GSA news & information

VOLUME 1, NUMBER 9 SEPTEMBER 1979

Annual Report for 1978: Report of the Treasurer

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

This report is for the calendar year 1978. For the third year in a row, the Society was in the black. This is a significant achievement when we take into account that the cost of our principal product, publication, rose at a significantly higher rate than the overall rate of inflation.

The figures used in this report are taken from the unqualified report made by our auditors, Peat, Marwick, Mitchell & Co. The Audit Committee of the Council, consisting of Paul A. Bailly, Chairman; Don U. Deere; and Jack A. Simon, met with the auditors for the purpose of defining audit objectives and to discuss the scope of procedures essential to their implementation. It is the opinion of your Treasurer, the Audit Committee, and the auditors that the handling of Society funds and the completion of documentation are in the best condition they have ever been. In addition, management is receiving operating statements on a much more current basis.

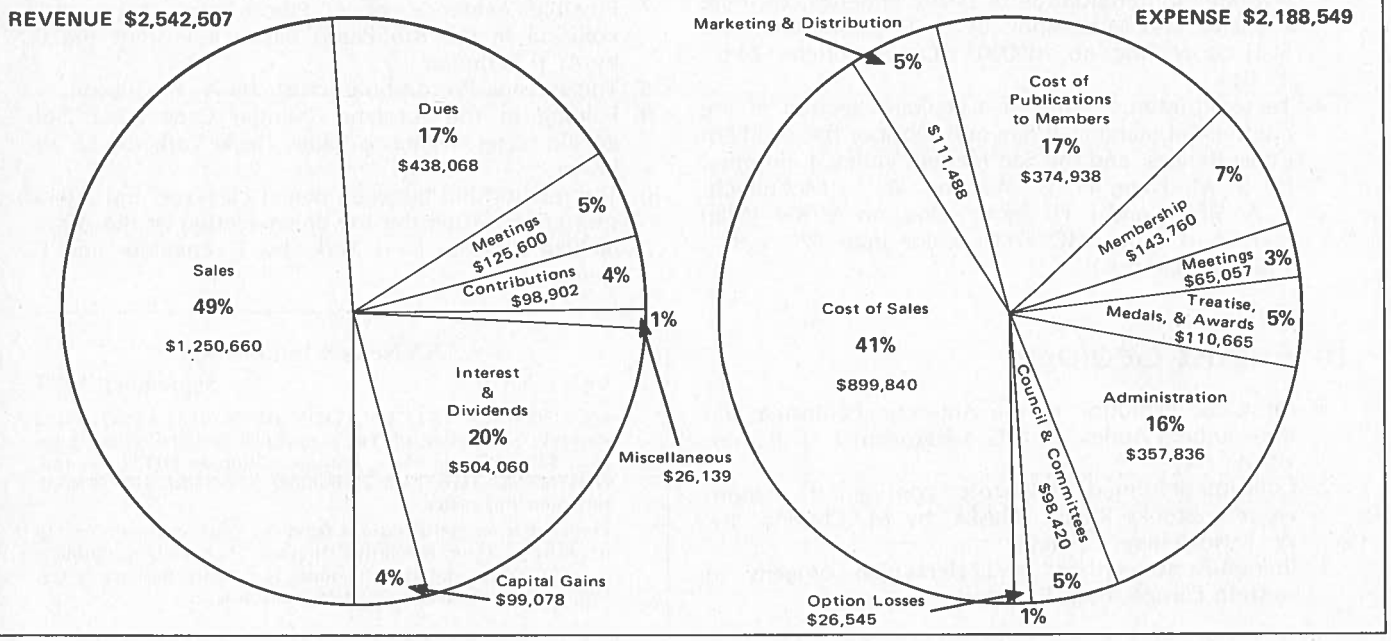
As of December 31, 1978, current assets of the Society were $10,034,049, and current liabilities were $964,814, a current ratio of 10.4:1; a very creditable situation.

Total operating revenue for 1978 was $1,939,369, and total operating expenses were $2,136,461, an operating deficiency of $197,092. This deficiency was increased by $25,543 owing to write-offs of *Treatise on Invertebrate Paleontology* grants from prior years and a loss on the sale of a fixed asset. Thus, the total operating loss was $222,635. However, this operating loss was more than offset by income of $576,593 from investments, giving a final excess of income over expenses of $353,958. The reduction of income and expenses in comparison to 1977 was due largely to the transfer of the *Bibliography and Index of Geology* program to AGI.

Below are pie diagrams showing the distribution of revenue and expenses for the year.

Respectfully submitted,
William B. Heroy, Jr., *Treasurer*

THE GEOLOGICAL SOCIETY OF AMERICA SOURCE AND APPLICATION OF FUNDS, 1978



UPDATE

Articles in *Bulletin, Part II* August 1979

Articles in *Bulletin, Part II* are listed below. (Summaries only of these articles are in *Bulletin, Part I.*) Articles in *Part II* are not on the separates subscription.

Paper copies of *Part II* in its entirety are available at cost ($6/month) as a special service to those users (members and nonmember subscribers) who request them. Any such order should be addressed to the Publication Sales Department and be accompanied by advance payment, and no discount can be offered for multiple orders or orders for a sequence of months.

1. Taconic and younger deformation and metamorphism in the Croton Falls area, southeastern New York, by Patrick W. G. Brock and Douglas G. Mose. Doc. no. M90801. (On microfiche: 38 p., 8 figs., 5 tables.)
2. Ground-water recharge to the aquifers of northern San Luis Valley, Colorado, by David Huntley. Doc. no. M90802. (On microfiche: 86 p., 21 figs., 19 tables.)
3. Depositional control of aquifer characteristics in alluvial fans, Fresno County, California, by David Cehrs. Doc. no. M90803. (On microfiche: 28 p., 10 figs., 5 tables.)

Articles in *Bulletin, Part II* September 1979

1. Biogenic silica accumulation in the central equatorial Pacific and its implications for Cenozoic paleoceanography, by M. Leinen. Doc. no. M90901. (On microfiche: 67 p., 12 figs., 4 tables)
2. Dolomite and quartz lamellae stress and strain analysis in a multiply-deformed terrane, west-central Vermont, by J. C. Detenbeck, R. S. Stanley. Doc. no. M90902. (On microfiche: 52 p., 13 figs., 2 tables)
3. Hydraulic differentiation of heavy minerals, offshore Alabama and Mississippi, by S. E. Drummond and S. H. Stow. Doc. no. M90903. (On microfiche: 24 p., 11 figs.)
4. Tectonic interpretation of a geologic section of the continental margin off San Luis Obispo, the southern Coast Ranges, and the San Joaquin Valley, California, by B. M. Page, H. C. Wagner, D. S. McCulloch, E. A. Silver, and J. H. Spotts. Doc. no. 90904. (Map and Chart series MC—28G, color map 57" x 48", with 12-page text)

In August *Geology*

1. Mesozoic evolution of the Antarctic Peninsula and the southern Andes, by C.G.A.Harrison, E. J. Barron, W. W. Hay
2. Collision-deformed Paleozoic continental margin, western Brooks Range, Alaska, by M. Churkin, Jr., W. J. Nokleberg, C. Huie
3. Iberian-Armorican arc and Hercynian orogeny in western Europe, by J.-P. Lefort
4. Miocene peralkaline volcanism in west-central British Columbia—Its temporal and plate-tectonics setting, by M. L. Bevier, R. L. Armstrong, J. G. Souther
5. Phyllosilicate alteration of plagioclase studied by transmission electron microscopy, by R. Page, H. R. Wenk
6. Trans-North Atlantic similarity among Mesozoic and Cenozoic invertebrates correlated with widening of the ocean basin, by W. C. Fallaw
7. On the interpretation and classification of Precambrian organic-walled microfossils, by W. L. Diver, C. J. Peat
8. Limits of U-series analysis: Phase 1 results of the Uranium-Series Intercomparison Project, by R. S. Harmon, T.-L. Ku, R. K. Matthews, P. L. Smart
9. Radiocarbon-dated upper Pleistocene glacial sequence, Fraser Valley, Colorado Front Range, by A. R. Nelson, A. C. Millington, J. T. Andrews, H. Nichols

