GSA news & information

SUPPLEMENT TO GEOLOGY MAGAZINE

SEPTEMBER 1977

Preparation of manuscripts for new *Bulletin* format to take effect January 1, 1978

Beginning January 1, 1978, contributors to the *Bulletin* must prepare their manuscripts to fit the new *Bulletin* format. The new *Bulletin* will consist of two parts: Part I will have the same appearance as the present *Bulletin*; Part II will be reproduced on microfiche. Publication of the new *Bulletin* will begin January 1, 1979.

Part I. Summaries

Summaries of articles submitted for Part I of the new *Bulletin* must be between 1,000 and 2,000 words in length. They may contain no more than two illustrations; one is preferable. The space requirements for each illustration, including captions, must be calculated in terms of the number of words displaced at the rate of 20 words per square inch of illustration, subtracted from the maximum of 2,000 words. Illustrations should be planned for not more than 20% reduction. Foldouts will not be permitted.

A summary in Part I of a longer article in Part II must use the same title and authorship, except that the term "Summary" will follow the title. Summaries must carry a list of references cited. Note particularly that in such articles the references cited must be included in the word count.

An article in Part I that summarizes or discusses material presented in the Map and Chart series, rather than an article in *Bulletin* Part II, will require careful advance planning. Discussions and Replies to be included in Part I need not meet the minimum length requirement.

Part II. Microfiche

Articles submitted for Part II of the new *Bulletin* may be of any reasonable length commensurate with the subject matter. They may include as many page-size or smaller illustrations and as many tables as needed. They may include an extensive "Selected Bibliography" instead of the more restricted and more conventional list of "References Cited."

Preparation and Submittal of Manuscripts

Both the Part I summary and the longer Part II article should be prepared in manuscript style and transmitted together, for both will receive the usual GSA technical review. However, Part I summaries will be copy-edited before printing, whereas the longer Part II articles will not be copy-edited before microfiche reproduction from author-prepared, camera-ready copy.

Authors will first submit two double-spaced copies of Part I and Part II versions, together with copies of all illustrations at a final reduced size no larger than 8½ x 11 inches. After technical review, both versions will be returned to the authors for revision as recommended. In retyping after revision, Part I summaries should again be typed double-spaced to facilitate copy-editing and typesetting, Part II articles should be retyped according to GSA guidelines for preparation of camera-ready copy for microfiche.

Authors will be fully responsible for the content and accuracy of the final typescript for Part II articles, for, as noted above, these articles will not be copy-edited by GSA. Format paper and special instructions to typists will be sent to contributors when articles are returned for revision.

When revised manuscripts are submitted to GSA, the originally reviewed copies of all text and illustrations for both Part I summaries and Part II articles should also be returned. Authors should retain one complete copy of each revised manuscript and each illustration as insurance against loss or damage.

For additional information or questions, address the Science Editor or the Assistant to the Science Editor, Geological Society of America, 3300 Penrose Place, Boulder, Colorado 80301, or phone (303) 447-2020.

Volume VI of memorial series now available

The Geological Society of America Memorials, Volume VI, is now available at $8.00. The 200-page volume contains memorials for 1974 to the following deceased Members and Fellows of the Society:

