentration of bicarbonate-rich inflow waters led to saturation with respect to calcite, most of which must have been deposited as cement within alluvial fans. Evaporation continued in the capillary zone of the mud flats, first precipitating calcite, then magnesian calcite, and eventually protodolomite. The carbonates accumulated as soft micritic mud.

During periods of desiccation, the mud cracked and the mud-crack polygons

contributed sand- and silt-size dolomitic micrite intraclasts to be transported to the central lake by the next storm. When the central lake was large, oil shale accumulated in it, with the organic matter derived from flocculent ooze consisting of bottom-dwelling blue-green algae and fungi. During dry periods the lake shrank, and trona and halite precipitated in the central portions.

□ 50308—Green River Formation, Wyoming: A Playa-Lake Complex. *Ronald C. Surdam, Claudia A. Wolfbauer, Department of Geology, University of Wyoming, Laramie, Wyoming 82071.* (11 p., 16 figs., 4 tbls.)

Recent observations in the Green River Formation suggest that ancient "Lake Gosiute" was a playa-lake complex. The playa-lake model is tested in a basin-wide study of surface and subsurface observations. The rocks deposited in and around Lake Gosiute can be divided into marginal silt and sand, carbonate mud-flat, and lacustrine facies. Each facies has a characteristic carbonate mineral assemblage. The marginal facies is characterized by calcite concretions and calcareous cements. The mud-flat facies is characterized by calcite and (or) dolomite. The lacustrine facies is characterized either by trona (sodium carbonate) or by oil shale (either calcitic or dolomitic). The regional distribution pattern of lithologic facies and mineral zones in the Green River Formation of Wyoming is identical with that of modern playa-lake complexes. Moreover, in the Tipton Shale Member proposed by Bradley to have been deposited in a large, deep, open, fresh-water lake, there is strong evidence demonstrating large fluctuations in the position of the shoreline and progressive increases in salinity and alkalinity of the lake water. By mapping the regional distribution and types of lateral changes characterizing individual stromatolite units, the fluctuations in shoreline position can be quantified. The vertical distribution of fossils and oolites in the Green River Formation allows an evaluation of water chemistry. In addition, the assemblage of sedimentary structures in the Tipton Shale Member is compatible only with a sedimentologic model characterized by shallow-water deposition and frequent subaerial exposure.

Thus, the deep-water stratified-lake model is untenable not only for the Wilkins Peak Member but also for the Tipton Shale Member of the Green River Formation. In contrast, the playa-lake model is consistent with the physical, chemical, and paleontologic aspects of the Green River Formation of Wyoming.

□ 50309—Paleomagnetism of Miocene Volcanic Rocks of Guam and Curvature of the Southern Mariana Island Arc. *E. E. Larson, R. L. Reynolds, Cooperative Institute for Research in Environmental Sciences and Department of Geological Sciences, University of Colorado, Boulder, Colorado 80302; M. Ozima, Y. Aoki, H. Kinoshita, S. Zasshu, Geophysical Institute, University of Tokyo, Tokyo, Japan; N. Kawai, T. Nakajima, Department of Material Science, University of Osaka, Osaka, Japan; K. Hirooka, Geological Laboratory, Fukui University, Fukui, Japan; R. Merrill, S. Levi, Geophysics Group, University of Washington, Seattle, Washington 98105.* (5 p., 6 figs., 1 tbl.)

Directions of paleomagnetism in dikes and flows of Miocene age on Guam deviate considerably but systematically from the present Earth field direction. The mean inclination of the eight sites is 24°, which is nearly exactly that of the axial dipolar field for this latitude; but the mean declination lies 55° clockwise from true north. A simple explanation is that the southernmost portion of the Mariana island arc has been tectonically rotated about a vertical axis in a clockwise direction about 50° to 60° since Miocene time but has undergone little, if any, latitudinal shifting. These conclusions are consistent with seismic data for the southern Mariana arc which suggest components of right-lateral strike slip as well as thrust movement along the generally east-trending zone separating the Philippine Sea plate on the north from the Pacific plate on the south.