In September *Geology*

1. Digitally acquired undistorted side-scan sonar images of submarine landslides, Mississippi River delta, by D. B. Prior, J. M. Coleman, and L. E. Garrison.
2. Initiation of shallow mass movement by vegetative-type conversion, by J. V. De Graff.
3. An isotopic paleotemperature record for late Wisconsinan time in northeast Iowa, by R. S. Harmon, H. P. Schwarcz, D. C. Ford, and D. L. Koch.
4. Possible role of mantle-derived CO_2 in causing two "phreatic" explosions in Alaska, by I. Barnes and G. A. McCoy.
5. K-Ar ages of basalt flows of the Meseta Buenos Aires in southern Chile and their relation to the southeast Pacific triple junction, by R. Charrier, E. Linares, H. Niemeyer, and J. Skarmeta.
6. Jurassic and Early Cretaceous radiolarians in Puerto Rican ophiolite—Tectonic implications, by P. H. Mattson and E. A. Pessagno, Jr.
7. Possible evidence of a Precambrian continental collision in the Rio Pardo basin of eastern Brazil, by A. J. Pedreira.
8. The missing Precambrian crust, by A. Y. Glikson.
9. Folding in the foreland, Middle Ordovician Dolgeville facies, Mohawk Valley, New York, by D. W. Fisher.
10. The relationship between pencil cleavage and lateral shortening within the Devonian section of the Appalachian Plateau, New York, by T. Engelder and P. Geiser.

GSA News & Information
Vol. 1 No. 9 September 1979

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Prepared from contributions from the staff and membership by John C. Frye, Executive Director; Jo Fogelberg, Publications Manager; and June Thomas, Judy Hall, Barbara Patterson, and Ann Fogel, Production Assistants.

PRELIMINARY ANNOUNCEMENT AND CALL FOR PAPERS

SOUTH-CENTRAL SECTION, GSA, 14th Annual Meeting
Wichita, Kansas, March 3–4, 1980

THE SOUTH-CENTRAL SECTION of the Geological Society of America will hold its 14th annual meeting in Wichita, Kansas, on March 3 and 4, 1980. The host will be the Department of Geology at Wichita State University, Wichita, Kansas.

TECHNICAL SESSIONS. Two days of technical sessions will be held on March 3 and 4, with premeeting and postmeeting field trips on March 2 and 5, respectively. Field trips will be announced at a later date. Technical sessions will be arranged after abstracts of proposed papers have been reviewed by the Program Committee.

PLEASE HELP US FIND GOOD PAPERS. The quality of submitted abstracts has been excellent for previous meetings. If you are thinking about preparing a paper, do it now! A postal card to **David E. Smit** will get an abstract form to you. The use of the GSA section meeting abstract form, completed according to the instructions, is mandatory.

ABSTRACT FORMS may be obtained from the following persons:

David E. Smit
Program Committee Chm.
Department of Geology
Wichita State University
Wichita, KS 67208
(316) 689-3140

OR

Abstracts Coordinator
Geological Society of America
3300 Penrose Place
Boulder, CO 80301
(303) 447-2020

STUDENT AWARDS. Student papers are encouraged, and awards will be made to students presenting the most outstanding papers. Student papers should be clearly identified as such and should be authored exclusively by students.

ABSTRACTS ARE DUE October 12, 1979.

Send one original and four copies to

David E. Smit
Program Chairman
Department of Geology
Wichita State University
Wichita, Kansas 67208

All papers in ordinary sessions will be 15 minutes, plus 5 minutes for discussion.

Acceptance or rejection of an abstract will be based on the abstract as submitted by the author. Authors will be notified of acceptance well in advance of the meeting.

CAROUSEL PROJECTION EQUIPMENT will be provided for 2" x 2" (35-mm) slides only (*dual projectors by prior request only*). Please bring your own loaded carousel trays if possible.

FIELD TRIPS will be announced at a later date.

ANNOUNCEMENTS concerning registration, motel accommodations, and events for guests will appear in a later issue of *GSA News & Information* and as part of the *Abstracts with Programs* for 1980.

ADDITIONAL INFORMATION, REQUESTS, OR SUGGESTIONS SHOULD BE DIRECTED TO

John C. Gries, Local Committee Chairman
Department of Geology
Wichita State University
Wichita, Kansas 67208
(316) 689-3140

CALENDAR OF SECTION MEETINGS FOR 1980

SOUTH-CENTRAL
Wichita State University, Wichita, Kansas
March 3-4, 1980
Abstract deadline: October 12, 1979

NORTHEASTERN
Benjamin Franklin Hotel, Philadelphia, Pennsylvania
March 13-15, 1980
Abstract deadline: October 31, 1979

CORDILLERAN
Oregon State University, Corvallis, Oregon
March 19-21, 1980
Abstract deadline: October 12, 1979

SOUTHEASTERN
Birmingham Hyatt House, Birmingham, Alabama
March 27-28, 1980
Abstract deadline: October 26, 1979

NORTH-CENTRAL
Indiana University, Bloomington, Indiana
April 10-11, 1980
Abstract deadline: November 23, 1979

ROCKY MOUNTAIN
Weber State College, Ogden, Utah
May 16-17, 1980
Abstract deadline: December 21, 1979

PRELIMINARY ANNOUNCEMENT AND CALL FOR PAPERS

NORTHEASTERN SECTION, GSA, 15th Annual Meeting
Philadelphia, Pennsylvania, March 13–15, 1980

The **Northeastern Section** of the Geological Society of America will meet March 13 to 15, 1980, at the Ben Franklin Hotel in Philadelphia, together with the Northeastern Section of the Paleontological Society and the Eastern Section of SEPM. The meeting is sponsored by the Philadelphia Geological Society.

TECHNICAL SESSIONS will be held Thursday, Friday, and Saturday, March 13, 14, and 15.

Several symposia have been arranged or are in the planning stages. These include: (1) Late Wisconsin Glaciation of New England (Grahame Larson, Michigan State); (2) Off-Shore Geology and Geophysics (Charles E. Curtis, International Exploration, 577 Sackettsford Road, Ivyland, PA 18974); (3) Engineering Geology in Northeastern United States and Eastern Canada (A. J. Depman, 124 St. James Avenue, Merchantville, NJ 08109); (4) Geology and Geochemistry of, Uranium (David Grandstaff and Gene Ulmer, Temple University); (5) Dynamics of Stratigraphic Accumulation (Peter Goodwin and W. J. Anderson, Temple University); (6) Ordovician Paleocommunities and Paleogeography of Eastern North America (C. W. Stearn, McGill University, for the Northeastern Section of the Paleontological Society). The Eastern Section of SEPM hopes to have a symposium whose subject is not yet determined; suggestions should be addressed to Stephen P. Leatherman, University of Massachusetts. Further suggestions are welcome and should be addressed to Lucian B. Platt, Bryn Mawr College, or William B. Fergusson, Villanova University.

CALL FOR PAPERS. Papers are invited for presentation at the technical sessions and symposia and/or for poster sessions. Papers of general geological interest as well as those of regional scope will be considered. Those with little new data or interpretations will have lower priority for inclusion. Authors with a large body of data are urged to evaluate the poster session format as a way of presentation. Others are also urged to consider this format as a favorable alternative to oral presentation at conventional sessions. Fifteen minutes will be allowed for presentation in the technical sessions (and five minutes for discussion).