Hans W. Ahlmann (1889–1974) by Gunnar Hoppe and Valter Schytt; John Willis Ambrose (1904–1974) by Raymond A. Price; Ernst Valdemar Antevs (1888–1974) by Terah L. Smiley; Richard William Bayley (1919–1974) by Harold L. James; Robert Ware Bridgman (1915–1974) by Norman H. Donald, Jr.; Charles Wilson Brown (1874–1974) by Alonzo W. Quinn; Frank Edward Byrne (1907–1974) by Howard J. Pincus; Frank Cathcart Calkins (1878–1974) by Max D. Crittenden, Jr.; Anthony R. Cariani (1918–1974) by John G. Douglas; Frank Rinker Clark (1881–1974) by Frank A. Morgan; Thomas Pipes Clendenin (1896–1974) by William Paxton Hewitt; Ernst Cloos (1898–1974) by F. J. Pettijohn; Elmer Fred Davis (1887–1974) by Thomas L. Bailey and Francis E. Vaughan; John Gray Douglas (1900–1974) by John C. Dunlap; Forrest Durham (1915–1974) by Ronald J. Lipp; Maurice Ewing (1906–1974) by J. Lamar Worzel; Elliott Gillerman (1913–1974) by Frank C. Foley; George Edward Goodspeed (1887–1974) by Julian D. Barksdale; Jarvis Bardwell Hadley (1909–1974) by John T. Hack and Richard Goldsmith; William Harold Irwin (1908–1974) by Jerry S. Dodd and Roxy Root; Philip Hennen Jennings (1899–1974) by John T. Rouse; Glenn Lowell Jepsen (1903–1974) by Erling Dorf; J. Harlan Johnson (1892–1974) by John L. Wray; George Moses Knebel (1899–1974) by W. E. Wallis; Eleanora Bliss Knopf (1883–1974) by John Rodgers; Marjorie K. Korringa (1943–1974) by Duane R. Packer, William R. Dickinson, and Kathryn M. Nichols; L. Don Leet (1901–1974) by Francis Birch, Marland P. Billings, and James B. Thompson; Gerald Raleigh MacCarthy (1897–1974) by William A. White, Roy L. Ingram, and Walter H. Wheeler; Virgil Ivor Mann (1920–1974) by Walter H. Wheeler; Phil F. Martyn (1903–1974) by Martin M. Sheets; Charles Warren Merriam (1905–1974) by Charles A. Anderson; Walter Franklin Pond (1885–1974) by Walter B. Jones; Hubert Elias Risser (1914–1974) by Jack A. Simon; Gordon Rittenhouse (1910–1974) oy F. J. Pettijohn; William Walden Rubey (1898–1974) by James Gilluly; Robert F. Sitler (1929–1974) by Glenn W. Frank; Anna I. Jonas Stose (1881–1974) by R. V. Dietrich; Alexander Stoyanow (1879–1974) by Charles A. Lee and G. Austin Schroter; Garvin Lawrence Taylor (1908–1974) by August Goldstein, Jr.; Robert Orion Vernon (1912–1974) by Philip E. LaMoreaux; Merton Y. Williams (1883–1974) by V. J. Okulitch and H. V. Warren.

The Olympic Hotel, 4th and Seneca (206) 682-7700, with lower rates, has just been named the headquarters hotel for the Seattle annual meeting. This is a change from the Washington Plaza Hotel, as announced in the April issue of GSA News & Information.

Geological Society of America
Cordilleran Section

Guidebooks for 1977 meeting, Sacramento, California

1.	Guidebook: Paleozoic-Mesozoic Rocks of the Northern Sierra Nevada	$ 2.50	________
2.	Field Trip Guide to the Geysers-Clear Lake Area	$ 4.00	________
3.	Geological Road Log for the California Mother Lode Country along Highway 49 between Mariposa and Grass Valley	$ 1.00	________
4.	Guidebook: Tectonics and Stratigraphy of the Calaveras Complex, Central Sierra Nevada Foothills	$ 1.50	________
5.	Guidebook: San Andreas Fault in Marin County with Section across the Coast Ranges from Sacramento to San Francisco	$ 4.00	________
6.	Guidebook to the Geology of the Klamath Mountains, Northern California	$ 7.50	________
7.	Field Trip Guide to the Kings-Kaweah Suture, Southwestern Sierra Nevada Foothills, California	$ 2.00	________
8.	Field Guide: Great Valley Sequence, Sacramento Valley	$ 4.50	________
9.	Guidebook: Plate Tectonic History of the Yolla Bolly Junction, Northern California	$ 1.50	________
10.	Field Trip around the Sacramento-San Joaquin Delta	$ 1.50	________
	Entire set, guides 1-10 above (no discount)	$30.00	________

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All orders must be prepaid. Make checks payable to Geological Society of America.
No discounts available.
Price includes shipping, handling, and tax.

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Networks of amateurs for science organized by International Environmental Resources

The potential of students as scientific observers is a concept that has come of age. In the Geological Society of America, the idea of student observers has been current since the tenure of Luna Leopold as President, but little progress has been made in organizing a program that would win the interest of students and their teachers. Now, stimulus to do so comes from Internet (the International Environmental Resources Network) by which growing numbers of students in the United States and Canada are being organized as "networks of amateurs for science." Internet is being developed under contract with the United Nations Educational, Scientific, and Cultural Organization and the United Nations Environment Program. As of March, the Internet network consisted of 4,700 students and 55 teachers in 21 areas, and the number of participants grows monthly. This network is being employed to collect data and samples for various kinds of research. Internet is described by its Director, John Whitman, in *Science*, vol. 194, p. 1228 (December 17, 1976).

