GSA news & information

SUPPLEMENT TO GEOLOGY MAGAZINE

MARCH 1978

Report of the President

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

The past year has been hard on the teeth of the Council since a considerable amount of bullet-biting was called for. Through the efforts of our Executive Director, John C. Frye, with the help of Richard F. Drozda, our new Controller, and with the cooperation of the GSA staff, the Society is operating in the black on a sound, businesslike basis. Lest this give us cause for unseemly displays of joy, it appears to be a fact of life that continuing inflation makes life easier for the politicians, and it will continue to erode our resources. Thus, we cannot conclude that this favorable balance will be a permanent condition.

As a result of this and other considerations, the Council looked ahead to the future and concluded that the publication of the *Bulletin* in its present form would not be responsive to the needs of the membership during the next decade. We have at present almost a two-year backlog of accepted papers. We cannot reduce this backlog without either rejecting an unconscionable percentage of the papers submitted or increasing subscription rates by a prohibitive amount. In addition to this, there are uncertainties about the attitude of the Post Office Department with regard to page charges. A number of alternatives were considered, and it was decided to convert to a new format in two parts: one in edited hard copy consisting of 2-page summaries of the papers, the second in author-prepared copy on microfiche consisting of the complete text. This format would provide the maximum of information at minimum cost (with no page charges) and would allow publication of more complete papers more rapidly than is at present possible. The change will take place on January 1, 1979.

Another problem that has troubled the Society in recent years is related to the divided responsibilities for the production of the *Bibliography* and GeoRef between GSA and AGI. Under the existing contract, each organization had conflicting objectives and furthermore, GSA bore a large potential liability without having full control of the situation. As a result, the termination option in the contract was executed, and a new agreement is being drawn up turning full responsibility for both the *Bibliography* and GeoRef over to AGI, with GSA acting only as an advisor. This new arrangement should eliminate the conflicts and should ensure a healthy future for both the *Bibliography* and GeoRef.

A third problem was obtaining a new Science Editor. The Society owes a great debt to Warren Hobbs, Paul Averitt, Henry Spall, and John Van Couvering for filling the gap while a search was undertaken. Negotiations with Peter J. Smith were terminated due to the inability of obtaining an immigration visa for him in a finite length of time. The position was advertised, the response was excellent, and by the time this report is published the new Science Editor, Vernon E. Swanson, should be hard at work.

One of my greatest pleasures during my year as President was going to Section meetings. I attended four and wish that I could have gone to all of them. There is a great *esprit de corps* at these meetings, and many of them are larger than Annual Meetings were twenty years ago. It has been very valuable for both the Council and for the Sections to continue the practice started by Bob Folinsbee of having Section representatives attend all Council meetings. As the Society continues to grow, there will be many

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problems, especially relating to meetings, their purpose, format, and location, that will require inputs not only from the Council, representing the national membership, but also from the Sections, representing the different parts of North America.

Finally, I should like to express my gratitude to the membership of the Society for allowing me the privilege of acting for a year as its representative; to the Section Officers and the officers of the Associated Societies for the grace with which they accepted my stated policy of keeping them surly but not mutinous; to the staff of the Society for their dedication to the Society and for the consideration they gave to my (and your) problems.

Respectfully submitted,
CHARLES L. DRAKE, President

Council Actions: Fall Meeting, November 6 and 8, 1977

The following actions were taken by the GSA Council at its fall meeting in Seattle:

1. Adopted the *Annual Report for 1976* as the report of the Council.
2. Approved the 1978 operating budget.
3. Approved certain financial resolutions.
4. Appointed a GSA Auditing Committee.
5. Selected members for the 1978 committees and to be Society representatives.
6. Ratified the slate for the 1978 Committee on Committees.
7. Discussed the appointment of a Science Editor.
8. Assigned national officers to attend the 1978 Section annual meetings.
9. Advanced 35 Members to Fellowship and ratified the election of 140 candidates to Membership in the Society; approved certain bylaw changes concerning exempt categories.
10. Voted to support the *Treatise on Invertebrate Paleontology* for 1978 by a contribution of $20,000.
11. Accepted reports from standing committees, GSA Sections, GSA Divisions, and representatives to non-GSA groups.
12. Ratified the award winner selected by the Hydrogeology Division.
13. Adopted a resolution of thanks to outgoing officers, councilors, committee people, and all those responsible for the successful Seattle annual meeting.
14. Selected the dates of May 9-10, 1978, for the spring meeting of the Council to be held in Boulder, Colorado.
15. Discussed ways and means of preparing for the GSA centennial in 1988.
16. Discussed the GSA-AGI GeoRef/*Bibliography and Index of Geology* contract and approved transfer of GSA's interests to AGI on January 1, 1979.
17. Discussed the implementation of the copyright law that becomes effective 1-1-78.
18. Voted to appropriate $1,000 to each Section for use by GSA Student Associates to participate in Section field trips and/or meetings.
19. Voted to co-sponsor a symposium, "The Impact of the Geosciences on Critical Energy Resources," to be held at the AAAS annual meeting in Washington, D.C., in February 1978.
20. Appointed an *ad hoc* Committee on Long-Range Planning of Annual Meetings.
21. Voted to set GSA's annual meetings at 3½ to 4 days.
22. Named William A. Thomas, Georgia State University, as the general chairman of the 1980 GSA annual meeting in Atlanta.
23. Discussed the possibility of GSA and AGU jointly publishing the final report of the International Geodynamics Program.
24. Discussed the new two-part *Bulletin* format.
25. Abolished the $20 abstract fee effective 1-1-79, with the necessary revenue from each Section to be recovered through the registration fees and collected by headquarters on a pro-rated basis, based on the number of abstracts.
26. In order to improve communications, appointed specific councilors to serve as liaison between the divisions and the Council.
27. Approved six Penrose Conference proposals and discussed the revised Penrose Conference Guidelines.
28. Received a progress report from the *ad hoc* Committee on Criteria for Associated Societies.
29. Discussed ways of participating in the 1979 USGS Centennial.
30. Took other minor actions, records of which are on file at headquarters.

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Report of the Executive Director

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

The Society's operations during 1977 were relatively stable. The financial crisis of 1975 is well behind us. Although the final audit has not been completed at the time of writing, it appears certain that income slightly exceeded outgo for the year. It should be remembered, however, that income from the endowment is included on the income side of the ledger, and that some of it is used for operating expenses as well as to cover the costs of research grants, *Treatise on Invertebrate Paleontology* subsidy, medals, and other nonoperating costs.

The total membership stayed at slightly above 12,000 during the year. The five optional dues packages started in 1976 were continued for 1977 and for 1978. It is anticipated that a more flexible system, allowing each member greater freedom of choice, will be worked out during the coming year for use during 1979. During 1977, 19% of the total membership were students. The choice of option packages shifted slightly from 1976 with the following results:

Option A, 21% (students 10%): basic membership, monthly *GSA News and Information* newsletter,

Option B, 9% (students 9%): *GSA News & Information,* 2 *Abstracts with Programs,* 24 separates of *Bulletin* articles,

Option C, 27% (students 34%): 12 issues of *Geology* with *GSA News & Information* section, 2 issues of *Abstracts with Programs*, 24 separates of *Bulletin* articles,

Option D, 7% (students 7%): *GSA News & Information*, 2 issues of *Abstracts with Programs*, 12 issues of *Bulletin,*

Option E, 36% (students 40%): 12 issues of *Geology* with *GSA News & Information* section, 2 issues of *Abstracts with Programs*, 12 issues of *Bulletin.*

For the Members and Fellows, these choices meant 43% took the *Bulletin* and 36% selected an option from which they could order separates; 63% took *Geology*; and 21% received only *GSA News & Information.* Among the students 90% selected options that gave them the *Bulletin* or separates from the *Bulletin.*

The headquarters staff, which had been decreased by 16% below its peak at the beginning of 1975, was relatively stable during the year. Paul Averitt served as Interim Science Editor for the entire year, and by year's end, Vernon E. Swanson had been employed to assume those duties on a permanent basis in February 1978. Henry Spall continued as Editor of *Geology*, with assistance from John Van Couvering and Paul T. Moyer.

