GSA news & information

SUPPLEMENT TO GEOLOGY MAGAZINE

New incentives and flexibility for authors in the GSA *Bulletin*

The ***Bulletin*** of the Geological Society of America begins its 89th year of publication January 1979. Generations of noted geologists have regularly advanced the principles and knowledge of Earth science on its pages. The 1979 ***Bulletin*** will continue this publication record and continue to be available in the many thousands of State, Federal, university, company, and private libraries in more than 50 countries throughout the world.

The ***Bulletin*** has undergone significant changes in size and format several times during its history, and in January 1979 it will undergo another change.

The change in format for the GSA ***Bulletin*** in January 1979 is a major change for authors and users as well as for the Society. Of necessity, 1979 will be a year of transition, and transitions create special problems. The Executive Committee has given careful and detailed consideration to these problems and to the suggestions and questions from the membership; for 1979, the committee has approved several measures intended to ease the difficulty of the transition.

As has been announced, the long-range objective of the new ***Bulletin*** is to have two- or three-page summaries of articles in ***Part I***, which will look much the same as the present ***Bulletin***; the complete text of the articles with all the necessary supporting data will be published in ***Part II*** on microfiche. The major advantages of the new two-part system when fully operative will be enormously increased speed of publication, greatly reduced cost, and a greatly increased capacity for more published articles.

During 1979 articles in the old format that were submitted to the ***Bulletin*** before 1978 will also appear in ***Part I***.

It is hoped that these measures that will apply throughout 1979 will ease the transition to the new-format ***Bulletin***.

GSA will welcome your comments and suggestions, especially during this transition year, regarding these transition initiatives.

The specific measures intended to ease the transition are as follows:

- The Society will prepare, at no charge, the camera-ready copy from suitable author-prepared manuscript and illustrations for those authors who find it difficult to prepare the finished camera-ready copy for their *Part II* articles.
- Senior authors of articles in *Part II* on microfiche will be provided with 50 free offprints of the *Part I* summary and 50 free copies of the microfiche on which the *Part II* article appears, or, if they prefer, 50 free paper copies of the *Part II* article.
- Paper copies of *Part II* will be made available at cost ($6/month) as a special service to those users (members and nonmember subscribers) who request them. Any such order should be accompanied by advance payment, and no discount can be offered for multiple orders or orders for a sequence of months.
- Medium-length articles that do not lend themselves readily to the *Part I/Part II* format will be considered for publication during 1979 in *Part I* of the *Bulletin*. A guideline for maximum length for such articles is 20 manuscript pages, although it is requested that the author query the Science Editor's office to establish suitability of the article for this limited-space format before submitting the manuscript to GSA.

"Floods and People," sixth environmental report, now available on request from GSA

"Floods and People: A Geological Perspective," the sixth report of the GSA Committee on Geology and Public Policy, deals with the relationships between hydrology (including the timing of floods), physiography of floodplains, and use of flood-prone lands by human beings. Stressing the "inevitability" of floods in virtually all regions, the report (written for the layman) places special emphasis on understanding the concepts of probability used in describing the frequency of floods, the brevity of the hydrologic record, and the close association of natural river processes with the landscape of the river valley.

If individuals and society are to cope intelligently with the hazards of floods, structural measures including reservoirs and floodways and institutional approaches involving land-use planning and insurance must be evaluated in light of the geologic and hydrologic setting of flood-prone lands. Although historical factors may have demanded human settlement in close proximity to threatening rivers, the rationale for current and future settlement on lands periodically inundated by water, whether along rivers or coasts, demands close examination. It is the premise of "Floods and People" that informed citizens, planners, and elected officials provide in the long run the only hope that the mistakes of the past will be avoided in the future. Recognizing that much has already been written about floods, the committee hopes that the geological perspective of its report is a useful addition to the education of the public.

The report includes definition of floods, natural factors controlling flood magnitudes, effects of changes in land use, the timing of floods, and means of coping with flood hazards. The report is available free to members of GSA. It is hoped that members will find this and earlier reports[1] useful in teaching or in connection with their participation as professionals or citizens in local and State planning activities. In keeping with GSA policy of encouraging the widest dissemination of information to the public, additional copies of the report may be freely reproduced.