Internet could provide a means of coordinating systematic geological observations by students, and the experience of the Internet staff could be invaluable in designing effective projects. With these optimistic thoughts in mind, the Society's Committee on Environment and Public Policy has begun discussion with Mr. Whitman on how the GSA membership could participate in Internet. This announcement is a step toward determining the degree of interest, the nature of possible projects, and the names of volunteers.

Internet currently links together interested students at the 7th through 12th grades, but college students could also act as observers and as classroom advisors. A typical geological project might be instigated by a GSA member who would eventually evaluate the observations and report the conclusions. The students making the observations, perhaps working in widely scattered places, would provide their results through high school teachers who have been identified by Internet. The person initiating the project would prepare a brief booklet that would be distributed by Internet, giving a description of the factor to be observed, its significance, the method of observation, forms for recording, and instructions to teachers and students. For example, a manual for observing the dates of spring flowering—the first Internet project—covers 8 pages.

A student who participates in an Internet project would do more than contribute to the progress of science. The student would gain an increased awareness of environmental issues; the benefits of exchange of information, experiences, and ideas; the learning that comes from work on actual research projects; and the satisfaction derived from identifying and helping to solve environmental problems.

Clearly, students are capable of observing many kinds of events that bring geologic change. John Whitman mentions events that may be precursors to earthquakes, and it is easy to comprehend others that bring changes to land, water, and ecological systems. The factors to be observed might span the continent, or they might be simply of local significance.

GSA members who wish to know more about Internet and who would be interested in suggesting and initiating a project are invited to make their interests known to Harold E. Malde (U.S. Geological Survey, Mail Stop 913, Box 25046, Federal Center, Denver, CO 80225), who is coordinating this matter for the Committee on Environment and Public Policy.

Nominations Committee seeks members' advice and suggestions

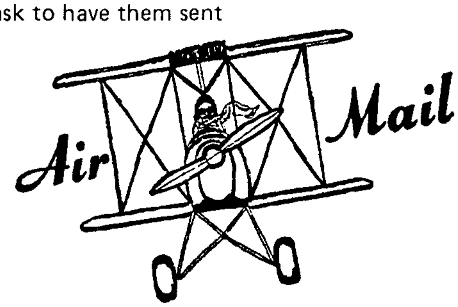
The Committee on Nominations seeks members' advice in one of the most important contributions that can be made to the health of the Society. Early in 1978, the committee will draw up a list of Members or Fellows whom they consider to be suitable replenishments for the gradually changing group that guides and manages Society affairs. Their final lists will be presented to the Council in May. In its turn, the Council will decide on a slate of officers to be placed on the ballot for the fall election. Chances are that a single slate will be presented for vote of the membership, though write-in votes are encouraged and are always welcome. The single slate concept, however, is all the more reason why your advice is needed for the Committee on Nominations. Its members cannot possibly know all of the potential leaders of the Society—they need your help. Nominations are to be made for president (usually the incumbent vice-president), vice-president, treasurer, and four councilors.

All suggestions received by February 1, 1978, will receive careful consideration. Write directly to headquarters. Suggestions will be forwarded to the committee.

To ensure thorough consideration by the committee, please back up each suggested nomination with a brief biographical sketch and a summary of his or her chief contributions to geology.

NOTE:

All members living outside North America will probably receive *Abstracts with Programs* **after** the meeting unless they write to GSA headquarters and ask to have them sent



gsa publications

Bibliography and Index of Paleozoic Crinoids, 1969-1973

MICROFORM PUBLICATION 8 — By G. D. Webster. 1977. 235 pages on three 24x microfiche. ISBN: 0-8137-6008-9. $4.50.

This volume continues and updates GSA Memoir 137, *Bibliography and Index of Paleozoic Crinoids, 1942-1968* (Webster, 1973). It includes papers published from 1969 through 1973 illustrating or describing Paleozoic crinoids. In addition, a number of papers published from 1939 through 1968, overlooked or unavailable to the author earlier, are indexed.

The bibliography lists 279 new titles of which 236 are indexed. Other papers included are 21 papers concerning crinoid paleoecology, correlation, geographic and geologic distribution, systematics, functional morphology, skeletal chemistry, sedimentation, extinctions, developments, or summaries of meetings, and 21 titles of abstracts. These papers and abstracts show some of the diversity of crinoid studies and their applications. The average increase in the number of papers for the five-year period 1969 through 1973 is 29.8 percent over the average for the preceding nine years.