The annual meeting in Seattle was the third largest in the history of the Society, being exceeded in size only by the 1971 Washington, D.C., meeting and the 1976 Denver meeting. Total registration at Seattle was 3,956. A total of 971 papers were presented during the three days, and 490 participants took part in 13 field trips conducted before and after the meeting. In the employment interview area, 53 employers conducted 751 interviews, and an additional 36 employers used the service but interviewed elsewhere. In the exhibit hall, 98 booth spaces were occupied by educational and technical exhibits.

All six of the GSA Sections conducted successful annual meetings during the year, and five topical Penrose Conferences were held.

There were 269 applicants for research grants in 1977, and 119 grants were funded. A total of $85,495 was awarded; of this total $65,000 came from endowment income, $13,986 from industry contributions, $4,500 from past grant recipients, $1,300 from dues statement check offs, and $600 from the Harold T. Stearns Fund.

Two major and far-ranging actions were taken by the Council during the year, and in both cases, implementation is well along by the headquarters staff. First, an agreement to consolidate the production and distribution of the *Bibliography and Index of Geology* with the GeoRef operation was agreed to by the governing bodies of GSA and AGI. Starting with the 1979 volume year, GSA will no longer be the publisher of the *Bibliography* and that function, as well as full control of the total operation, will be taken over by AGI. It is the intent of GSA to cooperate in any way possible to assure a smooth transition in the transfer of this important operation.

The second major decision was to change the format of the *Bulletin*, again starting with the 1979 volume year. Scientific publication in general is facing mounting problems of cost escalation, and many societies are considering ways of coping with these problems in the future. The specific problems

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of the *Bulletin* were an increasing backlog, an increasing delay in the time of publication after acceptance, and costs of publication that were increasing faster than the general rate of inflation. To cope with these problems, the decision was to initiate a two-part *Bulletin:* Part I with the general appearance of the present *Bulletin*, containing summaries of long papers, and some short papers; and Part II containing the complete text to be published from author-prepared copy on microfiche. During a transition period in 1979, Part I will contain the remaining conventional format papers not published by that time. It is hoped that the new system will greatly speed up the time of publication, eliminate the backlog, and reduce costs so that subscription prices can be reduced.

Respectfully submitted,
JOHN C. FRYE, Executive Director

Critical readers of manuscripts

Ian Allison
C. A. Anderson
E. D. Andrews
Ernest E. Angino
Richard L. Armstrong
Joseph G. Arth
Hans Avé Lallemant
Milo Backus
D. Baer
Edgar H. Bailey
A. K. Baird
David Baker
Victor R. Baker
Fred Barker
Wm. A. Berggren
Myron Best
Edward Beutner
W. E. Bickford
John M. Bird
Peter Birkeland
Pierre Biscaye
M. C. Blake, Jr.
Sam Boggs
Bill Bonnichsen
Carl O. Bowin
John Platt Bradbury
William A. Braddock
J. Bradshaw
George Brindley
D. A. Brobst
Wilfred B. Bryan
B. C. Burchfiel
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C. Wayne Burnham
Robert Butler
Wallace M. Cady
F. William Cambray
K. D. Card
Albert Carozzi
Neville L. Carter
James E. Case
Frederick W. Cater
Robert A. Chadwick
Charles E. Chapin
Carleton A. Chapman
D. R. Chapman
Bill Chapple
Alfred H. Chidester
Nik Christensen
Michael Church
William R. Church
Michael Churkin
R. E. Clemons
Ed Clifton
Donald R. Coates
George V. Cohee
James M. Coleman
Jon J. Connor
Kenneth L. Cook
Lindrith E. Cordell
Darrel S. Cowan
M. L. Crawford
S. Cyrus Creasey
Max D. Crittenden
Eleanor Crosby
Gary W. Crosby
John Crowell
Robert L. Cullers
Robert R. Curry
R. David Dallmeyer
G. Brent Dalrymple
Paul Damon
Jeffrey Daniels
E. Julius Dasch, Jr.
Walter E. Dean
Jelle deBoer
Gabriel Dengo
Rodger E. Denison
John G. Dennis
George Desborough
John L. Dewes
John Dickey
William R. Dickinson
Menno G. Dinkelman
John Dixon
Frank Dodge
R. Dolan
Thomas W. Donnelly
R. A. Dott, Jr.
John Doveton
Aleksis Dreimanis
Harald G. Drewes
David E. Dunn
Gordon Eaton
Edwin B. Eckel
Donald Eckelmann
John C. Eichelberger
David Elliott
D. P. Elston
Wolfgang Elston
William W. Emmett
A.E.J. Engel
Jack B. Epstein
Donald E. Eschman
Frank G. Ethridge
Joel Earl Everson
Rodger Faill
Gunter Faure
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J. P. Fitzsimmons
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Richard M. Foose
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Jacob Freedman
Melvin Friedman
Paul D. Fullagar
Gordon Gastil
David Gold
Samuel S. Goldich
Ronald Greeley
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Priscilla C. Grew
Sherman Gromme
Richard Groshong
Leo M. Hall
Warren B. Hamilton
Gilbert N. Hanson
Jack E. Harrison
Joseph H. Hartshorn
Norman L. Hatch, Jr.
James W. Hawkins
George Haselton
Hollis D. Hedberg
Carl E. Hedge
Donald O. Hermes
Michael W. Higgins
David P. Hill
Jack Hillhouse
F. Allan Hills
Robert J. Hite
Linc Hollister
Victor F. Hollister
Jose Honnorez
David M. Hopkins
John Horn
G. S. Horne
Robert S. Houston
Keith A. Howard
M. King Hubbert
Ralph E. Hunter
W. Porter Irwin
G. R. Jiracek
Arvid M. Johnson
Ross B. Johnson
D. E. Karig
Robert Kay
G. R. Keller
V. C. Kelly
Phillip R. Kemmerly
M. J. Kennedy
W. J. Kidd
E. M. Kipp
Kim Klitgord
James Knox
Paul D. Komar
John C. Kraft
W. C. Krumbein
Albert M. Kudo
George Kukla
Mel Kuntz
Edward P. Laine
Kenneth R. Lajoie
Lynton S. Land
Walter Langbein
Marcus Langseth
Marvin Lanphere
William P. Leeman
Stephen F. Linten
Peter W. Lipman
Donald R. Lowe
Wallace Lowry