□ 50310—Form and Growth of Fingered Sheet Intrusions. *David D. Pollard, National Center for Earthquake Research, U.S. Geological Survey, Menlo Park, California 94025; Otto H. Muller, David R. Dockstader, Department of Geological Science, University of Rochester, Rochester, New York 14627.* (13 p., 17 figs.)

The form of several sheet intrusions in a sandstone-shale host rock is regular, but much more complex than the term "sheet intrusion" implies. The periphery of a sill emanating from the Shonkin Sag laccolith in Montana is composed of fingers of igneous rock with lengths of about 100 m, widths of 3 to 5 m, and thicknesses of 1.2 m to 0.6 m. At finger terminations, the host rock is wedged aside and compacted, and along the sides of fingers, buckling and shearing of strata are common. Energy expended by magma to dilate and flow through a sheet is small compared to that for fingers. Initiation of fingers is attributed to instability of the advancing interface between viscous magma and a

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more viscous host rock. Fingers coalesce into a sheet such that cusp-shaped grooves filled with deformed host rock remain in the contact. Systematic offsets of sheet-intrusion contacts form where offset fingers coalesce. Several dikes 5 to 20 m thick near La Veta, Colorado, have offset contacts as much as 3 m, which give the dike the appearance of a clapboard wall.

□ 50311—Chemical Characteristics and K-Ar Ages of Indian Kimberlite. *D. K. Paul, D. C. Rex, P. G. Harris, Department of Earth Sciences, University of Leeds, England.* (3 p., 1 fig., 2 tbls.)

Kimberlite occurs as intrusive pipes in the Precambrian shield area of India. Regional mineralogical and chemical variation with highly significant differences in Al_2O_3 , MgO, CaO and P_2O_5 exist between the localities. New K-Ar ages on eight whole rock analyses suggest that the known Indian occurrences are of Precambrian age.

□ 50312 — Preliminary Petrographic, Chemical, and Age Data on Some Intrusive and Associated Contact Metamorphic Rocks, Pioneer Mountains, Southwestern Montana. *E-an Zen, U.S. Geological Survey, 959 National Center, Reston, Virginia 22092, R. F. Marvin, H. H. Mehnert, U.S. Geological Survey, Denver, Colorado 80225.* (4 p., 3 figs., 3 tbls.)

Petrographic and chemical data on five types of intrusive rocks of the so-called Pioneer batholith from northeastern Pioneer Mountains, southwest Montana, show that the rocks range in composition from quartz diorite to granite. The volumetrically most important body is coarse-grained biotite-hornblende "granite" that superficially resembles the Butte Quartz Monzonite of the Boulder batholith, some 60 km to the northeast. In their K_2O content, the rocks belong to Tilling's "sodic series" of the Boulder batholith.

K-Ar dating on biotite and hornblende

shows that the dates of intrusion of all but the quartz diorite are about 70 m.y. The quartz diorite probably was intruded 76.5 m.y. ago, as given by its hornblende age. Its biotite age of 70.5 m.y. agrees with those of the younger intrusions. Metamorphic rocks of the Silver Hill Formation (Cambrian) at one locality yielded the same 70-m.y. age on biotite porphyroblasts. These ages compare closely with those of the Boulder batholith and of the Philipsburg batholith and show the same tendency for the less mafic rocks to be younger.

□ 50313—Chemistry and Mineralogy of Precambrian Paleosols in Northern Michigan. *J. Kalliokoski, Department of Geology and Geological Engineering, Michigan Technological University, Houghton, Michigan 49931.* (6 p., 6 figs.)

Paleosol profiles can be recognized on a basement terrain of granodiorite, peridotite, and diabase that underlie the upper Keweenaw (?) Jacobsville sandstone. The main characteristics of the granodiorite and peridotite profiles are a substantial loss in SiO_2 , Al_2O_3 , and alkaline earths, a smaller loss in Fe_2O_3 and NiO, the concentration of dolomite and quartz in paleo-caliche horizons, and the strong pigmentation of some of the primary minerals at the lower fringe of weathering. The granodiorite paleosol consists of a mixture of illite, chlorite, vermiculite, biotite, muscovite, K-feldspar, dolomite, quartz, hematite, and rutile. The peridotite paleosol contains chlorite, vermiculite, dolomite, quartz, hematite, and talc.

