VOLUME 36 NUMBER 3 JUNE 1976

OKLAHOMA GEOLOGY NOTES

OKLAHOMA GEOLOGICAL SURVEY

Cover Picture

OGS Exhibit at International Petroleum Exposition

Tulsa was the site of the International Petroleum Exposition (IPE) for the 5-day period of May 17-21. The IPE holds its exposition once every 5 years, in the Expo Building of the Tulsa State Fairgrounds, and the 1976 show, conducted on IPE's 53d anniversary, completely filled a 10-acre building and extended outside to a 5½-acre display area.

This year's exhibit constituted the biggest display of energy equipment and technology that IPE has ever put on. Nearly 500 firms from the United States, Canada, the United Kingdom, France, Japan, West Germany, Rumania, and Italy exhibited equipment and services. An estimated 50,000 people attended.

The Oklahoma Geological Survey prepared two educational exhibits that were shown as part of the Energy-Science Panorama. An Energy Fuels Map of Oklahoma (right side of photograph), constructed for the Survey by Phillips Petroleum Company, was used to show the distribution of oil and gas fields, coal deposits, refineries, gas-processing plants, petrochemical plants, coal mines, and other items of interest. The second exhibit showed current mining and land-reclamation practices in eastern Oklahoma's coal field (left side of photograph). Coordination of the Survey's role in the IPE was handled by John F. Roberts.

—*Kenneth S. Johnson*

Editorial staff: William D. Rose, Rosemary Croy, Elizabeth A. Ham

Oklahoma Geology Notes is published bimonthly by the Oklahoma Geological Survey. It contains short technical articles, mineral-industry and petroleum news and statistics, an annual bibliography of Oklahoma geology, reviews, and announcements of general pertinence to Oklahoma geology. Single copies, seventy-five cents; yearly subscription, $3.00. All subscription orders should be sent to the address on the front cover.

Short articles on aspects of Oklahoma geology are welcome from contributors. A set of guidelines will be forwarded on request.

This publication, printed by the Transcript Press, Norman, Oklahoma, is issued by the Oklahoma Geological Survey as authorized by Title 70, Oklahoma Statutes 1971, Section 3310, and Title 74, Oklahoma Statutes 1971, Sections 231-238. 1,500 copies have been prepared for distribution at a cost to the taxpayers of the State of Oklahoma of $2,608.85.

BIBLIOGRAPHY AND INDEX OF OKLAHOMA GEOLOGY 1975[1]

Compiled by ELIZABETH A. HAM[2] and WILLIAM D. ROSE[2]

BIBLIOGRAPHY

1. Albano, M. A., 1975, Subsurface stratigraphic analysis, "Cherokee" Group (Pennsylvanian), northeast Cleveland County, Oklahoma, part 1: Shale Shaker, v. 25, p. 94-103, 2 figs., 6 pls. (Abstract in Petroleum Abstracts, v. 15, p. 1030.)
2. Albano, M. A., 1975, Subsurface stratigraphic analysis, "Cherokee" Group (Pennsylvanian), northeast Cleveland County, Oklahoma, part 3: Shale Shaker, v. 25, p. 114-124, 2 figs., 6 pls. (Abstract in Petroleum Abstracts, v. 15, p. 1146.)
3. Albano, M. A., 1975, Subsurface stratigraphic analysis, "Cherokee" Group (Pennsylvanian), northeast Cleveland County, Oklahoma, part 3: Shale Shaker, v. 25, p. 134-143, 6 pls. (Abstract in Petroleum Abstracts, v. 15, p. 1198.)

Alberstadt, L. P., *see* Walker, K. R., and Alberstadt, L. P.

4. Albright, J. L., 1975, Carbon black, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 239-250, 2 figs., 11 tables.

Alfonsi, P. P., *see* Huffman, G. G.; Alfonsi, P. P.; Dalton, R. C.; Duarte-Vivas, Andres; and Jeffries, E. L.

Al-Shaieb, Zuhair, *see* Olmsted, R. H., and Al-Shaieb, Zuhair

5. American Gas Association, American Petroleum Institute, and Canadian Petroleum Association, 1975, Reserves of crude oil, natural gas liquids, and natural gas in the United States and Canada and United States productive capacity as of December 31, 1974: v. 29 (May 1975), 254 p., maps, tables, charts.

American Petroleum Institute, *see* American Gas Association, American Petroleum Institute, and Canadian Petroleum Association

6. Ampian, S. G., 1975, Clays, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 287-315, 24 tables.
7. Amsden, T. W., 1974 [1975], Late Ordovician and Early Silurian articulate brachiopods from Oklahoma, southwestern Illinois, and eastern Missouri: Oklahoma Geological Survey Bulletin 119, 154 p., 51 figs., 28 pls., 13 tables.

Anderson, K. H., *see* Kurtz, V. E., Thacker, J. L., Anderson, K. H., and Gerdemann, P. E.

8. Anderson, W. P., Jr., 1974, A field study of Centrahoma field: Shale Shaker, v. 25, p. 78-84, 4 figs., 2 tables. (Abstract in Petroleum Abstracts, v. 15, p. 1029-1030.)

[1]Includes some earlier listings.
[2]Oklahoma Geological Survey.

9. Argall, G. O., Jr., 1975, Eagle-Picher strips 45 feet to mine: World Mining, v. 28, no. 5, p. 40-42, 4 figs.

Arnold, Bill, *see* Cullers, R. L.; Chaudhuri, Sambhudas; Arnold, Bill; Lee, Moon; and Wolf, C. W., Jr.

10. Ashton, J. H., and Rowell, A. J., 1975, Environmental stability and species proliferation in Late Cambrian trilobite faunas: a test of the niche-variation hypothesis: Paleobiology, v. 1, p. 161-174, 4 figs., 3 tables. (Refers to Oklahoma trilobites.)

11. Asquith, G. B., and Cramer, S. L., 1975, Source and depositional environment of the Upper Triassic sandstones of the Texas high plains [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 142. (Reprinted in Oklahoma Geology Notes, v. 35, p. 70.)

12. Asquith, G. B., and Cramer, S. L., 1975, Transverse braid bars in the Upper Triassic Trujillo Sandstone of the Texas Panhandle: Journal of Geology, v. 83, p. 657-661, 4 figs., 1 table. (Mentions Ouachita uplift as source.)

13. Astarita, A. M., 1975, Depositional trends and environments of "Cherokee" sandstones, east-central Payne County, Oklahoma: Oklahoma State University unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 35-36.)

14. Atkins, R. L., 1975, Oklahoma, *in* Exploration, yearbook 1975 (review of 1974), *pt. 1 of* International oil and gas development: International Oil Scouts Association, v. 45, p. 231-243.

15. Atkins, R. L., 1975, Oklahoma, *in* Production, U.S., Canada and foreign, yearbook 1974 (review of 1973), *pt. 2 of* International oil and gas development: International Oil Scouts Association, v. 44, p. 307-393. (Compiled from Vance Rowe Reports and Dwight's Natural Gas Well Production Histories.)

16. Averitt, Paul, 1975, Coal resources of the United States, January 1, 1974: U.S. Geological Survey Bulletin 1412, 131 p., 12 figs., 10 tables.

Babitzke, H. R., *see* McMahon, A. D., Hague, J. M., and Babitzke, H. R.

Baesemann, J. F., *see* Heckel, P. H., and Baesemann, J. F.

17. Baker, R. B., and Grant, Douglas, 1975, Delineating woodland areas in the Red River Basin from ERTS-1 and Skylab imagery: relation to geologic formations and soil types and potential for fiber production [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 143. (Reprinted in Oklahoma Geology Notes, v. 35, p. 70-71.)

18. Bell, A. E., 1975, Use of the water table aquifer model to project depletion of the Ogallala aquifer—High Plains of Texas [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 146-147. (Reprinted in Oklahoma Geology Notes, v. 35, p. 71.)

19. Biederman, E. W., Jr., 1975, Inorganic origin of petroleum: discussion: American Association of Petroleum Geologists Bulletin, v. 59, p. 880-885, 1 fig. (Includes Oklahoma City field and Lucien field.)

20. Biederman, E. W., Jr., 1975, Time of hydrocarbon expulsion, paradox for geologists and geochemists: discussion: American As-

sociation of Petroleum Geologists Bulletin, v. 59, p. 2050-2053. (Refers to Cherokee Group, Oklahoma.)
21. Bingham, R. H., and Moore, R. L., 1975, Reconnaissance of the water resources of the Oklahoma City quadrangle, central Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 4 (prepared in cooperation with U.S. Geological Survey), 4 sheets, scale 1:250,000. (Abstract in Selected Water Resources Abstracts, v. 8, no. 18, p. 88.)
22. Boerngen, J. G., Van Trump, George, Jr., and Ebens, R. J., 1975, Analytical data for geologic units in Missouri and parts of Kansas, Oklahoma, and Arkansas: U.S. Geological Survey open-file report 75-137, 276 p.
Bolles, Kathryn, *see* Olson, E. C., and Bolles, Kathryn
23. Bolt, J. R., and DeMar, Robert, 1975, An explanatory model of the evolution of multiple rows of teeth in *Captorhinus aguti*: Journal of Paleontology, v. 49, p. 814-832, 14 figs., 1 pl. (Discusses Oklahoma Permian cotylosaur.)
24. Bonem, R. M., 1975, Comparison of ecology and sedimentation in Pennsylvanian (Morrowan) bioherms of northeastern Oklahoma with modern patch reefs in Jamaica and the Florida Keys: University of Oklahoma unpublished Ph.D. dissertation, 194 p., 40 figs., 20 pls., 21 tables.
25. Bonem, R. M., 1975, Lower Pennsylvanian (Morrowan) biotic associations—a comparison with a modern patch reef developed on a carbonate mud substrate [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 149. (Reprinted in Oklahoma Geology Notes, v. 35, p. 71-72.)
Bray, D. E., *see* Reiter, L., and Bray, D. E.
26. Briggs, Garrett, 1974, Carboniferous depositional environments in the Ouachita Mountains—Arkoma basin area of southeastern Oklahoma, *in* Briggs, Garrett (editor), Carboniferous of the southeastern United States: Geological Society of America Special Paper 148, p. 225-239, 8 figs.
Burkart, M. R., *see* Morris, R. C., Burkart, M. R., Palmer, P. W., and Russell, R. R.
Burke, Kevin, *see* Hoffman, Paul, Dewey, J. F., and Burke, Kevin.
Canadian Petroleum Association, *see* American Gas Association, American Petroleum Institute, and Canadian Petroleum Association.
27. Cannon, P. J., 1975, Rock type discrimination using radar imagery [abstract]: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meetings Abstracts, v. 2, p. 8-9. (Reprinted in Oklahoma Geology Notes, v. 35, p. 125-126.)
28. Cannon, P. J., 1975, Skylab view of Arbuckle Mountains: Oklahoma Geology Notes, v. 35, p. 165-166. (Cover photo and description.)
29. Carleton, D. A., and Fanelli, L. L., 1975, Natural gas liquids, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 837-859, 3 figs., 19 tables.
30. Carleton, D. A., Harper, W. B., Michalski, Bernadette, and Moore, B. H., 1975, Crude petroleum and petroleum products, *in* Metals,

minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 903-1018, 10 figs., 59 tables.

31. Carter, Claire, and Laufeld, Sven, 1975, Ordovician and Silurian fossils in well cores from North Slope of Alaska: American Association of Petroleum Geologists Bulletin, v. 59, p. 457-464, 5 figs. (Refers to Oklahoma species.)

32. Carter, J. L., 1975, Lower Carboniferous brachiopods from Axel Heiberg and Melville Islands, Canadian Arctic Archipelago, *in* Pojeta, John, Jr., and Pope, J. K. (editors), Studies in paleontology and stratigraphy: Bulletins of American Paleontology, v. 67, no. 287, p. 71-97, 4 pls. (Refers to Oklahoma brachiopods.)

Chaudhuri, Sambhudas, *see* Cullers, R. L.; Chaudhuri, Sambhudas; Arnold, Bill; Lee, Moon; and Wolf, C. W., Jr.

33. Clampitt, R. L., and Reid, T. B., 1975, An economic polymerflood in the North Burbank Unit, Osage County, Oklahoma [preprint]: Society of Petroleum Engineers of American Institute of Mining Engineers, 50th Fall Meeting, Preprint no. SPE-5552, 8 p. (Abstract in Petroleum Abstracts, v. 15, p. 1868.)

34. Clarke, R. G., 1975, Abrasive materials, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 125-136, 1 fig., 14 tables.

35. Cleaves, A. W., 1975, Middle Pennsylvanian (Strawn Group) depositional systems, north-central Texas [abstract]: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meetings Abstracts, v. 2, p. 11-12. (Reprinted in Oklahoma Geology Notes, v. 35, p. 126.)

36. Cocke, J. M., and Strimple, H. L., 1974, Distribution of algae and corals in Upper Pennsylvanian Missourian rocks in northeastern Oklahoma: [publisher not given], 42 p., 20 figs., 3 tables.

37. Coffman, J. L., and von Hake, C. A., 1973, Earthquake history of the United States, revised edition (through 1970): National Oceanic and Atmospheric Administration Publication 41-1, 208 p., figs., photos, charts, maps.

Coleman, M. S., *see* Newton, C. D., Shepard, W. W., and Coleman, M. S.

Coleman, M. S., *see also* Pigg, Jimmie, Coleman, M. S., and Roach, Bill

38. Conrad, K. M., 1975, Applications of log pressure data in the Anadarko Basin: Petroleum Engineering, v. 47, no. 7, p. 40, 42, 44, 48. (Abstract in Petroleum Abstracts, v. 15, p. 1549.)

Cramer, S. L., *see* Asquith, G. B., and Cramer, S. L.

39. Cressy, P. J., 1975, ^{26}Al in cores of the Keyes chondrite: Journal of Geophysical Research, v. 80, p. 1551-1554, 2 figs., 2 tables.