[1]Previously published reports of the GSA Committee on Geology and Public Policy (formerly the Committee on Environment and Public Policy) are as follows:

1. "Environmental Impact of Conversion from Gas or Oil to Coal for Fuel" by Vernon E. Swanson, Helen L. Cannon, Peter H. Given, James R. Jones, John W. Kaakinen, Harold E. Malde, Stanley B. McCaleb, Joseph Y. Parce, and Terry L. Thoem (July 1974)
2. "Development of Oil Shale in the Green River Formation" by Hollis Dole, Tom Beard, John Bredehoeft, G. U. Dinneen, John Donnell, John Rold, Paul Russell, Stanley Schumm, and Ellis Sedgely (July 1974)
3. "Impact of Barrier-Island Development—Geologic Problems and Practical Solutions" by Robert A. Morton, Cyril J. Galvin, Jr., James D. Howard, Joe C. Moseley, Orrin H. Pilkey, Limberios Vallianos, and James A. Veltman (June 1976)
4. "Geologic Constraints in the Urban Environment" by Wallace R. Hansen, Donald R. Coates, James R. Dunn, F. Beach Leighton, Andrew M. Spieker, Robert E. Wallace, and Stanley D. Wilson (June 1976)
5. "Impacts and Management of Off-Road Vehicles" by Howard G. Wilshire, Geoffrey B. Bodman, Don Broberg, William J. Kockelman, Jack Major, Harold E. Malde, Charles T. Snyder, and Robert C. Stebbins (May 1977)

Research proposals in the Earthquake Hazards Reduction Program solicited by USGS

The United States Geological Survey requests proposals for research contracts under the continuing Earthquake Hazards Reduction Program.

The areas of interest are:

A. **Earthquake Hazards Studies.** Programs sought include evaluation of earthquake potential (tectonic framework and recurrence intervals); studies of earthquake effects (ground motion, ground failure, assessment of other earthquake-related hazards, and post-earthquake studies); and studies of earthquake losses and risk analysis.

B. **Earthquake Prediction Studies.** Programs sought include the location of areas where large earthquakes are most likely to occur (seismotectonics and stress level determination); studies of earthquake precursors and the development of techniques to predict the time, location, and magnitude of earthquakes; field programs to monitor manifestations of stress and strain changes; and the development of computer-based models of physical processes related to earthquakes.

C. **Studies in Support of Both Hazards and Prediction.** Programs sought include investigations of the physical basis of earthquakes; studies of crust and upper mantle behavior; laboratory investigations of rock properties; and studies of regional seismicity.

Written inquiries concerning this program and requests for Proposal Information Package No. RFP-680W should be addressed to Contracting Officer, U.S. Geological Survey, Mail Stop 85, 345 Middlefield Road, Menlo Park, California 94025.

Due date for receipt of proposals is February 16, 1979. It is anticipated that funding of selected programs will start on or after October 1, 1979.

Penrose Conference, Granite II, in June 1979

A Geological Society of America Penrose Conference, Granite II, will be held June 24–29, 1979, at Fairmont Hot Springs, Gregson, Montana. Granite II is the second of two Penrose Conferences on granite rock; this session will concentrate on problems associated with epizonal batholiths. The intent of the 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 discussions 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 (held September 10–16, 1978, in Lakeshore and Mammoth Lakes, California) 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.

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.

Application deadline: April 1, 1979; registration fee: approximately $300.

▪ NOTICE ▪

February 1, 1979, has been set as the deadline for receipt at headquarters of nominations for the Penrose Medal, Day Medal, Honorary Fellowship, and National Medal of Science.

To ensure thorough consideration by the particular subcommittee, please back up each suggested nomination with a brief biographical sketch and a summary of the nominee's chief contributions to geology. In the case of the Penrose and Day Medals, a selected bibliography must accompany the nomination.

NRC programs for postdoctoral research in 1979

Applications are now being accepted for the NRC Research Associateship Programs for 1979. These programs provide scientists and engineers opportunities for postdoctoral research in the fields of atmospheric and Earth sciences, chemistry, engineering, environmental sciences, life sciences, mathematics, physics and space sciences.

Awardees conduct research on problems of their choice in selected federal research laboratories at approximately 65 geographic locations in the United States. The programs are open to recent recipients of the doctorate and, in many cases, to senior investigators also. Some programs are open to non–U.S. citizens.

Approximately 250 new awards will be made on a competitive basis in 1979. The basic stipend (subject to income tax) will be $18,000 for recent recipients of the doctorate. Higher stipends are awarded to senior investigators. The awards include relocation grants and funds for limited professional travel during tenure.

Applications must be made to the NRC and must be postmarked by January 15, 1979. Results will be announced in the spring.

Application materials and detailed information about specific opportunities for research are available from the Associateship Office, JH 608-D3, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418, (202) 389-6554.