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Robert G. Luidke
James Lyons
Don R. Mabey
Kenneth Macdonald
Thomas Maddock, Jr.
Louis J. Maher, Jr.
Robert J. Malcuit
Bruce Malfait
Charles F. Mansfield
Rudi Markl
Cecilia Martin
Mario Martinelli
Harold Masursky
William H. Mathews
A. R. McBirney
F. McCoy
George E. McGill
Donald B. McIntyre
Edwin D. McKee
Win Means
Martin A. Menzies
Daniel F. Merriam
G. V. Middleton
Alfred T. Miesch
Robert Milici
Martin Miller
John D. Milliman
Hugh H. Mills
Peter Misch
Akiho Miyashiro
Robert H. Moench
Paul A. Mohr
Richard J. Moiola
George Moore
Gregory Moore
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Benjamin A. Morgan III
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E. W. Mountjoy
John D. Mudie
Paul B. Myers, Jr.
Alan E. Nairn
William P. Nash
R. S. Naylor
Clifford Nelson
H. F. Nelson
A. Conrad Neumann
Norman D. Newell
Donald Noble
Warren J. Nokleberg
Carl Nordin
D. Kirk Nordstrom
William R. Normark
Donald K. Norris
Leroy A. Odom
John L. O'Keefe
Keith O'Nions
F. Ortega-Gutierrez
Ben M. Page
Allison R. Palmer
Robert C. Palmquist
Thomas Pearce
Harold R. Pestana
Zell E. Peterman
Donald W. Peterson
Mark P. Phillips
A. R. Philpotts
M. Dane Picard
David Z. Piper
Lucian B. Platt
Richard Poore
Stephen C. Porter
Noel Potter, Jr.
Christopher Powell
Dennis Powers
Paul C. Ragland
C. B. Raleigh
Nicholas M. Ratcliffe
Omer Raup
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Jack A. Redden
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John Reynolds
E. V. Richardson
Mary Jo Richardson
William I. Ridley
Arthur W. Rose
Charles A. Ross
Jason Saleeby
D. H. Sallenger
J. P. Schafer
Steven Schamel
Robert Schneider
Peter A. Scholl
Stanley A. Schumm
Martha R. Scott
Wm. R. Seager
V. M. Seiders
Karl E. Seifert
A.M.C. Sengor
Robert P. Sharp
Denis Shaw
John Shih
Ronald L. Shreve
Eli Silver
Norman H. Sleep
Norman Sohl
Robert R. Sokal
Ronald K. Sorem
William Spence
Rolfe S. Stanley
Roger Stewart
John C. Stormer
V. T. Stringfield
John Sumner
Daniel A. Sundeen
Vern E. Swanson
Jaan Terasmae
Lawrence W. Teufel
William A. Thomas
James B. Thompson, Jr.
Charles H. Thorman
Othmar R. Tobisch
Terry E. Tullis
Donald L. Turcotte
Robert J. Twiss
Norbert Untersteiner
Franklyn B. Van Houten
Jack R. Van Lopik
Peter R. Vogt
William B. Wadsworth
Ernest E. Wahlstrom
Theodore R. Walker
Chester A. Wallace
Lionel E. Weiss
Jeffrey Weissel
Christian Werner
Walter Wheeler
George W. White
Philip Whitney
Donald O. Whittemore
E.H.T. Whitten
Van Slyck Williams
Robert Wintsch
David R. Wones
Thomas L. Wright
Louis York
Davis A. Young
Robert E. Zartman

Publications completed in 1977

The following publications, totaling 16,688 pages, were issued by the Society during 1977:

Periodicals: *Abstracts with Programs* for the national meeting in Seattle and *Abstracts with Programs* for meetings of the South-Central, Southeastern, Northeastern, Cordilleran, North-Central, and Rocky Mountain Sections of the Society; 12 issues of the *Bibliography and Index of Geology,* Volume 41, and the cumulative *Bibliography and Index of Geology,* Volume 40; 12 issues of the monthly *Bulletin,* Volume 88; 12 issues of *Geology* with "GSA News & Information" sections, Volume 5.

Series: Maps and Charts series, MC-16, MC-17, MC-18, and MC-20; Memorials preprints and Volumes V, VI, and VII; 3 Memoirs; 2 Microform Publications; Reviews in Engineering Geology III; 2 Special Papers.

Reprints: Reprints for the year included the August issue of *Geology*, Memoir 5, Special Paper 171, and the *Treatise on Invertebrate Paleontology,* Part O.

Miscellaneous: Other publications in 1977 were the *Annual Report for 1976* printed in the March, May, June, July, and September issues of "GSA News & Information" sections in *Geology*; *Information for Contributors;* Spring and Fall Mini-Catalogs; Newsletters: *The Engineering Geologist, The Hydrogeologist, The Quaternary Geologist and Geomorphologist, The Coal Geologist*, and *History of Geology Newsletter;* Report of the Committee on Environment and Public Policy; *Yearbook for 1977* (membership directory).

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Two Penrose Conferences on granitic rocks scheduled for summer and fall of 1978

Two Penrose Conferences on Granitic Rocks, sponsored by the Geological Society of America, are (1) scheduled for September 10-16, 1978: Granite I, "The Origin and Evolution of Granitic Magmas"; and (2) scheduled for the summer of 1979, Granite II, "High-Level Batholiths: Their Origin, Emplacement, and Influence on Sedimentation."

Granite I

The objectives of this conference will be to discuss, in depth, various approaches to the problems of magma generation and evolution, with emphasis on the location of plutonism and the origin of zoned plutons.

Discussions will range from the location of granitic plutons in space and time, with specific reference to plate boundaries and the effects of high-level chambers and volcanism on mesozonal plutons. Associated field trips and discussions will examine the problems of zoned plutons and geochemical trends in granitic batholiths. The aim of the conference is to integrate the problems of heat source, provenance, assimilation, and crystallization in order to explain the plutons now observed. Two afternoon field trips and an all-day field trip across the Sierra Nevada batholith are planned to provide focus for the deliberations of the participants.

Conveners for Granite I are Dallas Peck, U.S. Geological Survey, and David R. Wones, Virginia Polytechnic Insititute and State University.

This conference will be held at Huntington Lake, California, and Mammoth Lakes, California.

Persons interested in Granite I should write to David R. Wones, 4044 Derring Hall, Virginia Polytechnic Institute and State University, Department of Geological Sciences, Blacksburg, Virginia 24061, indicating why you wish to attend.

The registration fee will be $275, and a separate field-trip fee will be approximately $50. The fees will include transportation to and from the San Francisco Airport, lodging based on double accommodations, meals, field-trip costs, and all other conference costs. Deadline for application is May 1, 1978.

Granite II

Granite II will concentrate on problems associated with epizonal batholiths. The intent of this conference is to promote interchange between participants, with a variety of batholith-related interests, including granitic and volcanic petrologists, structural geologists, geophysicists, and sedimentary petrologists/sedimentologists. The goal will be to elucidate the present state of the art and to outline possible future avenues of interdisciplinary research.

The central theme for discussion will be the tectonics of zoned, unzoned, and complex shallow-level batholiths. Specific topics will include source of magma, tectonic-triggering mechanisms for magmatization, structural controls on the nature of emplacement of magma, the relative timing of deformation and associated volcanic and hypabyssal activity, the role of high-level batholiths in gravity sliding, and sedimentation associated with the emplacement and unroofing of batholiths.

Symposia discussion will be extended to the outcrop during a two-day integrated field study of the Boulder batholith and related igneous rocks, major Laramide structures influenced by the batholith, and Cenozoic sediments derived from its unroofing and genetically related to the Laramide structures. The final sessions of the conference will be devoted to a summarization and overview of the major conclusions of both Granite I and Granite II.