40. Cromwell, D. W., 1975, The stratigraphy and environment of deposition of the lower Dornick Hill Group (Lower Pennsylvanian), Ardmore basin, Oklahoma, part 1: Shale Shaker, v. 25, p. 154-160, 5 figs. (Abstract in Petroleum Abstracts, v. 15, p. 1294.)

41. Cromwell, D. W., 1975, The stratigraphy and environment of deposition of the lower Dornick Hills Group (Lower Pennsylvanian), Ardmore basin, Oklahoma, part 2: Shale Shaker, v. 25, p. 174-177, 182. (Abstract in Petroleum Abstracts, v. 15, p. 1457.)

42. Cromwell, D. W., 1975, The stratigraphy and environment of deposition of the lower Dornick Hills Group (Lower Pennsylvanian), Ardmore basin, Oklahoma, part 3: Shale Shaker, v. 25, p. 190-197. (Abstract in Petroleum Abstracts, v. 15, p. 1632.)
43. Crow, F. R., and Mitchell, A. L., Jr., 1975, Wind effects on chemical films for evaporation suppression at Lake Hefner: Water Resources Research, v. 11, no. 3, p. 493-495, 4 figs. (Abstract in Selected Water Resources Abstracts, v. 8, no. 22, p. 16.)
44. Cullers, R. L.; Chaudhuri, Sambhudas; Arnold, Bill; Lee, Moon; and Wolf, C. W., Jr., 1975, Rare earth distributions in clay minerals and in the clay-sized fraction of the Lower Permian Havensville and Eskridge shales of Kansas and Oklahoma: Geochimica et Cosmochimica Acta, v. 39, p. 1691-1703, 9 figs., 5 tables.

Dalton, R. C., *see* Huffman, G. G.; Alfonsi, P. P.; Dalton, R. C.; Duarte-Vivas, Andres; and Jeffries, E. L.

45. Davies-Jones, R. P., and Golden, J. H., 1975, On the relation of electrical activity to tornadoes: Journal of Geophysical Research, v. 80, p. 1614-1616, 2 figs. (Studies of Oklahoma tornadoes.)
46. Davies-Jones, R. P., and Golden, J. H., 1975, Reply: Journal of Geophysical Research, v. 80, p. 4557-4558, 1 fig. (Reply to comment by Stirling A. Coalgate about entry 45, above.)
47. Davies-Jones, R. P., and Golden, J. H., 1975, Reply: Journal of Geophysical Research, v. 80, p. 4561-4562. (Reply to comment by B. Vonnegut about entry 45, above.)
48. Davis, M. W., and Ehrlich, Robert, 1974, Late Paleozoic crustal composition and dynamics in the southeastern United States, *in* Briggs, Garrett (editor), Carboniferous of the southeastern United States: Geological Society of America Special Paper 148, p. 171-185, 8 figs.
49. Davis, W. E., Jr., 1975, Considerations for fraction stimulation of the deep Morrow in the Anadarko Basin [preprint]: Society of Petroleum Engineers of American Institute of Mining and Metallurgical Engineers Preprint No. SPE-5391, p. 13-23. (Abstract in Petroleum Abstracts, v. 15, p. 945.)

DeMar, Robert, *see* Bolt, J. R., and DeMar, Robert

Dewey, J. F., *see* Hoffman, Paul, Dewey, J. F., and Burke, Kevin

50. Dickey, P. A., 1975, Possible primary migration of oil from source rock in oil phase [geologic note]: American Association of Petroleum Geologists Bulletin, v. 59, p. 337-344, 4 figs. (Includes Oklahoma Pennsylvanian shales.)

Dickinson, W. R., *see* Graham, S. A., Dickinson, W. R., and Ingersol, R. V.

51. Dietzman, W. D., 1975, Depth and producing rate classification of petroleum reservoirs in the United States, 1971: U.S. Bureau of Mines Information Circular 8675, 23 p.
52. D'Lugosz, J. J., 1975, Geohydrology of the Vamoosa aquifer [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 159-160. (Reprinted in Oklahoma Geology Notes, v. 35, p. 72.)

Donahue, Jack, *see* Rollins, H. B., and Donahue, Jack

53. Doyle, E. M., 1975, Oklahoma, *in* Reports from states and official

observers: Oil and Gas Compact Bulletin, v. 34, no. 1, p. 39-42.

54. Doyle, E. M., 1975, Oklahoma, *in* Reports from states and official observers: Oil and Gas Compact Bulletin, v. 34, no. 2, p. 71-75.

55. Doyle, J. A., Van Campo, M., and Lugardon, B., 1975, Observations on exine structure of *Eucommiidites* and Lower Cretaceous angiosperm pollen: Pollen et Spores, v. 17, p. 429-486, 4 figs., 11 pls. (Refers to Oklahoma angiosperm pollen specimens.)

56. Drake, H. J., 1975, Stone, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 1153-1171, 18 tables.

Duarte-Vivas, Andres, *see* Huffman, G. G.; Alfonsi, P. P.; Dalton, R. C.; Duarte-Vivas, Andres; and Jeffries, E. L.

Eakin, J. L., *see* Eckard, W. E., Eakin, J. L., Heath, L. J., and Johnston, K. H.

Ebens, R. J., *see* Boerngen, J. G., Van Trump, George, Jr., and Ebens, R. J.

57. Eckard, W. E., Eakin, J. L., Heath, L. J., and Johnston, K. H., 1973, Experiments to increase petroleum recovery from low-permeability reservoirs: U. N. Ecafe Mineral Resources Development Series, no. 41, v. 2, p. 168-175. (Study of West Avant field, Oklahoma.)

Ehrlich, Robert, *see* Davis, M. W., and Ehrlich, Robert

Ekebafe, S. B., *see* Visher, G. S., Ekebafe, S. B., and Rennison, R.

58. Ela, R. E., 1975, Cement, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 251-275, 19 tables.

59. England, C. B., 1975, Soil moisture accounting component of the USDAHL-74 model of watershed hydrology: Water Resources Bulletin, v. 11, p. 559-567, 3 figs. (Concerns soils near Chickasha, Oklahoma; abstract in Selected Water Resources Abstracts, v. 8, no. 23, p. 10.)

60. Environment Information Center, Inc., 1974, The energy directory: Environment Information Center, Inc., Energy Reference Department, 418 p.

61. Ervin, C. P., and McGinnis, L. D., 1975, Reelfoot rift: reactivated precursor to the Mississippi embayment: Geological Society of America Bulletin, v. 86, p. 1287-1295, 5 figs. (Includes Ouachita front; abstract in Geology, v. 3, p. 518.)

62. Erxleben, A. W., 1975, Deltaic and related carbonate systems in the Pennsylvanian Canyon Group of north-central Texas, *in* Deltas: models for exploration: Houston Geological Society, p. 399-425. (Abstract in Petroleum Abstracts, v. 15, p. 1254.)

Ethington, R. L., *see* Suhm, R. W., and Ethington, R. L.

63. Everett, J. R., and Petzel, Gerald, 1973 [1974], An evaluation of the suitability of ERTS data for the purposes of petroleum exploration, *in* Summary of results, volume 2: Earth Resources Technology Satellite Symposium, 3d, Washington, D.C., December 10-14, 1973, NASA SP-356, p. 50-61, 16 figs. (Study of Anadarko basin.)

64. Fader, S. W., and Morton, R. B., 1975, Groundwater in the Grand (Neosho) River basin, Kansas and Oklahoma: U.S. Geological Survey open-file report 75-366, 35 p., 4 figs., 4 pls., 1 table.

65. Fader, S. W., and Morton, R. B., 1975, Groundwater in the Middle

Arkansas River basin: U.S. Geological Survey open-file report 75-367, 44 p., 7 figs., 4 pls., 1 table.
66. Fader, S. W., and Morton, R. B., 1975, Groundwater in the Verdigris River basin: U.S. Geological Survey open-file report 75-365, 26 p., 2 figs., 4 pls., 1 table.
Fanelli, L. L., *see* Carleton, D. A., and Fanelli, L. L.
Fanelli, L. L., *see also* Harper, W. B., Jaske, R. J., and Fanelli, L.L.
67. Farmer, G. T., Jr., 1975, New bifoliate tubular bryozoan genera from the Simpson Group (Middle Ordovician), Arbuckle Mountains, Oklahoma, *in* Pojeta, John, Jr., and Pope, J. K. (editors), Studies in paleontology and stratigraphy: Bulletins of American Paleontology, v. 67, no. 287, p. 123-138, 5 pls.
68. Faust, Josef, and Richards, R. H., 1975, Dr. R. W. Brauchli, 1895-1975: Shale Shaker, v. 26, p. 14.
69. Fay, R. O., 1975, A possible origin for copper in Oklahoma: Oklahoma Geology Notes, v. 35, p. 151-153, 1 fig., 1 table.
70. Fay, R. O., 1975, The type section of *Mortoniceras* and the holotype specimens of Lower Cretaceous *Texigryphaea* of the southwestern United States: Oklahoma Geology Notes, v. 35, p. 43-57, 24 figs.
71. Federal Power Commission, 1975, National gas survey, volume 1, the Commission report: 387 p., figs., photos, tables.
72. Feenstra, Roger, and Wickham, John, 1975, Evolution of folds around the Broken Bow uplift, Ouachita Mountains, southeastern Oklahoma: American Association of Petroleum Geologists Bulletin, v. 59, p. 974-985, 14 figs., 1 table. (Abstract in Petroleum Abstracts, v. 15, p. 1341.)
73. Finch, W. I., Wright, J. C., and Sullivan, M. W., 1975, Selected bibliography pertaining to uranium occurrence in eastern New Mexico and west Texas and nearby parts of Colorado, Oklahoma, and Kansas: U.S. Geological Survey, 98 p. (National Technical Information Service PB-241 629.)
74. Flower, R. H., 1975, American Lituitidae (Cephalopoda), *in* Pojeta, John, Jr., and Pope, J. K. (editors), Studies in paleontology and stratigraphy: Bulletins of American Paleontology, v. 67, no. 287, p. 139-173, 6 pls. (Includes Oklahoma cephalopods.)
75. Fowler, J. C., and Waters, K. H., 1975, Deep crustal reflection recordings using "Vibroseis" methods—a feasibility study: Geophysics, v. 40, p. 399-410, 9 figs. (Study of northeastern Oklahoma.)
76. Friedman, S. A., 1975, New coal preparation plant opens in Le Flore County: Oklahoma Geology Notes, v. 35, p. 133-134. (Cover photo and description.)
77. Friedman, S. A., 1975, Oklahoma, *in* 1975 Keystone coal industry manual: New York, McGraw-Hill Mining Publications, p. 599-603, 1 fig., 2 tables.
78. Friedman, S. A., 1975, Oklahoma coal versus Wyoming coal: Oklahoma Geology Notes, v. 35, p. 59.
79. Frost, J. G., 1975, Winterset algal-bank complex, Pennsylvanian, eastern Kansas: American Association of Petroleum Geologists Bulletin, v. 59, p. 267-291, 36 figs., 10 tables. (Includes northeastern Oklahoma.)
80. Galloway, W. E., Yancey, M. S., and Whipple, A. P., 1975, Seismic stratigraphic model of depositional platform margin, eastern

Anadarko basin [abstract]: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meetings Abstracts, v. 2, p. 28-29. (Reprinted in Oklahoma Geology Notes, v. 35, p. 126-127.

Gastaldo, R. A., *see* Lee, M. R., Gastaldo, R. A., and Matten, L. C.

Gerdemann, P. E., *see* Kurtz, V. E., Thacker, J. L., Anderson, K. H., and Gerdemann, P. E.

81. Gerolde, S., 1975, Water-treatment workovers raise production: Oil and Gas Journal, v. 73, no. 14, p. 132-134. (Describes treatment of wells near Norman; abstract in Petroleum Abstracts, v. 15, p. 746.)

Golden, J. H., *see* Davies-Jones, R. P., and Golden, J. H.

82. Goldstein, August, Jr., 1975, Geologic interpretation of Viersen and Cochran's 25-1 Weyerhaeuser well, McCurtain County, Oklahoma: Oklahoma Geology Notes, v. 35, p. 167-181, 5 figs., 1 table. (Abstract in Petroleum Abstracts, v. 15, p. 2096.)

83. Gordon, M., Jr., and Sutherland, P. K., 1975, Ammonoids of the upper Wapanucka Limestone and their bearing on the Morrowan-Atokan boundary in Oklahoma [abstract]: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meetins Abstracts, v. 2, p. 30. (Reprinted in Petroleum Abstracts, v. 15, p. 856, and in Oklahoma Geology Notes, v. 35, p. 127.)

84. Graham, S. A., Dickinson, W. R., and Ingersoll, R. V., 1975, Himalayan-Bengal model for flysch dispersal in the Appalachian-Quachita system: Geological Society of American Bulletin, v. 86, p. 273-286, 6 figs.

Grant, Douglas, *see* Baker, R. B., and Grant, Douglas

85. Gustavson, J. B., 1975, Evidence for interaction between a Ouachita crustal chip and a Mississippian embayment rift [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 494. (Reprinted in Oklahoma Geology Notes, v. 35, p. 77.)

Gutjahr, C. C. M., *see* Hood, A., Gutjahr, C. C. M., and Heacock, R. L.

Gutschick, R. C., *see* Nitecki, M. H., Gutschick, R. C., and Repetski, J. E.

Hague, J. M., *see* McMahon, A. D., Hague, J. M., and Babitzke, H. R.

86. Hall, V. S., 1975, Environmental geology: a selected bibliography: Geological Society of America Microform Publication 1, 4 98-frame fiche.

87. Ham, E. A., and Rose, W. D., 1975, Bibliography and index of Oklahoma geology, 1974: Oklahoma Geology Notes, v. 35, p. 83-121. (Abstract in Petroleum Abstracts, v. 15, p. 1457.)

88. Hamilton, P. A., White, D. H., Jr., and Matson, T. K., 1975, The western states, *pt. 2 of* The reserve base of U.S. coals by sulfur content (in two parts): U.S. Bureau of Mines Information Circular 8693, 322 p.