AGI announces February 1, 1979, deadline for applications for geoscience scholarships

The American Geological Institute will again offer scholarships for geoscience majors who are United States citizens and members of the following ethnic minority groups: American Black, American Indian, Native Hawaiian, American-Samoan, Hispanic-American, or Puerto Rican. More than 50 such scholarships were awarded for the 1978–1979 school year and approximately the same number will be awarded during 1979–1980. Geoscience majors currently enrolled in accredited institutions as either undergraduate or graduate students are eligible to apply for the scholarships.

The term "geoscience" is used broadly to include major study in the fields of geology, geochemistry, geophysics, hydrology, meteorology, oceanography, and space and planetary sciences.

Monies for support/funding of this program are administered by the AGI Minority Participation Program Advisory Committee and have come from six member societies of which GSA is one; more than 16 mining, petroleum, geological supply, and geophysical companies; and many individuals.

Requests for application materials or nominations for scholarships should be addressed to William H. Matthews III, Director of Education, American Geological Institute, Box 10031, Lamar University Station, Beaumont, Texas 77710. The deadline for filing the completed application is February 1, 1979.

Antler orogeny topic of Penrose Conference

A Penrose Conference on the "Antler orogeny—Mid-Paleozoic tectonism in western North America," sponsored by the Geological Society of America, will be held in Nevada from September 9 to 15, 1979. Conveners of the conference are Tor H. Nilsen and John H. Stewart, U.S. Geological Survey, Menlo Park, California.

First recognized in Nevada about 25 years ago, the Antler orogeny has been the subject of numerous studies by workers in Alaska, western Canada, the western United States, Mexico, and Central America. Sedimentologists, structural geologists, paleontologists, field mappers, stratigraphers, geophysicists, and historical geologists have all examined various aspects of the orogeny. However, the orogeny has not been fully or satisfactorily explained in terms of either modern plate tectonics or more classical geosynclinal theory. Particularly puzzling is the relative synchroneity of the orogeny from Alaska to Central America. In addition, the well-documented eastward-directed overthrusts of siliceous oceanic sedimentary rocks over carbonate shelf rocks in the western United States, amounting to more than 100 km of movement without major igneous activity or thermal events, has not been satisfactorily explained. The conference will bring workers in Alaska, Canada, the western United States, Mexico, and Central America together for a long-needed exchange of ideas and information.

Sessions being planned include (1) mid-Paleozoic geology and paleogeography of western North America and Central America before, during, and after the Antler orogeny; (2) structural analyses and studies of the Antler orogenic belt; (3) sedimentology of Antler flysch and related deposits; (4) interpretation of the Antler orogeny in terms of classical geosynclinal theory and plate tectonics; and (5) paleobiogeographic effects of the orogeny.

Four days will be occupied with discussion, and emphasis will be placed on informal communication at meetings of both the entire group and smaller working groups. The type area of the Antler orogeny in Nevada will be examined during a two-day field trip, which will focus on study of overthrust lower Paleozoic oceanic deposits and postorogenic flysch sequences. A one-day field trip will examine Antler flysch in the Sun Valley area (only if meeting is held in Sun Valley).

The registration fee will be about $300 per person, which will include lodging, meals, and field trip. Attendance will be limited to 50 persons. Application deadline is June 1, 1979. If you are interested in attending this conference, please write to the conveners.

Annual Report for 1977 available on request

Librarians who wish to receive a copy of the GSA Annual Report for 1977 for archival purposes may obtain a photocopy by writing to:

The Geological Society of America
3300 Penrose Place, Boulder, Colorado 80301
(Attention: Administrative Assistant)

Penrose Conference on Mesozoic and Cenozoic microplate tectonics of western North America

Recent data from geology, paleontology, and paleomagnetics have clearly documented a tectonic style for western North America dominated by translation and rotation of small plates. This process has been underway for at least the last 230,000,000 years, is still operating today, and has been the chief architect in shaping the margin of the Pacific Coastal region of North America. Dominant movements have resulted in truncation along the southwestern margin of North America and accretion along the northwestern margin. Some blocks within the accreted terranes of Alaska are far traveled, as paleomagnetic data suggest derivation from the Southern Hemisphere. Other blocks in the Coast Ranges of Oregon and California have undergone large rotations with at most a small amount of northward movement.

