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Geometry and Depositional Systems of the Orr and Patterson Sands, Bloyd Formation (Pennsylvanian), Eastern Franklin and Western Johnson Counties, Arkansas

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ABSTRACT

The Orr and Patterson sandstones occur in the Trace Creek Shale Member, Bloyd Formation, in surface exposures on the northern Arkansas structural platform. The Orr sandstone exhibits regional thickening trends to the south and southeast into the Arkoma Basin as shown by isolith maps for the area studied. The depositional environment that formed this sandstone comprised fluvial or deltaic channels feeding a destructive delta system to the southeast. The Patterson sandstone lies stratigraphically above the Orr sandstone, and is confined essentially to Franklin and Johnson counties. It is poorly developed or not present in Washington and western Crawford Counties. The Patterson occurs as a sand build-up formed by a lobate constructive delta system in the north of the area studied but thins to the south.

INTRODUCTION

The major structural elements in northwest Arkansas are the Ozark Dome, the northern Arkansas structural platform, and the Arkoma Basin. The northern Arkansas structural platform is a stable cratonic shelf that has undergone slight structural deformation. Strata on the platform have a slight regional dip southward toward the Arkoma Basin. The structural character of the Arkoma Basin is that of an east-trending trough bounded to the north by normal faults. Basinal strata are folded into anticlines and synclines. The structural deformation in the basin is much greater than that of the platform and increases in intensity southward.

The regional stratigraphy of northwestern Arkansas includes pre-Atoka carbonates, shales and minor sandstones on the platform north of the Boston Mountains. Both the Boston Mountains and the Arkoma Basin have pre-Atoka carbonates, shales and minor sandstones and Atoka sandstones and shales. The Atoka clastics are the predominant stratigraphic sequence in both the basin and the Boston Mountains. The sedimentary sequence on the platform is approximately 4,000 feet thick and increases in thickness southward to over 20,000 feet in the Arkoma Basin (Branan, C. B., Jr., 1968, Am. Assoc. Petroleum Geologists Memoir 9, v. 2:1658-1667).

METHODS AND MATERIALS

The data base used for this study was 108 mechanical logs obtained from wells drilled in search of natural gas in the Arkoma Basin of eastern Franklin and western Johnson Counties. Data were also obtained from two surface sections measured along the southern divide of the Boston Mountains, north of the Cass fault zone. The mechanical logs (Figure 1) were used to construct isolith maps and log signature maps. The surface sections were used to make surface to subsurface correlations and determinations of lithic characteristics of the sandstone units. From the isolith maps, log signature maps and the surface sections, interpretations were made for the depositional systems of the Orr and Patterson sandstones.

RESULTS AND DISCUSSION

Orr Sandstone

The Orr sandstone is the lowermost sandstone unit in the Trace Creek Shale Member of the Bloyd Formation. The Trace Creek Member overlies the Kessler Limestone Member of the Bloyd Formation and underlies the basal sandstone unit of the Atoka Formation. The Orr is present throughout eastern Franklin and western Johnson Counties, Arkansas, in both surface exposures and in the subsurface. It ranges in thickness from 10 feet in northern Franklin County to 160 feet in southwestern Johnson County (T9N,R25W). In surface exposures the Orr locally contains a basal shale pebble conglomerate and is best developed in northeastern Johnson County.

An isolith map of the Orr (Figure 2) in eastern Franklin and western Johnson Counties reveals a blanket sand with a regional thickening to the southeast. Superimposed upon this regional trend are belts of thicker sand accumulation that trend southeast and south. Log signatures associated with these trends in northwestern Johnson and northeastern Franklin Counties suggest abrupt bases with abrupt tops probably formed by fluvial channel deposits. In southwestern Johnson County, the Orr sand thickness is greatest, and log signatures have both gradational tops and bottoms suggesting deltaic distributary channel deposits. Away from these thickening trends, the Orr is poorly developed with shale. The signatures have gradational bases and abrupt or gradational tops indicating interbedded sand and shale deposited by interchannel or interdistributary depositional environments.

The depositional system operating during the deposition of the Orr sandstone was that of a wave dominated high destructive delta. The types of sand deposits present in eastern Franklin and western Johnson Counties are fluvial channel, distributary channel, and delta plain deposits. These depositional environments were supplying sediment to a high destructive delta to the southeast.

Patterson Sandstone

The Patterson sandstone is the upper sand unit in the Trace Creek Shale Member of the Bloyd Formation. It is separated from the Orr sandstone below and the basal Atoka sandstone above by intervals of shale (Figure 1). The Patterson is absent or poorly developed west of Franklin County. In surface exposures in northern Franklin and northern Johnson Counties the Patterson has a gradational base of alternating thin layers of sandstone and shale and is capped by a massive bedded, fossil fragment-bearing sandstone. The Patterson ranges in thickness from 30 feet to 110 feet in eastern Franklin and western Johnson Counties. The thickest and best sand development occurs in the northeast part of central Franklin County.