Conveners of Granite II are Charles J. Vitaliano and Lee J. Suttner of Indiana University and Donald W. Hyndman of the University of Montana. The conference will be held in the Summer of 1979 near Butte, Montana, in the Boulder batholith region.

Persons interested in attending Granite II should write to Charles J. Vitaliano, Department of Geology, Indiana University, Bloomington, Indiana 47401, indicating their reasons for wishing to attend.

The registration fee and final deadline for application will be announced later.

Heat transport processes in the Earth subject of Penrose Conference, November 13–17, 1978

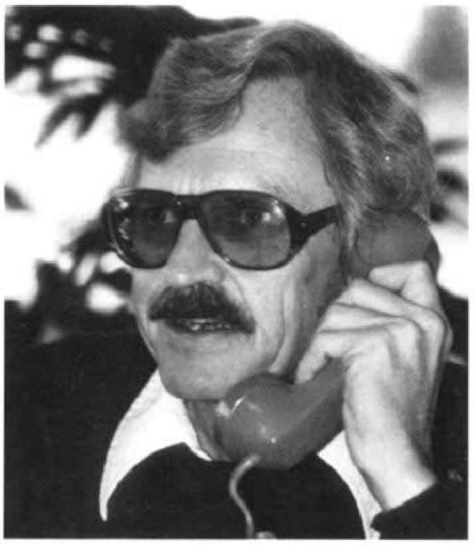
A Geological Society of America Penrose Conference on Heat Transport Processes in the Earth will be held in Los Alamos, New Mexico, from November 13 to 17, 1978. The conference will cover both convective and conductive processes, including: (1) geological applications, such as heat-flow problems associated with magmatic intrusions and mantle convection; (2) geothermal problems, including geologic and hydrologic field description under both natural conditions and exploitation; (3) heat storage and waste heat injection, where aquifers are used as receptacles for heated fluid; (4) heat transport associated with the disposal of high-level radioactive waste in the Earth; and (5) coal gasification and petroleum-enhanced recovery methods, such as steam flood, hot-water flood, and in situ combustion. Common problems will be emphasized, including data collection, process description (both physical and mathematical), process simulation, and interpretation of results.

A field trip to the Fenton Hill Hot Dry Rock Demonstration Site, located 35 miles west of Los Alamos on the west rim of the Valles Caldera, will be included in the five-day conference. Attendance will be limited to 60 persons, and the cost will be approximately $300 per person. Those interested in attending should contact either of the co-conveners: James W. Mercer or Charles R. Faust, U.S. Geological Survey, National Center, Mail Stop 431, Reston, Virginia 22092. Please include a brief statement of your potential contribution to the conference. Deadline for application is September 1, 1978.

Swanson named Science Editor of the Geological Society of America publications program

On February 1, 1978, Vernon E. Swanson entered on duty as Science Editor of GSA, thereby ending a 2½-year tempestuous search for a full-time Editor. Vern is a specialist on the geochemistry and the environment of deposition of organic materials, and he is the author of about 90 published reports. He is a veteran of thirty years of work with the U.S. Geological Survey. During this period, he served as Head of the Denver Technical Reports Unit of the USGS and as Deputy Chief of the Branch of Coal Resources. He is a friend of the written word and of the well-turned phrase.

Paul Averitt, who has served as Interim Science Editor since January 1, 1977, stepped down on February 1, 1978, according to a previous plan and his own wishes. He remained on duty as deputy to Vern until March 1 to aid in the orderly transfer of duties. We bid Paul goodbye with our thanks and good wishes as we welcome Vern aboard.



Vernon E. Swanson

The $20 abstract fee will be dropped after 1978

After much debate and discussion the Council of GSA acted on November 8, 1977, to abolish the abstract fee after 1978. In view of the fact that the fee had already been rescinded for the 1978 annual meeting in Toronto, this action means that after the 1978 Section meetings, the abstract fee will no longer be collected from individual authors.

The Council was mindful of the fact, however, that discontinuance of the abstract fee left a deficit in income that must be made up from some source. A modest increase in the registration fee for meetings will be used as a source of this replacement income.

You can join GSA at your Section meeting this spring

You are invited to join GSA at your Section meeting. A gift will be given to each person who applies for membership on the Special Section Meeting Membership Application, available only from the GSA Book Sales Booth.

New Student Associates will receive a 1977 Denver-minted uncirculated Eisenhower dollar. New Members will be excused from the $5 registration fee.

gsa publications

Stratigraphy and Depositional History of the Star Peak Group (Triassic), Northwestern Nevada

SPECIAL PAPER 178 — By K. M. Nichols and N. J. Silberling. 1977. vi + 74 pages, 31 figures. ISBN 0-8137-2178-4. $7.75

The Star Peak Group is redefined to include the mainly calcareous strata that overlie the predominantly volcanic rocks of the Koipato Group and in turn are overlain by the terrigenous clastic rocks of the Auld Lang Syne Group. The Star Peak Group ranges in age from late Spathian (latest Early Triassic) to late Karnian (middle Late Triassic), and it is as much as 1,200 m thick. The outcrop area exceeds 5,000 km² in northwestern Nevada.

All of the major components of the Star Peak Group are explicable in terms of a complicated pattern of carbonate deposition and diagenesis and contemporaneous tectonism. The regional synthesis presented in this paper describes an unusually compact example of lateral and vertical interrelations representing depositional environments that range from supratidal to below wave base.

In the older parts of the Star Peak Group, complex stratigraphic patterns among a variety of primary and secondary carbonate rocks and terrigenous clastic rocks resulted from localized relative uplift, first early and then late in Middle Triassic time. Following the earlier of these tectonic episodes, regionally uniform calcareous rocks of late Anisian age blanketed most of the outcrop area. The more western of these rocks grade upward into dark cherty limestone which was deposited in basinal and slope environments concomitantly with uplift and erosion, during Ladinian time, in the central part of the Star Peak outcrop area. South and southeast of the uplifted area, subsidence and peritidal deposition took place

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followed by deposition of supratidal algal-laminate dolomite. This dolomite was deposited across the beveled uplift and correlates with platform-margin and basinal limestone farther west. Thereafter, lower Karnian platform limestone thickly blanketed the outcrop area and built regressively westward out over the basinal deposits. Following a widespread mid-Karnian break in deposition, local erosion, and deposition of terrigenous clastic rocks, platform carbonate rocks again blanketed the outcrop area during late Karnian time and extended an unknown distance westward, perhaps as far as the original site of the Sierran–eastern Klamath belt.

A new scheme of Star Peak stratigraphic nomenclature is proposed. Although the correlations, stratigraphic relations, and rank of previously named formations of the Star Peak Group have been revised, their lithologic boundaries have not been changed from those embodied in their original descriptions.

CONTENTS: Acknowledgments. Abstract. Introduction: Regional geologic setting, Terminology and conventions. Stratigraphy: Eastern region—Tobin Formation, Dixie Valley Formation, Favret Formation, Augusta Mountain Formation, Cane Spring Formation; Central region—Fossil Hill Formation, Augusta Mountain and Cane Spring Formations; Western region—Prida Formation, Congress Canyon Formation, Augusta Mountain and Cane Spring Formations; Correlative strata beyond the Star Peak outcrop area—Shoshone Range, Toiyabe Range, New Pass Range, Northwestern Nevada. Depositional history. Paleotectonic interpretation. References cited.