89. Harper, W. B., Jaske, R. J., and Fanelli, L. L., 1975, Natural gas, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 795-836, 3 figs., 25 tables.

Harper, W. B., *see* Carleton, D. A., Harper, W. B., Michalski, Bernadette, and Moore, B. H.

90. Harris, S. A., 1975, Hydrocarbon accumulation in "Meramec-Osage" (Mississippian) rocks, Sooner Trend, northwest-central Oklahoma: American Association of Petroleum Geologists Bulletin, v. 59, p. 633-664, 13 figs., 1 table.

Heacock, R. L., *see* Hood, A., Gutjahr, C. C. M., and Heacock, R. L.

Heath, L. J., *see* Eckard, W. E., Eakin, J. L., Heath, L. J., and Johnston, K. H.

91. Heckel, P. H., 1975, Solenoporid red algae (*Parachaetetes*) from Upper Pennsylvanian rocks in Kansas: Journal of Paleontology, v. 49, p. 662-673, 3 figs., 1 pl. (Includes Oklahoma species.)

92. Heckel, P. H., 1975, Stratigraphy and depositional framework of the Stanton Formation in southeastern Kansas: Kansas Geological Survey Bulletin 210, 45 p., 26 figs., 1 pl. (geologic map). (Describes relationship to Oklahoma beds.)

93. Heckel, P. H., and Baesemann, J. F., 1975, Environmental interpretation of conodont distribution in Upper Pennsylvanian (Missourian) megacyclothems in eastern Kansas: American Association of Petroleum Geologists Bulletin, v. 59, p. 486-509, 6 figs. (Abstract in Petroleum Abstracts, v. 15, p. 889.)

94. Heine, R. R., 1975, Geochemistry and mineralogy of the Permian red beds and related copper deposits, Payne, Pawnee, and Noble Counties, Oklahoma: Oklahoma State University unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 36.)

95. Hoffman, Paul, Dewey, J. F., and Burke, Kevin, 1975, Aulacogens and their genetic relation to geosynclines with a Proterozoic example from Great Slave Lake, Canada, *in* Dott, R. H., Jr., and Shaver, R. H. (editors), Modern and ancient geosynclinal sedimentation: Society of Economic Paleontologists and Mineralogists Special Publication No. 19, p. 38-55, 10 figs., 1 table. (Includes southern Oklahoma aulacogen and Ouachita geosyncline.)

96. Holdaway, K. A., 1975, Evaporites from the sea? A western Kansas Permian enigma [abstract]: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meetings Abstracts, v. 2, p. 36. (Reprinted in Petroleum Abstracts, v. 15, p. 854, and in Oklahoma Geology Notes, v. 35, p. 128.)

97. Hood, A., Gutjahr, C. C. M., and Heacock, R. L., 1975, Organic metamorphism and the generation of petroleum: American Association of Petroleum Geologists Bulletin, v. 59, p. 986-996, 7 figs. (Includes Anadarko basin.)

98. Hu, C. H., 1975, Ontogenies of three Late Cambrian trilobites from the Deadwood Formation, northern Black Hills, South Dakota, *in* Pojeta, John, Jr., and Pope, J. K. (editors), Studies in paleontology and stratigraphy: Bulletins of American Paleontology, v. 67, no. 287, p. 251-272, 3 figs., 3 pls. (Refers to Oklahoma trilobite.)

99. Huffman, G. G.; Alfonsi, P. P.; Dalton, R. C.; Duarte-Vivas, Andres; and Jeffries, E. L., 1975, Geology and mineral resources of Choctaw County, Oklahoma: Oklahoma Geological Survey Bulletin

120, 39 p., 18 figs., 5 tables, geologic map. (Abstract in Petroleum Abstracts, v. 15, p. 2067-2068.)

Ingersoll, R. V., *see* Graham, S. A., Dickinson, W. R., and Ingersoll, R. V.

100. Interstate Oil Compact Commission, 1975, Oklahoma—history of production statistics: Oil and Gas Compact Bulletin, v. 34, no. 2, p. 43.

101. Jameson, W. C., and Schiel, J. B., Jr., 1975, Possible man-made sinkholes at Southard, west-central Oklahoma: a case study in landscape modification: Oklahoma Geology Notes, v. 35, p. 187-193, 3 figs., 1 table.

Jaske, R. J., *see* Harper, W. B., Jaske, R. J., and Fanelli, L. L.

Jeffries, E. L., *see* Huffman, G. G.; Alfonsi, P. P.; Dalton, R. C.; Duarte-Vivas, Andres; and Jeffries, E. L.

Jennings, M. E., *see* Moench, A. F., Sauer, V. B., and Jennings, M. E.

Jeran, P. W., *see* McCulloch, C. M., Jeran, P. W., and Sullivan, C. D.

102. Johnson, K. S., 1975, Gypsum-capped mesa in southwestern Oklahoma: Oklahoma Geology Notes, v. 35, p. 41-42. (Cover photo and description.)

103. Johnson, K. S., 1975, Medicine Bluffs, Wichita Mountains: Oklahoma Geology Notes, v. 35, p. 2. (Cover photo description.)

104. Johnson, K. S., 1975, Tombstone topography in Arbuckle Group, Wichita Mountains: Oklahoma Geology Notes, v. 35, p. 82. (Cover photo description.)

105. Johnson, K. S., Wolfe, W. D., and Smith, M. V., 1975, Stratigraphy of the Permian Blaine Formation and associated strata in north-central Texas, [abstract]: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meetings Abstracts, v. 2, p. 39-40. (Reprinted in Petroleum Abstracts, v. 15, p. 858, and in Oklahoma Geology Notes, v. 35, p. 128.)

Johnston, K. H., *see* Eckard, W. E., Eakin, J. L., Heath, L. J., and Johnston, K. H.

106. Jouzel, J., Merlivat, L., and Roth, E., 1975, Isotopic study of hail: Journal of Geophysical Research, v. 80, p. 5015-5030, 17 figs., 4 tables. (Includes specimens from Oklahoma.)

107. Keller, G. R., and Shurbet, D. H., 1975, Crustal structure of the Texas Gulf Coastal Plain: Geological Society of America Bulletin, v. 86, p. 807-810, 4 figs., 1 table. (Includes Ouachita belt.)

108. Kelley, V. C., and Northrop, S. A., 1975, Geology of Sandia Mountains and vicinity, New Mexico: New Mexico Bureau of Mines and Mineral Resources Memoir 29, 135 p., 92 figs., 4 tables, 4 maps. (Refers to correlation with Oklahoma Pennsylvanian.)

109. Keyes, W. F., 1975, Potash, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 1051-1062, 1 fig., 11 tables.

Keyes, W. F., *see* Merwin, R. W., and Keyes, W. F.

110. King, P. B., 1975, Ancient southern margin of North America: Geology, v. 3, p. 732-734. (Includes Ouachita Mountains.)

111. Klingman, C. L., 1975, Salt, *in* Metals, minerals, and fuels, *v. 1 of*

Minerals yearbook 1973: U.S. Bureau of Mines, p. 1085-1095, 15 tables.
112. Knox, L. W., 1974, Ostracods from the area of the type rocks of the Morrowan Series (Lower Pennsylvanian), Arkansas and Oklahoma: Indiana University unpublished Ph.D. dissertation. (Abstract printed in Dissertation Abstracts International, Pt. B, v. 35, p. 5024-B—5025-B; reprinted in Petroleum Abstracts, v. 15, p. 1087.)
113. Knutson, E. G. (compiler), 1975, Survey of United States uranium marketing activity, April 1975: U.S. Energy Research and Development Administration, 26 p. (Includes data on Inola Black Fox Nuclear Station and lists Kerr-McGee Corporation.)
114. Koelling, G. W., 1975, Helium, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 601-607, 9 tables.
115. Kolata, D. R., 1975, Middle Ordovician echinoderms from northern Illinois and southern Wisconsin: Paleontological Society Memoir 7, Journal of Paleontology, v. 49, pt. 2 of 2, Supplement to no. 3, 74 p., 19 figs., 15 pls., 9 tables. (Refers to Oklahoma crinoid species.)
116. Kornfeld, J. A., 1975, Anadarko basin Arbuckle gets another look: World Oil, v. 181, no. 6, p. 86, 87.
117. Kousparis, Dimitrios, 1975, Quantitative geophysical study of the Cleveland sand reservoir (Pennsylvanian) in eastern part of Logan County, Oklahoma: University of Oklahoma unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 38-39.)
118. Krancer, A. E., 1975, Nannofossils of the Ozan Formation (Cretaceous), McCurtain County, Oklahoma: University of Oklahoma unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 39.)
119. Krancer, A. E., 1975, Nannofossils of the Ozan Formation (Upper Cretaceous) of southeastern Oklahoma: Oklahoma Geology Notes, v. 35, p. 3-19, 3 pls, 1 table. (Abstract in Petroleum Abstracts, v. 15, p. 646.)
120. Krepps, W. J., 1975, Ted G. Becker, 1930-1975: Shale Shaker, v. 26, p. 56.
121. Krumme, G. W., 1975, Mid-Pennsylvanian source reversal on the Oklahoma platform: Tulsa University unpublished Ph.D. dissertation, 161 p. (Abstract printed in Dissertation Abstracts International, Pt. B, v. 36, p. 1104-B; reprinted in Petroleum Abstracts, v. 15, p. 2020.)
122. Kulhawy, F. H., 1975, Stress deformation properties of rock and rock discontinuities: Engineering Geology, v. 9, p. 327-350, 5 figs., 15 tables. (Includes data on Oklahoma rocks.)
123. Kurtz, V. E., 1975, Franconian (Upper Cambrian) trilobite faunas from the Elvins Group of southeast Missouri: Journal of Paleontology, v. 49, p. 1009-1043, 4 pls., 7 figs. (Refers to Oklahoma species.)
124. Kurtz, V. E., Thacker, J. L., Anderson, K. H., and Gerdemann, P. E.,

1975, Traverse in late Cambrian strata from the St. Francois Mountains, Missouri to Delaware County, Oklahoma: Missouri Geological Survey Report of Investigations No. 55, 112 p., 4 figs., 1 pl.

125. Lalla, Wilson, 1975, A stratigraphic study of the Osage-Layton format in northeastern Oklahoma: Shale Shaker, v. 26, p. 66-78, 6 figs., 4 cross sections.

Lane, H. R., *see* Ormiston, A. R., and Lane, H. R.

126. Laub, R. S., 1975, The ancestry, geographical extent, and fate of the Brassfield coral fauna (Middle Llandovery, North America), *in* Pojeta, John, Jr., and Pope, J. K. (editors), Studies in paleontology and stratigraphy: Bulletins of American Paleontology, v. 67, no. 287, p. 273-286, 4 figs., 2 tables. (Includes Oklahoma coral.)

Laufeld, Sven, *see* Carter, Claire, and Laufeld, Sven

127. Lawson, J. E., Jr., 1975, Detection of small local earthquakes in Oklahoma with a high-pass vertical seismograph [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 182. (Reprinted in Oklahoma Geology Notes, v. 35, p. 73.)

128. Leach, D. L., Nelson, R. C., and Williams, D., 1975, Fluid inclusion studies in the northern Arkansas zinc district: Economic Geology, v. 70, p. 1084-1091, 7 figs. (Includes Tri-State district.)

129. Lee, M. R., Gastaldo, R. A., and Matten, L. C., 1975, A preliminary report on petrified wood from the Ogallala Formation of northwest Oklahoma [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 182-183. (Reprinted in Oklahoma Geology Notes, v. 35, p. 73.)

Lee, Moon, *see* Cullers, R. L.; Chaudhuri, Sambhudas; Arnold, Bill; Lee, Moon; and Wolf, C. W., Jr.

130. Loeblich, A. R., Jr., and Wicander, E. R., 1974, New Early Devonian (Late Gedinnian) microphytoplankton: *Demorhethium lappaceum,* n.g., n. sp., from the Bois d'Arc Formation of Oklahoma, U.S.A.: Neues Jahrbuch für Geologie und Paläontologie Monatshefte, no. 12, p. 707-711, 6 figs., (Abstract in Petroleum Abstracts, v. 15, p. 1254.)

131. London, W. W., 1975, A geological and engineering study of the Mustang pool, Canadian County, Oklahoma, part 1: Shale Shaker, v. 26, p. 4-12, 9 figs. (Abstract in Petroleum Abstracts, v. 15, p. 1989.)

132. London, W. W., 1975, A geological and engineering study of the Mustang pool, Canadian County, Oklahoma, part 2: Shale Shaker, v. 26, no. 2, p. 26-35, 9 figs., 1 table. (Abstract in Petroleum Abstracts, v. 15, p. 2098.)

133. London, W. W., 1975, A geological and engineering study of the Mustang pool, Canadian County, Oklahoma, part 3: Shale Shaker, v. 26, p. 50-55, 3 figs.

134. Lowe, D. R., 1975, Regional controls on silica sedimentation in the Ouachita system: Geological Society of America Bulletin, v. 86, p. 1123-1127, 4 figs. (Abstract in Petroleum Abstracts, v. 15, p. 1573, and in Geology, v. 3, p. 454.)

Lugardon, B., *see* Doyle, J. A., Van Campo, M., and Lugardon, B.

135. Luke, R. F., 1975, The structure of the eastern part of the Mill

Creek syncline: University of Oklahoma unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 39-40.)

Lundin, R. F., *see* Petersen, L. E., and Lundin, R. F.

136. McCaslin, J. C., 1975, Deep tests continue to dot Anadarko basin: Oil and Gas Journal, v. 73, no. 39, p. 163, 1 fig.

137. McCaslin, J. C., 1975, New Oklahoma gas area growing fast: Oil and Gas Journal, v. 73, no. 34, p. 133.

138. McCulloch, C. M., Jeran, P. W., and Sullivan, C. D., 1975, Geologic investigations of underground coal mining problems: U.S. Bureau of Mines Report of Investigations 8022, 30 p., 26 figs. (Includes Hartshorne coal.)