An isolith map of the Patterson (Figure 3) in eastern Franklin and western Johnson Counties indicates that it is a blanket sand that has a regional decrease in sand content to the south. Superimposed upon the regional trend are zones of thicker sand accumulation. These zones extend from a common zone of greatest sand thickness in the north that bifurcates to the south and southeast with decreased sand content to the south. Log signatures associated with these trends suggest a basal unit of alternating sand and shale in the northern part of

the area capped by a massive sand unit. To the south the upper massive sandstone unit disappears near the Arkansas River. Away from these thickness trends the log signatures suggest alternating units of sand and shale.

The upper massive unit of the Patterson in the north represents distributary mouth bar and distributary channel deposits. The interbedded sand and shale sequences in the southern part of the area are delta front deposits overlying prodelta shales. The off-trend signatures are interdistributary-crevasse deposits overlying delta front sands.

The depositional system active during deposition of the Patterson sandstone was a river-dominated, constructive lobate delta. The depositional environments active within this system in eastern Franklin and western Johnson Counties were prodelta, delta front, distributary channel, distributary mouth bars, and interdistributary environments.

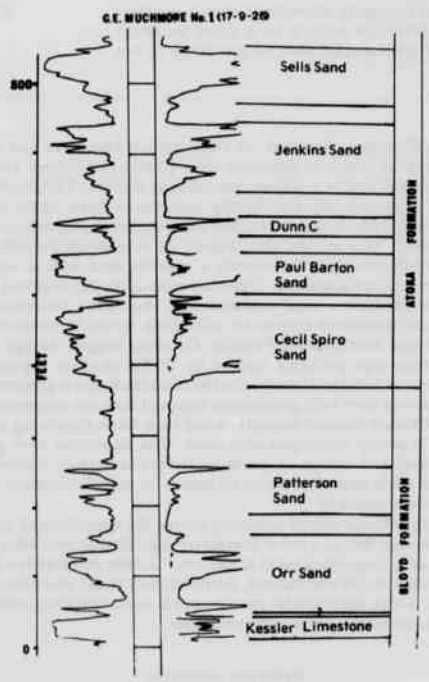

Figure 1. Gamma ray and resistivity logs illustrating expression of Bloyd and Atoka sandstone units and their nomenclature.

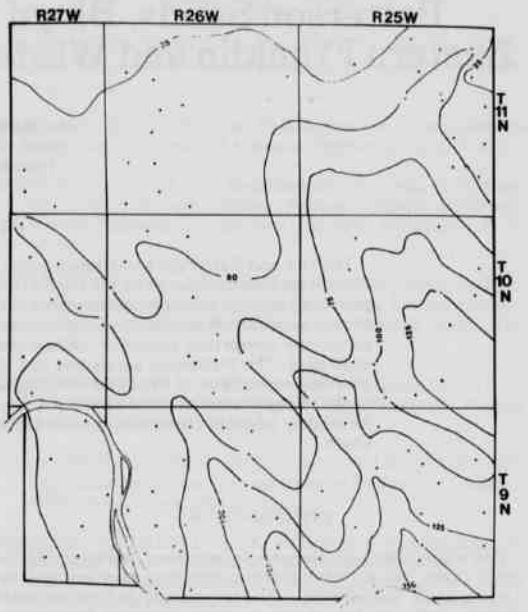

Figure 2. Isolith map of the Orr Sandstone contour interval is 25 feet.

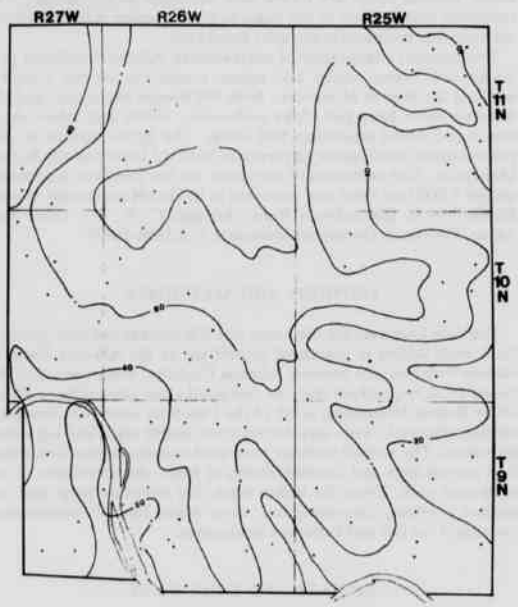

Figure 3. Isolith map of the Patterson Sandstone contour interval is 20 feet.