Landslides

Reviews in Engineering Geology, Volume III — Edited by Donald R. Coates. 1977. viii + 278 pages, 226 figures, 29 tables. ISBN 0-8137-4103-3. $27.00

The purpose of this volume is (1) to update significant information about landslides and present new case histories and (2) to refocus previous works into new syntheses and insights. The volume represents contributions not only from the authors but also from governmental agencies, universities, and consulting firms. More than 60 reviewers participated in the work.

The study contains more landslide case histories than any publication to date and also has many reviews and integrated analyses of landslide phenomena. Topical features that are presented include (1) climate—arctic, temperate, tropical, arid; (2) terrain—subaerial and subaqueous with extremes of mountainous to nearly flat slopes; (3) lithology—bedrock, regolith sediments; (4) landslide types—rock avalanches, rock glides, debris flows, debris avalanches, slumps, liquefaction flows, earthflows, and others; (5) landslide size—some of the largest on record as well as smaller ones; and (6) landslide causes—excessive moisture, earthquakes, man-induced.

The chapters have been grouped into five parts as a reader convenience and for organizational emphasis. Part 1, Overview, provides a fabric and some generalizations of landslides that illustrate the broad sweep of this phenomenon and enhances the reader's understanding of the remaining chapters. Part 2, Regional Studies, contains those chapters that are primarily devoted to appraisal of landslides on a regional basis. Part 3, Specific and Local Studies, contains chapters that concentrate on either a particular landslide or on specific earth materials that have hosted the landslide. Part 4, Engineering Geology and Highway Engineering, specifically addresses the engineering aspects of landslides as they relate to human activities, and especially to highway construction. Part 5, Environmental Planning, stresses the interdisciplinary nature of landslide problems. These problems are not only geology and engineering problems but also societal problems in which all citizens must cooperate for their ultimate solution.

A new landslide classification scheme is introduced in this volume that recognizes the importance various materials play in the production of different landslide types, whether in bedrock, regolith, or sediments.

CONTENTS: PART 1. OVERVIEW includes Landslide perspectives by D. R. Coates and Regional landslide types in Canada by J. D. Mollard. PART 2. REGIONAL STUDIES includes Causes of rock-slope failure in a cold area: Labrador-Ungava by K.-H. Wyrwoll; Large landslides of the Columbia River Gorge, Oregon and Washington by L. Palmer; Regional slope-stability controls and engineering geology of the Fraser Canyon, British Columbia by D. R. Piteau; and Complex mass-movement terrains in the western Cascade Range, Oregon by F. J. Swanson and D. N. Swanston. PART 3. SPECIFIC AND LOCAL STUDIES includes Landslides and the weathering of granitic rocks by P. B. Durgin; Problems with Lake Albany "clays" by J. R. Dunn and G. M. Banino; Large submarine slide in Kayak Trough, Gulf of Alaska by B. F. Molnia, P. R. Carlson, and T. R. Bruns; Large, Holocene low-angle landslide, Samar Island, Philippines by J. A. Wolfe; and Martinez Mountain rock avalanche by C. G. Bock. PART 4. ENGINEERING GEOLOGY AND HIGHWAY ENGINEERING includes Utiku landslide, North Island, New Zealand by M. L. Stout; Engineering geology of the Woodstock rockslide, New Hampshire by B. K. Fowler; Relationship between morphology, hydrology, geotechnics, and vegetation on an old northern Ohio landslide by H. F. Krist and M. R. McComas; Engineering geology of the slope in stability of two overconsolidated north-central Texas shales by R. G. Font; Engineering geology of multiple landsliding along I-45 road cut near Centerville, Texas by C. C. Mathewson and J. H. Clary; and Three major California freeway landslide areas by F. B. Leighton. PART 5. ENVIRONMENTAL PLANNING includes Slope-stability studies in the San Francisco Bay region, California by T. H. Nilsen and E. E. Brabb; Landslides in West Virginia by P. Lessing and R. B. Erwin; and Landslides at Sardis in western Turkey by G. W. Olson.

March BULLETIN briefs

Brief summaries of articles in the March 1978 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.*

• 80301—Algal and cryptalgal structures and platform environments of the late pre-Phanerozoic Noonday Dolomite, eastern California.

Lauren Wright, Eugene G. Williams, Department of Geosciences, Pennsylvania State University, University Park, Pennsylvania 16802; Preston Cloud, U.S. Geological Survey and Department of Geological Sciences, Biogeology Clean Laboratory, University of California, Santa Barbara, California 93106. (13 p., 11 figs.)

A late pre-Phanerozoic platform, almost continuously blanketed by algal mats, is recorded in the distributional pattern, composition, and textures of the Noonday Dolomite, Death Valley region, California. The platform, apparently L-shaped, was at least 160 km long. It lay west and south of the Nopah upland, established much earlier, and north of a fault-bounded east-trending depression containing units of the older Pahrump Group.

A lower member of the Noonday consists of very finely crystalline, laminated, and relatively pure dolomite. The laminations, although commonly deposited horizontally, also outline mounds having a synoptic relief of a few metres to nearly 200 m. Algal or cryptalgal fabrics are common. Especially large mounds in the Nopah Range lie on the down-dropped south side of a contemporaneous fault, indicating tectonic control of size and location. The laminated mounds are characterized by large-scale vertical stacking, best explained as produced by differential growth of algal mats. The configuration of the laminations indicate that the mats grew to depths of at least 100 m but probably did not extend more than 150 m below the mound crests. The absence in the lower member of features attributable to moving water and the paucity of clearly detrital material indicate quiet water and very low relief in the bordering land.

An upper member consists of (1) discontinuous bodies of thinly and evenly bedded siltstone and silty dolomite that ordinarily occupy the deeper of the intermound lows; (2) a laterally continuous unit of silty dolomite with wavy laminations and small, rippled to subhemispherical, laterally linked stromatolites; and (3) an upper unit of massive to laminated silty dolomite, containing large domal and bosslike stromatolites and associated with bodies of strongly cross-bedded quartz-dolomite sandstone. These features evidence the entry onto the platform of detritus supplied by increasingly stronger uplift of the Nopah Upland and the sweeping of the platform by increasingly stronger currents.

We interpret the carbonate of the lower member and much of the carbonate of the upper member as having been precipitated from ambient waters by removal of CO_2 during algal photosynthesis.

• 80302—Drinking water: A geochemical factor in human health.

W. D. Keller, Department of Geology, University of Missouri-Columbia, Columbia, Missouri 65201. (3 p.)

Water that is drunk primarily to slake thirst may also supply major, and especially minor or trace elements, nutritionally essential to good health and longevity. Of the 14 trace elements known to be essential for human beings, apparently some are significantly more readily assimilated from water than from food.

Modern, municipal water-treatment plants condition water more for the sake of the steam boiler, laundry, and industry (the large volume users) than for the stomach. This paper considers water for drinking purposes from the perspective of health benefits. Means are explored by which healthful drinking water may be formulated.

The use of glacial milk, essentially an aqueous extract (solution and suspension) of rocks, by the natives of Hunza, West Pakistan, has been cited as a major factor contributing to purported excellent health and unusual longevity of those peoples. A suspension of rock flour can supply not only immediately assimilable substances in solution, but also continuous, delayed-action, mineral-nutrient reserves after ingestion.

