GSA news & information

SUPPLEMENT TO GEOLOGY MAGAZINE

JUNE 1976

# The separates option during 1975 analyzed

1975 was the first year that an option to receive only separates from the *Bulletin* was offered to the GSA membership. As 5,147 of the Fellows, Member, and Student Affilates elected to take that option, it proved to be popular. After one year of operation, it seems appropriate to examine the performance of the option and the preferences directly expressed by the placing of orders. The following analysis is based on a computer compilation of data as of 1 March 1976 and, therefore, cannot be viewed as a final tabulation. This is particularly true for the last half of 1975, as several months remain during which separates may be ordered. The over-all numbers as of March first are: 49,291 separates had been ordered by 2,793 members who selected the option. There had been 13,557 packages of separates mailed for an average of 3.64 separates per order. The maximum number of copies that had been ordered for any single article was 944, and the minimum number ordered was 26. On the basis of percentage of orders from a single *Bulletin* number, the highest percent of orders going to any article was 17.3 percent and the minimum was 0.7 percent.

An attempt to analyze subject matter preferences of the membership on the basis of separates orders is frustrating, to say the least. Perhaps it demonstrates again that the membership of GSA has interests embracing all aspects of Earth and planetary sciences. The monthly "best sellers" ranged from plate tectonics, geochemistry, sedimentology, and seismology, through geomorphology and remote sensing, to Mars. As evidence that their position in the *Bulletin* number had no bearing on their selection, their position ranged from no. 1 to no. 18. As evidence that the monthly "best sellers" were not selected on the basis of length, they ranged from 4 to 17 pages, with an average length of 10 pages. Nor did the place of residence of the authors determine the number of orders, as there were authors from outside of North America on both the "best seller" list and the "least ordered" list. The minimum order for each month sheds even less light on preference, unless it is to indicate that Discussions and Medal Awards citations are not as sought after for reprint collections as are original papers.

The over-all performance appears to be reasonably satisfactory for a first year of the separates option—the year when (hopefully) most of the mistakes were made. However, the figures that are available to date for 1976 indicate that only 37 percent of the membership has selected a separates option (options B and C) again this year, which is a decline from the 44 percent during 1975.

SEPARATES ORDERS BY MONTH, 1975

| Month | Total | "Best seller" |
|---|---|---|
| January | 5,400 | 643 |
| February | 5,119 | 586 |
| March | 5,443 | 944 |
| April | 3,651 | 586 |
| May | 3,800 | 612 |
| June | 4,640 | 581 |
| July | 4,035 | 460 |
| August | 3,882 | 572 |
| September | 3,828 | 366 |
| October | 3,725 | 489 |
| November | 3,676 | 561 |
| December | 2,092 | 335 |

**If your separates are delayed . . .**

Mailings of GSA authors' offprints and subscribers' *Bulletin* separates are delayed because of the following procedures. The *Bulletin* and *Geology* are mailed to subscribers from our warehouse in Burlington, Vermont; after publication of the above issues, offprints and separates are shipped to Boulder where they are processed and mailed to the authors and subscribers, by library rate, which takes from two to four weeks; foreign mail is sent by surface first class, which takes from six to eight weeks. Please allow time for delivery.

# GSA'S FINANCIAL SITUATION UP-DATED

The Society has gone through a year and a half of financial crisis. Many actions have been taken to correct the situation. Some of these actions have been described in News & Information, some are reflected in dues statements, and some are so minor that space will not be taken to describe them.

It seems, however, that the membership would be interested in the broad, general picture and also to know that the Society is finally operating in the black again—barely; the general reserve fund, however, has been dissipated, so we no longer have a soft cushion to fall upon.

These broad features are illustrated in the two sets of accompanying charts. The data presented are from part of the analysis prepared for the May meeting of the GSA Council. Figure 1 tells the overall story of the past four years. At the beginning of this period the general reserve fund was still large, the market value of the endowment was at its highest point and contained significant amounts of capital gains, and the general economy looked very good indeed. It was during such optimistic times that plans were made for the launching of a new journal, *Geology*, and for expansion of a number of in-house operations at headquarters. These factors are all reflected in the staff and payroll increases continuing into early 1974, as shown in Figure 2.

During the mid part of this four-year period, the market value of investments precipitously declined, and potential capital gains turned to potential (or realized) capital losses. This is not reflected on the chart because Figure 1B shows only income from interest and dividends and does not include capital gains or losses. The high rate of inflation during this same period, however, did have a direct effect on the shapes of the curves.

Figure 1C shows total income from dues and the cost of all publications distributed to the membership. It shows that the optional dues that were instituted now cause the dues to pay the costs of publications received. (There is, however, no residue from the dues payment to cover the $2 per member to the AGI or the costs of the membership unit at headquarters.)

The restrictions of headquarters operations during the past year and a half are clearly reflected in Figure 2. Also, the effect of inflating costs is evident, as an 18 percent reduction in total staff hours has resulted in only a 5½ percent reduction in total payroll.

Happily, at the present time the Society is operating within the constraints of its income. It must be remembered, however, that there is no longer an adequate reserve fund and that continuing inflating costs dictate continued fiscal vigilance.

John C. Frye
Executive Director

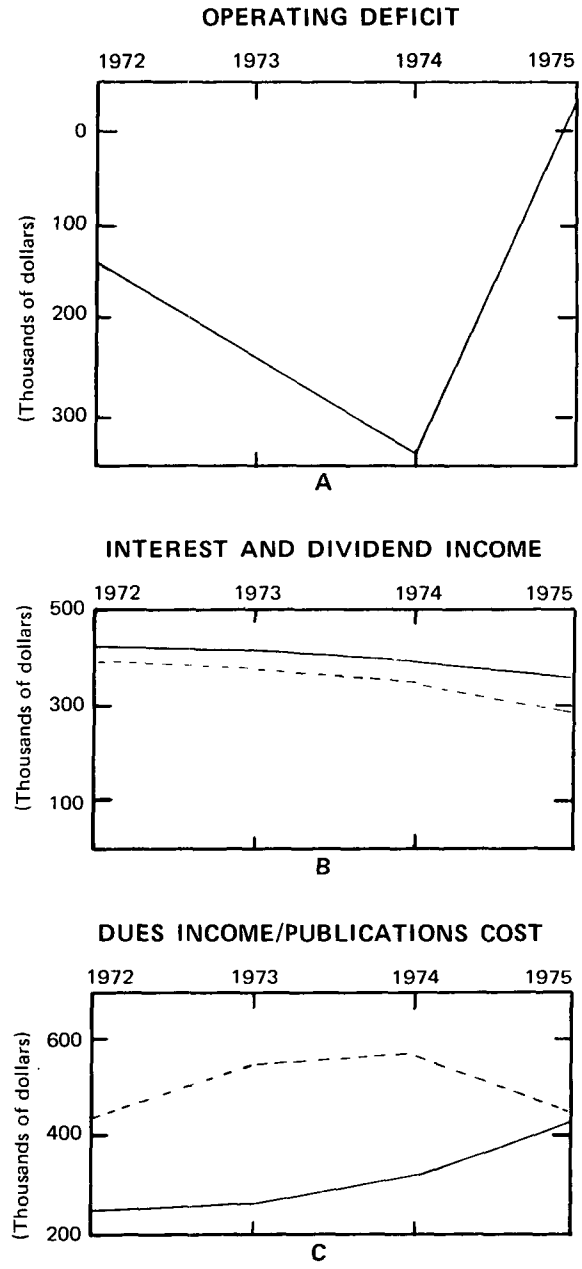


**Figure 1. Major features of GSA finance.**

A. Operating deficits during 1972, 1973, and 1974, with a slight surplus in 1975. The chart shows differences between total income and total expenditures. The total income figures include interest and dividends from all investments but not capital gains or losses.

B. Total interest and dividend income from all investments, solid line; income to current operating fund, less funds dedicated to medals, awards, and so forth, dashed line.