The format of the index part of this volume follows that of the author's earlier work and is divided into two parts, each of which is subdivided into two sections. Section 1 of Part I lists identified taxa represented by thecae or crowns or parts thereof. Section 2 of Part I tabulates unidentified thecae or crowns or their parts. Part II lists columnals with Section 1, Part II, giving those identified to genus or species, whereas Section 2, Part II, compiles the unidentified columnals. Type species are noted.

Geologic epoch, or range of epoch, is reported for each species. Precise locality data for each species are not included in this volume. Locality data, therefore, must be obtained by reference to the papers cited. Locality data are given only for the state in the United States and for the province in Canada, Australia, and China. Russian localities are listed by geologic region, province, or local geographic feature. Otherwise, only country names are given.

An appendix is included that lists new genera recognized in the literature indexed.

CONTENTS: Acknowledgments. Introduction. Bibliography. Part I. Crowns and parts of crowns: Section 1. Identified crowns and parts of crowns; Section 2. Unidentified crowns and parts of crowns. Part II. Columnals: Section 1. Identified columnals; Section 2. Unidentified columnals. Appendix 1. New genera introduced in literature indexed.

September BULLETIN *briefs*

Brief summaries of articles in the September 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.*

• 70901—Structural geology of the Nenana River segment of the Denali fault system, central Alaska Range.

Robert G. Hickman, Campbell Craddock, Kirk W. Sherwood, Department of Geology and Geophysics, University of Wisconsin, Madison, Wisconsin 95706 (present address, Hickman: Union Oil Company of California, Research Center, Brea, California 92621). (14 p., 13 figs., 1 tbl.)

The Denali fault system, one of the major tectonic elements of southern Alaska, forms an arc 2,100 km long across southern Alaska. In the central Alaska Range, the system consists of a northern Hines Creek strand and a southern McKinley strand, 30 km apart, which divide the area into northern, central, and southern terranes. There is evidence for at least two episodes of deformation in the northern terrane, four in the central, and two in the southern during Paleozoic and Mesozoic time. During each, the inferred axis of maximum compressive strain was subhorizontal and about north-south, but the direction shifted to north-northwest–south-southeast during a late Paleocene–Eocene folding episode. Tectonic stability during Oligocene–middle Miocene time was followed by differential uplift of crustal blocks during late Miocene–Pliocene time.

The Hines Creek fault may preserve a record of the early history of the fault system. Strong contrasts between lower and middle Paleozoic rocks juxtaposed along the fault suggest large dextral strike-slip displacement, but major convergent movement cannot be ruled out. Movement throughout the Hines Creek fault ceased by middle Cretaceous time, but local dip-slip movements continued into the Cenozoic era. The McKinley fault is an active dextral strike-slip fault, with Cenozoic offset of probably at least 30 km and possibly much greater. Mean Holocene displacement rates are 1 to 2 cm/yr. These rates would produce a 30-km offset in 1.5 to 3.0 m.y., or a 400-km offset in 20 to 40 m.y.

The Denali fault may be part of a transform fault system connecting the Juan de Fuca Ridge and the landward extension of the Aleutian subduction zone. However, it is more likely that the fault forms the northern boundary of a small lithospheric plate caught between the Pacific and American plates.

• 70902—Specification of fabric shapes using an eigenvalue method.

N. H. Woodcock, Department of Geology, University of Cambridge, Sedgwick Museum, Downing Street, Cambridge CB2 3EQ, England. (6 p., 6 figs.)

Eigenvalues, derived from the "orientation tensor" method for analyzing directional data, are useful indicators of fabric shape. Three possible methods of graphing these eigenvalues are discussed. These provide a convenient visualization of fabric shapes and strengths. Examples are given of the use of such graphs for representing field data and for tracing progressive deformation of fabrics.

• 70903—Oligocene and Miocene metamorphism, folding, and low-angle faulting in northwestern Utah.

Robert R. Compton, Department of Geology, Stanford University, Stanford, California 94305; Victoria R. Todd, U.S. Geological Survey, Menlo Park, California 94025; Robert E. Zartman and Charles W. Naeser, U.S. Geological Survey, Denver, Colorado 80225. (14 p., 13 figs., 4 tbls.)