Cooperative effort between geologists knowledgeable about water and nutritionists knowing the needs for optimum human health should upgrade the role of drinking water in human health and longevity.

• 80303—Western margin of Australia: Evolution of a rifted arch system.

J. J. Veevers, D. Cotterill, School of Earth Sciences, Macquarie University, North Ryde, New South Wales, 2113, Australia. (19 p., 17 figs.)

The 4,000-km-long western Australian margin and adjacent ocean floor are probably unique among older (>100 m.y.) passive margins and adjacent oceans in having such a thin (<1.5 km) cover of sediments deposited since con-

tinental break-up in Late Jurassic and Early Cretaceous time. The oceanic seismic basement and the unconformity on the faulted continental surface at break-up (collectively, reflector R_4) are thus traceable in seismic-reflection profiles across the ocean-continent boundary, and in many places are a continuous surface. Drilling shows that the oldest oceanic crust adjacent to the margin is almost the same age as the oldest part of the continental break-up unconformity.

Two types of margin are distinguished by the shape of R_4: *stepped,* in which R_4 is offset at the ocean-continent boundary by a long transform fault, and *smooth*, including the transition from normal ocean floor through oceanic upgrowths, called epiliths, that developed after the start of sea-floor spreading. The marginal plateaus of the western margin originated variously as epiliths or from the post–break-up subsidence of regions that originally lay between rifted arches.

After 100 to 150 m.y. of rifting along a multiple rift valley arch system analogous to that of modern East Africa, with concomitant deposition in inter-arch and extra-arch basins, the northwestern margin was initiated by plate divergence 160 m.y. ago (Late Jurassic time) and the southwestern margin 125 m.y. ago (Early Cretaceous time). After break-up, a diachronous clay was deposited on the newly generated sea floor and behind the subsiding continental rim or half-arch (the former rift valley shoulder) in what is called a rim basin. The rim subsided below sea level 30 to 45 m.y. after break-up, and thereafter sediments were dispersed seaward across the entire margin.

• 80304—Late Quaternary tectonic movements and sea-level changes at Timor and Atauro Island.

J. Chappell, Department of Geography, S.G.S., Australian National University, Canberra, A.C.T. 2600, Australia; H. H. Veeh, School of Earth Sciences, Flinders University of South Australia, Adelaide, Australia.
(13 p., 10 figs., 2 tbls.)

Flights of raised coral terraces on the north coast of East Timor and at Atauro Island, north of Timor, are described stratigraphically and dated by Th^{230}-U^{234} determinations. The exposures at southern Atauro enable detailed reconstruction of the history of transgressions and regressions, especially for the period 140,000 to 105,000 yr B.P. Sea-level changes identified in Barbados and New Guinea are closely confirmed. The Atauro uplift rate is 0.47 m/1,000 yr, as estimated from the highest position of shallow-water coral faunas in the reef, which is dated as 120,000 old. The extrapolated rate is used to estimate ages of higher reefs; these ages correlate quite well with periods of major glacio-eustatic rise indicated by the O^{18} record of Pacific cores back to 700,000 yr B.P. Reefs from three sites along the north coast of Timor have been dated within the 84,000, 105,000, and 120,000 yr B.P. high sea-level periods and indicate uplift at 0.5 m/1,000 yr. A 120,000-yr-old reef from a fourth north Timor site, near Dili, indicates much slower uplift, about 0.03 m/1,000 yr.

• 80305—Glowing avalanches from the 1974 eruption of the volcano Fuego, Guatemala.

David K. Davies, Michael W. Quearry, Department of Geology, University of Missouri at Columbia, Columbia Missouri 65201 (present address, Davies: Department of Geosciences, Texas Tech University, Lubbock, Texas 79409; present address, Quearry: Texaco, Inc., P.O. Box 60252, New Orleans, Lousiana 70160); Samuel B. Bonis, División Geológica, Instituto Geográfico Nacional, Avenida las Americas, Guatemala City, Guatemala.
(16 p., 26 figs., 5 tbls.)

Glowing avalanches from the 1974 eruption of the volcano Fuego, Guatemala, deposited between 0.005 and 0.01 km^3 of nonimbricated, nongraded, nonwelded debris on the southern flanks of the volcano. Avalanches emerged from notches in the crater rim, and traveled some 7 km from the vent at an average speed of 60 km/hr. Each glowing avalanche consisted of two parts, (1) the main mass of moving debris, or underflow, and (2) a superjacent gas and dust cloud. The postdepositional thickness of individual underflows is generally less than 2 m, but successions of glowing avalanches produced deposits as much as 15 m thick in some ravines. The underflows and their superjacent gas and dust clouds followed topographic lows. Where underflows were confined laterally by valley walls, the surface of the underflow was featureless, after deposition. Where underflows were able to spread laterally, they developed a surface morphology of channels, levees, and overbank areas. The coarsest fragments were deposited in the channels.

The underflows probably flowed in laminar fashion as high concentration dispersions, similar to normal debris flows. No unequivocal evidence of large-scale gas expansion of the underflows was noted. Gas emission is considered to have occurred during transportation, but it probably played a minor role in fluidization of the underflow. The ability of these glowing avalanches to transport particles as much as 5 m in diameter some 7 km from the crater is considered to be a reflection of the high yield strength of the underflow.

Deposits from the 1974 eruption had a mean grain size of -3.0ϕ (8 mm), were extremely poorly sorted ($\sigma_1 = 4.6$) strongly fine skewed ($SK_1 = 0.63$), and platykurtic ($K_G = 0.71$). All grain size distributions were bimodal with a dominant intermodal low at -1.0ϕ (2 mm). The small percentage of particles in the -1.0ϕ size interval is considered to reflect the inherent mechanical instability of particles of this size.

Turbulently flowing gas and dust clouds, as much as 1,000 m high, accompanied each avalanche, and cloud height increased with increasing distance of travel. The fine-grained dust of the superjacent gas and dust clouds was not deposited on top of the underflow. Prevailing winds blew the fine-grained component to the west-southwest.

• 80306—Subaerial crusts, caliche profiles, and breccia horizons: Comparison of some Holocene and Mississippian exposure surfaces, Barbados and Kentucky.

Rand S. Harrison, Department of Earth Sciences, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2; Randolph P. Steinen, Department of Geology and Institute of Material Science, University of Connecticut, Storrs, Connecticut 06268. (12 p., 9 figs.)

Roadcuts along Interstate Highway 64 in northeastern Kentucky expose a succession of Mississippian carbonates that contain a number of ancient exposure surfaces. These subaerial surfaces vary from thin surficial crusts to thick caliche profiles and complex brecciated horizons, and to a large extent they are similar, in both fabric and inferred origin, to subaerial surfaces developed on Pleistocene reef sediments exposed on Barbados.

The most characteristic fabrics include laminations, micritic pellets, multiple episodes of fracturing, root voids, and a diversity of carbonate cement morphologies. In fact, variations in the form and distribution of the cements provide some of the most positive criteria for recognizing near-surface subaerial diagenesis. Evidence of vadose diagenesis 2 to 3 m below some of the ancient exposure surfaces indicates that relative fluctuations in sea level of at least this magnitude occured during Mississippian time.

• 80307—Sedimentation and echo characteristics in the abyssal hills of the west-central North Atlantic.

Thomas H. Shipley, Geophysics Laboratory, Marine Science Institute, University of Texas, Galveston, Texas 77550. (12 p., 6 figs.)