ABSTRACTS, which are limited to 250 words, must be submitted, camera-ready, on official 1979 forms available from

Abstracts Coordinator
Geological Society of America
3300 Penrose Place
Boulder, CO 80301
(303) 447-2020

OR

Lucian B. Platt
Program Committee Chairman
Department of Geology
Bryn Mawr College
Bryn Mawr, PA 19010
(215) 645-5113

ABSTRACTS ARE DUE October 31, 1979.

Send one original and four copies to

Lucian B. Platt
Department of Geology
Bryn Mawr College
Bryn Mawr, PA 19019

Acceptance or rejection of an abstract will be based on the review by the program committee. Abstracts will be judged for information, originality, correctness of format, and readability. Early submission of abstracts will be appreciated and will facilitate finding solutions if problems arise.

STUDENT PAPERS. Three awards ($100, $50, and $25) will be made for the best student papers presented on a research problem. To be eligible, the abstracts must be by a single author and must be designated on the abstract form as a student paper.

PROJECTION EQUIPMENT will be available for 2" x 2" slides in carousels. The meeting rooms are limited to single projectors and screens. Bringing your own carousel trays may reduce problems during the talks.

EXHIBIT SPACE will be available adjacent to the session area. Individual booths will be a standard size, but double booths will be available. The cost of a booth for educational institutions will be reduced. For additional information contact Earl Shapiro, Dept. of Geology, Rutgers University, Camden, NJ 08102, phone (609) 757-6292.

DETAILED INFORMATION concerning registration, accommodations, and other activities will appear in a later issue of *GSA News and Information* and as a part of the *Abstracts with Programs* for 1980.

ADDITIONAL INFORMATION, REQUESTS, OR SUGGESTIONS should be directed to

William B. Fergusson, Local Committee Chairman
Dept. of Civil Engineering
Villanova University
Villanova, PA 19085

PRELIMINARY ANNOUNCEMENT AND CALL FOR PAPERS

CORDILLERAN SECTION, GSA, 76th Annual Meeting
Corvallis, Oregon, March 19–21, 1980

THE CORDILLERAN SECTION of the Geological Society of America will hold its 76th annual meeting with the anual meeting of the Paleontological Society, Pacific Coast Section, on the campus of Oregon State University, Corvallis, Oregon, March 19-21, 1980.

WELCOMING PARTY. A no-host cocktail party will be held from 1930 to 2300 hours on Tuesday evening, March 18, at Nendel's Inn, Corvallis.

REGISTRATION. Registration will be by preregistration and also at the location of the welcoming party, Tuesday, March 18, from 1600 to 2100 hours, and during the meeting at the Memorial Union at Oregon State University. Preregistration costs are $20 for professionals, $2 for GSA Student Associates, and $5 for other students. On-site registration is $30 for professionals and $5 for all students. All are urged to take advantage of the lower preregistration rates. **Preregister before February 22, 1980.**

SYMPOSIA. Tectonics of Small Plates of the Pacific (Gordon Ness, L. D. Bibee); Economic Geology of the Pacific Northwest (Miles Silberman, Cyrus Field); Estuarine and Coastal Processes of the Pacific Northwest (Paul Komar); Forest Geomorphology of the Pacific Northwest (Fred Swanson); Cenozoic Volcanism of Central and Eastern Oregon (Gordon Goles); Mesozoic Tectonics of the Pacific Northwest (Darrell Cowan); Geological Development of the Klamath Mountains, (Allan Karp); History of Geology of the Pacific Northwest (Ellen Drake).

FIELD TRIPS

Premeeting: (1) Volcanic and Volcaniclastic Geology of the East Flank of the Central Cascade Range to Deschutes River, March 17-18; (2) Eocene Stratigraphy and Structure along the Klamath Borderland, Oregon, March 17-18; (3) Tertiary Geology of the Central Part of the Oregon Coast Range, March 17-18; (4) Geology of the North-Central Klamath Mountains, Northern California, March 17-18; (5) Geology of Mary's Peak and the Eastern Coast Range, Oregon, March 18.

Postmeeting: (6) Western Cascade Range between Clackamas and Northern Santiam Rivers, Oregon, March 22-23; (7) Beach Processes and Erosion Problems on the Oregon Coast, March 22; (8) Cenozoic Stratigraphy, Sedimentology, and Biostratigraphy of Coos Bay Synclinorium and Cape Blanco Area, Southwestern Oregon, March 22-23; (9) Forest Geomorphology and Hydrology in the H. H. Andrews Experimental Forest, Western Cascade Range, Oregon, March 22; (10) Cretaceous Rocks of Central Oregon, March 22-23.

ABSTRACTS, which are limited to 250 words, **MUST** be submitted camera-ready on official abstract forms available from

George H. Keller
School of Oceanography
Oregon State University
Corvallis, OR 97331

or

Abstracts Coordinator
Geological Society of America
3300 Penrose Place
Boulder, CO 80301

Abstracts are due October 12, 1979. Acceptance or rejection of an abstract will be based on the abstract as submitted by the author.

Send one original and four copies to

George H. Keller,
Local Committee Co-chairman
School of Oceanography
Oregon State University
Corvallis, OR 97331

All papers in ordinary sessions will be 15 minutes, plus 5 minutes for discussion.

All abstracts will be reviewed by an Abstract Review Committee for informative content, correct structure, reliability of data, Cordilleran Section geographic coverage, and originality. Only one paper will be accepted from a single author; if papers are co-authored, no more than one paper may be presented by an author. Authors will be notified of acceptance well in advance of the meeting.

CAROUSEL PROJECTION EQUIPMENT will be provided for 2" x 2" (35-mm) slides only (dual projectors by prior request only). Please bring your own loaded carousel trays, if possible.

BUSINESS MEETING. The Cordilleran Section business meeting and luncheon will be in the Memorial Union at 1200 hours on Thursday, March 20.

HOUSING. Housing will be in local motels. Additional information available later.

DETAILED INFORMATION concerning registration and other activities will appear in a later issue of *GSA News & Information* and as a part of the *Abstracts with Programs* for 1980.

Direct additional information requests or suggestions to

Robert S. Yeats, Local Committee Co-chairman
Department of Geology
Oregon State University
Corvallis, OR 97331, (503) 754-2484

PRELIMINARY ANNOUNCEMENT AND CALL FOR PAPERS

SOUTHEASTERN SECTION, GSA, 29th Annual Meeting
Birmingham, Alabama, March 26–28, 1980

THE SOUTHEASTERN SECTION of the Geological Society of America will hold its 29th annual meeting at Birmingham, Alabama, March 26-28, 1980. The meeting is sponsored by the Department of Earth Science, University of Alabama, Birmingham; the Department of Geology and Geography, University of Alabama, Tuscaloosa; and the Alabama Geological Society.

CALL FOR PAPERS. Papers are invited for presentation at the symposia and technical sessions. Uninvited papers will be allowed 15 minutes for presentation and 5 minutes for discussion. Time limitations will be adhered to by the session chairmen. Symposia and technical session themes are listed below. Deadline for abstracts is October 26, 1979.

SYMPOSIA. Stratigraphy, Sedimentology, and Paleoecology of Mississippian Rocks. Coordinator: W. A. Thomas, Department of Geology and Geography, University of Alabama, Tuscaloosa, AL 35486. History of the Geological Sciences in the Antebellum South. Coordinator: James X. Corgan, Department of Geology, Austin Peay State University, Clarksville, TN 37040. Vertebrate Paleontology. Coordinator: Judith A. Schiebout, Department of Geology, Louisiana State University, Baton Rouge, LA 70803. Special Registration for Geologists. Coordinator: G. L. Stirewalt, EBASCO Services, Boone Bldg. 2211 West Meadowview, Greensboro, NC 27407.