An area of 3,000 km^2 in and around the Grouse Creek Mountains and the Raft River Mountains exposes Precambrian, Paleozoic, and Triassic sedimentary rocks that were folded several times and displaced tens of kilometres on low-angle faults. Overturned folds and local imbrications indicate transport westward and northward during two episodes of metamorphic deformation and transport eastward after metamorphism. Metamorphic grade increases downward in the allochthonous sheets and autochthon and increases westward in the autochthon. Mineral grains are flattened into the horizontal plane, and shear strains increase upward, suggesting that the deformations were caused by gravity acting on a broadly heated dome. Rb-Sr dating of granitic plutons affected by the deformations indicates that (1) the area is underlain by adamellite, about 2.5 b.y. old, in which deformation decreased progressively downward; (2) the first metamorphic deformation probably ended before 38.2 ± 2.0 m.y. ago; and (3) the second metamorphic deformation was still underway 24.9 ± 0.6 m.y. ago.

High-grade allochthonous rocks that lie on low-grade parts of the autochthon indicate as much as 30 km of eastward transport after metamorphism. Parts of the dome sagged to form broad basins 12 m.y. ago, and the coarse sediments and tuffs that accumulated in them were overrun by allochthonous sheets measuring at least 11 by 19 km. Two Rb-Sr mineral isochrons and several fission-track ages indicate that some parts of the area cooled below 400°C only 10 m.y. ago.

• 70904—Volcanism of Afar: Small-scale plate tectonics implications.

Franco Barberi, Istituto di Mineralogia e Petrografia, *Università di Pisa, Pisa, Italy; Jacques Varet, Département des Sciences de la Terre, Université de Paris XI, 91 Orsay, Paris, France.* (16 p., 16 figs.)

Structures analogous to oceanic spreading ridges, transform faults, and "leaky" fracture zones have been identified in Afar. They were formed during the past 3 to 4 m.y. and permit identification of the present plate boundaries within Afar and determination of the amount of spreading in this interval. At least two microplates are required in the zone of the junction of the African, Arabian, and Somalian plates. Variations of the spreading rate along single ridges or from one ridge to another, ridge jumping, migration of spreading with time, and counterclockwise rotation of the microplates are inferred by comparing volcanological, chronological, and geochemical data with aeromagnetic data. Deformation affects both accreting and transform plate boundaries within zones similar in width to the microplates, whose interiors are also systematically affected by regional faulting and locally by volcanism and transverse faulting. This indicates that although plate tectonics can explain most of the Afar features it fails when applied at such a small scale.

• 70905—Profiles and ages of young fault scarps, north-central Nevada.

Robert E. Wallace, U.S. Geological Survey, Menlo Park, California 94025. (15 p., 20 figs.)

The geomorphic characteristics of young fault scarps can be used as a key to the ages of fault displacements.

The principal features of scarps younger than a few thousand years are a steep free face, a debris slope standing at about 35°, and a sharp break in slope at the crest of the scarp. The principal slope of older scarps declines with age, so that scarps of about 12,000 yr of age have maximum slope angles of 20° to 25°, and slopes as low as 8° to 9° represent ages much older than about 12,000 yr. The crestal break in slope broadens with age.

The material in the scarp face, whether loose fanglomerate or indurated bedrock, controls to a large extent the rate of scarp degradation.

Where more than one displacement has occurred along a fault, a composite or multiple scarp develops. Composite or multiple scarps suggest mean recurrence intervals on individual faults measured in thousands of years.

• 70906—A contribution to the geochronology and petrology of the island of Lanai, Hawaii.

Norbert Bonhommet, Université de Rennes, 35031 Rennes-Cedex, France; Melvin H. Beeson and G. Brent Dalrymple, U.S. Geological Survey, Menlo Park, California 94025. (5 p., 3 figs.)

Chemical analyses of four lava flows from Lanai, Hawaii confirm petrographic observations that the flows of Lanai are typical Hawaiian tholeiites, somewhat more similar in composition to those of Mauna Loa than to those of Kilauea. K-Ar analyses of six samples indicate that Lanai is 1.25 ± 0.04 m.y. old, which is consistent with the hypothesis that the volcanoes of the Hawaiian Islands become older to the northwest from the active volcanoes of Mauna Loa and Kilauea to Kauai.

• 70907—Erosion by volcanic base-surge density currents: U-shaped channels.

Richard V. Fisher, Department of Geological Sciences, University of California, Santa Barbara, Santa Barbara, California 93106. (11 p., 13 figs., 1 tbl.)

