
Stratigraphic Architecture, Depositional Systems, and Lithofacies of the Mississippian Upper Barnett Two Finger Sand Interval, Midland Basin, Texas

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ABSTRACT

The upper Barnett Two Finger Sand interval in West Texas forms oil and gas reservoirs that produce from natural fractures and low-permeability intraparticle nano- to micropores in the matrix. The section contains two mixed medium silt- to very fine sand-sized siliciclastic-carbonate units that are composed of relatively thin 0.5 mm to 1 m hybrid/cogenetic event beds that amalgamate to form a deepwater submarine fan system in the Mississippian Tobosa Basin. Siliceous mudstones occur between these coarser-grained units. Sediment sources for the fan lobes originated from the northern and eastern margins of the Tobosa Basin in an inner ramp setting. The depositional setting, based on elevated total organic carbon (up to 3.1%), lack of wave-related hydrodynamic features, and the presence of cephalopods and radiolarians, is interpreted as having been below storm-wave base in a generally dysaerobic outer ramp to basin bottom water setting with brief periods of oxygenation. Most of the organic matter is type III, but a minor amount of type II organic matter is present. Calculated vitrinite reflectance (Ro) values average 1.2%, which places the Two Finger Sand interval within the late oil to early gas window. Core-plug porosity ranges from 0.5 to 7.5% with permeability generally less than 0.06 md. Pore types include intraparticle fluid-inclusion pores and clay-platelet mineral pores. Some microvugs (<1 to 10 μm) are observed that may be related to dissolution. Rare organic-matter pores are present. Based on decline curves from producing wells and shut-in pressure tests performed during the development of the Moonlight Field, it was concluded that the permeability network in the reservoir consists of natural fractures. After a few years of production, however, the decline curves suggest that some production is from the matrix. The concepts developed concerning the depositional setting and sediment-source areas and sediment flow directions may aid in the development and extension of the Two Finger Sand interval play.

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