Surprisingly, the broad outlines of this fundamental tectonic style for western North America have only been perceived within the past few years, and the time is now ripe for a multidisciplinary conference to pull together the disparate thread of ongoing research and to plan a coordinated assault on major problems. A Penrose Conference, which offers an ideal vehicle to achieve coordination between the paleontologists, geologists, and geophysicists who are now separately working on various aspects of microplate tectonic history, will be held during the week of October 7 to 12, 1979, on Lopez Island, Washington. The conveners are Myrl Beck, Western Washington State University, Bellingham, Washington; David L. Jones, U.S. Geological Survey, Menlo Park, California; and Allan Cox, Stanford University, Stanford, California. Those interested in attending are invited to apply to the conveners.

Three broad themes will be explored: (1) character, age, and distribution of microplates that accreted to North America during the Mesozoic, with emphasis on paleomagnetic and geologic evidence for their site of origin, the amount of displacement, and the time of their arrival; (2) Cenozoic rotations and translations, and their relation to volcanism, sedimentation, and faulting in the context of interaction between the North American plate and the Pacific, Farallon, and Kula plates; and (3) geometric and physical constraints to detachment, movement, and accretion of microplates.

Fee for the conference will be announced later, but it will be approximately $275–$300. Deadline for application: July 1, 1979.

South-Central Section announces slate

The following slate of nominees will be voted on at the annual business meeting of the South-Central Section on April 9, 1979, at Mountain View, Arkansas:

Chairman . . . . . John C. Gries (1980–81)
Vice-Chairman . . . . . Donald E. McGannon, Jr. (1980–81)
Secretary-Treasurer . . . . . Page Twiss (1980–83)
Management Board (2-year terms, 1979–81):
Members-at-Large: Elizabeth A. Elliott, August Goldstein, Jr., Karen L. Willoughby

Symposium on uranium evaluation and mining planned for April 23–27, 1979, in Buenos Aires

The International Atomic Energy Agency and the OECD Nuclear Energy Agency will sponsor a Symposium on Uranium Evaluation and Mining Techniques, Buenos Aires, Argentina, April 23–27, 1979. The Department of Energy (DOE) will coordinate the U.S. participation in the symposium.

The symposium will provide a forum for presentation and discussion of many subjects related to uranium resource evaluation and some consideration to mining of uranium ores. The principal topics for discussion will be world supply and demand; standardization of definitions and terminology; physical exploration and delineation of ore reserves; mining or other recovery methods; estimation of undiscovered uranium resources; and availability of reserves and resources.

The U.S. point of contact for the symposium is John H. Kane, Special Assistant for Conferences, Technical Information, Department of Energy, Washington, D.C. 20545.

AEG schedules annual meeting, October 1979

The 1979 Annual Meeting of the Association of Engineering Geologists is scheduled for October 9–12, 1979, in Chicago, Illinois. The meeting will feature two days of field trips and two days of technical sessions following the general theme "State of the art in engineering geology." The field trips, scheduled for October 9 and 10, will include visits to problem areas of the Lake Michigan shoreline; to tunnels being constructed for the renowned Chicago deep tunnel project; and to other sites of interest to engineering geologists. The technical sessions, scheduled for October 11 and 12, will include topics on dam inspections, ground water, coal mining, and legal aspects of geological practice. Various evening entertainment and cultural activities are planned. For further information, contact Abe Dolgoff, Chairman, c/o Sargent & Lundy, Inc., 55 East Monroe Street, Chicago, Illinois 60603; (312) 269-7142.

Necrology

Notice has been received of the following deaths: Leonidas Theodore Barrow, Houston, Texas; Thomas R. Beveridge, Rolla, Missouri; Neil Campbell, Spokane, Washington; Alan J. Galloway, Carmel, California; Geoffrey Gilbert, Victoria, British Columbia; E. C. Harder, Montreal, Quebec; Louis O. Heintz, Glendale, California; Everett D. Jackson, Cupertino, California; Glen W. Ledingham, Balboa Island, California; Gordon A. Macdonald, Volcano, Hawaii; James M. Schopf, Columbus, Ohio; Paul Albert Smith, Arlington, Virginia; Ralph W. Spencer, Palos Verdes Estates, California; Walter C. Stoll, Madrid, Spain; Richard O. Stone, Los Angeles, California; Clyde G. Strachan, Tulsa, Oklahoma.

Hawaii symposium on intraplate volcanism and submarine volcanism planned for July 16–22, 1979

Sponsors

International Association of Volcanology and Chemistry of the Earth's Interior; United States Geological Survey, Hawaiian Volcano Observatory; University of Hawaii; Inter-Union Commission on Geodynamics; United States Geodynamics Committee.