TECHNICAL SESSIONS. Sedimentation, Economic Geology, Geochemistry, Mineralogy, Geophysics, Structural Geology, Geomorphology, Hydrology, Geological Education, Stratigraphy, Petrology.

FIELD TRIPS. Geology of the Pine Mountain Window and Adjacent Terrain, Alabama-Georgia Piedmont; Depositional Setting of the Mississippian Hartselle Sandstone and Lower Bangor Limestone, Northwest Alabama; Sedimentary Environments of the Eutaw Formation in Alabama and East Mississippi; A New Pleistocene Vertebrate Fauna from Little Bear Cave, Colbert County, Alabama.

James F. Tull, Field Trip Chairman
Department of Geology and Geography
University of Alabama
Tuscaloosa, AL 35486
(205) 348-5059

ABSTRACTS, which are limited to 250 words, must be submitted camera-ready on official abstract forms available from

OR

Michael J. Neilson
Program Committee Chairman
Earth Science Department
University of Alabama, Birmingham
Birmingham, AL 35294
(205) 934-2243

Abstracts Coordinator
Geological Society of America
3300 Penrose Place
Boulder, CO 80301
(303) 447-2020

Abstracts are due October 26, 1979. Contributors to the symposia should submit their abstracts to the appropriate symposium coordinator. Technical session abstracts (one original and four copies) should be submitted to

Michael J. Neilson
Program Committee Chairman
Earth Science Department
University of Alabama, Birmingham
Birmingham, AL 35294

SPOUSES' ACTIVITIES. A full schedule of activities is being organized.

CAROUSEL PROJECTION EQUIPMENT will be provided for 2" x 2" slides and single projectors only. Please bring your own loaded carousel trays, if possible.

DETAILED INFORMATION concerning registration, accommodations, and activities will appear in a later issue of *GSA News & Information* and as a part of the *Abstracts with Programs* for 1980.

ADDITIONAL INQUIRIES OR SUGGESTIONS SHOULD BE DIRECTED TO

Denny N. Bearce
Local Committee Chairman
Earth Science Department
University of Alabama,
Birmingham
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(205) 934-2439

Michael J. Neilson
Program Committee Chairman
Earth Science Department
University of Alabama,
Birmingham
Birmingham, AL 35294
(205) 934-2243

NEW FELLOWS, MEMBERS, AND STUDENTS

New Members. The following 566 Members have been elected to Membership by Council action during the period from October 1, 1978, through March 31, 1979 (* indicates a transfer from Student Associate to Member status.)

James S. Aber *
Gerda A. Abrams
Mark A. Adams *
Nairn R. Albert
Hussein Aldis
Eugene Aleshin
Craig S. Alexander
Erlece P. Allen
Philip R. Ames
George M. Anderson II *
Norman N. Anderson *
Orin J. Anderson
David E. Andrews *
John W. Armon
Nicholas T. Arndt
Barbara Arney *
Sidney R. Ash
Katherine L. Avary *
Charles F. Avery *

John Bacheller III *
William C. Bagby *
Jack B. Bailey
Keith S. Bailey
Charles A. Baker *
Gordon K. Baker
Naydean M. Baker
Robert W. Baker
Joel E. Baldwin, II
Kenneth S. Baldwin *
Indira L. Balkissoon *
Nancy L. Barber
Judith A. Barker
Costas Barlas
Thomas H. Barnes *
James R. Barnicle
Clive M. Barton
Robert A. Basse *
Asish R. Basu
Wolfgang Baum *
Brian A. Beck *
Candace A. Beck
Daniel F. Belknap *
Ann Elizabeth Bell
Marvin J. Bender
Gail V. Bennett *
John L. Berkley *
Kevin T. Biddle *
Kenneth M. Binkely
Jutta Hager Binstock *
Richard U. Birdseye *
Phillip C. Birkhahn
Paul R. Black *
Kenneth W. Bladh *
Marilyn R. Blair *
Jon F. Blickwede
Donald R. Boothry *
David J. Bottjer *
Steven Eugene Boyer *
Ray E. Boyle *
Pieter H. M. Braam
Dwight C. Bradley
Richard H. Brainard *
Carlton E. Brett *
Robin Brett
Richard F. Bretz
John P. Briggs
Michael D. Brondos *
Christopher Brooks
Janet L. Brown *
Lawrence G. Brown
Robert W. Bruhn
Charles A. Burshears *
Jacqueline C. Burton *
John H. Byrne

Paula A. Cammarata *
Edith C. Campbell
Jock A. Campbell
Steven C. Cande *
Gerald G. Carlson *
Paul R. Carney
Michael D. Carr *
W. Thomas Carson, III
Claire Carter
James W. Castle *
Lorraine M. Cavanaugh *
Robert V. Chandler
Jeffrey M. Citrone *
Stewart F. Clark, Jr.
James H. Clary
Karen H. Clautice
Thomas F. Coe *
James Channing Cole *
Bernard Colletta
Donley S. Collins *
Edward W. Collins *
Darlene A. Condra *
Cathy L. Connor
Theresa M. Cookro
Christopher L. Corbitt *
William C. Corea *
Patricia H. Cornelison *
Robert J. Coskey
Paul W. Cousins *
Roy E. Cox *
Richard G. Craig *
Mark G. Creager *
Rex E. Crick *
Keith A. W. Crook
Michael Levi Cummings *

Alfred P. Daigle
Debra L. Daniel *
Cheri L. Daniels *
Danny A. Dansereau
Joseph R. Davis *
Katherine M. Davis *
Marie E. Davis
Philip A. Davis, Jr.
Philip T. Davis *
Gerard A. De Busschere *
Edward C. De La Pena *
Jane E. Denne
Donald J. De Paolo *
W. Thomas Deurel *
Carolyn S. De Vine *
Gwendolen M. Ditson *
John W. Donaldson
David R. Donica *
Jaroslav Dostal
William F. Downs
Ellen T. Drake *
Grenville Draper *
Alan L. Dreher
James T. Dunlavey *
Howard B. Dutro
Jon D. Dykstra

Steven S. Edgerton
Brian D. Edwards *
Morad Eghbal
Stephen N. Ehrenberg *
Arthur B. Elliott
Paul J. English *
Richard J. Erdlac, Jr. *
Russell C. Evarts *
Duane A. Eversoll

Richard G. Fairbanks *
Edward L. Falk
Edward W. Fall *
Richard J. Fantel *
Christopher D. Farrar *
Michael E. Farrell *
John C. Farris
Paul J. Fast
James J. Fawcett
Manuel N. Fernandez *
Johathan H. Fink *
Patricia A. Fink *
Stanley C. Finney *
Joseph A. Fischer
John Fisher
Robert E. Fisher *
Paul H. Fishman
John C. Fitzmaurice *
Julianne F. Fliegner *
Christopher J. Foell *
Steven V. Fogarty *
Duncan Foley *
Daniel J. Fornari *
Michael K. Frazier
Peter Stevens Frischmann *
David Frishman *
Joseph P. Frizado *
Hans Fuechtbauer
Kazuya Fujita *
Bruce W. Furst *

