Journal of the Arkansas Academy of Science

Volume 36 Article 33

1982

Stratigraphy of a Pennsylvanian Deltaic Sequence in Russellville, Arkansas

Christopher F. Moyer
Arkansas Tech University

Ken Fritsche
Arkansas Tech University

LITERATURE CITED

BARBOUR, R. W., and W. H. DAVIS. 1969. Bats of America. Univ. Kentucky Press. Lexington. 286p.

FARNEY, J. P., and J. K. JONES, JR. 1980. Notes on the natural history of bats from Badlands National Monument, South Dakota. Prairie Nat. 12(1):9-12.

GUNIER, W. J., and W. H. ELDER. 1973. New records of *Myotis leibii* from Missouri. Amer. Midl. Nat. 89(2):489-490.

HALL, E. R. 1981. The mammals of North America. 2nd Ed. John Wiley & Sons, New York. Vol. 1:187-189.

JONES, J. K., JR., D. C. CARTER, and H. H. GENOWAYS. 1979. Revised checklist of North American mammals north of Mexico, 1979. Occ. Pap. Mus., Tex. Tech Univ. 62:5.

ROBBINS, L. W., M. D. ENGSTROM, R. B. WILHELM, and J. R. CHOATE. 1977. Ecogeographic status of *Myotis leibii* in Kansas. Mammalia 41(3):365-367.

SCHWARTZ, C. W., and E. R. SCHWARTZ. 1981. The wild mammals of Missouri. Revised Ed. Univ. Mo. Press and Mo. Dept. Cons. Columbia, Mo. pp. 70-71.

SEALANDER, J. A. 1979. A guide to Arkansas mammals. River Road Press. Conway, Arkansas. 313p.

WEBB, O. L., and J. K. JONES, JR. 1952. An annotated checklist of Nebraskan bats. Univ. Kans. Publ., Mus. Nat. Hist. 5(21):269-279.

V. RICK MCDANIEL, Department of Biological Science, Arkansas State University, State University, Arkansas 72467; MICHAEL J. HARVEY, Ecological Research Center, Department of Biology, Memphis State University, Memphis, Tennessee 38152; RENN TUMLISON, Department of Biological Science, Arkansas State University, State University, Arkansas 72467; and KEN N. PAIGE, Department of Biology, Northern Arizona University, Flagstaff, Arizona 86011.

STRATIGRAPHY OF A PENNSYLVANIAN DELTAIC SEQUENCE IN RUSSELLVILLE, ARKANSAS

A well exposed outcrop of the Upper Atoka Formation, the Hartshorne Sandstone, and the McAlester Formation is located in a road-cut two miles south of the Russellville city limits along the east side of State Highway 7. It consists of north dipping strata (75°) of Upper Atoka, Hartshorne, and McAlester units of Pennsylvania age, including the Hartshorne coal. The rock units are the south flank of the Shinn Syncline, where the Hartshorne Sandstone forms a resistant ridge.

The outcrop has been interpreted as a prograding delta complex. A coarsening, thickening upward sequence from the base supports this interpretation (Figure).

The outcrop grades from shales at the southern end of the exposure, through silts and sands, into medium-grained, massive sands. Forty-six feet of organic rich silts including the Hartshorne coal are at the north end of the Hartshorne coal seam.

Deltaic Sequence. The exposure is a small delta complex with the total thickness of the study area being 238 feet. The outer fringe consists of shales and silty shales with lenses of fine sand. The sand-shale ratio increases upward progressively in the section. Bioturbation is evident in the shales. The inner fringe consists of interbedded wavy, thinly laminated, fine-grained sands; bedded fine- to medium-grained sands; and massive, fine- to medium-grained sands. The coarser, thicker sands contain mica fragments and carbonized fossil plant debris. Two possible channel fills consist of massive medium-grained sands, although these two units could be proximal inner fringe deposits under higher energy conditions.

