High-Frequency Sequence Stratigraphic Analysis of the Barnett Shale, Johnson County, Fort Worth Basin, Texas, USA

Abouelresh, Mohamed O.[1]; Slatt, Roger M.[1] (1) Geology and Geophysics, University of Oklahoma, Norman, OK.

The Fort Worth basin is a shallow, north-south-elongated trough in north-central Texas which contains the Mississippian Barnett Shale, one of the most important unconvential gas shales in the United States. The Barnett Shale entirely comprises the interval between 7721 ft and 7990 ft in the Spencer Trussel#1H well which is located at the east-central edge of the Fort Worth basin. In this core, the lower Barnett Shale is separated from the upper Barnett Shale by a major sequence boundary. Two distinctive spectral gamma-ray log responses occur in response to more detrital siliceous mudstone below the boundary and more calcareous and biogenic, siliceous mudstone above the boundary. Detailed analysis of the core and spectral gamma ray log have also led to identification of five depositional sequences in the lower Barnett and twelve depositional sequences in the upper Barnett.

The identification of submarine surfaces of erosion, condensed sections and transgressive surfaces of erosion further subdivide these depositional sequences into systems tracts. Approximately 43 % of the total thickness is comprised of Lowstand Systems Tracts (LST), 38 % is Transgressive Systems Tracts (TST) and only 19 % is Highstand Systems Tracts (HST). These proportions suggest a subsurface high structure within the study area during deposition of the Barnett Shale. The presence of several lag deposits in the LST of sequence 5 and the high frequency of sea-level fluctuation during the development of sequences 9 to 17 further support this interpretation.

The clay-rich mudstone in the lower Barnett (sequences 1-5) reveals that the sea level was generally high, trapping coarse sediment further landward, along the paleoshoreline. The abundance of phosphatic deposits in TST's is suggestive of an anoxic depositional environment with a low rate of sedimentation. The abundance of phosphatic deposits in LST's assured their transport from upslope source areas by sediment gravity flows, resulting in high rates of deposition of these, and also of calcareous-rich lithologies. The large number of sequences comprising the upper Barnett (sequences 9-17) indicates a high frequency of relative sea level fluctuations.

The RHP curve shows intervals of anoxic conditions which correlate with TST and condensed sections and intervals of oxic conditions coinciding with HST and sometimes with LST. These relationships have been identified in other Barnett Shale cores.