Larry D. Galbiati *
John E. Gansfuss
Richard S. Gaps
Carlos A. Garcia
Gary W. Gardner
Donald L. Gautier *
Judith Ann Gennett
Nicholas Gessler
John R. Giardino *
John A. Gifford *
Helene Gignac *
Peter A. Gintautas
Douglas D. Given *
Holly J. Glaser *
Ernest Gomez
Nelson Gonzalez-Gonzalez
Owen L. Goodenkauf
Kathleen S. Goodman
Vivien M. Gornitz
Stephen J. Gosselin *
Ronald G. Graber *
Charles G. Graf
Robert C. Grayson, Jr. *
Efford W. Greer *
Joan F. Grette *
Jack Grippi *
Mark L. Griswold *
L. Peter Gromet *

C. Stephen Hasse *
Danny K. Hagans *
William W. Haible *
Walter D. Hall
Abdullatif S. Hamdan
Deborah S. Hamel *
Jake M. Hancock
Richard W. Hanford, Jr.
John Hanou
Randall T. Hanson
William L. Harmon *
John R. Harper *
W. Douglas Harrison
Daniel D. Hart *
Kay S. Hatton
Nathan Hawley *
Dan E. Haymond *
Robert M. Hazen
Paul V. Hehn *
Paul L. Heller
Steven J. Hendrick *
Roger J. Henning *
John L. Hern
John W. Hertel
Roy E. Hesler *
Martha H. Hickman
Robert D. Higgins
David A. Higgs *
Nurit Hildebrand-Mittlefehld *
Samuel L. Hilderbrand *
Edward F. Hill *
John E. Hiner *
Nancy Ann Hlavin
Richard P. Hoblitt *
Ron N. Hoffer *
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PENROSE CONFERENCES

A Penrose Conference on tectonics and geophysics of the Appalachians will be held April 28 through May 2, 1980, at Unicoi Conference Center, Helen, Georgia. The conveners are Isidore Zietz, U.S. Geological Survey, Mail Stop 927, Reston, Virginia 22092; Robert D. Hatcher, Jr., Department of Geology, Florida State University, Tallahassee, Florida 32306; and Harold Williams, Department of Geology, Memorial University of Newfoundland, St. Johns, Newfoundland A1B 3X5, Canada.

In the past few years there has been a quantum jump in available data, both geological and geophysical, for the entire Appalachian belt. A tectonic lithofacies map of the Appalachian orogen (scale 1:1,000,000) by Harold Williams provided students with an overview of the Appalachians to help evaluate the system within the framework of plate tectonics. To accompany this map, detailed aeromagnetic and gravity maps have been prepared. Seismic reflection data in the Appalachian plateau, Valley and Ridge provinces, and adjacent offshore have been made available by the oil companies and the U.S. and Canadian Geological Surveys. Recently continuous seismic reflection profiles were obtained by COCORP across the southern Appalachians in Tennessee and Georgia. These geophysical data, when coupled with the geology, are providing important new concepts pertaining to the development of the Appalachian mountain system.

While the focus of the conference is to be primarily on the Appalachians, comparisons (geological and geophysical) will be made to other mountain chains such as the Caledonides, the Alps, and the Cordilleras. The Appalachians will serve as a possible model and it is hoped that generalizations will be made concerning the interrelationships between thrusting and other processes in all mountain chains.

Four days will be occupied with discussions, both formal and informal. One day will be devoted to a field trip to be conducted along the route of the COCORP seismic line. The conference fee will be approximately $275, which will cover transportation from Atlanta International Airport to the Conference Center, meals and lodging at the Center, return transportation to Atlanta International Airport, and the field trip.

Deadline for applications is December 1, 1979. If you are interested in attending the conference, please write to Isidore Zietz.

TREATISE ON INVERTEBRATE PALEONTOLOGY

PART A—INTRODUCTION
(Fossilization, Biogeography, Biostratigraphy)
Edited by Richard A. Robison and Curt Tiechert
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$25.00

Part A begins with a general chapter on the manner in which organisms become fossilized. It is followed by several chapters on biogeography and biostratigraphy of the Precambrian and each of the Phanerozoic systems. In addition, the chapter on the Precambrian includes a section with systematic descriptions of metazoans as well as comprehensive generic lists of other fossils.

This volume contains 570 pages and 371 figures. Contents and authorship are indicated as follows:

Fossilization . . . . . A. H. Müller
Precambrian . . . . . M. F. Glaessner
Cambrian . . . . . A. R. Palmer
Ordovician . . . . . Valdar Jaanusson
Silurian . . . . . A. J. Boucot
Devonian in the Eastern Hemisphere . . M. R. House
Devonian in the Western Hemisphere . . A. W. Norris
Carboniferous . . . . . C. A. Ross
Permian . . . . . C. A. Ross and J.R.P. Ross
Triassic . . . . . Bernhard Kummel
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AUGUST BULLETIN SEPARATES

Summaries

At the request of members, the Summaries section may be ordered as one separate by those who have purchased the separates option. To order, write "August Summaries" on coupon.

• S90801—Taconic and younger deformation and metamorphism in the Croton Falls area, southeastern New York: Summary.

Patrick W. G. Brock, Department of Earth and Environmental Sciences, Queens College, Flushing, New York 11367 Douglas G. Mose, Department of Chemistry, George Mason University, Fairfax, Virginia 22030.

• S90802—Ground-water recharge to the aquifers of northern San Luis Valley, Colorado: Summary.

David Huntley, Department of Geological Sciences, San Diego State University, San Diego, California 92182.

• S90803—Depositional control of aquifer characteristics in alluvial fans, Fresno County, California: Summary.

David Cehrs, U.S. Department of Agriculture, Science and Education Administration, Agricultural Research, Water Management Research, Fresno, California 93726.

• S90804—Geology and structure of the southern part of the Tobacco Root Mountains, southwestern Montana: Map summary.

D. J. Vitaliano, W. S. Cordua, H. R. Burger, T. B. Hanley, D. F. Hess, F. K. Root, Department of Geology, Indiana University, Bloomington, Indiana 47401 (present addresses: Cordua: Department of Planetary and Earth Sciences, University of Wisconsin, River Falls, Wisconsin 54022. Burger: Department of Geology, Smith College, Northampton, Massachusetts 01060. Hanley: Department of Earth Science, Columbus College, Columbus, Georgia 31907. Hess: Department of Geology, University of Western Illinois, Macomb, Illinois 61445. Root: Inserch Exploration, Inc., P.O. Box 4815, Midland, Texas 79701).

• S90805—Major tectonic elements and tectonic problems along the line of section from northeastern Oregon to west-central Montana: Map summary.

Donald W. Hyndman, Department of Geology, University of Montana, Missoula, Montana 59812.

Bulletin Briefs

Titles and abstracts of conventional articles in the August 1979 GSA Bulletin, Part I *are provided on the following pages to aid members who have purchased the separates option to select* Bulletin, Part I *separates of their choice. See instructions for ordering on page 143.*

• 90806—Origin of the plutonic mafic rocks of southern Novia Scotia.

Carlos A. R. de Albuquerque, Department of Geology, Saint Mary's University, Halifax, Canada B3H 3C3 (13 p., 11 figs., 3 tbls.)

Mafic rocks of the Appalachian orogenic belt of southern Nova Scotia were analyzed for major elements, Ba, Sr, Rb, Zr, Nb, Y, and rare-earth elements. These plutonic rocks comprise plagioclase peridotite, norite, high-K diorite, and tonalite. Comparisons with volcanic rocks and other plutonic calc-alkalic rocks indicate that mafic rocks of orogenic belts are very similar in composition to continental tholeiitic basalts, whereas the plagioclase peridotite is chemically comparable to picrites. The high-K diorites have distinctive geochemical characteristics and show only a few analogies with volcanic rocks.

It is suggested, on the basis of the modeling of the data, that the noritic magma could have been originated by partial melting of upper-mantle material with light rare-earth element abundances five to ten times those of chondrites and heavy rare-earth element abundances two to five times the chondritic abundances. The plagioclase peridotite can be derived from a contaminated magma, although the contamination appears to be of mantle (or lower crust) origin. An origin by hybridization of mafic magma with a granitic liquid for the high-K diorites is consistent with the data available.