C. Total income from all dues, solid line; total cost of publications distributed to members, dashed line.

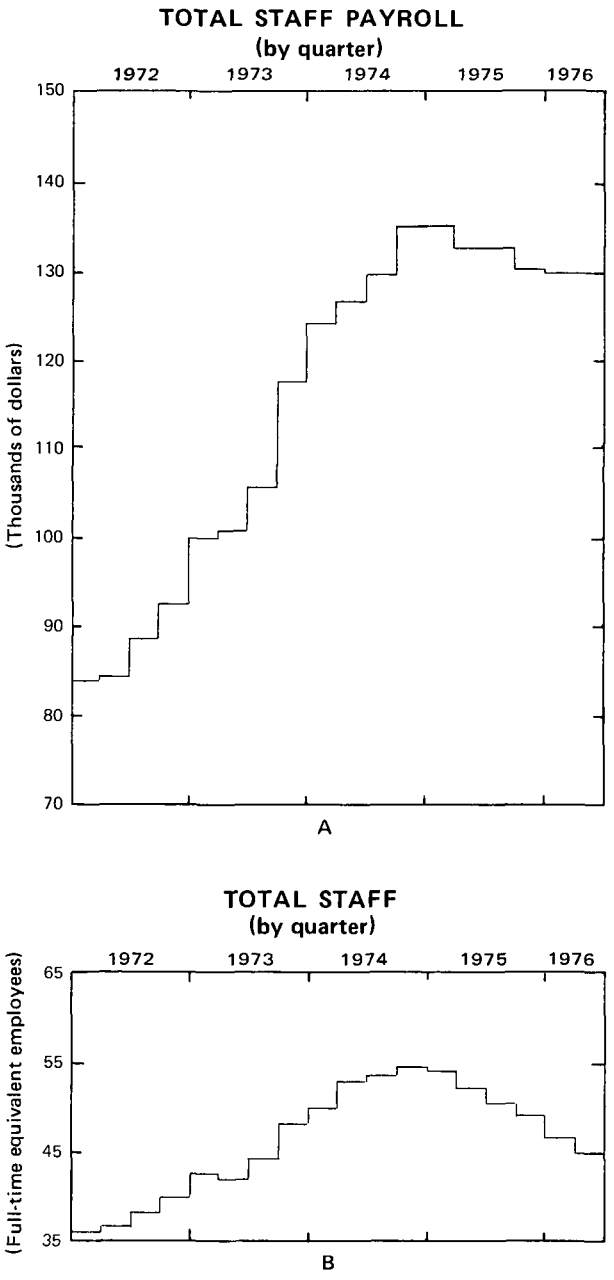


**Figure 2. Headquarters staff.**

A. Total staff payroll by quarter, starting with first quarter of 1972.

B. Total GSA staff in full-time equivalents by quarter, starting with first quarter of 1972. Second quarter of 1976 is in part estimated.

## Committee on Committees seeks nominations

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

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

The 1976 Committee on Committees is made up of the following people: Albert W. Bally (chairman), Mary R. Dawson, Robert P. Sharp, and Samuel J. Tuthill.

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

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

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

Budget
Environment and Public Policy
GSA-Treatise Advisory
Headquarters Advisory
Penrose Medal
Day Medal
Honorary Fellows
National Medal of Science
Investments
Membership
Nominations
Penrose Conferences
Publications
Research Grants
Joint Technical Program Committee

## Guatemalan Geological Society established

The Guatemalan Geological Society (Sociedad Geológica de Guatemala) was officially established on July 7, 1975. The present President is Mr. Oscar Salazar, Head of the Geology Division of the National Geographic Institute.

The Society meets monthly every first Monday, at 16:30, on the premises of the Instituto Centroamericano de Investigacion y Tecnología Industrial (ICAITI), Avenida La Reforma 4-47, Zona 9, Guatemala City. Visitors are welcome to attend the sessions.

# The Cushman Foundation for Foraminiferal Research joins GSA as an Associate Society

*The Cushman Foundation for Foraminiferal Research became the eighth society associated with the Geological Society of America on October 18, 1975, when the Council of GSA approved the relationship. The following article, prepared by Don. L. Eicher, Vice-President of the Cushman Foundation, presents a brief statement of its formation and activities. The membership of the Foundation now exceeds 700, and they will be sponsoring scientific sessions and other functions at GSA's annual meetings.*

The Cushman Foundation was incorporated June 27, 1950, by a group of seven scientists, together with the four immediate members of the Cushman family—Joseph A. Cushman's widow, son, and two daughters. Their aim was to secure financial means of maintaining an international journal that would occupy the place vacated by Joseph Cushman's privately financed journal, which had concluded its 25-volume existence the previous December, following Dr. Cushman's death in April 1949. Among the incorporators and first directors, there was a widely felt need for a medium of rapid presentation of the results of research that were becoming increasingly important to the solution of geologic problems.

At its modest beginning in April 1925, the highly exteemed pioneering journal *Contributions from the Cushman Laboratory for Foraminiferal Research* predated by two years the *Journal of Paleontology,* whose first editor was Joseph A. Cushman. The Foundation's new journal *Contributions from the Cushman Foundation for Foraminiferal Research*, like its predecessor, published the results of research on the evolution, biology, ecology, structure, and systematics of Foraminifera, plus reviews of current literature.

The new journal differed, however, in an enlarged format and in that publication was open to all. As a result, it has served the field of Foraminifera in ways comparable to and expanded from that served by the publications of the Cushman Laboratory for Foraminiferal Research in Sharon, Massachusetts, during the years of its existence—1923 to 1949.

In the 26 years since its incorporation, the Cushman Foundation has supported two series of publications—*Contributions* and *Special Publications*. The *Contributions,* a quarterly journal, after completion of 21 volumes in 1970, was succeeded in 1971 by the enlarged quarterly *Journal of Foraminiferal Research,* now in its 6th volume. The *Special Publication* series has published 13 numbers with the 14th in press. These are irregularly scheduled monographic works or groups of related papers on a specific subject, made possible by specially contributed funds, originally initiated by a gift from Frieda Billings Cushman. In addition, the Foundation continues the sale of the still-remaining Cushman publications of the former Laboratory, which it received by gift from Alice E. Cushman, Dr. Cushman's daughter who served as Secretary of the Cushman Laboratory.

The Foundation is managed by a Board of 15 directors—persons of recognized standing in paleontology, biology, geology, or oceanography—representative of scientific and educational institutions, the petroleum industry, the Smithsonian Institution, and the U.S. Geological Survey.

An international board of associate editors, representative of the various specialized fields in Foraminifera, serves to funnel the best qualified papers of general interest and review articles to the editor and assistant editors.

The Foundation in its endeavor to provide prompt, high-quality publication for articles dealing with new discoveries, current problems, evaluations of phylogenetic questions, biostratigraphy, and taxonomy in the tradition of meticulousness and excellence established at the Cushman Laboratory more than a half-century ago, stands in a position of service not only to the field of Foraminifera and allied organisms but to a multitude of related geologic and oceanographic problems.

Don L. Eicher
Vice-President

## A reminder of an important member service

**MEMBER DISCOUNT**

All Fellows, Members, and Student Associates may purchase Society publications at a MEMBER DISCOUNT OF 20 PERCENT from list prices, subject to the following:

1. Members must place their orders over their own signatures. Orders submitted on corporate order forms will be filled at list prices.
2. Only one copy of any title may be purchased at member discount. Additional copies of the same title must be purchased at list price.
3. The member discount does not apply to GSA's periodicals: **Abstracts with Programs, Bibliography and Index of Geology, Geological Society of America Bulletin,** and **Geology.**

**CASH-WITH-ORDER DISCOUNT**

Members (and nonmembers) may take a discount of 5 percent when they send payment with their orders.

1. The cash discount applies to purchases of all of the Society's publications, including single issues of periodicals.
2. GSA members may take a member discount of 20 percent plus 5 percent for cash on their prepaid orders for their first copy of a book, map/chart, or microform publication. Prepaid orders from members for additional copies of the same title are subject to the 5 percent cash discount.