Location

A coastal town on the Island of Hawaii, easternmost island in the Hawaiian chain, and site of active Mauna Loa and Kilauea Volcanoes.

Conveners

Robert Decker, Charles Drake, Dartmouth College; Gordon Eaton, Hawaiian Volcano Observatory; Charles Helsley, University of Hawaii.

Organization

Four days of scientific meetings will be interspersed with three days of field trips on the Big Island of Hawaii. Field trips to other Hawaiian Islands will be offered before and after the symposium if interest dictates.

Symposium Topics

All aspects of intraplate volcanism, both continental and submarine, will be discussed, but with special emphasis on the Hawaiian Islands. A variety of tectonic settings will be considered. Magma energy research will be an additional special topic for discussion.

Tentative Scientific Program

Intraplate Volcanism—Oceanic and Continental: What, where, and when?

Intraplate Volcanism—How?

Submarine Volcanism along Mid-Ocean Ridges

Geochemistry and Petrology of Intraplate Volcanic Rocks

Origin of Submarine Magnetic Anomalies

Origin of the Hawaiian Islands

Magma Energy Research—A discussion of the means of extracting thermal energy from molten rock

Open—Topics to be selected from among those of abstracts submitted

Schedule

A second circular including registration form and call for papers is available from Lois Elms, The Western Experience, 1140 Pearl Street, Suite 219, Boulder, Colorado 80302.

December BULLETIN briefs

Brief summaries of articles in the December 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.***

• 81201—Tectonic implications of the heat flow of the western Snake River Plain, Idaho.

Charles A. Brott, David D. Blackwell, Department of Geological Sciences, Southern Methodist University, Dallas, Texas 75275; John C. Mitchell, Idaho Department of Water Resources, Boise, Idaho 83707. (11 p., 5 figs., 1 tbl.)

Heat-flow values within the western Snake River Plain average about 1.7 $\mu cal/cm^2$ sec, but even higher values are measured in granitic rocks along the margins of the Snake River Plain (2.5 $\mu cal/cm^2$ sec or higher). The heat-flow distribution is related to the combined effects of crustal thermal refraction and a large, transient crustal heat source. A regional model consistent with the heat-flow pattern and other geophysical and geological data is described which assumes the emplacement of a large heat source (mafic intrusion?) under the western Snake River Plain about 10 to 15 m.y. ago. An anomaly of about 0.3 $\mu cal/cm^2$ sec is predicted over the center of the heat source at the present time. The timing of the emplacement of the heat source corresponds with the age of voluminous silicic volcanism in the western Snake River Plain. A time-progressive thermal model is presented for the Snake River Plain which is consistent with

the time progression of silicic volcanism. Based on the model, higher regional heat-flow values are predicted for the eastern Snake River Plain. Confirmation of the high regional heat-flow values is not possible in the bore holes available (200 ± m deep) because of regional circulation of cold ground water in the Snake Plain Aquifer. However, a close correlation between integrated crustal and upper mantle temperature and observed elevation changes along the axis of the Snake River Plain is strong support for the heat-flow model. The possibility of high heat flow in the eastern part of the Snake River Plain implies that the area may have significant geothermal potential in spite of the low surface heat flow. The regional aseismic warping observed in the eastern Snake River Plain can be interpreted as a thermal contraction phenomenon involving the crust and upper mantle.

• 81202—Silicic lavas in Paleozoic flyschlike deposits in New South Wales, Australia: Behavior of deep subaqueous silicic flows.

Ray Cas, School of Earth Sciences, Macquarie University, North Ryde, New South Wales, Australia 2113 (present address: Department of Earth Science, Monash University, Wellington Road, Clayton, Victoria, Australia 3168). (7 p., 5 figs., 2 tbls.)

Regionally extensive dacite-andesite and rhyodacite porphyries within the mid-Paleozoic flyschlike fill of the Hill End Trough of New South Wales have characteristics that are consistent with their being lava flows: conformable, no crosscutting relationships; planar coherent, irregular autobrecciated and quenched margins; vesicular; internally coherent and not vitriclastic; internally uniformly porphyritic and not zoned; and observable topographic influence on the character of succeeding stratigraphic units.

The relatively deep marine environment that is inferred from the flyschlike nature of the enveloping stratigraphic succession may be responsible for the regionally extensive character of these lavas. Although subaerial equivalents are demonstrably viscous and immobile, subaqueously erupted and emplaced silicic lavas may behave fluidly and may be highly mobile because of the inability of volatiles to escape under conditions of high environmental (water) pressures.