Small U-shaped channels eroded by volcanic base surges occur on the steep outer slopes of some tuff cones but rarely on the gentle outer slopes of tuff rings. This suggests that their development is a function of velocity. Corroborating evidence from the 1952 phreatomagmatic eruption of Barcena Volcano is as follows: U-shaped furrows were cut by volcanic density currents on the steep slopes of the volcano, but at the base of the volcano, where the velocity decreased, dunes were deposited with long axes perpendicular to the furrows. These dunes were similar to those deposited by base surges on the low slopes surrounding Taal Volcano, Philippines, during its 1965 eruption.

To be preserved, U-shaped base-surge channels must be quickly buried by deposits from penecontemporaneous eruptions; otherwise, as ready-made avenues for run-off, stream action soon destroys them. Even it preserved on steep sides of a volcano, however, exposures in cross section are rare because (1) the channels are filled with pyroclastic deposits or (2) later stream dissection parallels them without revealing the cross-sectional profile or else completely destroys them.

An explanation of the origin of U-shaped channels stems from (1) the parameters of base-surge flow deduced from descriptions of historic base surges and their deposits, (2) descriptions of prehistoric base-surge deposits, (3) the development of U-shaped furrows by base surges at Barcena Volcano, Mexico, and (4) descriptions herein of prehistoric U-shaped channels and their depositional fill at Koko Crater, Hawaii. Fortunate circumstances of erosion on the side of Koko Crater provide excellent cross-sectional exposures along a short stretch of the shoreline.

U-shaped channels eroded by base surges superficially resemble equilibrium semicircular channels cut by streams and mudflows, but the profiles develop by a different mechanism. The fronts of advancing volcanic base surges develop a cleft and lobe pattern; the lobes appear to be individual turbulent cells that splay outward from the source. To carve a smooth U-shaped profile, the concentration of particles must increase gradually (perhaps exponentially) from the edges of the lobes to their central part, where the boundary effects are least and forward velocity is greatest. Small channels that are cut into erodible material by turbidity currents also have rounded cross-sectional profiles and may be cut by a mechanism similar to that ascribed here to base-surge flow.

• 70908—Evidence in the Bering Strait region for differential movement between North America and Eurasia.

William W. Patton, Jr., Irvin L. Tailleur, U.S. Geological Survey, Menlo Park, California 94025. (7 p., 7 figs.)

North-trending folds and regional deflection of Cordilleran trends in the Bering Strait region strongly suggest east-west compression and crustal shortening between the North American and Eurasian continents during late Mesozoic or early Cenozoic time. Along the northwest coast of Alaska, the west- and southwest-trending grain

of the Cordilleran belt appears to be deflected by a belt of folds and thrust faults that can be traced from Cape Lisburne southward across the Seward Peninsula and Yukon-Koyukuk province to the Kaltag fault. Fold axes are generally overturned to the east, and locally Paleozoic strata are thrust eastward onto Mesozoic strata. Major geologic trends on the north side of the Kaltag fault appear to be offset as much as 130 km to the east. On the Bering-Chukchi shelf, increasing evidence suggests that Cordilleran trends between Alaska and Siberia are buckled into a tight southward-looping orocline. The Paleozoic and early Mesozoic stratigraphic sequence on St. Lawrence Island is nearly identical with that found in the western Brooks Range, 400 km to the north, and distinctive belts of late Paleozoic and Mesozoic mafic volcanic and intrusive rocks and alkalic intrusive rocks appear to be traceable in an arc stretching southward from the Kobuk-Selawik area to St. Lawrence Island and then northward onto the Chukotsk Peninsula.

Oroclinal bending in the Bering Strait region and in the eastern Brooks Range appears to have foreshortened the northern part of the Alaska Cordillera by at least 800 km. As neither of these deflections is reflected in the arcuate trends of the Alaska and Aleutian Ranges, the northern part of Alaska may have been decoupled from the southern part along the Kaltag fault.

This compressional event in Late Cretaceous or early Tertiary time may be related to opening of the North Atlantic Ocean basin.

• 70909—Late Paleozoic strike-slip faulting in southern Europe and northern Africa: Result of a right-lateral shear zone between the Appalachians and the Urals.

François Arthaud, Philippe Matte, Laboratoire de Géologie Structurale, Université des Sciences et Techniques du Languedoc, Place E. Bataillon, 34060 Montpellier-Cédex, France (16 p., 10 figs.)