# GSA research grants awarded

At its March meeting, the 1976 Committee on Research Grants reviewed 256 applications and recommended 111 of them to the Council for financial support. Four grants were awarded to senior investigators and 107 to students working toward advanced degrees. The total amount awarded was $70,950 with grants ranging from $270 to $1,250 each. These funds consist of $50,000 from the Council from the endowment fund, $15,200 from contributions from industry, $5,050 received in donations from past research grant recipients, and $600 income from the Harold T. Stearns Fellowship Fund.

The committee voted to recommend James Walter Castle, University of Illinois at Urbana-Champaign, to be this year's recipient of the Harold T. Stearns Award for research on one or more aspects of the geology of the circum-Pacific region. Castle's project is titled Sedimentation in some modern Pacific trenches and comparison with the Caples terrane, New Zealand.

The committee singled out the following young scientists and their outstanding proposals to be brought to the attention of the membership of the Society:

James D. O'Brient, Stanford University: A study of igneous processes in the development of hypabyssal porphyries based on the Rabb Canyon pegmatites and rhyolite porphyry, Grant County, New Mexico

John Walter Shervais, University of California, Santa Barbara: Petrology and structure of the Alpine lherzolite massif at Balmuccia, Italy

Jesse Paul Shore, University of California, Berkeley: Investigation of the creep properties of Yule marble during experimental extrusion

Ronald K. Stoessel, University of California, Berkeley: Geochemistry of sepiolite

Charles Ross Williamson, University of Texas at Austin: Sedimentology and diagenesis of the Bell Canyon Formation (Permian), Delaware basin, Texas–New Mexico

The following eleven companies, foundations, or individuals made generous donations to augment our funding:

Alcoa Foundation
Ashland Oil, Inc.
Chevron Oil Field Research Company
Gulf Oil Foundation
Michel T. Halbouty
Marathon Oil Company
Mobil Oil Corporation
Phillips Petroleum Company
Shell Development Company
Texaco, Inc.
Union Oil Company of California Foundation

Twenty-five promising young Earth scientists were chosen as recipients of these funds. The names of the recipients of these funds, their institutions, grant titles, and the names of the donors are as follows:

Alan W. Ambuehl, Louisiana State University: Authigenic silica in Gulf Coast sediments (Halbouty)

Michael David Brondos, University of Kansas: Micropaleontology and depositional environments of the Stanton Formation in southeastern Kansas (Halbouty)

H. Paul Buchheim, University of Wyoming: Paleoecology of fossil fishes as an aid in the interpretation of depositional environments of Green River Formation oil shales, Green River Basin, Wyoming (Shell)

James Walter Castle, University of Illinois at Urbana-Champaign: Sedimentation in some modern Pacific trenches and comparison with the Caples terrane, New Zealand (Shell)

Diana L. Duckworth, University of Chicago: A model for the physiological control of mineralogy and trace element composition of biogenic carbonate (Phillips)

Curtis L. Gorman, University of South Carolina: A study of the net budget of dissolved oxygen, oxygen-demanding substances and suspended sediment in a small intertidal marsh basin (Union)

Mary Bremer Haas, University of Cincinnati: Benthic Foraminifera of the Calabrian: Stratigraphy and paleoecology (Union)

Murray Noel Hutchison, University of Toronto: Refinement and application of the sphalerite geobarometer (Alcoa and Gulf)

Markes Eric Johnson, University of Chicago: Recurrent community patterns in epeiric seas: Central North American craton during the Llandovery Epoch (Lower Silurian) (Mobil)

Timothy L. Kirst, Louisiana State University, Baton Rouge: Authigenic cements and their relation to the geopressured zone (Halbouty)

Edward William Landing, University of Michigan: Late Cambrian–earliest Ordovician conodont biostratigraphy of New Brunswick, Cape Breton Island, and east Newfoundland (Marathon)

Judy A. Massare, Johns Hopkins University: Speciation in the *Urosalpinx* lineage (Neogastropoda; Muricidae) (Chevron)

Peter J. McCabe, McMaster University, Ontario: Mid-Carboniferous fluvial sediments of southeast New Brunswick (Shell)

James E. McGovney, University of Wisconsin: Reinterpretation of the Thornton "reef" complex (Silurian), northern Illinois, and comparison with Michigan basin subsurface reefs (Halbouty and Texaco)

Charlotte Jean Mehrtens, University of Chicago: Paleoenvironmental reconstruction of a shelf margin: The Caradoc (Middle Ordovician) of southern Quebec (Gulf)

*(next page, please)*

# research grants . . .

Lorraine M. Monnier, University of Wisconsin: Biostratigraphy and structure of the Cache Creek Series, Tagish and Tutshi Lakes, southeast Yukon Territory and northwest British Columbia, Canada (Phillips)

John D. Pigott, University of Texas at Austin: Petrographic and geochemical study of lithified and associated unlithified carbonate sands and muds of a Holocene reef, Discovery Bay, Jamaica, West Indies (Mobil)

James Bruno Risatti, University of Illinois at Urbana: Biogeochemistry of peat formation (Ashland)

Ganapathy Shanmugam, University of Tennessee: Depositional environments of the Middle Ordovician Sevier Shale Formation in eastern Tennessee (Chevron)

Joseph P. Smoot, Johns Hopkins University: The production of carbonate sediments in the Wilkins Peak Member of the Green River Formation (Gulf and Union)

George D. Stanley, Jr., University of Kansas: Structure and paleoecology of Triassic coral buildups in western North America (Ashland)

Christopher Anne Suczek, Stanford University: Tectonic relations of the Harmony Formation, northern Nevada (Texaco)

David R. Van Alstine, California Institute of Technology: Paleomagnetic determination of late Precambrian to Early Ordovician apparent polar wandering with respect to North America with particular emphasis on Cambrian magnetostratigraphy (Marathon)

Joe R. Wadsworth, Jr., University of Georgia: Effects of tidal range on morphology and distribution of tidal channels (Chevron and Gulf)

Charles Ross Williamson, University of Texas at Austin: Sedimentology and diagenesis of the Bell Canyon Formation (Permian), Delaware basin, Texas–New Mexico (Texaco)

In response to our request for donations for the research grants program from former grant recipients, we are continuing to receive donations at headquarters. Persons who have contributed to this fund since January 1, 1976, are listed below:

Charles A. Anderson
Paulo F. Bahia-Guimaraes
James B. Benedict
Charles S. Denny
F. M. Fryxell
Christopher D. Henry
A. D. Howard
G. Evelyn Hutchinson
Michael J. Kennish
P. B. King
Harry J. Klepser
Leonard H. Larson
Christina Lochman-Balk
Everett C. Olson
W. Armstrong Price
J. Fred Smith, Jr.
A. C. Waters

Application forms and detailed instructions for 1977 grants will be sent, upon request, by the Executive Director, Geological Society of America, 3300 Penrose Place, Boulder, Colorado 80301. The deadline date for filing applications is February 15, 1977.

## Memorial preprints available on request

Separate preprints of GSA memorials to the persons listed below are available on request by writing to GSA headquarters, 3300 Penrose Place, Boulder, Colorado 80301. Authors of the memorials are listed in parentheses.