The abyssal hills province of the western North Atlantic 600 km southeast of Bermuda contains irregular hills and basins 10 to 20 km wide, with about 400 m of relief probably generated by ridge-flank volcanism and faulting. Conical(?) abyssal hills 5 to 10 km wide with about 300 m of relief are thought to represent a later stage of midplate volcanism, perhaps related to the post-Eocene uplift of the Bermuda Rise.

The 3.5-kHz echo characteristics of the surficial sediments were combined with piston core data to produce a geologic map with six main units. Pelagic brown-clay sedimentation has been fairly constant at 1 to 3 m/m.y. since mid-Cretaceous time. In some of the high areas and on the Bermuda Rise at depths less than 5,500 m, a 30-m opaque unit records carbonate sedimentation that began sometime in Pliocene time with lowering of the calcium carbonate compensation depth. Three distinct echo characters are observed from the various stratified sediment bodies. One is owing to near-outcrop of a deep reflector unit. Another unit is composed of discrete, closely spaced reflectors of the Nares Abyssal Plain and parts of the southern fracture valley. A third unit contains widely spaced (20 m) reflectors restricted to the more northerly fracture valley and certain cross valleys. The stratified sediments in both the Nares Abyssal Plain and the fracture valleys consist of brown clays at the surface and gray clays at depth. The gray clays are interpreted as distal turbidites, having 12% more silt than the pelagic brown clays and always occurring in water depths greater than 5,700 m. The turbidity currents crossed the Nares Abyssal Plain into the southern valley and over low sills into the northerly fracture valley. The veneer of brown clay indicates that turbidity currents probably have not been active in this area for at least 300,000 yr.

• 80308—Uranium abundances and distribution in associated glassy and crystalline rhyolites of the western United States.

Robert A. Zielinski, U.S. Geological Survey, Denver Federal Center, Denver, Colorado 80225. (6 p., 2 figs., 1 tbl.)

The abundance and distribution of uranium have been determined in 11 units of rhyolitic lava and ash-flow tuff of calc-alkaline and transitional composition from the western United States in order to further evaluate the potential of rhyolitic glass as a source of uranium ores. Samples consist of coexisting obsidians, perlites, and felsites that range in age from Pleistocene to Oligocene. Uranium abundances in analyzed obsidians are 5 to 46 ppm. Obsidians and coexisting perlites have identical (±5%) uranium concentrations, which confirms that little or no uranium is lost during hydration. Felsites show uranium depletions as high as 80% relative to coexisting obsidians and perlites. Combination of this data with the results of earlier work on peralkaline rhyolites indicates that uranium depletion seems to increase with age, with different rates of depletion for calc-alkaline (slowest) and peralkaline (fastest) compositions. Uranium distribution is homogeneous in obsidians, perlites, and spherulites, but inhomogeneous in felsites. Electron microprobe analyses of the least-depleted felsites indicate that uranium is associated with concentrations of Fe-Ti-Mn oxides or is in accompanying accessory minerals. Secondary Fe-Mn oxides in older, depleted felsites are uranium-bearing, especially along fractures or flow layers. Uranium loss from felsites seems to be largely controlled by low-temperature solution over long time periods, with some precipitation in secondary phases.

• 80309—Mesozoic tectonics, North Island, New Zealand.

K. B. Spörli, Department of Geology, University of Auckland, Auckland, New Zealand. (11 p., 5 figs.)

The Kawhia synclinorium along the western margin of North Island, New Zealand, is a relatively simple open structure with a subvertical to steeply east-dipping axial surface and contains a Triassic-Jurassic shelf or arc-trench gap sequence. It is bounded to the east by a narrow zone of serpentinite and ultramafic rock corresponding to the magnetic Junction anomaly.

In the Waipapa and Torlesse terranes east of the Junction anomaly, three deformation phases can be recognized: (1) formation of mélange and imbrication of strata, with fold axes trending across the now-dominant basement grain and fold vergence predominantly toward the south; (2) strongly asymmetric folding and imbrication and further mélange formation on horizontal axes parallel to the present structural grain; folds verge to the east, and beds in the axial ranges have rotated to vertical and overturned attitudes; and (3) open folding

on steeply plunging axes. Phases 1 and 2 are part of the Early Cretaceous Rangitata orogeny or predate it. There is no evidence yet for the age of phase 3 structures.

It is hypothesized that the rocks of the Waipapa and Torlesse terranes were imbricated and accreted in a suture zone east of the Junction anomaly. Phase 1 structures were formed oblique to the trend of the New Zealand geosyncline because of a strike-slip component of movement transmitted to the sedimentary column only before and during early décollement. Age patterns in the Torlesse and Waipapa terranes indicate that simultaneously with accretion the clastic apron prograded from south to north.

• 80310—Morphology and distribution of residual limestone hills (mogotes) in the karst of northern Puerto Rico.

M. J. Day, Department of Geography, University College Dublin, Belfield, Dublin 4, Ireland (present address: Department of Geography, University of Wisconsin—Milwaukee, Milwaukee, Wisconsin 53201). (7 p., 6 figs., 2 tbls.)

Limestone towers, residual hills occurring in northern Puerto Rico, between Arecibo and Manati, have been examined by field investigation and photogrammetry. Previously, these landforms have been described only qualitatively; in this paper summit densities, heights, diameters, planimetric shapes, and orientations are quantified.

Tower heights are generally less than 25 m; diameters range from 10 to 200 m. Diameter/height ratios range from 1.42 to 7.50. These values place the hills in the Sewu class of Balazas' (1971) classification of tropical karst styles. Towers are predominantly elongate in plan view, and pronounced long-axis orientations are evident. Tower summits exhibit a distribution that approaches uniformity.

The relationship between the residual hills and the adjacent cockpit karst area indicates a similar origin for both areas, with differences in summit densities relating to the distribution of surficial deposits, which promote subsurface corrasion. Tower slope asymmetry occurs only in 35% of cases, and it is probably related to basal erosion, induration of the limestone surface being of secondary importance.

• 80311—A late Middle Pennsylvanian flora of the Narragansett basin, Massachusetts.

Paul C. Lyons, Weston Observatory, Boston College, Weston, Massachusetts 02193 (present address: U.S. Geological Survey, Reston, Virginia 22092); William C. Darrah, Spruce Hill, R.D. 1, Gettysburg, Pennsylvania 17325. (6 p., 3 figs., 2 tbls.)

Forty species of Pennsylvanian plant megafossils have been recovered from a new plant-bearing horizon in the middle part of the Rhode Island Group of the Narragansett basin. *Annularia sphenophylloides*, *Pecopteris arborescens*, *Asterophyllites equisetiformis*, *Pecopteris lamuriana*, *mariopertis nervosa*, *Sphenopteris minutisecta*, and *Cordaites principalis*, in order of abundance, constitute 77% of the flora. The fossil assemblage is of late Alleghenian to early Conemaughian age and indicates that the overlying beds are probably of Late Pennsylvanian age.

• 80312—Late Cretaceous high-potassium volcanism in eastern Srednogorie, Bulgaria.

M. Boccaletti, Istituto di Geologia e Paleontologia dell'Università, Via Lamarmora, 4 Firenze, Italy; P. Manetti, A. Peccerillo, Istituto di Mineralogia, Petrografia e Geochimica dell'Università, Via Lamarmora, 4 Firenze, Italy; G. Stanisheva-Vassileva, Geological Institute of Bulgarian Academy of Sciences, Sofia, Bulgaria. (9 p., 11 figs., 3 tbls.)

