The Woodford Shale in the Marietta Basin (Oklahoma and Texas)

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ABSTRACT

The Woodford Shale is an organic-rich siliceous shale deposited during the Late Devonian and Early Mississippian in Oklahoma and Texas, and it is considered one of the most important unconventional shale resources in the United States. The purpose of this study was to describe and characterize of cored Woodford Shale interval from a well in the Marietta Basin in North Texas and compare to correlative outcrop stratigraphic sections in the Criner Hills and Arbuckle Mountains in South Central Oklahoma.

This Marietta Basin core is composed mainly by five lithofacies: 1) Siliceous Mudstone, 2) Chert, 3) Siliceous Shale, 4) Argillaceous Mudstone, and 5) Green Mudstone. Lithofacies were characterize in hand samples and thin sections using Petrographic Microscope, Scanning Electron Microscopy (SEM), Energy-dispersive X-ray spectroscopy (EDS), X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF), and Rebound Hardness analysis. These methods combined with the Core Spectral Gamma Ray log assisted the generation of a sequence stratigraphic framework and the interpretation of depositional models for this Woodford Shale section.

The presence of the informal Lower, Middle, and Upper Member of the Woodford Shale were interpreted in the core. The contact with the underlying formation Sylvan Shale is visible in the lowermost section which is dominated by siliceous shales and green mudstones. The Middle section is dominated by siliceous mudstones and argillaceous shales. The upper contact was not cored, nevertheless the presence of high amount of phosphate nodules and chert beds support the interpretation of the Upper Member of Woodford Shale.

The combination of the mineralogical analysis (from XRD data) and hardness analysis (from the Rebound Hammer data) show the presence of brittle-ductile couplets mainly driven by the interbedded character of the lithofacies and the variability of the content of quartz (biogenic vs detrital) and Total Organic Content (TOC) of the beds.

Mineralized natural fractures are present in this core within brittle beds and bounded by clay-rich beds, a common character that has been studied in outcrops in previous publications with the difference that most the fractures are not straight but instead convoluted. Sinuous fractures support the interpretation the fractures were formed before or during early compaction of the shales. Mineralogy within and around the fractures are altered with presence of Magnesite, Calcite, and Dolomite. Radiolarians are very common in the Woodford Shale and have been interpreted as the source of the high silica content. In this core, some of these radiolarians are well preserve and show replacement of silica by other minerals during diagenesis.

This core in the Marietta Basin represent one of the most distal facies of the Woodford Shale constituted by a Transgressional Systems Tract (TST) in the lower and middle section and Highstand Systems Tract (HST) in the upper section supported by the changes in the trend of Silica-Aluminum (Si/Al) ratio and the variations in Titanium (Ti), Zirconium (Zr), Molybdenum (Mo), and Vanadium (V).