□ 50314—Subduction and Accretion in Trenches. *Daniel E. Karig, Department of Geological Sciences, Cornell University, Ithaca, New York 14850, George F. Sharman III, Scripps Institution of Oceanography, P.O. Box 109, La Jolla, California 92037.* (13 p., 8 figs., 2 tbls.)

Although the reality of subduction has been greatly strengthened by recent investigations, little information deals with the mechanisms by which material is sub-

ducted or accreted to the upper plate. An attempt to determine the gross evolution of subduction zones has been made, assuming that geographic variations in morphologic and geophysical characteristics of trenches can be transformed into temporal trends. Deformation associated with subduction extends across the lower trench slope, from the trench axis to the trench-slope break. This region is a rising tectonic element, but the upper slope is a subsiding region of sediment accumulation. An upper slope discontinuity separates this zone of subsidence from the rising frontal-arc block. Examination of very young trenches indicates that the upper-slope discontinuity marks the upper section of the continental or insular slope that existed before a subduction pulse began. As material is fed to the subduction zone, the distance between the upper slope discontinuity and the trench increases, and an accretionary prism develops, but its shape depends on the relative rates of sediment feed from the arc and from the offshore basin.

The lower boundary of the accretionary prism is the upper section of the seismic zone, which apparently widens and flattens as one or more accretionary prisms accumulate. The sediment cover on the downgoing plate and some of the igneous crust appears to be stripped off the plate before it reaches a point beneath the volcanic chain. Turbiditic sediments deposited in the trench axis are preferentially sheared off the underlying pelagic sediments and are accreted to the lower trench wall. The pelagic sediments and crustal material are probably accreted at deeper structural levels.

Where turbidites overlie pelagic sediments in the trench axis, the turbidites are stripped off in fold packets with axial surfaces having very low dips. These dewatered and rigidified structural units move up the lower slope, as subsequent packets are accreted. In trenches that subduct lithosphere carrying very thin pelagic sediment covers, accretion and uplift of crustal slabs seem to occur as topographic irregularities enter the trench.

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50315—The Vourinos Ophiolite, Greece: Cyclic Units of Lineated Cumulates Overlying Harzburgite Tectonite. *Everett D. Jackson, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025; Harry W. Green II, Eldridge M. Moores, Department of Geology, University of California, Davis, California 95616.* (9 p., 6 figs.)

The Vourinos ophiolite is composed of metamorphic and magmatic suite rocks. The contact between these major units is exposed and sharp. Beneath the contact the rocks have been highly deformed and complexly folded; above the contact they simply have been tilted vertically to expose a stratiform complex 1,500 m thick. The stratiform intrusive mass is characterized by cyclic units, rich in olivine at the base, and rich in feldspar at the top. Some cumulus diorite units at the top of the section grade into quartz diorite with hypautomorphic textures. Lineate lamination characterizes the cumulates, and may indicate the direction or orientation of the Mesozoic mid-oceanic ridge crest with respect to the present position of the complex. A siliceous dike swarm cuts the upper part of the stratiform complex. The section suggests that in the case of Vourinos, a large magmatic chamber formed at a mid-oceanic ridge crest and that intrusion was a much more important process than extrusion in the formation of oceanic crust in that area. The reported presence of cumulates in many other ophiolite complexes suggests that these relations may obtain generally at most or all spreading ridges. The contact between the metamorphic and magmatic suites of the complex would not have corresponded with seismic M.

50316—Potassium-Argon Age and Paleomagnetism of Diabase Dikes in Liberia: Initiation of Central Atlantic Rifting. *G. Brent Dalrymple, C. Sherman Grommé, U.S. Geological Survey, Menlo Park, California 94025; Richard W. White, U.S. Geological Survey, Denver, Colorado 80225.* (13 p., 8 figs., 5 tbls.)