The Srednogorie zone of Bulgaria was the site of extensive Late Cretaceous calc-alkalic and shoshonitic magmatism. The calc-alkalic volcanism developed mainly in the central and western parts, whereas shoshonitic volcanism was the predominant magmatic feature of the eastern part. Leucitic basanites, limburgites, and picrites occur in minor amounts in eastern Srednogorie. The shoshonitic volcanic rocks are intermediate to silicic in composition and are characterized by high K_2O, K_2ONa_2O around unity, high Rb, Sr, and Ba, and low TiO_2 contents. They are associated with calc-alkalic rocks less strongly enriched in K and incompatible elements. Petrographically, the calc-alkalic rocks are characterized by the presence of hydrous mineral phenocrysts that are not present in the shoshonitic rocks. Shoshonitic and calc-alkalic rocks have some common chemical characteristics such as low TiO_2, lack of absolute iron enrichment, and large overlap in many trace-element abundances. These are considered evidence for a genetic relationship between their primary magmas, which may have undergone different degrees of enrichment in incompatible elements.

The eastward increase of K-rich volcanic rocks relative to calc-alkalic rocks in the Srednogorie zone is believed to be related to distension tectonics connected with the opening of the Black Sea.

• 80313—Localization of minor folds by major folds.

A. J. Watkinson, Department of Geology, Washington State University, Pullman, Washington 99163; P. R. Cobbold, Institut de Géologie, Université de Rennes, Frances (3 p., 3 figs.)

Some naturally folded multilayer sequences show an association of major folds (which develop across the whole multilayer sequence) with localized minor folds (which are restricted to a few layers). The minor folds have highest amplitudes immediately adjacent to a major fold and attenuate rapidly away from that major fold. Analogous geometries have been duplicated in model experiments. Our mechanistic explanation for the initiation of growth of the localized folds uses an elastic beam analysis first put forward by Heteyni and assumes that an important effect of a developing major fold is to impart a localized bending moment on the layers under compression.

• 80314—Ultramafic and mafic inclusions and megacrysts in Pliocene basalt, Black Range, New Mexico.

R. V. Fodor, Department of Geosciences, North Carolina State University, Raleigh, North Carolina 27607. (9 p., 4 figs., 6 tbls.)

Inclusions in Pliocene alkalic basalt of the Black Range, southwestern New Mexico (and on the western margin of the Rio Grande rift), are spinel lherzolite, a differentiated suite of clinopyroxenite and gabbroic (metagabbroic) rock types (olivine-spinel gabbro; spinel gabbro; gabbro), and olivine and andesine megacrysts. All gabbros have reaction zones of mainly olivine and alkali feldspar surrounding orthopyroxene. Pyroxene and oxide geothermometry indicates equilibrium temperatures for lherzolite and gabbroic inclusions of ~1000 to 1050 °C.

Mineral compositions indicate that lherzolite nodules are of the Cr-diopside group, representing mantle material that equilibrated at ~33- to 45-km depth, whereas the remaining inclusions and megacrysts belong to the Al-augite group and had a high-pressure cumulate origin. The pyroxene compositions in the Al-augite group and the modal mineralogy (no garnet) indicate an origin in the 10- to 20-kb range. The absence of an olivine + plagioclase reaction in one gabbro, however, restricts its origin to a maximum pressure of about 11 to 14 kb. Differentiation among the Al-augite inclusions is displayed by progressive Fe enrichment in pyroxenes attended by decreasing Al in oxides. The reaction zones in gabbro developed from the contact between orthopyroxene and host-basalt magma. A bulk composition of one reaction zone shows that a contribution was probably made by the basalt, to account, in particular, for the formation of alkali feldspar in the reaction zones.

• 80315—Petrochemical and geochronological studies of plutonic rocks in the southern Appalachians: III. Leucocratic adamellites of the Charlotte belt near Salisbury, North Carolina.

J. Robert Butler, Paul D. Fullagar, Department of Geology, University of North Carolina, Chapel Hill, North Carolina 27514. (7 p., 7 figs., 3 tbls.)

The Salisbury, Yadkin, Southmont, Gold Hill, and Kannapolis plutons and related smaller bodies in the Charlotte belt of central North Carolina are leucocratic albite adamellite. The Rb-Sr whole-rock ages for these plutons are 413 to 386 m.y., and the Salisbury-group granites generally have low initial Sr^{87}/Sr^{86} ratios near 0.703. A mica date of 368 m.y. is an upper bracket for metamorphism. The Gold Hill fault truncates the Gold Hill pluton; major movement probably occurred between about 400 and 368 m.y. ago. Gold mineralization apparently is younger than major deformation. The gold deposits are strongly localized in shear zones, although some gold-bearing veins cut the Gold Hill and Salisbury plutons. Acadian deformation in this part of the southern Appalachians is mainly restricted to shear zones trending about 25°east of north and was accompanied or followed

by lower-greenschist-facies metamorphism that overprinted an earlier greenschist- to amphibolite-facies metamorphism.

• 80316—An interpretation of the gravity field of the Morin Anorthosite Complex, southwest Quebec.

P. Kearey, Gravity and Geodynamics Division, Earth Physics Branch, Department of Energy, Mines and Resources, Ottawa, Canada K1A OY3 (present address: Department of Geology, University of Bristol, Bristol BS8 1TR, United Kingdom). (9 p., 10 figs., 1 tbl.)

The Morin Anorthosite Complex of the western Grenville province is composed of an igneous sequence of anorthosite-leucogabbro-jotunite-quartz mangerite which intrudes granulitic gneisses and metasedimentary rocks. Separation of the gravity field observed over the complex into regional and residual gravity anomalies by a graphical method reveals that the negative and positive gravity anomalies associated with the Morin Complex are superimposed upon a regional negative anomaly that may be caused by a low-density mass no deeper than the lower crust. There is no evidence of a complementary dense mafic body underlying the complex. The negative residual gravity anomalies over the anorthosite-leucogabbro are attributed to an underlying body of relatively pure anorthosite of density 2.69 g/cm^3 intruded into a region whose average density is approximately 2.78 g/cm^3. The body of anorthosite is divided by a basement ridge into two lobes, which may represent different intrusions. These two lobes have the form of irregular sheets 2 to 4 km thick, underlain by thin pipes, which may represent feeders, extending to depths of at least 12 km. The anorthosite may extend subsurface to the northwest, northeast, and south of the main outcrop. Positive residual gravity anomalies are associated with jotunite, quartz mangerite, and metasedimentary rocks. Jotunite forms a thin surface sheet within the anorthosite-leucogabbro and possibly a more substantial body beneath its southern margin. Quartz mangerite forms an extensive body to the south of the massif and may extend beneath the Paleozoic cover of the St. Lawrence Lowlands.

• 80317—Trends in trans-North Atlantic commonality among Phanerozoic invertebrates, and plate tectonic events: Discussion and reply. (5 p., 2 figs., 4 tbls.)

Discussion: *Karl W. Flessa, Department of Geosciences, University of Arizona, Tucson, Arizona 85721; Joan M. Miyazaki, Department of Earth and Space Sciences, State University of New York at Stony Brook, Stony Brook, New York 11794.*

Reply: *W. C. Fallaw, Department of Geology, Furman University, Greenville, South Carolina 29613.*

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