Hans W. AHLMANN, 1889–1974 (Gunnar Hoppe and Valter Schytt)
Ernst Valdemar ANTEVS , 1888–1974 (Terah L. Smiley)
Richard William BAYLEY, 1919–1974 (Harold L. James)
Roland BLANCHARD, 1891–1966 (George Tunell)
Charles Wilson BROWN, 1874–1974 (Alonzo W. Quinn)
Francis CAMERON, 1902–1975 (F. Stuart Miller)
Anthony R. CARIANI, 1918–1974 (John G. Douglas)
Frank Rinker CLARK, 1881–1974 (Frank A. Morgan)
Ernst CLOOS, 1898–1974 (Francis Pettijohn)
John Gray DOUGLAS, 1900–1974 (John C. Dunlap)
Elliot GILLERMAN, 1913–1974 (Frank C. Foley)
George Edward GOODSPEED, 1887–1974 (Julian D. Barksdale)
Jarvis Bardwell HADLEY, 1909–1974 (John T. Hack and Richard Goldsmith)
William Eugene HAM, 1916–1970 (Donald F. Toomey)
Henry V. HOWE, 1896–1973 (James P. Morgan)
William Harold IRWIN, 1908–1974 (Jerry S. Dodd and Roxy Root)
Philip Hennen JENNINGS, 1899–1974 (John T. Rouse)
Glenn Lowell JEPSEN, 1903–1974 (Erling Dorf)
J. Harlan JOHNSON, 1892–1974 (John L. Wray)
George Moses KNEBEL, 1899–1974 (W. E. Wallis)
L. Don LEET, 1901–1974 (Marland P. Billings)
Gerald Raleigh MacCARTHY, 1897–1974 (William A. White)
Phil F. MARTYN, 1903–1974 (Martin M. Sheets)
Charles Warren MERRIAM, 1905–1974 (Charles A. Anderson)
Walter Franklin POND, 1885–1974 (Walter B. Jones)
Gordon RITTENHOUSE, 1910–1974 (Francis Pettijohn)
William Walden RUBEY, 1898–1974 (James Gilluly)
Robert F. SITLER, 1929–1974 (Glenn W. Frank)
Anna I. Jonas STOSE, 1881–1974 (Richard V. Dietrich)
Alexander STOYANOW, 1879–1974 (Charles A. Lee)
Garvin Lawrence TAYLOR, 1908–1974 (August Goldstein, Jr.)
Francis M. VAN TUYL, 1887–1975 (L. W. LeRoy)
Robert Orion VERNON, 1912–1974 (Philip E. LaMoreaux)

Memorials are also available through our bound volumes. Volumes I (1969 decedents) and II (1970 decedents) are $4 each; Volume III (1971 decedents) is $6; Volume IV (1972 decedents) is $7.50.

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

## Membership opinion poll tabulated

Opinion poll results on Fellowship and Membership favor retention of the two-class system. The Committee on Membership has reviewed the results of the poll and the many additional comments (some running to several typewritten pages!); we thank you for your responses.

The poll revealed a strong expression of opinion that the Society should retain the two-class system of Fellowship and Membership. A majority of respondents favor no change in current requirements or procedures for election to Fellowship, but they also feel that the present requirements should be more rigorously interpreted by Fellowship sponsors and the Committee on Membership.

Nearly 1,000 members or 8 percent of the total membership responded. Fellow opinion dominated in the survey, with 14 percent of the Fellows returning opinions (54 percent of the total return) as opposed to only 6 percent of the Members (41 percent of the total return) returning opinions.

The distribution of Fellow versus Member votes on various options were markedly disparate. Two-thirds of the total respondees wish to retain the two-class system. Section A of the accompanying table shows that Fellows favored dual class membership by a margin of 5 to 1; Members were almost evenly split on the issue. The small number of Student votes generally paralleled those of the Fellows Two-thirds of the Fellows approved current Fellowship requirements and procedures, whereas two-thirds of the Members voted for a change (Section B in table).

Fellows and Members also disagreed on how Fellowship should be determined if maintained. Of the four options offered for Fellowship procedural or eligibility changes, Section C of the table demonstrates that Fellow opinion dominated the vote for Option 2: Current Fellowship requirements should be maintained but more rigorously interpreted by sponsors and the Committee on Membership. More stringent requirements were next on their list. The Members were polarized in their opinions. The largest number voted for automatic Fellowship after a designated period, but almost as many voted for more stringent Fellowship requirements. Again, Student opinion was similar to that of Fellows. All three groups rejected Option 3: Fellowship based on three sponsor endorsements, with no Membership Committee evaluation.

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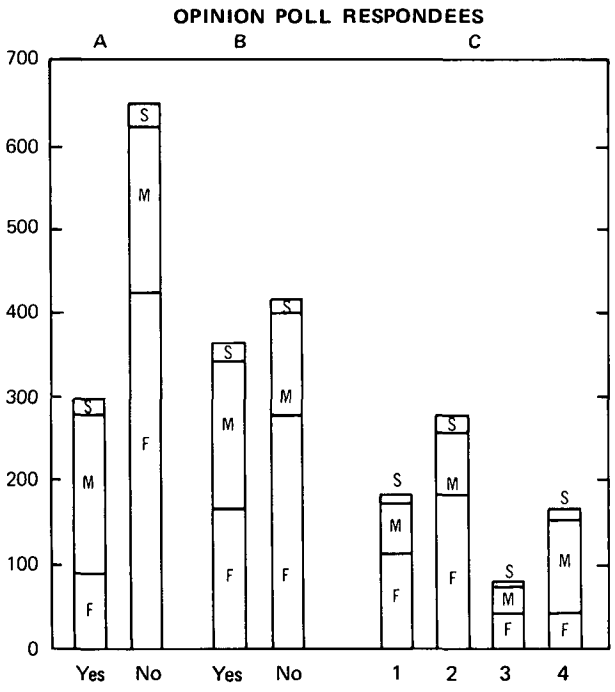
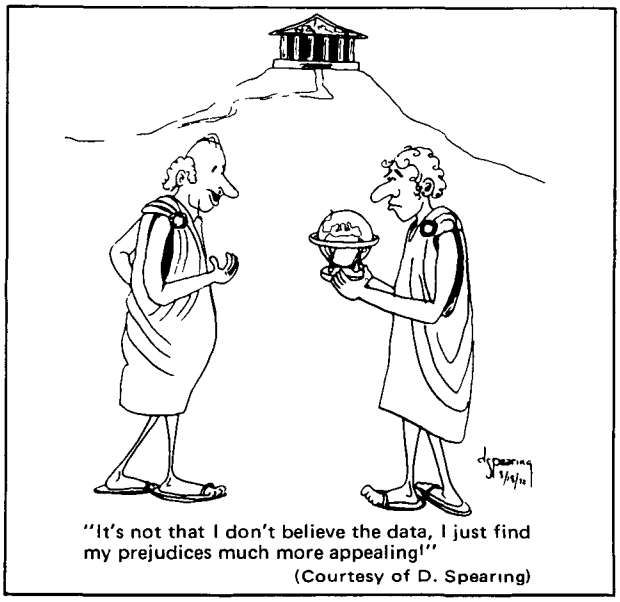
Further discussion and results of recommendations to Council will be reported in a future issue of News & Information




A. The present dual class of membership (Member-Fellow) should be abolished.

B. The current Fellowship requirements and procedures for election (three sponsors, Membership Committee review) should be changed

C If Fellowship requirements and procedures are changed, the changes should be made in accordance with one of the following guidelines:
1. Fellowship requirements should be made more stringent.
2. Current Fellowship requirements should be more rigorously interpreted by sponsors and the Membership Committee.
3 Three sponsor endorsements, with no committee evaluation, would produce automatic Fellowship.
4. Fellowship should be automatic after a designated period of Society membership.



"It's not that I don't believe the data, I just find my prejudices much more appealing!"
(Courtesy of D. Spearing)

# BOOK BRIEFS

*This feature is included occasionally in the News & Information section to keep members informed of recent books published by the Society.*

## Environmental Geology: A Selected Bibliography

MICROFORM PUBLICATION 1 — by Vivian S. Hall. 1975. 4 98-frame microfiche for use on 24x readers, $6.00

This bibliography contains more than 4,200 references, an author index, and two appendices. The titles listed are divided into the following categories: resources (579 references), geologic hazards (729 references), pollution (575 references), environmental impact (563 references), urban geology (173 references), land-use planning (734 references), waste (313 references), and water resources and management (561 references). The author's name is followed by the date of publication, title, place of publication, publisher, and the number of pages.

The titles listed in the bibliography, which extends into 1973, range from introductory works to highly technical publications. Included are reference works, bibliographies, and handbooks, as well as basic research reports, case studies, films, maps, documents, journals, journal articles, and monographs in the interdisciplinary area of environmental geology. Some works fit into two or more categories and have been listed under the primary area and cross-referenced from the other subject categories. These citations are international in scope and some are in foreign language editions; English translations of titles are given for most foreign language citations.