Late Paleozoic wrench faulting in southern Europe and northern Africa is interpreted as a right-lateral shear zone induced by the relative motion of two plates—a northern one that includes the Canadian Shield, Greenland, and stable Europe and a southern one that includes the African Shield plus an unknown eastern extension. The relative movement of these two plates was transformed into shortening at both ends of the shear zone and led to the formation of late Paleozoic mountain belts: the Urals to the east and the southern Appalachians to the west. Theoretical and experimental models of the dynamics of faulting may account for the arrangement of the fractures in the shear zone and for the observed displacements.

• 70910—Mechanism of burial metamorphism of argillageous sediments: 3. O-isotope evidence.

Hsueh-Wen Yeh, Samuel M. Savin, Department of Earth Sciences, Case Western Reserve University, Cleveland, Ohio 44106 (present address, Yeh: Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91125). (10 p., 10 figs., 5 tbls.)

O-isotope analysis of shales sampled from wells drilled through sedimentary deposits in the Gulf of Mexico region indicates that the sediments and rocks are not isotopically equilibrated systems—even those that have been buried to depths where temperatures are as high as 170 °C. In comparison with the coarser fractions, the finer fractions of both clay minerals and quartz are almost always richer in O^{18}. O-isotope disequilibrium among the clay fractions becomes less marked as burial temperature increases. O-isotope exchange between clay and pore water become more extensive at higher temperatures; this corresponds to more extensive diagenetic alteration of mixed-layer illite-smectite. There is no evidence for O-isotope exchange between detrital quartz and pore water. However, quartz that forms diagenetically as an accompaniment to the conversion of smectite to illite layers in the mixed-layer clay forms in equilibrium with the pore water.

The usefulness of O-isotope geothermometry for determination of the maximum temperatures to which shales have been heated during burial was investigated. Temperatures were calculated from the O-isotope fractionations between coexisting fine-grained quartz and clay from three wells; these calculated temperatures progressively approached the measured well (logged) temperatures as depth of burial and temperature increased. In one well, good agreement between calculated and measured temperatures was obtained for measured temperatures between 100 and 180 °C. In two other wells, satisfactory agreement was approached but not obtained at measured temperatures as high as 120 °C. Temperatures calculated from the O-isotope fractionations of quartz and calcite or calcite and clay were not reasonable. This probably reflects isotope exchange between calcite and pore water after the silicates attained their measured isotope ratios. Consequently, calcite is not a suitable mineral for use in isotope geothermometry of diagenetically altered shales.

• 70911—Regional stagnation of ice in northeastern Connecticut: An alternative model of deglaciation for part of New England.

Robert F. Black, Department of Geology and Geophysics, University of Connecticut, Storrs, Connecticut 06268. (6 p., 5 figs.)

Re-evaluation of published maps and reconnaissance of the rest of the Shetucket River basin lead to the conclusion that stagnation of the late Wisconsinan ice occurred simultaneously throughout the basin rather than in narrow zones during ice-margin recession as has been the accepted model for decades in New England. Evidence includes especially (1) ice-contact deposits laid down over large areas, from the highest hills to the valley bottoms, wherein ice to the south was required, and (2) a series of discontinuous ice-contact lake deposits extending tens of kilometres up all major valleys, which were graded to a major ice and drift barrier in the lower part of the basin. Neither of these situations is possible at the scale observed in ice-margin recession. Regional deglaciation suggests that previous estimates of the ground-water capacity of the valley fills and of the supply of coarse construction aggregates are too high.

• 70912—Sediment distribution and Cenozoic sedimentation patterns on the Agulhas Plateau.

Brian E. Tucholke, George B. Carpenter, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964. (10 p., 7 figs.)

Unconsolidated sediments on the Agulhas Plateau range in age from Maestrichian to Quaternary and consist of calcareous ooze. A composite sedimentary record from piston cores suggests three hiatuses in sedimentation which can be correlated with angular unconformities inferred from seismic profiles. These hiatuses encompass late Miocene–Pliocene, middle Oligocene, and late Paleocene-middle Eocene time and correlate with similar stratigraphic gaps widely distributed in Deep Sea Drilling Project boreholes. The deeper basins surrounding the plateau contain terrigenous and calcareous or siliceous hemipelagic sediments; sediment composition is controlled by depth and locality of deposition. Strong influence of bottom currents on sediment distribution during Cenozoic time is demonstrated by a well-developed erosional zone near 4,500-m depth around the plateau as well as by local erosion and sediment drifts on the plateau itself. The plateau can be divided into a northern and a southern province on the basis of differences in the nature of acoustic basement. Basement in the southern province is smooth with some faulting and contains weak internal reflectors unconformable with the basement surface; the reflectors may represent layered basalt flows or consolidated Mesozoic sediments deposited shortly after the formation of the plateau. Acoustic basement in the northern section is intensely faulted and shows no evidence of internal stratification.