Cross-bedding in both the inner fringe and channel(?) sands indicates a southern source (a northerly prograding delta). But cross-bedding observed perpendicular to the outcrop, along the ridge, shows a possible eastern source (a westerly prograding delta). Both cross-bed sets are probably diagonal sections of the true cross-bedding which would indicate a south-eastern source (a northwesterly prograding delta).

Ripple marks in the inner fringe sands suggest a north-flowing paleocurrent (a southerly source) because the downstream slopes of the ripples are steeper than the upstream slopes (Ehlers, 1980, p. 334). This situation applies to the ripples marks of the inner fringe sands. Blatt (1980, p. 162), however, does warn that ripples marks are an inadequate method of current direction indication as proven by dye experiments with modern shallow water sands. The upper sands of the inner fringe and channel(?) sands contain interference ripple marks with no current direction indication.

In Atoka time, deltaic sourcelands were generally to the north (the Ozark Plateau). But in Hartshorne time, uplift in the frontal Ouachita Mountains shifted deltaic patterns to an east-west flow (LeBlanc, 1981). The north-flowing paleocurrent, as seen in the beds, leads the authors to believe that the outcrop was possibly a small lobe flowing to the north of the major Hartshorne deltaic system. Wanless (1970, p. 234) also sees deformation of the Ouachita Basin as "providing new sourcelands for late Paleozoic deltas."

INTERPRETATION

The Outer Fringe—Unit 1 (Figure). The outer fringe is indicated by shales and silts with lenses of fine sands. Silts and clay are more prominant with occasional fine sand lenses probably deposited by traction. The sand-shale ratio increases with progradation.

Bioturbation is abundant in the shales, although an invertebrate fauna is absent. This lack of fauna is probably due to continuous deposition and the possibility of water salinity being lowered by fresh water input (Reading, 1978, p. 127). The silty nature of the rocks would indicate continuous deposition of sediment from suspension while the presence of sand lenses indicates a close proximity to a sand source where periodic sand inflow would accompany a fluctuation in salinity.

The Inner Fringe—Units 2-14 (Figure). The inner fringe consists of a sequence of wavy, thinly laminated, fine-grained sandstone interbedded with bedded fine- to medium-grained sandstones and massive beds of fine- to medium-grained sandstone.

The wavy, thinly laminated (1/8 to 1/4 inch thick) sands (units 3,4,6,8,12,14,16) represent periods of relatively inactive deposition. Drier climates and droughts could account for a decreased river flow and less sediment being transported to the delta system.