Appendix I lists 68 current reference titles useful in beginning or strengthening an environmental library collection. Appendix II lists names and addresses of corporate agencies and other publishers of titles listed in this work. These agencies are grouped and categorized as follows: 16 associations, 4 bureaus, 110 corporations, 33 governmental agencies, 11 institutes, 18 societies, and 32 universities.

## Mineral Resources of China

MICROFORM PUBLICATION 2 — by A. B. Ikonnikov. 1975. 6 98-frame microfiche for use on 24x readers, $9.00; or 6 microfiche with Xerox copies, unbound, $40.00.

The report presents a wealth of information on the production and reserves of mineral resources in China, prior to 1960. Statistical and other data were obtained chiefly from Chinese sources; few items related to mineral resources have been published in the post-1960 Chinese press. The report contains a 22-page introduction, one chapter on regional structural geology (72 pages), one on coal (60 pages), one on oil and gas (29 pages), one on iron resources (92 pages), and three chapters on nonferrous metals (176 pages). It also contains a comprehensive index to place names, 11 maps, and a reference list. The available data concerning mineral resources are more or less reliable, in the author's opinion, with the exception of those published during the "Great Leap Forward," starting in 1958.

The first comprehensive mineral survey, for iron and coal resources, started in 1870. The entire geological force in China in 1949 is estimated to have been about 800 individuals, of which about 200 were geologists and technicians. By the end of 1958 the number of workers in mineral exploration had increased to 330,000, including 21,000 trained geological personnel.

The introduction is largely a discussion of the reliability of source data and a brief history of geological education and mineral exploration in China. The chapter on coal has sections on general background, geologic age of deposits, coal basins, and appraisal of reserves. The chapter on oil and gas is divided into sections on general background, oil-bearing regions, oil shale regions, and appraisal of reserves. Each chapter on metalliferous deposits is divided into sections on general background, types of deposits, metal districts, and an appraisal of resources. The nonferrous metals discussed are divided into four groups: heavy metals, light metals, noble metals, and rare metals. The general background sections contain discussions of the pre- and post-1949 periods, which are mainly historical accounts of methods of prospecting and exploration discoveries, estimates of resources, and principal geologic maps.

The report contains a comprehensive alphabetical index to more than 1,000 place names in China, with Chinese characters, province, latitude and longitude, tectonic units, and minerals (elements) listed for each place name.

The 89 references include books, scientific periodicals, encyclopedias, yearbooks, newspapers, and other sources. The 11 maps of China include a map of administrative districts, a map of tectonic divisions, and maps showing resources.

The author deviates significantly from standard style of presentation (reference list and citation style), and the paper contains occasional typographic errors, but these do not detract from the readability of the text.

## Pennsylvanian conodont biostratigraphy and paleoecology of northwestern Illinois

MICROFORM PUBLICATION 3 — by Glen K. Merrill. 1975. Two standard 98-frame fiche for use on 24x readers and four 3x5 cards of direct prints of photographs of fossils, $6.00.

Pennsylvanian rocks form the bedrock surface beneath approximately 75 percent of Illinois. The study area (about 7,000 km$^2$) lies generally northwest of the Illinois River and northeast of the La Moine River; it includes Rock Island, Mercer, and Warren Counties plus the entire stratigraphic column in Knox, Peoria, Fulton, and Schuyler

Counties. The study area excludes Henry, Bureau, Stark, and LaSalle Counties. The work is both a geographic and stratigraphic extension of the study by G. K. Merrill and C. W. King, published in 1971.

The stratigraphic column for this region has become more or less a standard for the entire Illinois basin and, in some respects, for the Pennsylvanian system of North America as a whole. Moreover, the area was of major importance in the development of the Weller-Wanless model of Pennsylvanian cyclic sedimentation and the resulting concept of cyclothems.

The overwhelmingly dominant influence upon all the Pennsylvanian environments in this part of Illinois was the presence of one or more delta systems. Sedimentation and subsidence plus compaction were the major determinators of the distribution of land and shallow sea, although the greater part of the stratigraphic column can be regarded as subaerial deltaic in origin. Purely marine environments nevertheless span a wide range of conditions, and the conodont biofacies sharply differentiate and reflect this diversity.

The oldest marine unit is late Atokan in age and the youngest is early Missourian; the remainder are Desmoinesian in age. The studied marine units, all of which yield conodonts, in descending order are the Cramer (Trivoli in literature), Exline, Lonsdale, "Sparland," Pokeberry, "Sheffield," Brereton, St. David, Hanover, Oak Grove, Seahorne, "Seville," and Seville members; the aggregate thickness is approximately 200 m. More than 300 samples yielded in excess of 160,000 conodont specimens, which can be grouped into not fewer than 78 kinds that are considered species in disjunct element taxonomy. At least 10 multi-element genera and 40 multi-element species are represented. Six new species are described: *Diplognathodus illinoisensis, Neognathodus metanodosus, N. polynodosus, N. oligonodosus, N. anodosus,* and *Gondolella pulchra.*

*Neognathodus* is the most useful conodont genus for biostratigraphic control in these rocks. Four zones and subzones are based on species of this genus and it has permitted relatively precise interregional correlations. Secondary zonations can be based on other genera that supplement the *Neognathodus* zonations and assist in identifying units. In decreasing importance these are *Gondolella*, the *Idiognathodus-Streptognathodus plexus,* and *Diplognathodus.*

Ecologic controls on conodont distribution are believed to have been salinity, energy relative to wave base, pH, and possibly biologic antagonism.

## Contributions to the Geology of the Bering Sea Basin and Adjacent Regions

SPECIAL PAPER 151 — Edited by R. B. Forbes. 1975. x + 214 p., 83 figures, including 6 in b&w foldouts, 11 tables. $19.00.

The 10 selected papers in this volume were taken from the proceedings of two international symposia: the inauguration of the new Geophysical Institute Building at the University of Alaska, June 26–28, 1970, and the 2nd International Symposium on Arctic Geology held in San Francisco, February 1–4, 1971.

**Plate Tectonics and the Structural Evolution of the Aleutian–Bering Sea Region** (David W. Scholl, Edwin C. Buffington, and Michael S. Marlow). A partially decipherable geologic history includes formation of the Aleutian Ridge, the sedimentary infilling of the deep basin of the Bering Sea, and the structural evolution of the Beringian continental margin. The authors' conclusions imply that thousands of kilometres of oceanic crust underthrust the Kamchatka, Beringian, and Alaska margins from Late Triassic to Late Cretaceous time, and hundreds of kilometres underthrust the Aleutian Ridge in Cenozoic time.

**Contemporary Epicontinental Sedimentation and Shelf Grading in the Southeast Bering Sea** (Ghanshyam D. Sharma). Two broad depositional environments are suggested based on grain-size parameters. Sediment textural differences, shelf grading, and sediment transport from shallow shelf to deeper parts are attributed to storm-generated waves; theoretical wave dimensions are computed.

**Texture, Clay Mineralogy, and Chemistry of Bottom Sediments, West Beaufort Sea, Arctic Ocean** (A. S. Naidu, D. C. Burrell, D. W. Hood, and J. A. Dygas). Size distributions of the shelf sediments are generally positively skewed to nearly symmetrical and platykurtic and those of the extrashelf (slope and basin) to nearly symmetrical and mesokurtic. There is less organic carbon and more carbonate in the shelf sediments compared to the extrashelf. Organic carbon is correlative with clay content, and carbonate with coarse lithogenous and bioclastic content.

**Paleomagnetic Studies and Tectonics in the Aleutian Islands** (D. B. Stone). The paleomagnetic directions in Miocene and younger rocks generally coincide with the field expected for an axial dipole, implying that no significant tectonic movement has taken place since the rocks were formed. This is in contrast to the generally steeply dipping Eocene rocks. The paleomagnetic data put limits on the time of uplift and deformation and limits on the amount of lateral movement that occurred.