Tholeiitic diabase dikes that trend northwest are common in northwestern Liberia. K-Ar whole-rock and mineral ages determined from dikes that intrude Precambrian crystalline rocks are discordant and range from 186 to 1,213 m.y. Incremental heating experiments on three neutron-irradiated samples of these rocks give saddle-shaped $^{40}\text{Ar}/^{39}\text{Ar}$ release diagrams that reach minima of less than 300 m.y. at intermediate temperatures and that do not fit a $^{40}\text{Ar}/^{36}\text{Ar}$ versus $^{39}\text{Ar}/^{36}\text{Ar}$ isochron. K-Ar ages determined from diabase dikes and sills that intrude Paleozoic sedimentary rocks near the coast are all within the range 173 to 192 m.y. $^{40}\text{Ar}/^{39}\text{Ar}$ incremental heating data for one of these samples give a plateau age and a $^{40}\text{Ar}/^{36}\text{Ar}$ versus $^{39}\text{Ar}/^{36}\text{Ar}$ isochron age that is concordant with the conventional K-Ar age. The conventional and $^{40}\text{Ar}/^{39}\text{Ar}$ K-Ar data show that the dikes intruding Precambrian basement rocks contain large and variable amounts of excess ^{40}Ar , whereas the diabase intruding Paleozoic sandstone does not. All of the intrusive rocks are probably earliest Jurassic in age.

50317—Rock Magnetism and Paleomagnetism of Some North Pacific Deep-Sea Sediments. *H. P. Johnson, Cooperative Institute for Research and Environmental Sciences and Department of Geology, University of Colorado, Boulder, Colorado 80302; H. Kinoshita, Meteorological College, Asahi-Cho, Kashiwa, Japan; R. T. Merrill, Department of Oceanography and Geophysics Program, University of Washington, Seattle, Washington 98195.* (9 p., 11 figs., 1 tbl.)

Detailed paleomagnetic and rock magnetic studies have been conducted on eight deep-sea cores from the North Pacific. Magnetic studies include alternating field demagnetization, thermal demagnetization, anhysteretic remanent magnetization studies, magnetic hysteresis measurements over a variety of different temperatures, viscous and drying effects, strong field versus temperature measurements, x-ray diffraction, and x-ray fluorescence analy-

ses. Six of the eight cores studied contain an abundance of fossils, particularly silicoflagellates, and appear to have acquired their remanent magnetization sufficiently close to the surface to reliably record the Earth's paleomagnetic field. This work summarizes many of the problems in obtaining reliable paleomagnetic results from deep-sea cores, including possible spurious magnetic directions resulting from chemical changes, drying, and coring effects.

50318—New Analyses of Eocene Basalt from the Olympic Peninsula, Washington. *N. A. Lytle, Department of Oceanography, Dalhousie University, Halifax, Nova Scotia, Canada B3H 3J5; D. B. Clarke, Department of Geology, Dalhousie University, Halifax, Nova Scotia, Canada B3H 3J5.* (7 p., 6 figs., 1 tbl.)

Chemical analyses of samples of pillow lava, breccia, and minor intrusive rocks from the Olympic Peninsula show that the rocks have been altered through addition of at least water and carbon dioxide and that these rocks are tholeiitic basalt rather than spilite. A petrogenetic model involving partial melting of mantle peridotite to produce a magma which underwent fractional crystallization of olivine and equilibrated near atmospheric pressure accounts for the observed chemical features of the basalt. The characteristics and distribution of both the volcanic and associated sedimentary rocks suggests possible origin in an island arc environment.

50319—Peach Springs Tuff: Its Bearing on Structural Evolution of the Colorado Plateau and Development of Cenozoic Drainage in Mohave County, Arizona: Discussion and Reply.

Discussion: *Earl M. P. Lovejoy, Department of Geological Sciences, University of Texas at El Paso, El Paso, Texas 79968.*

Reply: *Richard A. Young, William J. Brennan, Department of Geological Sciences, State University of New York at Geneseo, Geneseo, New York 14454.*