• 81203—A chemical approach to the preferred orientation of mica.

Robert P. Wintsch, Department of Geology, Indiana University, Bloomington, Indiana 47401. (4 p., 1 fig., 1 tbl.)

The mineralogical and chemical changes accompanying diagenesis in Gulf Coast argillaceous sediments provide a good working model for such changes in similar sediments elsewhere. Knowledge of these reactions allows plausible explanations for mica fabric formation in mildly metamorphosed sediments to be developed.

Holeywell and Tullis have identified three preferred orientations of mica across the strain gradient in the Martinsburg Formation at Lehigh Gap, Pennsylvania. These are muscovite in the bedding plane, chlorite at 20° to the bedding plane, and a slaty cleavage defined first by muscovite and with increased strain by chlorite, both at 90° to the bedding plane. The muscovite orientation in the bedding plane is attributed to sedimentary deposition of muscovite and an illite-smectite mixed-layer phase, followed by a replacement of the smectite component by illite during diagenesis. The chlorite is probably diagenetic, and its orientation may reflect a 20° rotation of the bedding plane from the plane normal to λ_3. The orientation of muscovite and chlorite in the slaty cleavage is consistent with a pressure solution mechanism causing first the pressure solution of quartz and feldspars and the precipitation of muscovite, and later, with increased strain, the recrystallization of the earlier formed muscovite and chlorite.

• 81204—New evidence on the history of the St. Francis Sunk Lands, northeastern Arkansas.

James E. King, Quaternary Studies Center, Illinois State Museum, Springfield, Illinois 62706. (4 p., 2 figs.)

A radiocarbon-dated pollen diagram from Big Lake, a complex of relict braided channels on the Little River and part of the St. Francis Sunk Lands in northeastern Arkansas, indicates that the basal lake sediments are less than 180 yr old. This date approximates the time of the New Madrid earthquake of 1811–1812. The formation of the St. Francis Sunk Lands has been attributed to mid-Holocene alluvial drowning, and effects of the New Madrid earthquake upon the Sunk Lands have recently been considered minimal. However, this new evidence suggests that Big Lake was either altered or formed in recent times, possibly by this seismic event.

• 81205—Paleohydrology and migration of the groundwater divide in regions of tectonic instability in Israel.

Uri Kafri, Arnon Arad, Geological Survey of Israel, Jerusalem, Israel. (10 p., 9 figs., 1 tbl.)

The Upper Cretaceous Judea carbonate-rock aquifer is situated between the base levels of the Mediterranean Sea in the west and the Jordan rift valley in the east, which have a maximum elevation difference of 400 m. The gradients of the ground-water table vary from very steep (8%) to very moderate (0.04%). The present groundwater divide in the uplifted central Israeli mountains coincides with the north-south structural axis. The divide in the Yizre'el and Beer Sheva morphotectonic valleys, which cut across these mountains, is located very close to the Mediterranean base level. These valleys have a past history of repeated penetration by the sea since Neogene time. In Pliocene time the Mediterranean and the Jordan rift valley had the same elevation. Thus, one would expect that the divide was situated halfway between them. It can be shown, theoretically, that the later subsidence of the rift valley relative to the Mediterranean should have caused a westward shift and a simultaneous lowering of

the ground-water divide, as the eastern gradients became more gentle. This is the case in the Yizre'el and Beer Sheva valleys, where the bottom of the aquifer is below the base levels and the location of the ground-water divide is not controlled by the underlying structure. Although structural control appears to be dominant in the study area, it is recognized that the location of the divide is also controlled by nonuniformity of recharge and hydraulic conductivities. Some of the present water tables have a past history as parts of the paleo–ground-water systems. These are identified on the basis of fossil karst systems and gentle gradients leading to ancient base levels, indicated by nearshore marine or lacustrine sediments.

• 81206—Transgressive-barrier and shallow-shelf interpretation of the lower Paleozoic Peninsula Formation, South Africa.

David K. Hobday, Department of Geology, University of Natal, Pietermaritzburg, South Africa (present address: Bureau of Economic Geology, University of Texas at Austin, University Station, Box X, Austin, Texas 78712); Anthony J. Tankard, South African Museum, Cape Town, South Africa. (12 p., 15 figs.)

