High-Resolution Geochemical Assessment of Two Wolfcamp Formation Cores in the Southern Delaware Basin

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Hand-held, high-resolution X-Ray Fluorescence (XRF) is a non-destructive chemical analysis that can report relative chemical abundancies in core. In this study, XRF data were combined with X-Ray Diffraction (XRD) and Total Organic Carbon (TOC) analysis on two cores from the Wolfcamp formation in the southern Delaware basin. A chemofacies classification utilizing elemental concentrations and organic content was generated in conjunction with visual core analysis to help strengthen play development and reconstruct basin conditions.

The study cores were 1.6 miles apart and approximately strike-oriented. XRF data were collected every two-inches in shale sections and every foot in carbonate sections as well as discrete areas of interest. XRD and TOC data were generally collected every nine feet in carbonate sections and every three feet in shale sections, in addition to discrete areas of interest.

A regression was completed from data points with matching XRF and XRD data. This regression equation was used to separate data points into mineralogical facies. Hierarchical Cluster Analysis (HCA) was used to provide an alternate method of facies classification.

The two cores are representative of at least three different mud rock chemofacies, with several distinct sub-facies, depending on method of categorization. The Mendel 36-4 core was commonly siliceous (average quartz content > 50%), with multiple intervals of intercalated siltstones as well as several clay-rich sections. The upper 80% of the Mendel 26-2 core was dominated by stylolitized, fusulinid wackestone with calcite-filled vertical fractures. The remaining 20% of the core was characterized by a carbonate mudstone with an upward increase in calcite content and upward decrease in both quartz and clay.

In succession, the overlying Mendel 26 -2 and underlying Mendel 36-4 likely represented a semi-continuous sequence of a transgressive flooding period into a high stand systems tract where carbonate sediments were shed into the basin. In the Mendel 26-2 core, TOC and redox-indicator elements were not well correlated (R^2 of 0.5 of less), and were instead controlled by dilution from carbonate or terrigenous sediment. To improve the ability of a petroleum geochemist to characterize and group shale facies chemostratigraphically with XRF/XRD/TOC on a play- and field-level basis, additional analysis will need to be undertaken on closely spaced sets of cores with good dip- and strike-continuity.