**Petrology of Eclogitic Rocks from the Fairbanks District, Alaska** (Richard C. Swainbank and Robert B. Forbes). Eclogitic rocks occur as conformable bands and lenses intercalated with amphibolite, impure marble, and pelitic schist (lower amphibolite facies). On the ACF plot, the calcite-rich eclogitic variants appear to have been derived from marl, and the calcite-free varieties are compositionally similar to subgraywacke rather than mafic igneous rocks. K-Ar data indicate deformations of Paleozoic and Cretaceous age.

**Petrochemistry of the Quaternary Volcanic Rocks of the Kurile Islands** (Kenzo Yagi). Quaternary volcanic rocks include andesite and basalt of the tholeiite and high-alumina basalt series, and calc-alkalic rocks derived from these two series. $SiO_2$ content of these rocks ranges from 45 to 70 wt percent. Basaltic rocks with 50 to 55 wt percent account for 24 percent of the analyzed rocks, and andesitic rocks with 55 to 60 wt percent $SiO_2$ make up 37 percent of the total. There is remarkable zonation of volcanic rock types in the Kurile arc.

**Metamorphic Belts of the Northwestern Circum-Pacific Region** (N. L. Dobretsov). Six types of metamorphic belts are recognized. A comparison of each type of terrane reinforces the validity of Miyashiro's "paired metamorphic belts" and the views of de Roever and Marakushev about progressive changes in metamorphic type as a function of time and tectonic stage.

**Eclogite-Glaucophane Schist Complexes of the USSR**

**and Their Bearing on the Genesis of Blueschist Terranes** (N. L. Dobretsov and V. S. Sobolev). The Ural–Tien Shan terranes afford proof that schist containing glaucophane, lawsonite, and jadeite is not restricted to the relatively young (post-Paleozoic) metamorphic belts, and that the genesis of intracontinental blueschist belts is more compatible with trough or rift systems than with typical subduction zones of oceanic plates.

**Problem of Water Content in the Genesis and Ascent of Magma** (V. S. Sobolev). The nature of xenoliths in kimberlite and the mineral inclusions in diamonds suggest substantial upper-mantle differentiation down to at least 150 to 200 km. Magmas that may be extruded have been formed at relatively low partial water pressures. The possibility of crustal intrusion is increased by a rise in $P_{total}$, which results in magma formation at lower $P_{H_2O}$ as well. The homogenization of inclusions in the mineral phases indicates that the temperature of crystallization was higher than that of water-saturated melts. Water assimilation with varying partial pressure ($P_{H_2O}$) may play an essential role in magma mobility and temperature of crystallization.

**Upper Mantle Inhomogeneities with Reference to the Problem of Magma Formation** (N. V. Sobolev and V. S. Sobolev). Xenoliths of diamond-bearing eclogite and garnetiferous peridotite are noted in kimberlite pipes. The chemistry of the mineral phases associated with the diamonds indicates that crystallization occurred under conditions of low oxygen potential and that the appearance of free carbon as graphite or diamond is encouraged by reduced oxygen potential.

## Bathymetric Map of the Bering Shelf

MC-7 — Compiled and contoured by Richard Pratt and Fred Walton. The base map is a Lambert conformal conic projection with standard parallels of 52°30'N and 68°30'N. The horizontal scale is approximately 20 nautical miles to the inch. Depths are in metres. Black and white on one sheet, 34 inches by 43 inches. Folded in 9"x12" envelope, $4.00; rolled in sturdy mailing tube, $4.50.

The Bering Shelf lies immediately south of Bering Strait and northwest of the eastern part of the Aleutian island arc, between Siberia and Alaska. The bathymetric map reveals the Beringian continental margin which trends northwesterly across the southwestern part of the map area; the map includes the northeastern part of the Aleutian Basin which lies west of the Beringian continental margin.

The map encompasses the area between lat 55°N to 66°N and long 157°W to 178°E. Map scale is 40 km to the inch; contour intervals are 5 and 10 km over most of the shelf area, and 50 and 100 km along the Beringian margin and in the Aleutian Basin.

Sources of data include the Hydrographic Office, the National Ocean Survey, and the Coast and Geodetic Survey.

# June BULLETIN briefs

*Brief summaries of articles in the June 1976 GSA* Bulletin *are provided on the following pages to aid members who chose the lower dues option to select* Bulletin *separates of their choice. The Document Number of each article is repeated on the coupon and mailing label in this section.*

☐ 60601—Sedimentology of a Middle Ordovician quartz arenite–carbonate transition in the Upper Mississippi Valley. *Gordon S. Fraser, BP Alaska Exploration, Incorporated, 100 Pine Street, San Francisco, California 94111.* (13 p., 9 figs., 2 tbls.)

The St. Peter–Platteville transition consists of three formations representing an upward change in deposition from quartz arenites to shallow-water carbonate rocks. The St. Peter Sandstone is the lower unit and is composed of conglomerate and shale overlain by quartz arenites; it is divided into the Kress, Tonti, and Starved Rock Members. The Glenwood Formation is the middle unit; it consists of argillaceous sandstone, arenaceous mudstone, fissile shale, and arenaceous dolosiltite. The Pecatonica Formation is the upper unit; it consists of laminated and unlaminated carbonate rocks, sandstone with carbonate cement, and brecciated calcisiltite.

The Kress and Tonti Members were deposited as basal units during transgression over an erosional surface. The Tonti Member accumulated as a sheet sand in progressively shallower water northward. The transgression was followed by recession due to localized aggradation. The Starved Rock Member was deposited as a barrier-island complex. The Glenwood Formation accumulated in a lagoon north of the barrier island. Transgression resumed, and the Pecatonica Formation was deposited in a shallow subtidal environment over most of the area. Deeper water carbonate rocks, however, formed where the former lagoon was deepest, and tidal flat carbonate rocks formed over the submerged barrier island.

☐ 60602—Strike-slip faulting terminates the Basin and Range province in Oregon. *Robert D. Lawrence, Department of Geology, Oregon State University, Corvallis, Oregon 97331.* (5 p., 4 figs., 1 tbl.)

The pattern of faulting in southeastern Oregon is interpreted in terms of four major zones of right-lateral strike-slip faulting that separate blocks broken by normal faulting. The total amount of east-west extension is considered to decrease in the block north of each strike-slip fault zone. The right-lateral offset results from the decrease in extension. Extension essentially dies out across the northern two fault zones, which are thus considered the northern limit of the Basin and Range province. The greatest offset is apparently recorded on the next zone to the south by the displacement of the eastern edges of the Sierra Nevada and Idaho batholiths. The two southern zones offset the

Pleistocene to Holocene trend of the High Cascades by 10 to 20 km in a right-lateral sense. The Brothers fault zone, one of the northern zones, is of special interest because both ends of the fault are interpreted to be exposed at the surface.

☐ 60603—Implication of klippen and a new sedimentary unit at Gibi Mountain, Liberia, West Africa, in the problem of the Pan-African–Liberian age province boundary. *Charles H. Thorman, U.S. Geological Survey, Federal Center, Denver, Colorado 80225.* (6 p., 5 figs.)

Klippen of Precambrian mylonitic quartzite and subordinate itabirite and graphitic schist, tentatively correlated with rocks in the Pan-African age province (~550 m.y. old), overlie a Precambrian(?) to Cambrian(?) formation at Gibi Mountain and Liberian age province gneisses (~2,700 m.y. old), approximately 32 km northeast of the northwest-trending Pan-African–Liberian age province boundary. Small-scale folds in the allochthonous rocks and in the underlying formation at Gibi Mountain indicate relative northeastward movement of the Klippen. The age province boundary appears to be a southwestward-dipping fault zone along which the Pan-African age province was thrust over the Liberian age province in late Precambrian or early Paleozoic time. The formation at Gibi Mountain, consisting of arkose, shale, and conglomerate, is similar to units in the Rokel River Group in western Sierra Leone and appears to indicate a 225-km southeasterly extension of the late Precambrian(?) to Cambrian(?) basin proposed by Allen (1968) to have bordered the West African craton from Mauritania to Sierra Leone. Stratigraphic data in the crystalline rocks do not allow interpretation of the Pan-African–Liberian age province boundary as a cryptic suture, a zone marking the collision of two continental plates.