139. McDaniel, G. A., 1974, Application of sedimentary directional features and scalar properties to hydrocarbon exploration, *in* Braunstein, Jules (editor), Facies and the reconstruction of environments: American Association of Petroleum Geologists Reprint Series No. 10, p. 213-223, 13 figs., 2 tables. (Study of Hartshorne Formation in Arkoma basin; first published in A.A.P.G. Bulletin, v. 52, p. 1689-1699.)

140. McFarland, J. D., III, 1975, Lithostratigraphy and conodont biostratigraphy of the St. Joe Formation (Lower Mississippian), northwest Arkansas [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 217. (Reprinted in Oklahoma Geology Notes, v. 35, p. 74.)

McGinnis, L. D., *see* Ervin, C. P., and McGinnis, L. D.

141. McMahon, A. D., Hague, J. M., and Babitzke, H. R., 1975, Zinc, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 1303-1343, 6 figs., 37 tables.

142. McMurtry, W. E., 1975, In memoriam, Robert M. Becker: Shale Shaker, v. 26, p. 36.

143. Macurda, D. B., Jr., 1975, The *Pentremites* (Blastoidea) of the Burlington Limestone (Mississippian): Journal of Paleontology, v. 49, p. 346-373, 4 figs., 5 pls. (Refers to Oklahoma species.)

144. Manger, W. L., and Rice, R. W., 1975, Intraspecific variation in *Arkanites relictus* (Cephalopoda, Ammonoidea) from Morrowan strata, Arkansas and Oklahoma [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 212-213. (Reprinted in Oklahoma Geology Notes, v. 35, p. 74.)

145. Mankin, C. J., 1975, Oklahoma Geological Survey, annual report, July 1, 1974-June 30, 1975: Oklahoma Geology Notes, v. 35, p. 203-215.

146. Matson, T. K., and White, D. H., Jr., 1975, The reserve base of coal for underground mining in the western United States: U.S. Bureau of Mines Information Circular 8678, 238 p.

Matson, T. K., *see* Hamilton, P. A., White, D. H., Jr., and Matson, T. K.

Matten, L. C., *see* Lee, M. R., Gastaldo, R. A., and Matten, L. C.

147. Melton, F. A., 1975, Stereoscopic and mosaic aerial-photograph study of the structure of the central Ouachita Mountains in Oklahoma and Arkansas: Oklahoma Geological Survey Map GM-18, 1 sheet, 4 maps, 5 cross sections.

Merlivat, L., *see* Jouzel, J., Merlivat, L., and Roth, E.

148. Merwin, R. W., and Keyes, W. F., 1975, Sulfur and pyrites, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 1173-1191, 3 figs., 17 tables.

149. Meyer, G. D., 1975, The surficial geology of the Guthrie North quadrangle, Logan County, Oklahoma: Oklahoma State University unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 36-37.)

Michalski, Bernadette, *see* Carleton, D. A., Harper, W. B., Michalski, Bernadette, and Moore, B. H.

150. Miller, B. M., and others, 1975, Geological estimates of undiscovered recoverable oil and gas resources in the United States: U.S. Geological Survey Circular 725, 78 p., 39 figs., 8 tables.

151. Mining Informational Services, 1975, Oklahoma, *in* 1975 Keystone coal industry manual: New York, McGraw-Hill Mining Publications, p. 831. (Directory of coal companies and mines.)

Mintz, L. W., *see* Parsley, R. L., and Mintz, L. W.

152. Mistretta, S. B., 1975, Carbonate petrology and lithostratigraphy of the Lecompton Member (Pawhuska Formation), Jennings-Shamrock area, Oklahoma: University of Oklahoma unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 40.)

Mitchell, A. L., Jr., *see* Crow, F. R., and Mitchell, A. L., Jr.

153. Moench, A. F., Sauer, V. B., and Jennings, M. E., 1974, Modification of routed streamflow by channel loss and base flow: Water Resources Research, v. 10, p. 963-968, 8 figs., 1 table. (Study of North Canadian River, Oklahoma; abstract in Selected Water Resources Abstracts, v. 8, no. 2, p. 36.)

Moore, B. H., *see* Carleton, D. A., Harper, W. B., Michalski, Bernadette, and Moore, B. H.

Moore, R. L., *see* Bingham, R. H., and Moore, R. L.

154. Morning, J. L., 1975, Mining and quarrying trends in the metal and nonmetal industries, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 65-86, 18 tables.

155. Morris, R. C., 1974, Carboniferous rocks of the Ouachita Mountains, Arkansas: a study of facies patterns along the unstable slope and axis of a flysch trough, *in* Briggs, Garrett (editor), Carboniferous of the southeastern United States: Geological Society of America Special Paper 148, p. 241-279, 28 figs., 6 tables.

156. Morris, R. C., Burkart, M. R., Palmer, P. W., and Russell, R. R., 1975, Stratigraphy and structure of part of frontal Ouachita Mountains, Arkansas: American Association of Petroleum Geologists Bulletin, v. 59, p. 747-765, 17 figs. (Refers to Oklahoma Ouachita stratigraphy and structure; abstract in Petroleum Abstracts, v. 15, p. 1385.)

Morton, R. B., *see* Fader, S. W., and Morton, R. B.

Naney, J. W., *see* Yost, C., Jr., and Naney, J. W.

157. Nelson, Forrest, 1974, Appraisal of saline water in Oklahoma and its future development through desalting: Oklahoma Water Resources Board Report INT-OSW-RDPR-75-97, 164 p., 47 figs., 7 tables. (National Technical Information Service PB-239 396.)

Nelson, R. C., *see* Leach, D. L., Nelson, R. C., and Williams, D.

158. Newton, C. D., Shepard, W. W., and Coleman, M. S., 1974, Street runoff as a source of lead pollution: Water Pollution Control Federation Journal, v. 46, p. 999-1000. (Study of pollution in North Canadian River.)

159. Nicholas, R. L., and Rozendal, R. A., 1975, Subsurface positive elements within Ouachita foldbelt in Texas and their relation to Paleozoic cratonic margin: American Association of Petroleum Geologists Bulletin, v. 59, p. 193-216, 23 figs.

160. Nitecki, M. H., Gutschick, R. C., and Repetski, J. E., 1975, Phosphatic microfossils from the Ordovician of the United States: Fieldiana Geology, v. 35, p. 1-9, 8 figs. (Includes Oklahoma Simpson Group specimens.)

Nitecki, M. H., *see* Rigby, J. K., and Nitecki, M. H.

Nitecki, M. H., *see also* Thein, M. L., and Nitecki, M. H.

161. Noran, David, 1975, ERDA's enhanced-recovery program gathers momentum: Oil and Gas Journal, v. 73, no. 44, p. 77-81, 3 figs., 2 tables. (Includes North Burbank and North Stanley pools.)

Northrop, S. A., *see* Kelley, V. C., and Northrop, S. A.

162. Nriagu, J. O., 1975, Thermochemical approximations for clay minerals: American Mineralogist, v. 60, p. 834-839, 5 tables. (Includes Beavers Bend Illite.)

163. Oil and Gas Journal, 1975, Busy drillers link four Oklahoma gas fields: Oil and Gas Journal, v. 73, no. 41, p. 26, 27, 1 fig.

164. Oil and Gas Journal, 1975, Deep holes flourish in hot Anadarko basin rig work, *in* Action areas dot North America from the North Slope to Reforma: Oil and Gas Journal, v. 73, no. 1, p. 45-46, map.

165. Oil and Gas Journal, 1975, Downhole rocks, fluids to govern deep drilling: Oil and Gas Journal, v. 73, no. 26, p. 60. (Abstract in Petroleum Abstracts, v. 15, p. 1350; includes Anadarko basin.)

166. Oil and Gas Journal, 1975, Pennsylvanian zones lure southern Oklahoma wildcats, *in* Action areas dot North America from the North Slope to Reforma: Oil and Gas Journal, v. 73, no. 1, p. 46-47, map, 1 photo.

Oklahoma Agricultural Experiment Station, *see* U.S. Department of Agriculture, Soil Conservation Service, and Oklahoma Agricultural Experiment Station

167. Oklahoma Geological Survey, 1975, Index, volume 35, 1975: Oklahoma Geology Notes, v. 234-244.

168. Oklahoma Oil Maps, 1975, 1975 Oklahoma state pool map: Oklahoma City, 1 sheet, scale 3/16 inch = 1 mile.

169. Oklahoma Water Resources Board, 1974, Annual report: Publication 54, 38 p., 37 figs., photos. (Report for 1973.)

170. Oklahoma Water Resources Board, 1975, Oklahoma comprehensive water plan, phase 1: Publication 60, 122 p., figs., maps, photos, tables.

171. Oklahoma Water Resources Board, 1975, Salt water detection in the Cimarron terrace, Oklahoma: Ada, Oklahoma, Oklahoma Water Resources Board, U.S. Environmental Protection Agency, Report EPA-660/3-74-003, 166 p., 28 figs., 5 tables. (National Technical Information Service PB-242 269; abstract in Selected Water Resources Abstracts, v 8, no. 18, p. 37-38.)

172. Olmsted, R. H., and Al-Shaieb, Zuhair, 1975, Geochemical anomalies, uranium potential of south-central Oklahoma [abstract]: Economic Geology, v. 70, p. 1326.

173. Olson, E. C., 1975, Vertebrates and the biostratigraphic position of the Dunkard, *in* Barlow, J. A. (editor), The age of the Dunkard: I. C. White Memorial Symposium, 1st, Morgantown, West Virginia, 1972, p. 155-169, 3 tables. (Refers to Oklahoma red beds.)

174. Olson, E. C., and Bolles, Kathryn, 1975, Permo-Carboniferous fresh water burrows: Fieldiana Geology, v. 33, p. 271-290, 6 figs., 2 pls. (Includes Oklahoma examples from the Hennessey Group.)

175. Ormiston, A. R., and Lane, H. R., 1975, Exceptional Radiolaria and associated conodonts from the Sycamore Limestone, Arbuckle Mountains, Oklahoma [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 832. (Reprinted in Oklahoma Geology Notes, v. 35, p. 131.)

176. Ossian, C. R., 1975, Ordovician vertebrate remains from the Arbuckle Mountains of southern Oklahoma [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 222-223. (Reprinted in Oklahoma Geology Notes, v. 35, p. 75.)

177. Padgett, Ward, 1975, Sixty-sixth annual report, Department of Mines, Chief Mine Inspector, year ending December 31, 1974: Oklahoma Department of Mines, 61 p.

178. Pajalich, Walter, 1975, Sand and gravel, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 1097-1115, 2 figs., 11 tables.

Palmer, P. W., *see* Morris, R. C., Burkart, M. R., Palmer, P. W., and Russell, R. R.

179. Parsley, R. L., and Mintz, L. W., 1975, North American Paracrinoidea: (Ordovician: Paracrinozoa, new, Echinodermata): Bulletins of American Paleontology, v. 68, no. 288, 115 p., 8 figs., 13 pls., 1 table. (Includes Oklahoma specimens.)

180. Pearson, D. L., 1975, Palynology of the middle and upper Seminole coals (Pennsylvanian) of Tulsa County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 72 p., 2 charts, 2 figs., 3 tables. (Abstract in Oklahoma Geology Notes, v. 35, p. 162.)

181. Person, W. J., 1975, Seismological notes—November-December 1974: Seismological Society of America Bulletin, v. 65, p. 1038. (Lists Oklahoma earthquake, December 16, 1974.)

182. Petersen, L. E., and Lundin, R. F., 1975, Lower Devonian Ostracoda in western Tennessee [abstract]: American Association of Petroleum Geologists Bulletin, v. 59, p. 1729. (Refers to Haragan Formation, Oklahoma.)

Petzel, Gerald, *see* Everett, J. R., and Petzel, Gerald.

183. Pigg, Jimmie, Coleman, M. S., and Roach, Bill, 1975, Distribution of lead in the upper Deep Fork River system of Oklahoma: Oklahoma Academy of Science Proceedings, v. 55, p. 19-24, 1 fig., 3 tables.

184. Pirson, S. J., 1975, Aid to oil hunters: ME exploration: Oil and Gas Journal, v. 73, no. 13, p. 121-122, 126-129. (Concerns survey made in Anadarko basin; abstract in Petroleum Abstracts, v. 15, p. 696.)

185. Porfir'ev, V. B., 1975, Inorganic origin of petroleum: reply: American Association of Petroleum Geologists Bulletin, v. 59, p. 886-889, 1 fig. (Includes Oklahoma pools.)

186. Price, L. C., 1975, Evidence for and use of the model of a hot deep origin of petroleum in exploration [abstract]: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meetings Abstracts, v. 2, p. 60-61. (Reprinted in Oklahoma Geology Notes, v. 35, p. 129; includes southern Oklahoma and Anadarko shelf areas.)

187. Pruatt, M. A., 1975, The southern Oklahoma aulacogen: a geophysical and geological investigation: University of Oklahoma unpublished M.S. thesis, 59 p., 12 figs., 1 table (Abstract in Oklahoma Geology Notes, v. 35, p. 162-163.)

188. Rascoe, Bailey, Jr., 1975, Tectonic origin of preconsolidation deformation in Upper Pennsylvanian rocks near Bartlesville, Oklahoma: American Association of Petroleum Geologists Bulletin, v. 59, p. 1626-1638, 8 figs., 3 tables.

Rashid, M. A., *see* Wilson, L. R., and Rashid, M. A.

189. Reed, A. H., 1975, Gypsum, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 593-599, 13 tables.

190. Reed, A. H., 1975, Lime, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 715-724, 13 tables.

Reid, T. B., *see* Clampitt, R. L., and Reid, T. B.

191. Reiter, L., and Bray, D. E., 1975, Seismological analysis of a train derailment [abstract]: Seismological Society of America, Earthquake Notes, v. 46, no. 4, p. 56. (Recordings taken at Leonard Earth Science Observatory.)

Rennison, R., *see* Visher, G. S., Ekebafe, S. B., and Rennison, R.

Repetski, J. E., *see* Nitecki, M. H., Gutschick, R. C., and Repetski, J. E.