General Notes

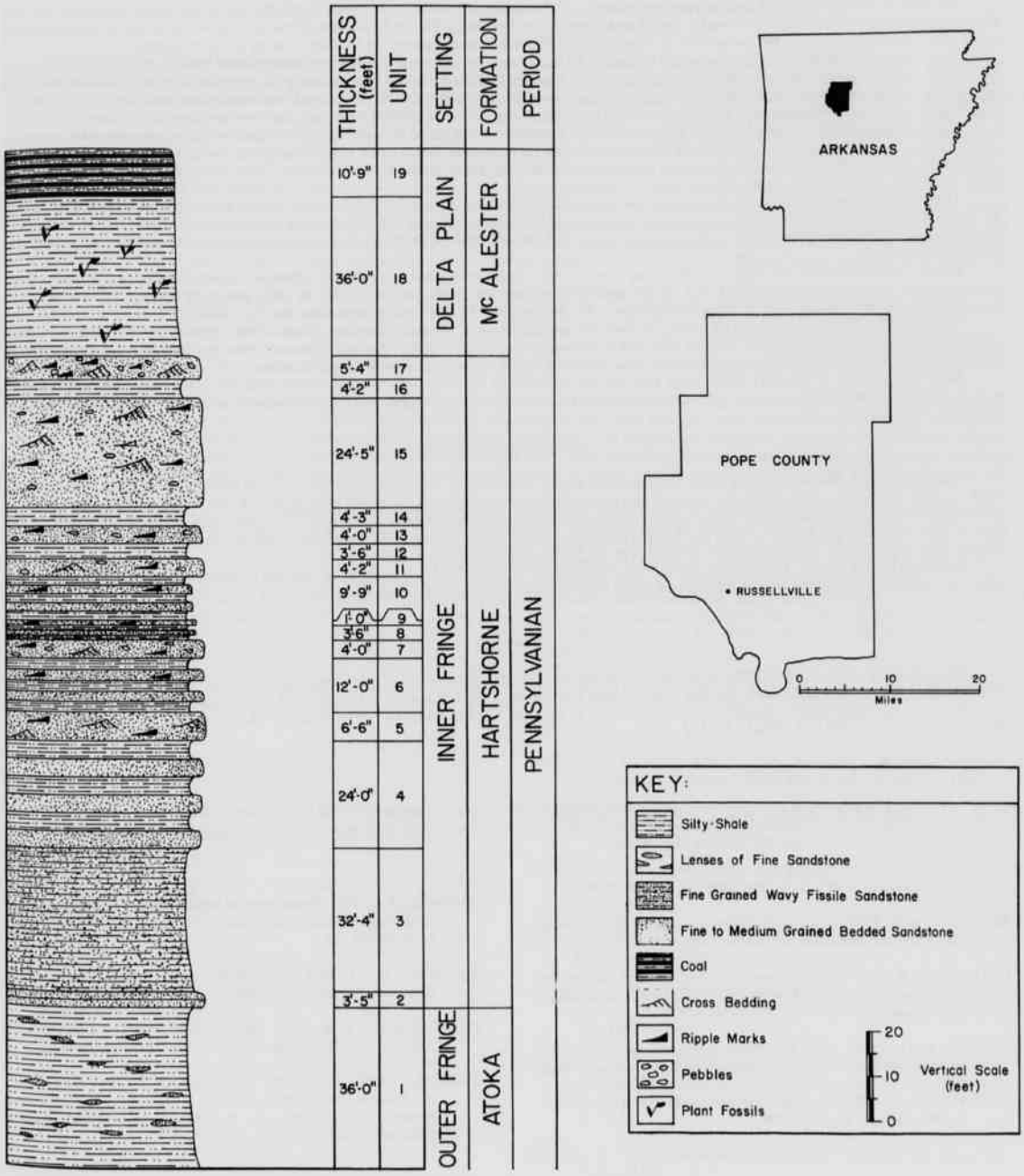

Figure. Index map and diagrammatic section of Pennsylvanian Deltaic sequence, Russellville, Arkansas.

The fine- to medium-grained bedded sandstone (units 4,61,8,10) interbedded with the wavy, thinly laminated sandstone represent "periodic flood-generated sediment incursions from the distributary mouth" as Reading (1978, p. 128) notes. These are deposited as mouth bars or blanket sands. As the delta progrades, the occurrence of sand deposits becomes more frequent and thicker due to a closer source.

The massive fine- to medium-grained sands (units 5,7,9,11,13) represent intensive flooding upstream. Cross-bedding, ripple marks, and clay pebbles are found in these deposits. The beds are thicker (3 to 8 inches) and generally are interbedded with very thin laminae of silt and sand (1/8 inch thick). Fossilized organic debris found in these beds occur as isolated pockets of coal, carbonized leaf impressions, and casts of logs. A well-preserved cast of *Lepidodendron* was found in unit 5. These deposits are also interpreted as mouth bar or blanket sand deposits.

Channel Deposits(?)—Units 15 and 17 (Figure). Channel deposition is suggested by massive medium-grained sandstone beds with large-scale cross-bedding (6 inches) and ripple marks with higher amplitudes than those of lower units, indicating higher energy conditions (Blatt, 1980, p. 136). These units contain a greater percentage of organic debris and clay pebbles than the lower units. The organic debris and pebbles are also larger than those found in the lower units.

The pebbles found in the sandstone are generally external molds although clay can be found in several of the pebble molds. The pebbles are flat and found throughout the beds of sand, not concentrated near any part of the bed. The pebbles were probably weathered out of the delta plain silts and marshes upstream. Their large surface area and light weight allowed them to remain in suspension longer, therefore they are found throughout the beds.