• 70913—Tectonic history of aseismic ridges in the eastern Indian Ocean.

Bruce P. Luyendyk, Walter Rennick, Department of Geological Sciences, University of California, Santa Barbara, Santa Barbara, California 93106. (10 p., 4 figs., 4 tbls.)

We have devised a model for the origin of the Ninetyeast Ridge, the Broken Ridge–Naturaliste Plateau, and the Kerguelen Plateau in the eastern Indian Ocean which demonstrates that they were created by fixed hot spots now beneath the Amsterdam–St. Paul and Kerguelen Islands. The model employs reconstructions constrained by relative motions between plates; the model was deduced from sea-floor data and by paleolatitudes from Australian paleomagnetic pole data. Paleolongitudes were constrained by holding the Ninetyeast Ridge over the Amsterdam–St. Paul spot. Predicted age gradients and trajectories result, and these agree very well with geologic observations on the aseismic ridges. The Ninetyeast Ridge was laid down mainly from the Amsterdam–St. Paul hot spot, but also from the spot now under Kerguelen. The ridge is predicted to be from about 90 to 20 m.y. old. Broken Ridge–Naturaliste Plateau and the Kerguelen Plateau were both formed from the Kerguelen Islands hot spot and were joined prior to the Australia-Antarctic rift about 55 m.y. B.P. Broken Ridge–Naturaliste Plateau is predicted to be from more than 100 to about 80 m.y. old. Kerguelen Plateau should be from more than 100 to 0 m.y. old, but several volcanic hiatuses are predicted.

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• 70914—Late Quaternary terrigenous and carbonate sedimentation on Grand Bank of Newfoundland.

Roger M. Slatt, Department of Geology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada (present address: Department of Geology, Arizona State University, Tempe, Arizona 85281). (11 p., 14 figs.)

Grand Bank is a shallow, flat-topped bank more than 100,000 km^2 in area that is separated from the Avalon Peninsula of southeastern Newfoundland by the deeper Avalon Channel. The channel and innermost bank are covered by a *gravel facies;* petrologic evidence shows that this facies was deposited by the late Wisconsin Avalon ice cap, which extended part way onto the bank. A seaward-fining quartz *sand facies* covers the rest of the bank and extends beyond the shelf break; petrologic evidence shows that this facies was derived by erosion of the underlying Mesozoic-Tertiary coastal plain succession during postglacial marine transgression.

Skeletal carbonate (mainly barnacles) has been accumulating on Grand Bank since the Holocene rise in sea level cut off its supply of all but minor ice-rafted terrigenous sediment. The Holocene carbonate fraction is in hydraulic equilibrium with the older terrigenous fraction, which, along with textural, petrologic, and other features, show that these palimpsest sediments are being reworked and mixed in response to the modern hydraulic regime. The seaward-fining textural pattern probably has also developed in response to modern processes, possibly by storm-induced bottom currents.

The results show that (1) combinations of source lithologies and depositional processes have interacted to produce a "classical" systematic decrease in grain size and corresponding increase in grain roundness and compositional maturity across the bank, (2) sediments of different ages and origins are readily mixed on this shelf, and (3) processes not related to glaciation form sedimentary deposits on a higher latitude continental shelf.

• 70915dr—Large-scale recumbent folding in the Valley and Ridge province of Alabama: Discussion and reply. (7 p., 2 figs., 1 tbl.)

Discussion: *William A. Thomas, Department of Geology, Georgia State University, Atlanta, Georgia 30303; James A. Drahovzal, Geological Survey of Alabama, University, Alabama 35486.*

Reply: *Charles E. Shaw, 12810 Westmere, Houston, Texas 77077.*

• 70916dr—Chemistry and mineralogy of Precambrian paleosols in northern Michigan: Discussion and reply. (2 p., 1 tbl.)

Discussion: *M. D. Lewan, Amoco Production Company Research Center, Geochemistry Group, P.O. Box 591, Tulsa, Oklahoma 74102.*

Reply: *J. Kalliokoski, Department of Geology and Geological Engineering, Michigan Technological University, Houghton, Michigan 49931.*

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