The Peninsula Formation of the lower Paleozoic Cape Basin is well exposed on the Cape Peninsula, where it comprises a 750-m-thick quartz arenite complex transgressively overlying back-barrier tidal flat deposits. Five sandstone facies are distinguished on the basis of distinct assemblages of sedimentary structures. The two lowermost facies are relatively thin and consist of northwestward (landward)-dipping plane-bedded sandstones, interpreted as barrier washover deposits, and small-scale back-barrier tidal channels, with cross-bedding of variable direction. At a higher stratigraphic level are large-scale channel deposits, which are ascribed to the lateral migration of tidal inlets. These sequences are characterized by ebb-oriented cross-bedding at the base, with smaller scale sets of longshore-directed or flood-oriented cross-bedding in the upper parts. A facies interpreted as beach foreshore, comprising seaward-dipping plane beds with multiple discordances and heavy mineral laminae, is occasionally preserved above the inlet sequences. The upper part of the Peninsula succession is dominated by tabular and lenticular sandstone bodies with megasets as much as 10 m thick showing complex internal organization of smaller structure. These intrasets are mainly trough cross-beds that are inclined either in the same direction as the major foresets or at a variable angle to them. This facies is compared with the tidal sand ridges and sand waves of North Sea type. A large proportion of the Peninsula tidal sand bodies migrated southwestward parallel to the shoreline; others are directed offshore.

The considerable thickness of the Peninsula transgressive sandstone is attributed to gradual subsidence balanced by substantial sediment supply, introduced mainly by a braided alluvial complex to the northwest. This led to vertical stacking of facies. Barrier inlet migration was rapid compared with the rate of transgression, thereby obliterating many of the features characteristic of barrier island deposits. The several-hundred-metre thickness of tidal sand body deposits indicates that the water depth remained within the critical limits of tidal current dominance. This regime was eventually terminated by marine regression and the accumulation of fossiliferous lagoonal siltstones and glaciogenic diamictites.

It is suggested that deposition of the Peninsula Formation was strongly influenced by storm processes. Extensive barrier washover sheet sands are attributed to storm surge. Furthermore, the two-part sequence within the tidal sandbar facies of a basal pebbly unit overlain by plane-bedded, fine-grained sandstone without heavy mineral segregation is identical to modern storm-generated sequences off Long Island, New York. The perpendicular to oblique relationship of shoreface channels to the tidal sandbars suggests incision by storm surge ebb currents, which deposited a pebbly lag on the bar toes.

• 81207—Early and middle Cenozoic drainage and erosion in west-central Arizona.

Richard A. Young, Department of Geological Sciences, State University College of Arts and Science, Geneseo, New York 14454; Edwin H. McKee, U.S. Geological Survey, Menlo Park, California 94025. (6 p., 4 figs.)

Latest Oligocene time (~25 m.y. ago) is established as a minimum age for the regional northeast-flowing drainage system in west-central Arizona that existed prior to the formation of the Grand Canyon. The amounts of erosion and fluvial deposition that occurred before eruption of the oldest dated volcanic rocks suggest a Paleocene to Eocene age span for the uplift and deformation in southwestern Arizona that initiated this drainage pattern. Recent refinements and revisions of the Tertiary stratigraphy in southwestern Utah indicate that the regional drainage from northern Arizona ended in basins like that represented by the Claron Formation and associated fluviolacustrine sedimentary rocks in southern Utah. This period of erosion and north- to northeast-flowing drainage is separated from the Grand Canyon erosion cycle by at least 15 m.y. of block faulting and interior basin deposition, followed by gradual capture and integration of the existing drainage by the Colorado River.

• 81208—Ordovician (Trenton to Richmond) depositional patterns of New York State, and their relation to the Taconic orogeny.

Gregory J. Zerrahn, Shell Oil Company, P.O. Box 60775, New Orleans, Louisiana 70160. (10 p., 7 figs., 1 tbl.)

A regional stratigraphic synthesis employing subsurface and outcrop data was conducted on a regressive sequence of Middle (Trenton) to Late (Richmond) Ordovician terrigenous rocks in New York and northern Pennsylvania. The sequence is divided into three conformable units: (1) basal shale, (2) medial siltstone, and (3) upper sandstone. Isopachous and lithologic trends of these units reflect tectonic evolution associated with the Taconic orogeny. These trends, coupled with paleocurrent data,

suggest that two diachronous source areas influenced Taconic sedimentation: an eastern area (Green Mountain axis) uplifted during Middle Ordovician time, and a southeastern area in Pennsylvania (ancestral Piedmont?) during Late Ordovician time.

Accepting a cordilleran-type model for the Taconic orogeny, it appears that the eastern source was an elongate low-relief orogenic welt resulting from thermal and isostatic disequilibrium. Subsurface trends, however, indicate that the southeastern uplift was of a more rugged relief and limited areal extent, suggesting that it may have resulted from a collision-type mechanism.