• 90807—Analysis of rotation of folds during progressive deformation.

Donald M. Ramsay, Department of Geology, University of Dundee, Dundee DD1 4HN, Scotland. (7 p., 7 figs.)

In the course of progressive deformation, fold hinges inclined to the principal strain axes undergo rotation within the X–Y plane toward the X axis (X > Y > Z). The amount of rotation depends on the initial angle of divergence from Y (Ψ_2), and the nature and magnitude of the strain. Initial values of Ψ_2 as low as 5° can produce significant deviation of the fold hinges at the level of strain attending orogenic folding, and the initial variability of fold hinges can be magnified to complex patterns. This rotation has been computed as a function of initial hinge orientation and the magnitude and type of strain. Where fold hinges were initially parallel or close to Y, they undergo small rotations, even for large strains. In host folds with assemblages of incongruous parasitic folds, the high strains in those limbs that approach parallelism with the axial surface are associated with dramatic rotations of initially divergent parasitic fold axes. In the crests of the host, however, lower strains and smaller initial deviation result in little change in the minor fold orientation. In this way the characteristic congruous and incongruous patterns of aberrant folds result.

Slight periclinal form in the initial folds provides a range of divergent axial orientations relative to the Y axis. In the course of subsequent straining, this variability becomes mag-

nified, and a marked degree of noncylindricality may result.

In regions of recumbent folding, the aerial extent of limbs approaching the orientation of the axial surface and exhibiting high layer-parallel extension predominates over hinge areas. In consequence, the parasitic folds in these limbs can develop the widespread patterns of divergent axes which are characteristic of such terranes.

• 90808—Deformation and metamorphism in the Hylas zone and adjacent parts of the eastern Piedmont in Virginia.

Andy R. Bobyarchick, Lynn Glover III, Orogenic Studies Laboratory, Department of Geological Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061 (present address, Bobyarchick: U.S. Geological Survey, National Center, MS 925, Reston, VA 22092).
(14 p., 11 figs., 1 tbl.)

Structural and petrographic studies of the Hylas zone northwest of Richmond, Virginia, reveal that late Paleozoic ductile shearing produced mylonites and ultramylonites from preexisting biotite gneiss, granite gneiss, and amphibolite in the Goochland complex and from Petersburg(?) granite. Rocks in the Goochland complex west of the Hylas zone underwent at least two deformations (D_1, D_2) prior to ductile shearing in the Hylas zone (D_3). D_3 caused a pervasive mylonitic foliation (S_C) and a later widely spaced shear cleavage (S_S) to be formed in rocks in the Hylas zone. Brittle deformation in the form of high-angle faulting and locally intense fracturing (D_4) was superimposed on the Hylas zone about 220 m.y. ago and is probably equivalent to the Palisades disturbance of New England. D_4 was associated throughout the Piedmont with synchronous downwarp and dominantly continental sedimentation to form a series of parallel Triassic basins represented in the study area by the Richmond Basin. Northwest-oriented high-angle faults that apparently displace Triassic sedimentary rocks are interpreted to predate the Late Cretaceous.

Regional prograde metamorphism of the Goochland complex to amphibolite facies (M_1) was inclusive of D_1 and D_2, because structural elements that compose these deformational events consist primarily of oriented metamorphic minerals. Well-equilibrated microstructures in the gneisses suggest that the M_1 peak persisted past D_2. M_1 is inferred to have occurred about 340 m.y. ago. D_3 was accompanied by retrograde metamorphism (m_2) to greenschist facies in the Hylas zone during late Paleozoic time. The presence of laumontite, quartz, and calcite in brecciated zones suggests that brittle deformation during D_4 occurred under zeolite facies conditions. Cenozoic reverse faulting 90 km along strike of the study area in the Brandywine area of the Coastal Plain in Maryland may indicate a continuation of the Hylas zone to the north.

Superposed deformation and intermittent reactivation of zones of instability similar to that of the Hylas zone are reported in the Eastern Piedmont fault system, which extends from Alabama to Virginia. Current stress release beneath the Coastal Plain may be influenced by the instability of the Hylas zone and analogous fault systems throughout the Piedmont.

• 90809—Stratigraphic history of the south-central Saharan region.

Sunday W. Petters, Department of Geology, University of Ibadan, Ibadan, Nigeria. (8 p., 7 figs.)

Analysis of the exposed marine and marginal marine strata in northwestern Nigeria and the neighboring Niger Republic (southeastern Iullemmeden basin) permits stratigraphic correlations throughout the intracontinental epeirogenic basin. This has shed considerable light on the paleogeography of the south-central Saharan region during Maestrichtian-Paleocene time. On the basis of the hypersaline lithologies and restricted faunas in the Maestrichtian-Paleocene cyclic marine deposits of the southeastern Iullemmeden basin, the terminus of the Saharan seaway was in northwestern Nigeria.

• 90810—Note on some spatial and temporal variations in ephemeral channel form.

Helen Rendell, Geography Laboratory, University of Sussex, Falmer, Brighton BN1 9QN, England; David Alexander, Department of Geography, University College London, Gower Street, London WC1E 6BT, England
(12 p., 9 figs., 4 tbls.)

The steady-state concept is hard to reconcile with the reality of flow in ephemeral channels. The interaction of flow and hydraulic geometry is usually considered at various states of time dependency, whereas channel slope is thought to be subject to change only over considerable periods of time.

The results of field work in two ephemeral channels cut in the Pliocene-Pleistocene clays of the Basento Valley, southern Italy, indicate that in this particular environment, hydraulic geometry is subject to rapid change both in space and time. In particular, channel slope is shown to have been subject to dramatic change within a period of two years. On the basis of field evidence, it is suspected that lagged disturbances are dominant in the channels such that the hydraulic geometry is continually adjusting to changed circumstances. It is suggested that in the case of these channels, the random influences are more easily identified and modeled than the deterministic ones.

• 90811—The determination of snow avalanche frequency through tree-ring analysis and historical records at Ophir, Colorado.

Paul E. Carrara, U.S. Geological Survey, Federal Center, Denver, Colorado 80225. (8 p., 9 figs.)

Tree-ring analysis can be a reliable method of determining past snow avalanche events when good historical records are lacking. Characteristic features in the tree-ring record indicative of disturbance include: (1) the occurrence of reaction wood, (2) abrupt changes in growth rate, (3) age of scars caused by avalanche impact, (4) age of trees in reforested tracks, and (5) examination of a "new leader."

This study was conducted at the town of Ophir, a small community in southwestern Colorado with a severe snow

avalanche hazard. Historical records indicate that snow avalanches reached the town, or its vicinity, four times during this century (1918, 1951, 1958, and 1959). Tree-ring analysis substantiated this record in part and produced evidence of at least one additional event (middle to late 1880s). From this combined information, the recurrence interval for major snow avalanches capable of endangering the town is thought to be at least as frequent as once in 20 yr. The limitations of tree-ring analysis encountered in this study are also discussed.

• 90812—Glacial and postglacial sediments in Lakes Superior and Michigan.

Jerry A. Lineback, Illinois State Geological Survey, Urbana, Illinois 61801; Carol I. Dell, Canada Centre for Inland Waters, Burlington, Ontario L7R 4A6 Canada; David L. Gross, Illinois State Geological Survey, Urbana, Illinois 61801. (11 p., 6 figs., 3 tbls.)