192. Riccardi, A. C., and Sabattini, N., 1975, Cephalopoda from the Carboniferous of Argentina: Palaeontology, v. 18, pt. 1, p. 117-136, 2 figs., pls. 22-24. (Refers to Oklahoma Mississippian species.)

Rice, R. W., *see* Manger, W. L., and Rice, R. W.

Richards, R. H., *see* Faust, Josef, and Richards, R. H.

193. Rigby, J. K., and Nitecki, M. H., 1975, An unusually well preserved heteractinid sponge from the Pennsylvanian of Illinois and a possible classification and evolutionary scheme for the Heteractinida: Journal of Paleontology, v. 49, p. 329-339, 3 figs., 1 pl. (Refers to Oklahoma sponge.)

194. Riley, L. R., 1975, Sycamore development in Stephens County, Oklahoma [preprint]: Society of Petroleum Engineers of America Institute of Mining Engineers Preprint No. SPE-5406, p. 123-130. (Abstract in Petroleum Abstracts, v. 15, p. 954.)

Roach, Bill, *see* Pigg, Jimmie, Coleman, M.S., and Roach, Bill

195. Roberts, J. F., 1975, Statistics of Oklahoma's petroleum industry, 1974: Oklahoma Geology Notes, v. 35, p. 226-234, 4 figs., 4 tables.

196. Roeder, D. H., 1975, Tectonic effects of dip changes in subduction

zones: American Journal of Science, v. 275, p. 252-264, 10 figs. (Includes Ouachita Mountains.)

197. Rollins, H. B., and Donahue, Jack, 1975, Towards a theoretical basis of paleoecology: concepts of community dynamics: Lethaia, v. 8, p. 255-270, 16 figs., 1 table. (Includes Wewoka Formation, Oklahoma.)

Rose, W. D., *see* Ham, E. A., and Rose, W. D.

Roth, E., *see* Jouzel, J., Merlivat, L., and Roth, E.

Rowell, A. J., *see* Ashton, J. H., and Rowell, A. J.

198. Rowland, T. L., 1975, Story of the Baden unit: Oil and Gas Journal, v. 73, no. 28, p. 158, 159-160, 2 figs., 1 table.

Rozendal, R. A., *see* Nicholas, R. L., and Rozendal, R. A.

Russell, R. R., *see* Morris, R. C., Burkart, M. R., Palmer, P. W., and Russell, R. R.

199. Ryan, J. P., 1975, Lead, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 685-713, 2 figs., 32 tables.

200. Ryan, P. J., 1975, A vertical intensity magnetic survey of the western part of the Arbuckle Mountains: University of Oklahoma unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 41.)

Sabattini, N., *see* Riccardi, A. C., and Sabattini, N.

201. Sando, W. J., 1974, Checklist of North American late Paleozoic coral species (Coelenterata, Anthozoa): U.S. Geological Survey Bulletin 1387, 36 p. (Includes Oklahoma species.)

202. Satterfield, I. R., and Thompson, T. L., 1975, Seventy-Six Shale, a new member of the Bainbridge Formation (Silurian) in southeastern Missouri, *pt. 3 of* Studies in stratigraphy: Missouri Geological Survey Report of Investigations No. 57, p. 109-119, 3 figs., 1 table. (Correlates Seventy-Six Shale with Prices Falls Shale Member of Clarita Formation in Oklahoma.)

Satterfield, I. R., *see* Sweet, W. C., Thompson, T. L., and Satterfield, I. R.

Sauer, V. B., *see* Moench, A. F., Sauer, V. B., and Jennings, M. E.

Schiel, J. B., Jr., *see* Jameson, W. C., and Schiel, J. B., Jr.

203. Schultz, D. J., 1975, Crystalline silica in mudrocks: University of Oklahoma unpublished M.S. thesis, 48 p., 14 figs., 1 table.

204. Scofield, Nancy, 1975, Layered series of the Wichita Complex, Oklahoma: Geological Society of America Bulletin, v. 86, p. 732-736, 5 figs., 1 table.

205. Scott, R. W., 1975, Patterns of Early Cretaceous molluscan diversity gradients in south-central United States: Lethaia, v. 8, p. 241-252, 4 figs., 2 tables. (Includes Oklahoma Comanchean.)

206. Sheehan, P. M., 1975, Lower Devonian brachiopods from the Solis Limestone, Chihuahua, Mexico: Journal of Paleontology, v. 49, p. 445-471, 3 figs., 4 pls. (Refers to Oklahoma species.)

207. Sheehan, P. M., 1975, Upper Ordovician and Silurian brachiopods from the Solis Limestone, Chihuahua, Mexico: Journal of Paleontology, v. 49, p. 200-211, 1 fig., 2 pls. (Refers to Oklahoma species.)

Shepard, W. W., *see* Newton, C. D., Shepard, W. W., and Coleman, M. S.

208. Sheridan, E. T., 1975, Coke and coal chemicals, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 413-445, 45 tables.
209. Shipley, R. D., 1975, Local depositional trends of "Cherokee" sandstones, Payne County, Oklahoma: Oklahoma State University unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 37.)
Shurbet, D. H., *see* Keller, G. R., and Shurbet, D. H.
210. Sias, Michael, and Wilhm, Jerry, 1975, The distribution of copper, lead, and zinc in the sediment and water of Lake Carl Blackwell: Oklahoma Academy of Science Proceedings, v. 55, p. 38-41, 2 tables.
211. Silka, L. R., 1975, Hydrogeochemistry of the Washita River alluvium in Caddo and Grady Counties, Oklahoma: Oklahoma State University unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 38.)
212. Simpson, L. C., 1974, *Acanthodes* and *Hybodus* in the Permian of Texas and Oklahoma: Journal of Paleontology, v. 48, p. 1291-1293, 3 figs.
213. Smith, G. E., 1974, Depositional systems, San Angelo Formation (Permian), north Texas—facies control of red-bed copper mineralization: Texas Bureau of Economic Geology Report of Investigations No. 80, 74 p., 20 figs., 9 pls. (Includes correlation with Oklahoma Permian and discussion of Oklahoma copper occurrences.)
Smith, M. V., *see* Johnson, K. S., Wolfe, W. D., and Smith, M. V.
Soil Conservation Service, *see* U.S. Department of Agriculture, Soil Conservation Service, and Oklahoma Agricultural Experiment Station
214. Southard, L. G., 1975, The mineral industry of Oklahoma in 1974 (preliminary): Oklahoma Geology Notes, v. 35, p. 20-21, 1 table.
215. Strimple, H. L., 1975, Crowns of *Parapisocrinus* from Oklahoma and Tennessee: Oklahoma Geology Notes, v. 35, p. 197-199, 1 fig.
216. Strimple, H. L., 1975, Middle Pennsylvanian (Atokan) crinoids from Oklahoma and Missouri: University of Kansas Paleontological Contributions, Paper 76, 30 p., 17 figs.
217. Strimple, H. L., 1975, A Morrowan crinoid fauna from the Hueco Mountains of Texas: Journal of Paleontology, v. 49, p. 702-705, 1 pl. (Includes Oklahoma species.)
218. Strimple, H. L., 1975, New Chesterian (Upper Mississippian) crinoids from Illinois: University of Kansas Paleontological Contributions, Paper 79, 9 p., 3 pls. (Refers to Oklahoma species.)
219. Strimple, H. L., 1975, A rare inadunate crinoid from the Barnsdall Formation (Upper Pennsylvanian) of Oklahoma: Oklahoma Geology Notes, v. 35, p. 23-26, 1 fig.
Strimple, H. L., *see* Cocke, J. M., and Strimple, H. L.
220. Suhm, R. W., and Ethington, R. L., 1975, Stratigraphy and conodonts of Simpson Group (Middle Ordovician), Beach and Baylor Mountains, West Texas: American Association of Petroleum Geologists Bulletin, v. 59, p. 1126-1135, 7 figs., 2 tables. (Abstract in Petroleum Abstracts, v. 15, p. 1660.)

Sullivan, C. D., *see* McCulloch, C. M., Jeran, P. W., and Sullivan, C. D.

Sullivan, M. W., *see* Finch, W. I., Wright, J. C., and Sullivan, M. W.

Sutherland, P. K., *see* Gordon, M., Jr., and Sutherland, P. K.

221. Sweet, W. C., Thompson, T. L., and Satterfield, I. R., 1975, Conodont stratigraphy of the Cape Limestone (Maysvillian) of eastern Missouri, *pt. 1 of* Studies in stratigraphy: Missouri Geological Survey Report of Investigations No. 57, p. 1-59, 3 charts, 4 figs., 3 pls., 1 table. (Includes discussion of correlation with Oklahoma Viola-Fernvale sequence.)

222. Tasch, Paul, 1975, Dunkard estheriids as environmental and age indicators, *in* Barlow, J. A. (editor), The age of the Dunkard: I. C. White Memorial Symposium, 1st, Morgantown, West Virginia, 1972, p. 281-294, 1 fig., 2 pls., 1 table. (Includes Oklahoma Wellington Formation.)

Thacker, J. L., *see* Kurtz, V. E., Thacker, J. L., Anderson, K. H., and Gerdemann, P. E.

223. Thein, M. L., and Nitecki, M. H., 1974, Chesterian (Upper Mississippian) Gastropoda of the Illinois basin: Fieldiana Geology, v. 34, 238 p., 103 figs., 71 tables. (Includes Oklahoma species.)

224. Thomas, J. B., 1975, The significance of light mineral fractions in sandstone provenance studies [abstract]: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meetings Abstracts, v. 2, p. 73-74. (Study of Vanoss Formation, Oklahoma; reprinted in Petroleum Abstracts, v. 15, p. 927.)

225. Thomas, W. A., 1975, Appalachian-Ouachita structure and plate tectonics [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 543-544. (Reprinted in Oklahoma Geology Notes, v. 35, p. 77-78.)

226. Thomas, W. A., 1974, Converging clastic wedges in the Mississippian of Alabama, *in* Briggs, Garrett (editor), Carboniferous of the southeastern United States: Geological Society of America Special Paper 148, p. 187-207, 9 figs.

Thompson, T. L., *see* Satterfield, I. R., and Thompson, T. L.

Thompson, T. L., *see also* Sweet, W. C., Thompson, T. L., and Satterfield, I. R.

227. U.S. Board on Geographic Names, 1975, Decisions on geographic names in the United States, April through June 1975, Decision List no. 7502: U.S. Department of the Interior, 32 p. (Names and defines Countyline, Pruitt City, and Rounds Creek.)

228. U.S. Board on Geographic Names, 1975, Decisions on geographic names in the United States, July through September 1975, Decision List no. 7503: U.S. Department of the Interior, 33 p. (Names and defines Cushing Lake, Keefton, Last Chance, Morse, and Salt Creek.)

229. U.S. Board on Geographic Names, 1975, Decisions on geographic names in the United States, October through December 1975, Decision List no. 7504: U.S. Department of the Interior, 45 p. (Names and defines Jug Motte Creek, Red Fork Creek, and Tom Steed Reservoir.)

230. U.S. Bureau of Mines, 1975, Statistical summary, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 87-124, 11 tables.
231. U.S. Department of Agriculture, Soil Conservation Service, and Oklahoma Agricultural Experiment Station, 1973, Soil survey of Jefferson County, Oklahoma: Washington, U.S. Government Printing Office, 65 p., 25 figs., 63 maps, 9 tables.
232. U.S. Department of Agriculture, Soil Conservation Service, and Oklahoma Agricultural Experiment Station, 1974, Soil survey, of Pontotoc County: Washington, U.S. Government Printing Office, 69 p., 20 figs., 63 maps, 10 tables.
233. U.S. Department of Agriculture, Soil Conservation Service, and Oklahoma Agricultural Experiment Station, 1974, Soil survey, Tillman County: Washington, U.S. Government Printing Office, 64 p., 16 figs., 74 maps, 10 tables.
234. U.S. Geological Survey, 1975, Aeromagnetic map of the Wichita Mountains area, southwestern Oklahoma: U.S. Geological Survey open-file report 75-16, 1 pl., scale 1:62,500.
Van Campo, M., *see* Doyle, J. A., Van Campo, M., and Lugardon, B.
Van Trump, George, Jr., *see* Boerngen, J. G., Van Trump, George, Jr., and Ebens, R. J.
235. Visher, G. S., Ekebafe, S. B., and Rennison, R., 1975, The Coffeyville Formation (Pennsylvanian) of northern Oklahoma, a model for an epeiric sea delta, *in* Deltas: models for exploration: Houston Geological Society, p. 381-397. (Abstract in Petroleum Abstracts, v. 15, p. 1251.)
von Hake, C. A., *see* Coffman, J. L., and von Hake, C. A.
236. Wagner, F. J., 1975, North American drilling activity in 1974: American Association of Petroleum Geologists Bulletin, v. 59, p. 1273-1310, 13 figs., 21 tables.
237. Walker, F. K., 1975, Bibliography and index of U.S. Geological Survey publications relating to coal, January 1971-June 1974: U.S. Geological Survey Circular 709, 14 p.
238. Walker, K. R., and Alberstadt, L. P., 1975, Ecological succession as an aspect of structure in fossil communities: Paleobiology, v. 1, p. 238-257, 7 figs., 3 tables. (Refers to Oklahoma Devonian brachiopods.)
239. Waller, T. H., 1974, Lower Cisco (Upper Pennsylvanian) sedimentary framework and facies-depositional model for the eastern shelf, north-central Texas: University of Kansas unpublished Ph.D. dissertation, 167 p. (Abstract in Dissertation Abstracts International, Pt. B, v. 36, p. 623-B; abstract reprinted in Petroleum Abstracts, v. 15, p. 1813.)
240. Walper, J. L., 1975, The evolution of the Delaware aulacogen in west Texas [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 243. (Reprinted in Oklahoma Geology Notes, v. 35, p. 76.)
241. Walper, J. L., 1975, Geotectonic evolution of Fort Worth basin [abstract]: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meetings Abstracts, v. 2, p. 78. (Reprinted in Oklahoma Geology

Notes, v. 35, p. 130-131; includes Oklahoma structures and deposits.)