☐ 60604—Effect of vegetation on lateral migration of anastomosed channels of a glacier meltwater river. *Derald G. Smith, Department of Geography, University of Calgary, Calgary, Alberta T2N 1N4 Canada.* (4 p., 6 figs., 1 tbl.)

A series of experiments were performed on bank materials of anastomosed channels in flood-plain silt deposits in the Alexandra Valley in Banff Park, Alberta, to determine the effect of vegetation roots on bank erodibility and lateral migration of channels. Underground roots from the dense growth of meadow grass and scrub willow provide the reinforcement of bank sediment and a riprap-like protection of channel banks from river erosion. Results from the experiments suggest that in cool environments with aggrading river conditions where overbank deposition of silt, clay, and fine sand dominate the valley fill, vegetation roots are able to rapidly accumulate and decay very slowly, thus affording protection to banks from erosion in deeper parts of the channels.

Experiments were performed with a specially designed erosion box, used as a means to simulate natural erosion conditions and measure the influence of vegetation roots in reducing bank erosion. Results indicate that the bank sediment with 16 to 18 percent by volume of roots with a 5-cm root-mat for bank protection, typical of the area, had 20,000 times more resistance to erosion than comparable bank sediment without vegetation. Assuming five severe erosion days per year, potential lateral channel migration would amount to 4.2 cm per year. Such resistance, due to vegetation, accounts for the remarkable stability of channels during the last 2,500 yr in the Alexandra Valley.

☐ 60605—High-$K_2O$ island-arc volcanic rocks from the Finisterre and Adelbert Ranges, northern Papua New Guinea. *A. L. Jaques, Geological Survey of Papua New Guinea, Box 778, Port Moresby, Papua New Guinea (present address, Research School of Earth Sciences, Australian National University, P.O. Box 4, Canberra 2600, A.C.T.)* (7 p., 4 figs., 3 tbls.)

A thick, extensive volcanic formation of Oligocene to early Miocene age, the Finisterre Volcanics, forms part of a Cenozoic sequence comprising the Finisterre and Adelbert Ranges of northern Papua New Guinea. The formation contains a high proportion of diverse volcaniclastic rocks and is lithologically similar to volcanic sequences described from island-arc assemblages elsewhere. The volcanic rocks are dominantly potassic basalt and low-silica andesite (48 to 56 percent $SiO_2$) containing 1.5 to 6.5 percent $K_2O$ and having low $TiO_2$ content typical of circumoceanic volcanic rocks. Two main groups can be recognized: abundant shoshonite and related rocks (absarokite, rare leucite trachyte) and high-K, high-Al basalt (with some high-K, low-Si andesite).

The Finisterre Volcanics are chemically similar to high-K rocks described from island arcs elsewhere in the southwest Pacific and in the Mediterranean. However, unlike some other island arcs, there is no evidence of a three-stage evolution from arc tholeiite to calc-alkalic andesite to shoshonite. The volcanic rocks probably formed in a volcanic arc that developed north of a northeastward-dipping subduction zone in response to early Tertiary plate interactions. The Finisterre volcanic magmas may have originated by partial melting of mantle material modified by slab-derived silicic melts.

☐ 60606—Use of calcite twin lamellae to infer differential stress. *William R. Jamison, John H. Spang, Department of Geology, University of Calgary, Calgary, Alberta, Canada T2N 1N4 (present address, Jamison, Center for Tectonophysics, Texas A&M University, College Station, Texas 77843).* (5 p., 4 figs., 3 tbls.)

The equation that relates the resolved shear stress coefficient ($S_1$), differential stress ($\Delta\sigma$), and the critical resolved shear stress ($t_C$) necessary to produce twin gliding is $t_r = S_1 * \Delta\sigma$. If we assume an infinite number of possible crystal orientations, it is possible to determine the percentage of grains that has a given value of the resolved shear stress coefficient ($S_1$) on one, two, or three twin sets. Therefore, if the percentage of grains exhibiting one, two, or three twin sets is known, the differential stress can be determined in terms of the critical resolved shear stress using the above equation. The method has been developed for the case of randomly oriented grains deformed in an irrotational, uniaxial stress field. The method also assumes that all twinning is observable and has occurred in only those orientations where twinning is theoretically possible. Twin gliding has previously been shown to be a mechanism of creep in calcite, and in many cases the method may actually overestimate the magnitude of the differential stress. The validity of this technique of differential stress magnitude determination has been tested by its application

to six experimentally deformed samples of Indiana limestone. The calculated differential stresses are within 21 percent of the experimental values for strains of less than 3 to 4 percent. At larger strain values, reasonably accurate differential stress values may also be determined, but this requires a greater degree of interpretation. Comparison of samples that contain naturally deformed crystals of both calcite and dolomite suggests that the critical resolved shear stress for dolomite is approximately five times greater than that for calcite.

☐ 60607—Diachronous deposition of ice-rafted debris in sub-Antarctic deep-sea sediments. *John Keany, Michael Ledbetter, Norman Watkins, Ter-chien Huang, Graduate School of Oceanography, University of Rhode Island, Kingston, Rhode Island 02881.* (10 p., 7 figs., 2 tbls.)

A simple model to explain the distribution of ice-rafted debris in deep-sea sediments of the Southern Ocean proposes that ice-rafted debris maxima in the high latitudes are associated with interglacial periods and in the lower latitudes with glacial periods. Initial testing of this model is now extended using nine *Eltanin* piston cores from the southeast Indian Ocean. Frequency variation in the Antarctic radiolarian *Antarctissa strelkovi* is used as a paleotemperature index, and the ice-rafted debris is measured for the 62- to 250-$\mu$m fraction. The merit in using ice-rafted debris temperature relationships (rather than magnitudes of debris) is demonstrated by the presence of high concentrations of ice-rafted debris in cores of low sedimentation rate, showing that the debris can be a residual coarse fraction rather than an index of higher deposition rates from icebergs.

Departures from the predicted ice-rafted debris paleotemperature correlations during the Brunhes epoch suggest complexities that could be due to such factors as anomalous ice-shelf development, ice surges, variations of preferred iceberg tracks, periods during which conditions are transitional between extreme glacial and interglacial, or differential sea-floor dynamic processes. To evaluate such possibilities, the model is now developed to include stages intermediate between extreme glacial and interglacial conditions. Complex ice-rafted debris variations are predicted to result across north to south traverses as climatic fronts sweep between extreme climatic conditions, resulting in difficulty in determining between-core correlations.

Attempts have been made to isolate periods of departure from the predicted ice-rafted debris paleotemperature correlations by computation of down-core–running correlation coefficients between the two variables. A present lack of fine stratigraphic control makes it impossible to test definitively the implications of the more complex model, and thus it stands as a proposed, yet unproven, source of departures from the simple model predictions.

☐ 60608—Channel width and the riffle-pool sequence. *K. S. Richards, Lanchester Polytechnic, Priory Street, Coventry CV1 5FB, England.* (8 p., 8 figs., 1 tbl.)

Investigations of channel geometry in a headwater stream in Cornwall, England, reveal that systematic variations of channel width occur in conjunction with the oscillations of bed topography in the riffle-pool sequence. The channel tends to be about 15 percent wider in the riffle section, where central bars of coarse bed material divert the flow against the banks. This is reflected in the occurrence of distinct downstream trends of width as a function of bankfull discharge in riffle and pool sections. There is some evidence that the widest channel occurs just downstream from the summit of the riffle, which indicates that the width oscillation lags behind the profile oscillation, presumably because it is related to flow characteristics induced by bed topography.

☐ 60609—A former continuation of the Alps. *Walter Alvarez, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964.* (6 p., 2 figs.)