The lacustrine sediment sequence above the glacial till under Lake Superior consists of red clays overlain by gray varved clay and nonvarved gray and brown clay. The Lake Michigan sequence also contains red clay at the base and brown and gray clays above. The red clays in Lake Michigan are found in areas overridden by glaciers of Valderan age as well as in the far southern end of the lake. Deposition of red clay took place in the northern part of the lake as the Valderan glaciers were melting and continued during the Algonquin stadial when the ice front reached a stillstand on the northern peninsula of Michigan. Red and gray clay outwash dumped into Lake Superior may also have escaped from the Superior Basin into the Lake Michigan Basin through the Au Train–Whitefish channel and other channels across the upper peninsula of Michigan. The connection of the two lakes began between about 11,000 C^{14} yr B.P. and ended about 10,000 C^{14} yr B.P., when the connection was broken by rebound or by lowering of water levels near the end of the glaciation in the Lake Superior Basin.

• 90813—Late Cenozoic subduction and continental-margin truncation along the northern Middle America Trench: Discussion and reply. (3 p.)

Discussion: *Myrl E. Beck, Jr., Peter W. Plumley, Department of Geology, Western Washington University, Bellingham, Washington 98225 (present address, Plumley: Earth Science Board, University of California, Santa Cruz, Santa Cruz, California 95060).*

Reply: *D. E. Karig, Department of Geological Sciences, Cornell University, Ithaca, New York 14853.*

• 90814—Western margin of Australia: Evolution of a rifted arch system: Discussion and reply. (4 p.)

Discussion: *H.M.J. Stagg, N. F. Exon, Bureau of Mineral Resources, P.O. Box 378, Canberra 2601, Australia.*

Reply: *J. J. Veevers, School of Earth Sciences, Macquarie University, North Ryde, New South Wales 2113, Australia.*

• 90815—New K-Ar dates and the late Pliocene to Holocene geomorphic history of the central Rio Grande region, New Mexico: Discussion. (2 p.)

Charles E. Stearns, Department of Geology, Tufts University, Medford, Massachusetts 02155.

SEPTEMBER BULLETIN SEPARATES

Summaries

At the request of members, the Summaries section may be ordered as one separate by those who have purchased the separates option. To order, write "September Summaries" on coupon.

• S90901—Biogenic silica accumulation in the central equatorial Pacific and its implications for Cenozoic paleoceanography: Summary.

Margaret Leinen, Graduate School of Oceanography, University of Rhode Island, Kingston, Rhode Island 02883.

• S90902—Dolomite and quartz lamellae stress and strain analysis in a multiply-deformed terrane, west-central Vermont: Summary.

Jeanne C. Detenbeck, Rolfe S. Stanley, Department of Geology, University of Vermont, Burlington, Vermont 05405.

• S90903—Hydraulic differentiation of heavy minerals, offshore Alabama and Mississippi: Summary.

S. Edward Drummond, Stephen H. Stow, Department of Geology and Geography, University of Alabama, University, Alabama 35486 (present address, Drummond: Department of Geosciences, Pennsylvania State University, University Park, Pennsylvania 16802).

• S90904—Tectonic interpretation of a geologic section section of the continental margin off San Luis Obispo, the Southern Coast Ranges, and the San Joaquin Valley, California: Map and Chart Series MC-28G summary.

Benjamin M. Page, Department of Geology, Stanford University, Stanford, California 94305; Holly C. Wagner, David S. McCulloch, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025; Eli A. Silver, Board of Earth Sciences, University of California, Santa Cruz, California 95064; John H. Spotts, Chevron Resources Company, 225 Bush Street, San Francisco, California 94119.

Bulletin Briefs

Titles and abstracts of conventional articles in the September 1979 GSA Bulletin, Part I *are provided on the following pages to aid members who have purchased the separates option to select* Bulletin, Part I *separates of their choice. See instructions for ordering on page 143.*

• 90905—Evolution of the Late Cretaceous forearc basin, northern and central California.

Raymond V. Ingersoll, Department of Geology, University of New Mexico, Albuquerque, New Mexico 87131. (14 p., 8 figs., 2 tbls.)

The Upper Cretaceous part of the Great Valley Sequence of California provides a unique opportunity to study deep-marine sedimentation, petrologic evolution, and tectonic evolution of a forearc basin. Actualistic models of submarine fan sedimentation and arc-trench evolution provide the basis for unraveling the complex depositional history of the bathyal to abyssal sediment deposited between the Sierra Nevada volcano-plutonic arc to the east and the Franciscan subduction complex to the west. Submarine fan components are lenticular stratigraphic units which can be correlated along strike on the basis of both paleontologic and petrologic data. The following depositional components are present: basin plain, outer fan, midfan, inner fan, slope, and shelf. Vertical successions of fan facies associations constitute retrograding and prograding suites that correspond, respectively, to onlapping and offlapping relations in the basin. Sedimentation rates are similar to those of other tectonically active flysch basins. Paleocurrents are predominantly southerly and westerly in the Sacramento Valley, and predominantly westerly in the San Joaquin Valley. Microfossil evidence and the lack of carbonate material suggest deposition below the Late Cretaceous calcite compensation depth.

Dimensions and geometries of tectono-stratigraphic components of the Late Cretaceous arc-trench system are similar to those of modern arc-trench systems. The Late Cretaceous arc-trench gap widened by the prograde accretion of the Franciscan Assemblage (subduction complex) and the retrograde migration of the Sierra Nevada volcanic front (arc). Sediment dispersal systems expanded as the basin widened. The Java arc-trench system provides a modern analogue for the Late Cretaceous forearc basin, with sediment fed laterally from the arc and dispersed longitudinally along the basin axis.

• 90906—Effect of volcanic activity on fluvial-deltaic sedimentation in a modern arc-trench gap, southwestern Guatemala.

W. David Kuenzi, Department of Geology, Western Michigan University, Kalamazoo, Michigan 49008; Oscar H. Horst, Department of Geography, Western Michigan University, Kalamazoo, Michigan 49008; Richard V. McGehee, Division of Earth and Physical Sciences, University of Texas at San Antonio, San Antonio, Texas 78285 (12 p., 16 figs., 1 tbl.)

The Pacific coastal plain in Central America forms the subaerial part of an arc-trench gap that is terminated as much as 60 km inland from the Pacific shoreline by the steep slopes of a row of active Quaternary volcanoes. The Samalá fluvial-deltaic system, which heads inland from the volcanic arc, displays a combination of all of the Holocene features (frequently shifting braided channel, flanking elongate dendritically branched lakes, and a high-destructive wave-dominated arcuate delta) that characterize the coastal plain in southwestern Guatemala. Historical records indicate that the catastrophic eruption of Santa María Volcano in 1902 dramatically increased the amount of sediment supplied to the Samalá River. Within a few years, deposition of sand and gravel raised the river bed 10 to 15 m, blocking the drainage of the river's tributaries to produce flanking lakes and allowing the river to easily shift its channel. Frequently, the braided system was diverted laterally into a flanking lake, interrupting deposition of organic-rich muds and locally filling the lake with prograding deltaic deposits. Continued channel shifting and aggradation of sand and gravel on the lower 25 km of the coastal plain have contributed to the growth of an elongate alluvial fan that probably originated during the Pleistocene.

Contemporaneous with aggradation of the fluvial system, an elongate deltaic platform prograded about 7 km seaward, between 1902 and 1922, in response to the deposition of approximately 4 km^3 of deltaic sediments. However, with waning sediment supply, the delta entered a destructive phase, and sands were redistributed laterally to prograding shoreface and beach environments, developing the present arcuate shoreline. The position of the arcuate shoreline has remained essentially unchanged since sometime before 1947; the volume of sediment derived from the active Santiaguito–Santa María volcanic complex and contributed to the shore zone by the Samalá River has been sufficient, since that time, to prevent further shoreline retreat. A new constructive phase of deltation would begin in the event of another great eruption.