Waters, K. H., *see* Fowler, J. C., and Waters, K. H.

242. Welch, J. R., 1975, Silver, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 1123-1138, 2 figs., 13 tables.

243. Westerstrom, L., 1975, Coal—bituminous and lignite, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 317-376, 7 figs., 49 tables.

Whipple, A. P., *see* Galloway, W. E., Yancey, M. S., and Whipple, A. P.

White, D. H., Jr., *see* Hamilton, P. A., White, D. H., Jr., and Matson, T. K.

White, D. H., Jr., *see also* Matson, T. K., and White, D. H., Jr.

Wicander, E. R., *see* Loeblich, A. R., Jr., and Wicander, E. R.

Wickham, John, *see* Feenstra, Roger, and Wickham, John

Wilhm, Jerry, *see* Sias, Michael, and Wilhm, Jerry

Williams, D., *see* Leach, D. L., Nelson, R. C., and Williams, D.

244. Williams, J. G., 1975, The resonant orbit of the Lost City meteorite: Journal of Geophysical Research, v. 80, p. 2914-2916.

245. Wilson, H. M., 1975, Pacific Lighting's exploration program strengthens its domestic gas resources: Oil and Gas Journal, v. 73, no. 16, p. 162-163, 1 fig. (Includes Anadarko basin.)

246. Wilson, L. R., 1975, Carl Colton Branson, 1906-1975: Oklahoma Geology Notes, v. 35, p. 224-226, 1 photo.

247. Wilson, L. R., and Rashid, M. A., 1975, Palynological evidence for a Pennsylvanian age assignment of the Gearyan Series in Kansas and Oklahoma [abstract and discussion] *in* Barlow, J. A. (editor), The age of the Dunkard: I. C. White Memorial Symposium, 1st, Morgantown, West Virginia, 1972, p. 183-193.

248. Wingate, F. H., 1975, Palynology of the Denton Shale (Lower Cretaceous) of southeastern Oklahoma: University of Oklahoma unpublished Ph.D. dissertation, 300 p., 2 figs., 22 pls., 3 tables. (Abstract in Dissertation Abstracts International, Pt. B, v. 35, p. 4073-B; abstract reprinted in Petroleum Abstracts, v. 15, p. 774.)

Wolf, C. W., Jr., *see* Cullers, R. L.; Chaudhuri, Sambhudas; Arnold, Bill; Lee, Moon; and Wolf, C. W., Jr.

Wolfe, W. D., *see* Johnson, K. S., Wolfe, W. D., and Smith, M. V.

249. Woodmansee, W. C., 1975, Uranium, *in* Metals, minerals, and fuels, *v. 1 of* Minerals yearbook 1973: U.S. Bureau of Mines, p. 1263-1287, 3 figs., 17 tables.

250. Work, P. L., 1975, Digitized well logs can help boost success in exploring shale intervals: Oil and Gas Journal, v. 73, no. 7, p. 84, 86, 88, 4 figs. (Woodford Shale analyses.)

Wright, J. C., *see* Finch, W. I., Wright, J. C., and Sullivan, M. W.

251. Wroblewski, E. F., 1975, Developments in Oklahoma and panhandle of Texas in 1974: American Association of Petroleum Geologists Bulletin, v. 59, p. 1401-1403, 1 fig., 2 tables. (Abstract in Petroleum Abstracts, v. 15, p. 1658.)

Yancey, M. S., *see* Galloway, W. E., Yancey, M. S., and Whipple, A. P.

252. Yochelson, E. L., 1975, Early Ordovician gastropod opercula and epicontinental seas: U.S. Geological Survey Journal of Research, v. 3, p. 447-450. (Refers to Oklahoma gastropods and Oklahoma algal mounds.)
253. Yost, C., Jr., and Naney, J. W., 1975, Earth-dam seepage and related land water problems: Journal of Soil and Water Conservation, v. 30, no. 2, p. 87-91. (Concerns Washita River basin; abstract in Selected Water Resources Abstracts, v. 8, no. 18, p. 23.)
254. Zachry, D. L., Jr., 1975, Early Pennsylvanian fluvial sedimentation in northwestern Arkansas [abstract]: American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meetings Abstracts, v. 2, p. 84-85. (Includes deposition in Arkoma basin.)
255. Zeliff, C. W., 1975, Subsurface analysis, "Cherokee" Group, southern Garfield and northern Kingfisher Counties, Oklahoma: University of Oklahoma unpublished M.S. thesis. (Abstract in Oklahoma Geology Notes, v. 36, p. 41.)
256. Zidek, Jiri, 1975, Oklahoma paleoichthyology, part 4: Acanthodii: Oklahoma Geology Notes, v. 35, p. 135-146, 6 figs.
257. Zidek, Jiri, 1975, Some fishes of the Wild Cow Formation (Pennsylvanian), Manzanita Mountains, New Mexico: New Mexico Bureau of Mines and Mineral Resources Circular 135, 22 p., 4 figs., 2 pls. (Refers to Oklahoma Gearyan Series.)

INDEX

TGS Field-Trip Participants Examine Coal Beds and Tar Sands

The annual field trip of the Tulsa Geological Society, attended April 30-May 1 by about 47 persons, covered parts of the Oklahoma-Kansas-Missouri tri-state area during sunshine and rain. Survey geologists L. R. Wilson and S. A. Friedman were leaders for the trip, along with George W. Krumme (Krumme Oil Co., Tulsa), Allan Bennison (consultant, Tulsa), Richard Norman (consultant, Jenks, Oklahoma), Larry Brady (Kansas Geological Survey), Jack S. Wells (Missouri Geological Survey), and Frederick N. Murray (Mapco, Tulsa), who expertly coordinated geologic and logistic aspects of the trip.

Participants viewed coal and heavy-oil deposits in the northeastern shelf area of the Oklahoma coal field and in adjacent areas of Kansas and Missouri. The thinning of the intervals between the Rowe, Mineral, and Croweburg coals, and the Verdigris Limestone (from the northern part of the Oklahoma coal field to southeastern Kansas and southwestern Missouri) and the stratigraphic relationships of the coal beds and associated strata were demonstrated at 3 strip mines in Oklahoma, 2 in Kansas, and a roadcut and a mine in Missouri.

A stop was made at the U.S. Energy Research and Development Administration research center (formerly operated by the U.S. Bureau of Mines) in Bartlesville, where ERDA personnel described current projects on tertiary recovery of petroleum. Another field stop was made at an open pit "tar sand" mine in Missouri, where heavy oil occurs in the Bluejacket Sandstone. This oil-impregnated sandstone is mined for direct use in road construction.

The guidebook for the field trip was edited by Robert Scott (Amoco Production Research) and includes an article on coal palynology by Dr. Wilson and one on coal reserves by Friedman. A limited number of books are available, at a cost of $4.00, through the Tulsa Geological Society, 2745 East 15th Street, Tulsa, Oklahoma 74104.

New Theses and Dissertations Added to OU Geology Library

The following M.S. theses have been added to The University of Oklahoma Geology and Geophysics Library:

Crystalline Silica in Mudrocks, by Douglas J. Schultz.

Experimental Analysis of Folding in Simple Shear, by Ronald E. Manz.

Structural Analysis and Mapping of the Eastern Caddo Anticline, Ardmore Basin, Oklahoma, by Leonard C. Dionisio, Jr.

The following Ph.D. dissertations have also been added to the library:

Intergranular Pressure Solution in the Tuscarora Orthoquartzite, by Duncan Fawcett Sibley.

Secular Variation of the Intensity of the Geomagnetic Field During the Past 3,000 Years in North, Central, and South America, by Sheng-Shyong Lee.

Hunton Bulletin Released by OGS

A major publication on one of Oklahoma's most important oil and natural-gas zones has just been released by the Oklahoma Geological Survey. Issued as Bulletin 121, *Hunton Group (Late Ordovician, Silurian, and Early Devonian) in the Anadarko Basin of Oklahoma* represents the results of years of investigation by Thomas W. Amsden, OGS geologist, who has long possessed an international reputation as a specialist on Silurian and Devonian strata.

The 214-page illustrated volume is a stratigraphic, biostratigraphic, and sedimentological study containing detailed data on porosity and permeability, geochemistry, and oil and gas production for each formation represented in the Hunton Group. A 4-part appendix to the bulletin lists core descriptions, well-sample descriptions, chemical analyses of cores, and porosity and permeability data from wells drilled in the Anadarko basin.

Accompanying the book are 10 large maps showing geology, structure, thickness of beds, insoluble residues, and $MgCO_3$ content of beds. A separate sheet contains four stratigraphic cross sections of Hunton strata. The soft-cover text and the 11 folded panels come packed together in an attractive, sturdy slipcase.

Bulletin 121 can be obtained from the Oklahoma Geological Survey, 830 Van Vleet Oval, Room 163, Norman, Oklahoma 73019. The price is $10.00.

Topographic-Map Prices Boosted Again

In response to increased costs of reproduction and distribution, the U.S. Geological Survey has announced an increase in prices for topographic maps. The Oklahoma Geological Survey, an authorized USGS map dealer, will raise its prices accordingly. The last general price increase was in 1972.

Effective July 15, standard topographic maps of the 7.5- and 15-minute series, including orthophotomaps and orthophotoquads, will cost $1.25 each. The 1:250,000-scale, 1° × 2° maps, formerly published by the Army Map Service, will cost $2.00 each.

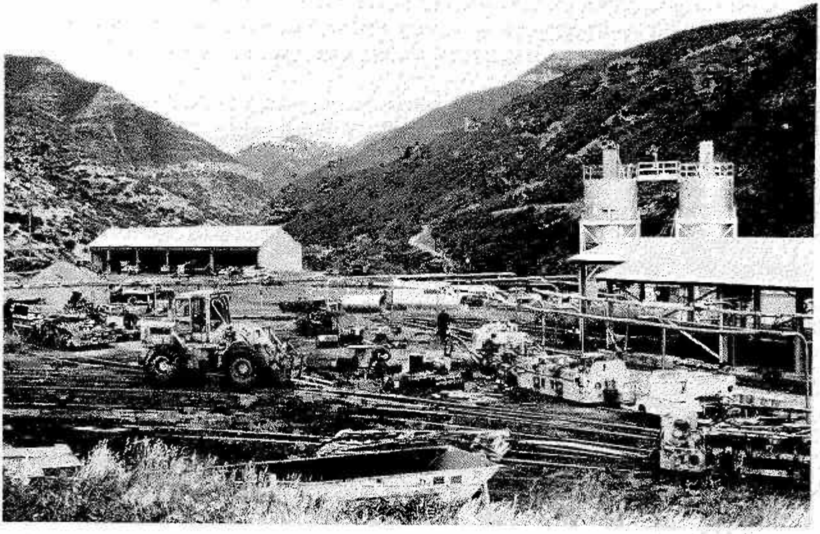
Price information for other USGS maps can be obtained by writing Publications Division, U.S. Geological Survey, National Center 341, Reston, Va. 22092.

Energy-Fuels Course Sponsored by OU

A study of energy fuels in the Piceance basin of Western Colorado will be carried out in a field-course program sponsored by The University of Oklahoma School of Petroleum and Geological Engineering. The field course, directed for the fourth straight summer by Kenneth S. Johnson, economic geologist with the Oklahoma Geological Survey, will be conducted for 3 weeks in the vicinity of Grand Junction. Enrollment is expected to be 15 to 20 students from The University of Oklahoma and other institutions.

Entitled the Energy Fuels Field Course and Workshop, the program extends from August 2 through August 20 and involves examination of petroleum deposits, oil shales, coal, tar sands, asphaltite, uranium ores, and examples of tests to stimulate natural-gas production through massive hydraulic fracturing and through nuclear stimulation. Informal discussion and instruction by engineers and geologists actively engaged in energy production are invaluable to the success of the program. The study area includes such scenic sites as the Colorado, Dinosaur, Black Canyon of the Gunnison, and Arches National Monuments.

For information concerning enrollment and expenses, contact Dr. Johnson at the Oklahoma Geological Survey, The University of Oklahoma, Norman, Oklahoma 73019 (phone 405/325-6541 or 325-3031).



Equipment and surface facilities at the underground coal mine of U.S. Steel Corporation, at Somerset, Colorado, on the western slope of the Rocky Mountains, were viewed last year by fuels-course participants.

OKLAHOMA ABSTRACTS

AAPG-SEPM Annual Meetings
New Orleans, May 23-26, 1976

The following abstracts are reprinted from the April 1976 issue, v. 60, of the *Bulletin* of The American Association of Petroleum Geologists. Page numbers are given in brackets below each abstract. Permission of the authors and of Gary Howell, AAPG managing editor, to reproduce the abstracts is gratefully acknowledged.

New Approach to Geologic Estimates of Oil and Gas Resources by U.S. Geological Survey

GORDON L. DOLTON, RICHARD B. POWERS, and EDWARD G. SABLE, U.S. Geological Survey, Denver, Colorado

Geologic interpretation and evaluation of potentially petroliferous areas provide the basis for oil and gas resource assessment. The Resource Appraisal Group, in conjunction with other personnel of the U.S. Geological Survey, systematically collected, summarized, and inventoried a large amount of geologic and geophysical data on a regional scale for the appraisal of undiscovered recoverable oil, natural gas, and natural-gas-liquid resources of the onshore and offshore United States. These data are amenable to treatment by many different resource-appraisal methods and eventually to computerized data-bank storage and retrieval procedures.

Geologic factors considered to be critical to the oil and gas resource appraisal methods used in this study include area, thickness, and age range of potential strata; character, volume, and age of producing and prospective reservoir beds; source beds, seals, and organic maturity; dominant lithologies; depositional environments; regional and local aspects of structure and tectonics; types of traps; indications of hydrocarbons; and known or suspected presence of hydrocarbons.

