The Barnett Shale — Role of Lithofacies, Sequence Stratigraphy, Depositional Model and Evolution through Time on the Reservoir Quality

Anne-Claire Chaboureau[1], Jason Flaum[2], Ursula Hammes[3], Antoine Bertoncello[1], Jean-Philippe Mathieu[1], Nikki Morris[2]
[1]TOTAL SA; [2]TOTAL; [3]Hammes Energy

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Abstract

The continued development of Unconventional Shale Plays across North America has demonstrated that these resources are a significant contributor towards current and future E&P activities across the oil and gas industry. The drilling intensity associated with such development generates a large and extensive volume of data. Using this data provides an extraordinary opportunity to characterize the variability of reservoir properties and the relations of such variability to production. However, as the economics of unconventional plays in North America is determined as much by above-ground factors as by subsurface characteristics, few studies integrate all available data to identify the highest quality reservoirs both vertically and horizontally within a given play. In this study, we evaluate the lithologic variability and associated reservoir quality properties of the Barnett Shale using sequence stratigraphic principles. Data was collected from six cored wells spanning a dip and strike oriented transect in the Late Mississippian Barnett Formation, Fort Worth Basin, TX. Available data include core description, XRD mineralogy, RockEval, Tight Rock Analysis (TRA), SEM images, and thin sections. Each well also contains a full quad-combo log suite including GR (total and spectral), resistivity, sonic (compressional), neutron porosity, and PEF. Seven facies have been distinguished based on mineralogy, sedimentary structures, and TOC content that maybe directly related to success of completion and production: 1) Siliceous mudstone massive to faintly laminated with

discontinuous, wavy laminations, dominantly biogenic silica and associated to a high TOC (>4%). 2) Siliceous/argillaceous mudstone, massive/faintly laminated to laminated, dominantly biogenic silica, higher clay content, and TOC between 2-3%. 3) An argillaceous mudstone with dominantly detrital silica, high clay content and carbonate, associated to a lower TOC (20% silica, clay, and carbonate), massive to thinly bedded with TOC 70% carbonate) with low TOC (7% and water saturation < 20%, associated surprisingly to relatively low GR (<100 API). They are distinguished by migrated bitumen filling preserved pores related to early silica diagenesis which is prone to organic porosity. This facies occurs frequently in the late TST to early HST and can be correlated throughout the study interval. It is conformably under- and overlain by more argillaceous facies which may provide frac barriers to the high water saturation carbonates above and below the Barnett shale.