Large-scale cut-and-fill structures and basal lag deposits are usually associated with channel deposits (Reading, 1978, p. 221 and p. 126). These features are not found in units 15 and 17. Cut-and-fill structures may have been destroyed by rock quarrying activity in the area. These structures are "commonly 20 feet or more in thickness". No bed in units 15 or 17 are greater than two feet thick.

The channel features associated with units 15 and 17 give an impression of channel deposition. Lack of other channel-related features indicate possible inner fringe deposition. The features observed in units 15 and 17 could be the result of close proximity to the distributary mouth. High flow conditions would be expected in such a location. The authors rule out neither possible interpretation.

Delta Plain—Unit 18 (Figure). Delta plain deposits are represented by thinly laminated siltstones with abundant plant fossils. A ten-foot section of interbedded Hartshorne coal and siltstone represents an accumulation of swamp vegetation which was converted to peat following burial (Wanless, 1970, p. 221).

ECONOMIC GEOLOGY

The Hartshorne coal of the Shinn Basin has two main seams, separated by about 30 feet of interbedded sandstone and shale (Stroud et al., 1969, p. 336). The lower seam, seen in the outcrop, has been mined to a minor extent (Cohoon, 1974, p. 68). At the center of the basin, the seams are as deep as 600 feet (Stroud et al., 1969, p. 336), therefore, mining of the lower seam is difficult. The upper seam has been mined extensively around the margins of the basin, by both surface and subsurface methods. Currently (1982) there are no mining operations in the area. Approximately four million tons of recoverable coal remain in the basin (Cohoon, 1974, p. 69).

Sand and gravel pits are scattered throughout the Shinn Basin. The Hartshorne Sandstone is quarried extensively as crushed and dimension stone in Logan County to the west. Crushed stone and filler material are quarried in the Russellville area.

SUMMARY

A prograding delta is indicated by a classic coarsening, thickening-upward sequence of strata from outer fringe shales in the lower beds, through inner fringe sandstones with possible channels and then to delta plain siltstone and marsh and swamp coal.

Depth of the water during deposition can be estimated at less than 100 feet (Wanless, 1970, p. 239) with the sands "not transported beyond 50 feet (15m) water depth" (LeBlanc, 1972, p. 153).

Appreciation is extended to Mr. Raymond Stroud for his instructive suggestions and Dr. Richard Cohoon for providing information and suggestions. We would like to thank Dr. Victor Vere for his guidance and support throughout this project. We thank Steve Gates for drafting the figure.

LITERATURE CITED

BLATT, H., et al. 1980. Origin of Sedimentary Rocks. Prentice-Hall, Inc. Englewood Cliffs, NJ. 782p.

COHOON, R. R. 1974. The Environmental Geology of the Russellville Arkansas Area. Ed.D. dissertation, Oklahoma State University, Stillwater. 179p.

EHLERS, E. G., et al. 1980. Petrology-Igneous, Sedimentary, and Metamorphic. W. H. Freeman and Co. San Francisco. 732p.

LEBLANC, R. J. 1972. Geometry of Sandstone Reservoir Bodies. AAPG Memoir 18. p133-190.

LEBLANC, R. J. 1981. Pennsylvanian Shallow Water Clastic Sediments of Western Arkansas and Eastern Oklahoma, part I & II. Film by Shell Oil Co.

READING, H. G. 1978. Sedimentary Environments and Facies. Blackwell Scientific Publication, Oxford, England. 557p.

STROUD, R. B., et al. 1969. Mineral Resources and Industries of Arkansas. U. S. Bureau of Mines Bull. 645. p.335-338.

WANLESS, H. R., et. al. 1970. Late Paleozoic Delta in the Central and Eastern United States. Published in Deltaic Sedimentation-Modern and Ancient. (J. P. Morgn, ed.) SEPM Special Publication #15, p213-245.

CHRISTOPHER F. MOYER, and KEN FRITSCHE, Department of Geology, Arkansas Tech University, Russellville, Arkansas 72801.