Engineering, development, and historical factors used include stage of exploration, production and reserve data, field and reservoir information, other resource estimates, and overall qualitative ratings of each province or region based on geologic and yield-analog procedures. [665]

OKLAHOMA ABSTRACTS is intended to present abstracts of recent unpublished papers relating to the geology of Oklahoma and adjacent areas of interest. The editors are therefore interested in obtaining abstracts of formally presented or approved documents, such as dissertations, theses, and papers presented at professional meetings, that have not yet been published.

Application of Remote Sensing (LANDSAT Data) to Petroleum Exploration

MICHEL T. HALBOUTY, Consulting Geologist and Petroleum Engineer, Independent Producer and Operator, Houston, Texas

The LANDSAT project is the most significant mission ever flown by NASA. The program offers the mineral and energy industries in the United States an opportunity to improve the nation's domestic-resource base in a shorter time and at a more reasonable cost than would have been possible otherwise.

Properly interpreted information from these images can save corporations millions of dollars in unnecessary exploration and development efforts while providing possible geologic clues which could lead to the discovery of tremendous reserves. The more the LANDSAT data are used, the more innovations for their use will be established.

LANDSAT data have broad use in the minerals/fuel field, including the following general applications:

(1) Detection of large-scale, previously unknown geologic structures which may be significant with respect to the localization of hydrocarbons. Such features commonly are not recognizable on traditional aerial photographs.

(2) The detection of very subtle tonal anomalies that may represent alteration of the soils resulting from miniseeps of gas from hydrocarbon reservoirs.

(3) The potential for detecting natural marine oil seeps with consequent improvement in efficiency of off-shore exploration.

(4) Detection on outcrops of important minerals and metals, especially in hostile environments.

(5) The monitoring of ice distribution and movement in Arctic areas, such as may affect transport of materials in and out of the Arctic, the cost of seismic exploraton in Arctic Sea ice areas, and the safety of exploration and production operations.

(6) The monitoring of oil-field development and transport facilities, such as the Alaska pipeline, and an assessment of this development upon the environment.

(7) The potential for improved communication and decision making within petroleum companies.

The proper use of LANDSAT imagery affords the explorationist a rapid and inexpensive tool which can add immeasurably to this geologic knowledge. [677]

USGS-AAPG Digitized Oil and Gas Field Map of North America—Status Report

WILLIAM W. MALLORY, U.S. Geological Survey, Denver, Colorado

The USGS-AAPG digitized oil and gas field map of North America is an ongoing cooperative project closely associated with the U.S. Geological Survey's Petroleum Data System, a computerized oil and gas pool data bank. The objectives of the project are multiple. The nominal product is an oil and gas field map of North America to be published by the survey at a scale of 1:5,000,000.

The unique aspect of this project is that field images are digitized and filed with the Petroleum Data System, thus allowing field images to be retrieved in any projection at any scale on a TV screen or in hard copy using any of the pool parameters in the system. This capability allows a wide variety of visual exhibits. For example, fields can be displayed by age of producing formation, by discovery method, by size groups, or by type of trap. The images so retrieved then can be overlaid upon any useful type of base map. Thus, all the fields which produce from Lower Cretaceous rocks of Colorado could be superposed on a map showing the lithofacies and thickness of these strata.

Nearly all the manuscript state maps are complete. Editing, drafting, and digitization are under way. The oil and gas field map of Michigan has been completed and the computer capabilities of this example are on display at the U.S. Geological Survey exhibit at this meeting.

The rapidity with which oil and gas information may be retrieved and the versatility of selection and combination of data will provide a new tool for domestic oil and gas explorationists. [694]

Probabilistic and Computer Methodologies Used by U.S. Geological Survey for Geologic Estimates of Undiscovered Oil and Gas Resources in United States

BETTY M. MILLER and HARRY L. THOMSEN, U.S. Geological Survey, Denver, Colorado

Recent assessments of undiscovered recoverable oil and gas resources for the United States, published in U.S. Geological Survey Circular 725 (1975), were made: (1) by assembling and reviewing a comprehensive bank of geologic and geophysical information gathered on more than 100 petroleum provinces by more than 70 specialists within the U.S. Geological Survey; (2) by applying a variety of resource appraisal methods to each potential petroleum province; and (3) through group appraisals by petroleum geologists using subjective probability. These methods included the application of subjective-probability-assessment procedures, computer applications to probability distributions, and the computation of cumulative functions and statistics for regional and total-resource aggregations by Monte Carlo procedures.

Resource-appraisal procedures and methodologies employed by the Resource Appraisal Group for the latest published survey assessments of remaining oil and gas resources are reviewed, with emphasis on probabilistic assessment techniques and computer applications of Monte Carlo procedures.

The results are summarized for the undiscovered recoverable oil and gas resources in 15 regions in the United States, onshore and offshore to water depths of 200 m. Probability distribution curves are demonstrated for oil and gas resource assessments on selected regions. [698]

Interactive Computer Program to Analyze Coal-Energy Resources (PACER)

ALLISON C. OLSON and SIMON M. CARGILL, U.S. Geological Survey, Reston, Virginia

The requirement for a rapid and timely retrieval and analysis of coal-resource inventory information has resulted in the development of software to adapt the Geologic Retrieval and Synopsis Program (GRASP) for application to the National Coal Resources Data System. The PACER system utilizes the basic search, retrieval, and analysis functions of GRASP, but also provides an interactive-editing capability to add, delete, or modify coal-resource and chemical-analysis records. It further permits tabular summary of information aggregated by location, coal rank, depth, and reliability for tonnage records and by location, rank, chemical, and BTU content for analysis records. The added editing capability provides a method for the user to enter new data into the master file and provides a check for data names not already in the dictionaries. It permits universal changes to a data element for all records residing in a selected data subfile, or selection by index key of a record previously identified for data change. This editing software, although unique to the assigned-record structure for a given master file, can be modified easily to accept additional files that have differing record structures. The coal-resource (tonnage) and analysis files contain information from published documents. Time-shared interactive software provides the user with the ability to respond to queries for resource-inventory information and to disseminate this information in comprehensible, hard-copy summaries. The editing capability ensures up-to-date maintenance for an ever-changing data base. [703]

AAPG Oil and Gas Field Data Bank Project, United States and Canada

JOHN T. ROUSE, Consulting Geologist, Billings, Montana; ROBERT S. AGATSTON, Atlantic Richfield Co., Dallas, Texas; JERLENE BRIGHT, The University of Oklahoma, Norman, Oklahoma; and RICHARD M. PROCTER, Geological Survey of Canada, Calgary, Alberta, Canada

In 1973 the AAPG Research Committee started work on the "Oil and Gas Field Data Bank and Map Project of the United States and Canada." The purpose of the project is to check, update, and enhance the data in a functional oil and gas field and pool data base, developed by The University of Oklahoma Office of Research Administration under a contract with the U.S. Geological Survey. It is referred to as the Petroleum Data System (PDS) which has been developed over the past 6 years. This system is supported by the General Information Processing System (GIPSY) developed at The University of Oklahoma. GIPSY is a complete information-management system with utility provisions for building, moving, protecting, updating, and deleting information.

The PDS data base contains available nonproprietary geologic and other related information, such as the official field and pool name, location, and discovery date; producing formation(s), age, depth, and thickness; geologic basin; cumulative oil and/or gas productions; API gravity;

reservoir lithology; porosity; and oldest formation penetrated. In some fields proved acreage, reservoir temperature, pressure, gas/oil ratio, and sulfur content are included. The file does not contain all information on every field, but includes as much information as is available publicly.

More than 100 AAPG volunteer workers throughout the United States and Canada are contributing their time and talents to the project. A grant to the AAPG from the U.S. Geological Survey covers operating expenses.

The Petroleum Data System is being updated constantly and enhanced with data from many other sources such as the International Oil Scouts Association and AAPG's Committee on Statistics of Drilling. However, in some areas, the sparsity of data makes it nearly impossible to complete most items for individual fields.

The PDS file is another useful tool in exploring for new oil and gas reserves. It is available through time-sharing at the University of Oklahoma. [716]

Chemical and Isotopic Investigation of Stratigraphic and Tectonic Dolomites in Arbuckle Group, Arbuckle Mountains, South-Central Oklahoma

K. A. SARGENT, Department of Geology, Furman University, Greenville, South Carolina

In the Arbuckle Mountains of south-central Oklahoma are excellent exposures of limestones and early diagenetic dolomites of Early Ordovician age. These units contain irregular bodies of late diagenetic dolomite associated with structures produced by a Late Pennsylvanian-Early Permian deformation.

Samples of limestone, early diagenetic dolomite, late diagenetic dolomite, and vein dolomite which cuts across all other structure were analyzed for 10 trace elements to determine if chemical differences are present between the early diagenetic and late diagenetic dolomites. On the basis of the trace-element analyses 20 samples were selected for carbon and oxygen isotopic analysis. The resulting trace-element and isotopic data were studied using standard statistical techniques and the multivariate linear-discriminant-function technique.

Four trace elements, Na, Li, Ni, and Cu, and the isotopic values δO^{18} and δC^{13} were found to discriminate at a high level between early diagenetic and the late diagenetic dolomite in the study area. A computer program was written for the IBM 1130 to utilize the functions generated by the linear-discriminant-function statistical technique to test unassigned dolomite samples and place these into the correct dolomite grouping.

The limestones and early diagenetic dolomites were similar in O^{18} content with δO^{18} averages of −6.9 and −6.8 respectively. This would indicate that the early diagenetic dolomitizing solutions were similar in isotopic composition to sea water. The late diagenetic dolomites were characterized by δO^{18} values higher than for the limestones and late diagenetic dolomites indicating that the late diagenetic dolomitizing solutions differed in isotopic composition from sea water. [719]

Lineament and Structural Analyses of Southeastern Kansas

R. C. SHUMAKER, C. I. PIERCE, and W. K. OVERBEY, JR., University of West Virginia, Morgantown, West Virginia

Analysis of satellite and low-altitude remote-sensing imagery over the shoestring sand area demonstrates that the lineaments mapped reflect northeast- and northwest-trending regional joint sets. A north-south set of lineaments has no corresponding joint set.

Surface drainage lineaments in flat Permian sedimentary rocks reflect major subsurface structure formed during Late Mississippian and Pennsylvanian Ouachita deformation.

Review of the regional geology preparatory to geologic analyses of lineament patterns suggests that: (1) the late Paleozoic Nemaha ridge follows a late Precambrian and/or Cambrian rift; (2) late Paleozoic deformation formed diamond- and wedge-shaped upthrusts by left-lateral movement along the Nemaha and Beaumont structural trends; (3) left-lateral movement along the Nemaha fault zone and within the Anadarko basin imparted a slight clockwise rotation to the southwestern part of the Ozark crustal block; (4) fault patterns within the Ozark block appear to have been formed by tensional stress; (5) joints within the Permian rocks of southeastern Kansas approximate the normal-fault directions of the Ozark block; (6) the varied joint patterns over different types of producing fields suggest that secondary recovery rates and induced fracturing direction might vary considerably within this comparatively small area. Joint fractures and remote-sensing lineament studies could be useful in designing recovery projects and oil-field development patterns which consider induced fracture orientations. [722]

Basinward Facies Changes in Wapanucka Limestone (Lower Pennsylvanian), Indian Nations Turnpike, Ouachita Mountains, Oklahoma

PATRICK K. SUTHERLAND and ROBERT C. GRAYSON, JR., School of Geology and Geophysics, The University of Oklahoma, Norman, Oklahoma

Important new exposures of the Wapanucka Limestone in the frontal belt of the Ouachita Mountains are on the new Indian Nations Turnpike, about 16 mi (26 km) south of McAlester, Oklahoma. The Wapanucka Formation in this area is repeated four times by faulting within a north-south distance of less than 2 mi (3 km). These exposures demonstrate a basinward change in facies southward, showing increases in thickness and in shales and an increase in spiculites as compared to crinoidal and oolitic grainstones. These exposures apparently represent the first documented case of basinward facies change southward from the main Wapanucka Limestone ridge.

The northernmost Wapanucka roadcut represents typical Wapanucka Limestone, as seen at many points along the frontal Ouachita belt. This exposure, 364 ft (111 m) thick, consists predominantly of interbedded spiculiferous, crinoidal, and oolitic limestones. Exposures south

of this ridge are much more subdued topographically, because of increasing percentages of shale. The third faulted "Wapanucka" exposure is 1.0 mi (1.6 km) south of the main ridge. Here the section measures 714 ft (218 m) from the lowest to the highest limestone, and is predominantly shale, with a few thin spiculiferous limestones. This sequence is considered to represent a basinward and deeper water facies of the Wapanucka, as present in the north, and was deposited approximately contemporaneously.

Conodonts from the lowest exposures in both sections suggest a correlation with a horizon probably no lower than the Dye Member of the Bloyd Shale of the type Morrowan in northwestern Arkansas. Goniatites from the middle part of the section have been placed by Mackenzie Gordon in the *Diaboloceras neumeiri* Zone, which is in the Trace Creek Member of the Bloyd Formation in northwestern Arkansas. Conodonts from this interval support the correlation. Conodonts from the highest beds indicate either a latest Morrowan or early Atokan age. [727]

Aulacogens and Megashears—Natural Habitat for Oil and Mineral Deposits

JACK L. WALPER, Texas Christian University, Fort Worth, Texas, and
J. M. Browning, J. M. Browning Consultants, Ltd., Calgary, Alberta, Canada

Sedimentary basins associated with linear structural features such as megashears, deflections, and geofractures striking at high angles to cratonic interiors have been prospected for oil since early in the history of petroleum exploration. Although long conceived as regional features, these linear structures only recently have been recognized to have a common origin as aulacogens or "failed arms" of plume-generated triple junctions formed during the process of continental breakup.

These features, trending at high angles from the rifted continental margin, mark ancient plate margins and establish the time of crustal rifting. Some, formed at an early stage in the evolution of the earth's crust, have remained active or become reactivated as major sites of crustal dislocation during subsequent episodes of continental breakup and collision. Others, governing the course of major rivers, become the site of deltas that have augmented the sedimentary fill. These long structural and varied depositional histories and the critical timing of the ongoing tectonic processes, often of a transcurrent nature, together with the accompanying sedimentation have given rise to major hydrocarbon accumulations. In addition to the formation of favorable source beds, structural and stratigraphic traps, the high-heat-flow characteristic of these features often enhances the generation of oil and gas.