There is strong evidence that microplates have played an important role in the tectonic evolution of the Western Mediterranean. A reconstruction of the Oligocene positions of these microplates leads to recognition of the Hercynian "Protoligurian Massif" (new term) and suggests that the Alpine belt (Late Cretaceous and early Tertiary deformation) formerly continued southwest from Alpine Corsica to Calabria and perhaps as far as the Betic Cordilleras of southern Spain. Fragments of this orogenic belt were dispersed during the Miocene-Pliocene episode of microplate movement that also produced the Apennine-Atlas orogenic belt. This hypothesis provides a new solution to the old question of why the Alps presently terminate in Corsica. A comparison of geological data from the Alps, northeastern Corsica, and Calabria supports the hypothesis that they were formerly continuous segments of the Alpine orogenic belt.

☐ 60610—Petrogenesis and postmagmatic geochemistry of the Italian Mountain Intrusive Complex, eastern Elk Mountains, Colorado. *Charles G. Cunningham, Jr., U.S. Geological Survey, Denver Federal Center, Denver, Colorado 80225.* (12 p., 8 figs., 5 tbls.)

The Italian Mountain Intrusive Complex lies within the Colorado mineral belt. It consists of Oligocene plutons, dikes, and associated hydrothermal lead-silver deposits. The rocks range in composition from quartz diorite to quartz monzonite. The core of the youngest intrusive mass is porphyritic and contains a central facies characterized by a partly aphanitic groundmass, which was formed by quench- and represents a late-stage venting of the intrusive complex. Upon venting, the youngest plutonic rocks fractured, fluids in the core boiled and were introduced into fractured quartz phenocrysts, and quartz veins were formed.

The evolution of the late magmatic and postmagmatic fluids is inferred from fluid inclusions. Pressure constraints imposed by measured fluid compositions and homogenization temperatures indicate that a pressure of 250 bars existed on the fluids at the time of venting. Depth of emplacement was between 950 and 2,700 m.

☐ 60611—Rb-Sr ages of Precambrian mafic dikes, Bighorn Mountains, Wyoming. *Alan M. Stueber, Department of Geology, Miami University, Oxford, Ohio 45056; Richard A. Heimlich, Department of Geology, Kent State University, Kent, Ohio 44242; Mohammed Ikramuddin, Department of Geology, Miami University, Oxford, Ohio 45056.* (6 p., 5 figs., 3 tbls.)

Rb-Sr isochron data from whole-rock samples of dolerite and metadolerite indicate emplacement of dikes 2,826 ± 58 m.y. ago, during formation of the Bighorn gneiss and granitic complexes. Whole-rock samples of other dolerite

dikes and mineral separates mark another intrusive event at 2,200 ± 35 m.y. B.P., well after the regional metamorphism. Two episodes of mafic dike emplacement are consistent with field relations but are not in agreement with recent K-Ar age determinations.

☐ 60612—Loess distribution by variable winds. *Richard L. Handy, Civil Engineering Department and Engineering Research Institute, Iowa State University, Ames, Iowa 50010.* (13 p., 12 figs., 3 tbls.)

Systematic decreases in loess thickness with distance from the source, usually considered to reflect a prevailing wind direction, may relate to variable wind directions. If winds blowing transverse to a linear source carry their load to a farthest distance designated $X_m$, winds blowing at an angle $a$ to the source will distribute their load over a reduced distance, $X_m \sin a$, leading to a proportionate increase in thickness by a factor of $1/\sin a$. Thus where $a$ is small, for winds nearly parallel to the source, deposition should be limited to a narrow corridor adjacent to the source, leading to greater accumulations in this area.

Representation of random wind directions by integration of the thickness equation gives a linear relationship between thickness and the logarithm of distance, as observed empirically along loess traverses and in sampling near dusty roads. Addition of a moderate prevailing wind to the variable wind model preserves the semilogarithmic thickness relation on the downwind side of the source but reduces thicknesses on the upwind side and substitutes a nearly linear relationship between thickness and distance from the source. Loess thickness contours should be approximately parallel to the source regardless of the prevailing wind direction. The contours bulge outward adjacent to wider source areas, probably because of increased dust concentrations in the air.

The variable wind hypothesis does not fully account for extraordinary thicknesses of loess within a few miles of the source. These extraordinary thicknesses appear to relate in part to a still-rising dust cloud and hence increased low-level dust concentrations in air close to the source.

☐ 60613—Basal metalliferous sediments from the eastern Pacific. *D. S. Cronan, AGRG, Department of Geology, Imperial College, London SW7, England.* (7 p., 3 figs., 5 tbls.)

Analyses by atomic absorption spectrophotometry and spark-source mass spectrography of 25 basal metalliferous sediment units from widely spaced locations on the western flank of the East Pacific Rise show that the deposits are enriched relative to normal pelagic sediment in Fe, Mn, Ni, Cu, Pb, Zn, and many trace elements. The elements are partitioned differently between the various mineralogic constituents of the sediment, with Fe and Mn largely in separate phases and many of the remaining elements primarily associated with reducible ferromanganese oxide minerals but also with iron minerals and other phases. Most of the iron in the deposits is probably of volcanic origin, and much of the manganese and minor elements is derived from sea water. The bulk composition of the deposits varies with age; this is thought to be due to variations in the incidence of volcanic activity at the East Pacific Rise crest where the deposits were formed.

☐ 60614—Granitic rocks of the southern Coast Plutonic Complex and northern Cascades of British Columbia. *T. A. Richards, Geological Survey of Canada, Vancouver, British Columbia, Canada V6B 1R8; K. C. McTaggart, Department of Geological Sciences, University of British Columbia, Vancouver, British Columbia, Canada V6T 1W5.* (19 p., 15 figs., 10 tbls.)

The mapped area, about 170 km east of Vancouver, British Columbia, lies at the intersection of the northwest-trending Mesozoic–early Cenozoic Coast Plutonic Complex and the north-trending late Cenozoic Cascade belt. The Late Cretaceous mesozonal Spuzzum intrusions (90 to 80 m.y. old) of the Coast Crystalline Complex are made up of a central diorite complex and a marginal tonalite. Modal variation in the diorite, which is pyroxenic in the central parts and hornblendic in the marginal, was controlled by $P_{H_2O}$ in the magma. The Yale intrusions (59 to 35 m.y. old), of tonalite, granodiorite, and quartz monzonite, are stocks and sills that may represent the latest intrusions of the Coast Plutonic Complex. The Chilliwack composite batholith (40 to 16 m.y. old) is represented by the Chilliwack batholith, the Mount Barr batholith, and the Silver Creek stock; these epizonal batholiths consist largely of tonalite, granodiorite, and quartz monzonite. Variation in the Chilliwack composite batholith is due mainly to differentiation at depth, followed by minor evolution both as the various phases rose and also after they were emplaced. The Fraser River–Straight Creek fault zone may have controlled the emplacement of many of the late Cenozoic plutons. During the past 40 m.y., intrusion and volcanism may have been nearly continuous in southwestern British Columbia and Washington.

☐ 60615dr—The Sudbury Basin, the Southern Province, the Grenville Front, and the Penokean orogeny: Discussion and reply.

Discussion: *Elwood R. Brooks, Department of Earth Sciences, California State University, Hayward, Hayward, California 94542.*

Reply: *Stephan J. Brocoum, Department of Geology, Texas Christian University, Fort Worth, Texas 76129; Ian W. D. Dalziel, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964. (Present addresses: Brocoum, E. D'Appolonia Consulting Engineers, Inc., 10 Duff Road, Pittsburgh, Pennsylvania 15235; Dalziel also of Department of Geological Sciences, Columbia University, New York, New York 10027.)*

☐ 60616dr—Variance of terrestrial heat flow between the North American craton and the Canadian Shield: Discussion and reply.

Discussion: *A Mirtsching, Gmelin-Institut fuer Anorganische Chemie und Grenzgebiete in der Max Planck Gesellschaft, (6) Frankfurt/Main, Varrentrappstrasse 40-42, West Germany.*

Reply: *Paul B. Slack, Cities Service Oil Company, 1600 Broadway, Suite 900, Denver, Colorado 80202.*



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