Fluvial-deltaic sedimentation in arc-trench geologic settings, under conditions of torrential rainfall, differs significantly from fluvial-deltaic sedimentation in other geologic settings. This difference may be attributed to periodic catastrophic volcanic eruptions, which locally produce high-relief unvegetated slopes and allow extremely high local rates of erosion and subsequent fluvial-deltaic sedimentation.

• 90907—The record of Cenozoic volcanism around the Gulf of California.

Gordon Gastil, Daniel Krummenacher, Department of Geological Sciences, San Diego State University, San Diego, California 92182; John Minch, Saddleback College, Mission Viejo, California 92675. (19 p., 3 figs., 3 tbls.)

Potassium-argon dating and chemical analyses of major oxides of volcanic rocks in areas adjacent to the Gulf of California provide a stratigraphic record of tectonic and magmatic evolution that has occurred during the past 30 m.y.

The important volcanic provinces are: the Pliocene-Holocene Gulf of California dacite; the Pliocene-Holocene west Baja California alkaline basalt-andesite; the Trans-Mexican Volcanic Belt; the "proto-Gulf" basalt from the coast of Nayarit; the late Miocene alkaline basalt of the Commondú Formation found in the Peninsula; the late Miocene basalt-andesite-rhyolite rocks straddling the northern half of the Gulf; the 18- to 22-m.y.-old hornblende andesite belt in the Peninsula of Baja California and the central coast of Sonora; and the Oligocene–early Miocene basalt-rhyolite belt, largely east of the Gulf.

Tectonics interpretation suggests that the subduction plane moved westward between Oligocene and middle Miocene time and that active calc-alkaline volcanism continued over a broad area around the northern Gulf even after the trench west of Baja California had been annihilated.

• 90908—Interpretation of lead-uranium ages of pitchblende deposits in the central Front Range, Colorado.

George Phair, U.S. Geological Survey, Reston, Virginia 22092 (13 p., 2 figs., 7 tbls.)

Published lead-uranium ages of 11 pitchblende ores from deposits of classes 2 and 3, defined by Sims and Sheridan, in the central Front Range, vary from a low of 35 m.y. to a high of 113 m.y. These age determinations are re-evaluated in the light of the following real or potential sources of error: (1) precision of the lead analyses; (2) precision of the lead isotope determinations; (3) uncertainties in the common lead correction arising from inappropriate choice of isotopic composition, excessive amounts of common lead, and postdepositional uranogenic enrichment; (4) leaching of uranium relative to lead; (5) radon loss; (6) sample size; and (7) loss of lead relative to uranium. It is concluded that the largest *sample to sample* age differences stem from factors 1, 4, and 6 and that the largest discordancies in the measured Pb^{206}/U^{238} and Pb^{207}/U^{235} ages *within single samples* can be related to factors 2 and 3.

The ages previously published were recalculated using improved common lead corrections and newer decay constants and were ranked in accordance with criteria 1 through 7. In 4 of the 11 samples dated, the use of the improved common lead correction reversed the age sequence $Pb^{206}/U^{238} < Pb^{207}/U^{235} < Pb^{207}/Pb^{206}$ commonly attributed to radon loss. Samples ranked the highest for dating purposes on the basis of criteria 1 through 7 yielded concordant Pb^{206}/U^{238}-Pb^{207}/U^{235} ages. Two such samples from class 2 deposits yielded Pb^{206}/U^{238} ages of 56.6 and 58.9 m.y.; the rounded average, 58 m.y., is considered to be a best estimate of the true age of the class 2 deposits. One sample from class 3 deposits was judged to be markedly superior to the other three on the basis of criteria 1 through 7, and, in addition, yielded the most concordant Pb-U ages of any samples from the Front Range. Its Pb^{206}/U^{238} age, 72.5 m.y., is considered to be a best estimate of the true age of the class 3 deposits. The preferred ages of the class 2 and class 3 deposits are in harmony with the published K-Ar ages obtained on separate members of the Cretaceous-Tertiary intrusive sequences to which, it is inferred, class 2 deposits are directly and class 3 deposits are indirectly related.

• 90909—Polymetamorphism in the Silurian-Devonian Goshen Formation of western Massachusetts.

Richard N. Abbott, Jr., Department of Geological Sciences, University of Maine, Orono, Maine 04473 (present address: Department of Geology, Dalhousie University, Halifax, Nova Scotia, B3H 3JF Canada). (6 p., 6 figs., 2 tbls.)

Textural interpretations combined with the areal distribution of metamorphic assemblages and chemistry of muscovite and chlorite in the Silurian-Devonian Goshen Formation of western Massachusetts dictate three episodes of metamorphism during the Devonian Acadian orogeny. The first and third episodes are interpreted as prograde events and the second as retrograde. The first metamorphic event (prograde) produced kyanite and staurolite. The second event (retrograde) produced chlorite and paragonite at the expense of previously formed prograde minerals. The third event resulted locally in the prograde replacement of chlorite embayments in garnet by biotite, muscovite, and quartz. Chemical reactions are suggested for each of the three metamorphic events.

• 90910—Flow competence in relation to stream channel form and braiding.

G. H. Cheetham, Department of Physical Geography, University of Uppsala, Box 554, S-751 22 Uppsala, Sweden (10 p., 10 figs., 3 tbls.)

In order to assess the role of competence in the braiding process, a technique was devised to measure point instantaneous bed-shear stresses based on the principle of equating particle moments under controlled conditions. In particular,

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the effects of channel form and stage changes on bed-shear stress are examined. Measurements in nine different cross sections at two stage levels indicate a distinct contrast between parent channels and distributaries. High stresses were recorded in both at higher discharge, but on reduced stage, the stress in the parent channel decreased appreciably but remained moderately high in the distributaries. This spatial pattern of competence changes with stage was further demonstrated by the analysis of hydraulic exponents of discharge which implied a cross-over effect in sediment-transporting ability. Distributaries at high stage appear to become a sedimentary bottleneck relative to the parent channel, thus providing a mechanism for bar growth. Morphological developments demonstrated two superimposed forms of braiding, one consequent upon channel widening and loss of competence, and the other, inherent fluid instability of high-energy flow, producing channel wandering.

• 90911—Genesis of the Skagit Gneiss migmatites, Washington, and the distinction between possible mechanisms of migmatization: Discussion and reply. (2 p.)

Discussion: *J. R. Ashworth, Department of Geological Sciences, University of Aston in Birmingham, Birmingham B4 7ET, Great Britain.*

Reply: *Bruce W. D. Yardley, School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, Great Britain.*

• 90912—Geologic structure and evolution of the Keta basin, West Africa: Discussion and reply. (4 p., 1 fig.)

Discussion: *David A. Hastings, Ghana Geological Survey, Takoradi, Ghana (present address: Department of Geology and Geological Engineering, Michigan Technological University, Houghton, Michigan 49931); M. Bacon, Department of Geology, University of Ghana, Legon, Accra, Ghana.*

Reply: *Benjamin N. Akpati, Department of Geosciences, California State University, Northridge, California 91330.*

• 90913—Granitic and metamorphic rocks of the Taif area, western Saudi Arabia: Discussion and reply. (4 p., 2 figs.)

Discussion: *W. R. Church, Department of Geology, University of Western Ontario, London, Ontario N6A 5B7, Canada.*

Reply: *A. O. Nasseef, Department of Geology, King Abdulaziz University, P.O. Box 1540, Jeddah, Saudi Arabia; I. G. Gass, Department of Earth Sciences, The Open University, Walton Hall, Milton Keynes, MK7 6AA, Great Britain.*

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