Some aulacogens are marked only by a line of alkaline intrusions, others have complex igneous histories and commonly become the site of base-metal mineralization of a syngenetic type.

Three of these features are examined, the Athapus cow aulacogen of northern Canada, the Wichita aulacogen of southern Oklahoma, and the Huancabamba deflection of central South America. Problems related to their time of formation are discussed and their sedimentary and tectonic evolution described so as to point up the formation of local structures and depositional basins and their relation to the evolution of the major tectonic feature.

Several other regional features having oil and gas potential, e.g. the Delaware basin of West Texas, the Bathurst Inlet of northern Canada, and the Mississippi embayment of the Gulf Coast, that now are being termed aulacogens are noted and some comparisons made. [730]

Preservation Window as Subunconformity Petroleum Source

GREGORY W. WEBB, Department of Geology and Geography, University of Massachusetts, Amherst, Massachusetts

Oklahoma City field is an unconformity trap with a second crop of oil and gas, the first having escaped at the unconformity surface prior to Pennsylvanian burial. The large second crop apparently was generated in the "preservation window," the shallower and thermally immature part of the pre-unconformity section which was preserved from erosional beveling, and thus could become source rocks after deep post-unconformity burial. A simple method of approximating the time of source-rock maturity, applying the methods of Connan and Hood and others to local age and thickness data, supports the preservation-window explanation both for Oklahoma City and for similar interpretations of post-unconformity maturation of pre-unconformity sources in the North Sea. Kimmeridgian shales in the Viking graben and the Moray Firth basin matured long after burial by the tight-sealing Cretaceous formations, and Carboniferous coals yielded gas to unconformably overlying Permian sandstones after deposition of the Zechstein salt cover.

The analysis indicates that much of the Jurassic of the Grand Banks had matured prior to Early Cretaceous uplift and beveling, suggesting the possible loss of a petroleum crop at that time. Scattered preservation windows exist but their later yield may have been both limited and inadequately trapped. The unconformity-cut dome east of Atlantic City resembles the Oklahoma City situation, and likewise may have leaked a first petroleum crop and received subsequently another from post-unconformity maturation. [732]

GSA Annual Meeting, North-Central Section Kalamazoo, Michigan, April 29-30, 1976

Interactive Computer Graphics and Petroleum Exploration

THOMAS A. JONES, CARLTON R. JOHNSON, and DANNY C. PHILLIPS, Exxon Production Research Company, P.O. Box 2189, Houston, Texas

The computer can be a valuable tool in geologic analysis because of its speed and its ability to handle large amounts of data. Maps and cross sections can rapidly be generated at the interactive terminal. These displays provide a method for analyzing multiple working hypotheses with a minimum of delay and effort. In addition, the interactive computer provides valuable instruction in three-dimensional analysis of geologic data.

Exxon recently developed procedures, which we call *Interactive Exploration,* which stress direct control of the computer by the explorationist via an interactive terminal in the field office. Such control offers distinct advantages in editing and updating data files and combining seismic interpretation, well tops, and lithofacies information into a single, integrated time-stratigraphic framework. This framework contains the salient structural and stratigraphic features, and can be supplemented with lithologic data from well cuttings to build a 3-D computer model that can provide geologic cross sections between any points; in addition, structure, isopach, or geologic maps may be obtained. These displays can be plotted within seconds for immediate use.

These capabilities are illustrated in a brief color movie made to demonstrate interactive exploration. It shows geophysicists and geologists utilizing the interactive terminal on an exploration prospect, a capability that may be an important key to a comprehensive, rapid, and more effective search for future oil and gas reserves. [484]

THE UNIVERSITY OF OKLAHOMA

Structural Analysis of Asymmetrical Folds Using the Finite Element Method

JAMES MICHAEL ANTHONY, The University of Oklahoma, M.S. thesis, 1976

Fold shapes and strain distributions produced in stiff single layers inclined up to 20° to the direction of principal shortening were investigated using finite-element computer models. The finite-element model was formulated for constant strain triangles using the constitutive equation for a compressible, linearly viscous fluid. The model of a stiff layer imbedded in a less viscous medium was designed to accommodate 2½ Biot wavelengths. Inclinations of the stiff layer to the shortening direction were 0°, 5°, 10°, 15° and 20°. At each inclination, folds were produced with viscosity ratios of 17:1, 24:1 and 42:1. Folds were initiated by prescribing symmetric sinusoidal perturbations with limb dips of 2°. Results from models with 0° initial inclinations are similar to results obtained by others. Folds are sinusoidal and symmetric, and strain distributions are symmetrically disposed about axial planes in both the matrix and stiff layer. As layer inclination is increased, these features change. The folds become asymmetric (as measured by the ratio of limb lengths), and the amount of asymmetry increases with inclination. Finite strain distributions in both the stiff layer and matrix are not symmetrically disposed about the axial plane. Strains in the matrix tend to parallel the long limb of the stiff layer, and are 'refracted' through the long limb at a larger angle than through the short limb. The long limb thickens more than the short limb, and fold shapes change from sinusoidal to shapes that approach kink folds.

Geology of the Lower Ordovician Rocks of the Choctaw Anticlinorium, Southeastern Oklahoma

JOSEPH F. DUNAGAN, JR., The University of Oklahoma, M.S. thesis, 1976

Previous investigations dealing with the geology of the inner Choctaw Anticlinorium have been contradictory and generally unsatisfactory and have usually interpreted the area as very gently deformed. This study attempts to provide an accurate map of lithologic distributions and a more realistic structural interpretation.

Map units were defined on the basis of lithologic contrasts. Shale is the most common rock type in the area, with less common occurrences of sandstone and shale. Samples of the three map units were examined, in hand specimen and thin section, but no significant differences between samples of similar lithology (that is, belonging to the same map unit) could be observed. Structural data such as orientations of fold hinges and cleavage and bedding surfaces were collected where possible. The major structural elements found in the map area are numerous small, disharmonic, isoclinal recumbent folds, and prominent slaty cleavage at consistently low angles that tends to obscure bedding in shales.

Field observations fail to demonstrate large-scale folding or high-angle faulting but do indicate that the area has been subjected to severe deformation with a pronounced low-angle component.

The distribution of rock types, the evidence of intense deformation, and the lack of evidence for large-scale folding and/or high-angle faulting suggest that a mechanism involving low-angle thrust faulting is responsible for the features observed in the map area. Such a mechanism of thrust faulting, combined with the lithologic types common in the map area, suggest that the pre-Bigfork Chert rocks of the inner Choctaw Anticlinorium acted as a major decollement zone, deforming in response to loading and subsequent gravity sliding of the entire sequence. Intense deformaton accompanied by large accumulations of strain occurred in the pre-Bigfork rocks, while the younger strata were transported with relatively little deformation.

Contemporaneous Faults: A Mechanism for the Control of Sedimentation in the Arkoma Basin, Oklahoma

MICHAEL WILLIAM McQUILLAN, The University of Oklahoma, Ph.D. dissertation, 1976

Basal Atokan and Morrowan deposition in the Arkoma basin was influenced by three down-to-the basin growth faults similar to those that have been reported from the Gulf Coast. Across the faults, from the upthrown northern to the downthrown southern side, there are abrupt increases in the thickness of the lower Atokan and Morrowan strata. The increase in the lower Atokan is about 2,000 feet across the Kinta fault, and 3,000 to 4,500 feet across the San Bois fault. The increase in the Morrowan section is less dramatic and amounts to 100 to 200 feet; the changes in stratigraphic section in proximity to faults also occurs subjacent to the antithetic and synthetic faults within the major blocks.

The basal Atokan sand has been subdivided into a lower Spiro "B," and overlying Spiro "A" facies. The Spiro "A" is a below-wave-base, submarine sand, deposited by density currents in trends subparallel to depositional strike. The trends of maximum Spiro "A" thickness, and best sorting, occur subjacent to faults; Spiro "A" exhibits thinning and more above-wave-base, marine offshore bar sand, accumulating and restricted to pods that exhibit thickening over fault block paleotopographical highs. The distribution of the Spiro "B" facies is restricted to a 50-square-mile area in Tps. 8 and 9 N., Rs. 22, 23 and 24 E. The Spiro "B" represents an interruption of the early stage of transgression over the eroded Wapanucka Limestone; it was following by a transgression and the deposition of the overlying Spiro "A" sand.

The Spiro "A" sand is very fine to medium (0.11 to 0.35 mm), subangular to well rounded, and poorly to well sorted. The textural maturity is poorest over the crestal portions of fault blocks and is best subjacent to the bounding faults.

Intergranular pore space in the Spiro "A" and "B" sands has been reduced by the formation of secondary quartz cement. Chlorite coatings on the surface of the detrital quartz grains preserved intergranular porosity by retarding the formation of secondary quartz overgrowths. The distribution of porous versus non-porous sand due to diagenetic alteration is related to depositional environment. In those areas of the fault blocks where the sand is somewhat shaly (e.g., crestal portions), the best porosities and permeabilities are preserved. Along the margins of the fault blocks where the sand is thickest and best sorted, alteration by diagenetic quartz was most severe. This relationship resulted in the best reservoir rock (those wells with the greatest gas deliverability rates) occurring over and near the crests of fault blocks where the sand is somewhat shaly and least affected by secondary quartz cement.

The Cromwell has been subdivided (in descending order), into three facies, the Cromwell I, II and III sands. All three sands were mapped subparallel with depositional strike and subparallel with the fault pattern. The distribution of the Cromwell I is limited to the area around the Kinta fault block. The Cromwell II and III sands are present throughout the area, but as a whole are quite shaly. The shaly character is related to sediment supply and rate of subsidence—when sand supply was low and subsidence slow, shaly and poorly developed sands were deposited. The secondary quartz cement alteration history of the Cromwell sands was found to be similar to that of the Spiro sands. The best preserved porosity and permeability occurs in areas where the Cromwell is somewhat shaly; however, the overall shaly character of the Cromwell results in only limited favorable reservoir facies.

The source of the Spiro sand was to the east and northeast, with a limited contribution of sediment from the north. The Spiro may be the western, distal portion of an early Pennsylvanian clastic wedge originating in the Appalachian area. The source of the Cromwell was probably similar to that of the Spiro; local sources however, may have contributed substantial amounts of sediment.

The Arkoma basin was an area of basinal subsidence at a rapid rate, beginning as early as Morrowan and increased in intensity during deposition of the basal Atokan. The rapid rate of subsidence and growth fault controlled sedimentation continued throughout deposition of the Atokan section.

The growth-fault mechanism might explain the transition from shelf and miogeosynclinal facies on the north to the eugeosynclinal (Stanley, Jackfork, and Johns Valley) facies to the south of the Choctaw fault. Perhaps the Choctaw fault was an ancient growth fault along which movement was reversed during the Ouachita disturbance.

The growth faults cutting the Morrowan basal Atokan section probably originated by movement in the basement and were perpetuated by basement movement and/or sedimentary loading and slumping.

Paleontology of the Garber Formation (Lower Permian), Tillman County, Oklahoma

LARRY C. SIMPSON, The University of Oklahoma, M.S. thesis, 1976

The Lower Permian vertebrate-bearing sites in Tillman County, Oklahoma, the N. E. Frederick and W. Grandfield sites, were studied to expand the knowledge of vertebrate paleontology of the Garber Formation as well as to determine the paleoecology at these two sites.

At the N. E. Frederick site the fossiliferous zones are in a large lense of predominantly gray claystone that contains a large fauna and flora. Included at the site are remains of many vascular plants, pelecypods, tubular worms, fish (*Xenacanthus, Orthacanthus, Anodontacanthus, Hybodus, Sagenodus,* paleoniscoids), amphibians (*Eryops, Trimerorhachis, Diplocaulus, Diadectes, Archeria*) and reptiles (*Captorhinus, Ophiacodon, Edaphosaurus, Dimetrodon*). The sediments as well as the fauna indicate that the gray claystone lense is a lacustrine deposit situated in red flood-plain deposits of a deltaic or coastal-plain stream. Evidence is preserved to indicate that the lake dried up, killing all of the aquatic animals. The basin later refilled with water, and the fauna and flora were reestablished before the final filling by sediments. This site not only contains the largest fauna presently known from the Garber Formation but also represents the only Garber occurrence of *Anodontacanthus, Hybodus, Sagenodus, Archeria,* and *Ophiacodon.*

At the W. Grandfield site the section consists of reddish-brown mudrock which contains conglomeratic channel-fill deposits. There is evidence that a scanty vegetation existed along the channels. Except for a few water-worn scraps of *Xenacanthus* and *Trimerorhachis,* the fauna is represented by three genera, *Eryops, Dimetrodon,* and *Araeoscelis,* all of which are either capable of locomotion on dry land or are completely terrestrial. Most of the vertebrate remains were found concentrated in a bone bed adjacent to one of the channels. The concentration of the specimens appears to have occurred in a backwash of the channel. This site appears to represent a relatively barren area traversed by a few shallow channels. *Araeoscelis* is new for the Garber Formation and represents the first discovery of the genus in Oklahoma.

New Zip Code for OGS

Persons who order publications or request other information from the Oklahoma Geological Survey should note our new zip code, 73019, which has been designated for The University of Oklahoma and all its departments. All student mail for the university should be sent to 73026, and mail for the Oklahoma Center for Continuing Education should be coded 73037.

The 73069 zip code, which used to apply to all Norman residents, is restricted as of July 1 to addresses west of Porter Street and Classen Boulevard. All addresses on or east of Porter Street and Classen Boulevard are assigned a 73071 zip, and post-office boxes at the main office and the Boulevard station are assigned to zip code 73070.

OKLAHOMA GEOLOGY NOTES

Volume 36 | June 1976 | Number 3

Page