• 81209—Upper Ordovician peralkalic granites from the Gulf of Maine.

O. Don Hermes, Department of Geology, University of Rhode Island, Kingston, Rhode Island 02881; R. D. Ballard, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543; P. O. Banks, Department of Earth Sciences, Case Western Reserve University, Cleveland, Ohio 44106. (14 p., 16 figs., 4 tbls.)

Specimens from fourteen outcrops of bedrock in the Gulf of Maine were collected with the submersible *Alvin* and include one felsic aphanitic pyroclastic rock, two calc-alkalic granites, and eleven peralkalic granites. The peralkalic granites range from hypersolvus to subsolvus varieties and exhibit slightly different textures and mineralogical features that reflect minor differences in their local crystallization and subsolidus histories. Similar chemistry and zircon ages of 400 to 450 m.y. indicate that all of these peralkalic granites from the gulf are genetically related. On the basis of similar mineralogy, texture, rock chemistry, and primary radiometric ages, these granites are interpreted to have been intruded during the same igneous episode as the subaerial alkalic granites of eastern Massachusetts.

The Gulf of Maine lies within the Avalon Platform province. The local occurrences of Upper Ordovician–Lower Silurian alkalic granites may indicate an igneous-tectonic episode that accompanied intraplate epeirogenic doming following the major compressional phase of the Taconic orogeny which more severely deformed rocks farther west. Emplacement of alkalic granite probably completed before renewed plate convergence and the final phase of Acadian plate collision during Devonian and throughout much of the rest of Paleozoic time.

• 81210—Evolution of slaty cleavage in relation to diagenesis and metamorphism: A study from the Hunsrückschiefer.

Ashit Baran Roy, Department of Geology, University of Rajasthan, Udaipur 313001, India. (11 p., 17 figs., 1 tbl.)

Detailed studies of the Hunsrückschiefer (Rheinisches Schiefergebirge), collected from the Katzenberg Mine,

southeast of Mayen (West Germany), indicate that the slaty cleavage fabric is represented by a variety of morphologic features. These include anastomosing thin films of layer silicates separating narrow lenses of rock matrix, the preferred dimensional orientation of flat grains of quartz, feldspar, and calcite occurring in the rock matrix bounded by films of layer-silicate minerals, and beardlike growth of chlorite, muscovite, and other minerals on those surfaces of quartz and other host minerals that make a high angle with the cleavage direction. Other features that help to define cleavage in slates are "seamlike" bunches of muscovite crowded with opaque minerals in metasiltstone layers and silty dikelike bodies in metaclaystone layers. There are also some veins of quartz-chlorite-calcite parallel to the direction of cleavage.

Evidence of mobilization of silty and clayey materials along cleavage planes and the presence of silty dikes along the cleavage planes suggest that the cleavage-forming deformation began during the prelithification stage of the rocks. The deformation at this stage, besides developing seams of muscovite, also caused formation of weak anisotropy by mechanical rotation of detrital micas to the planes of cleavage.

The earliest feature to develop following lithification and early diagenesis is the beardlike growth of chlorite, muscovite, and rutile on different host minerals. The layer-silicate films appeared in the rocks following growth of chlorite-muscovite porphyroblasts, in the earliest metamorphism of the rocks. It is argued that these films evolved through the development of fractures (which also pass through the chlorite-muscovite porphyroblasts), coupled with recrystallization following Riecke's principle. Further readjustments in the rocks caused flattening of minerals like quartz, feldspar, and calcite through solution. The veins of quartz-chlorite-calcite were the last to form in the rocks.

• 81211dr—Origin of Fisherman Island: Discussion and reply. (1 p.)

Discussion: *Mark Boulé, Shapiro and Associates, Inc., 812 Smith Tower, Seattle, Washington 98104.*

Reply: *Ervin G. Otvos, Jr., Gulf Coast Research Laboratory, Ocean Springs, Mississippi 39564.*

• 81212dr—Nature and significance of the Inyo thrust fault, eastern California: Discussion and reply. (6 p., 3 figs.)

Discussion: *George C. Dunne, Department of Geosciences, California State University, Northridge, Northridge, California 91324; Rachel M. Gulliver, Envicom Corporation, 4521 Sherman Oaks Avenue, Sherman Oaks, California 91403.*

Reply: *Calvin H. Stevens, Department of Geology, San Jose State University, San Jose, California 95192.*

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