The Utility of Collecting Whole Rock Core for Understanding the Wolfcamp A, Delaware Basin, SE New Mexico

Chris Flenthrope[1], Erik Kvale[2], and Brent Roggow[3]

[1]Devon Energy, Geologist, Delaware Basin
[2]Devon Energy, Geologist, Reservoir Technology & Optimization
[3]Devon Energy, Petrophysicist, Reservoir Technology & Optimization

ABSTRACT

Geologists, petrophysicists, and engineers have long debated how much whole core to cut to understand reservoir potential. To maximize the economic return, sample cuttings or rotary side wall cores might be preferred to whole core. However, thin-bedded units where rock types change drastically over inches to feet present challenges for geologists, petrophysicists, and reservoir engineers to create realistic models for mapping and reservoir stimulation that can be favorably compared to production. This rapid change in rock quality can reduce confidence in rotary side wall core placement and the accuracy of standard log suites. For example, abundant clay rich beds have been observed in Wolfcamp cores that were not detected in logs. In such successions, sampling strategy is critical to understanding the nature of the rock and what logs and petrophysical models can and cannot tell you about the intervals of interest.

These issues are particularly challenging within the Permian upper Wolfcamp Formation in the Delaware Basin in southeast New Mexico and west Texas. The Wolfcamp A interval within the uppermost Wolfcamp Formation is characterized by rapidly changing facies with non-calcareous to slightly calcareous organic-rich mudstones interbedded with fusulinid-dominated packstones and/or wackestones. The depositional systems within the Delaware Basin along a single stratigraphic timeline can be dominated by carbonates or siliciclastics depending on the location within the basin with each grading into the other. Upon inspection, many of the apparently disconnected facies are actually organized into hybrid event beds with the basal parts of the flow deposits dominated by carbonates and the upward portions dominated by siliciclastic mudstones with moderate to no carbonate cement. The distance from a point source area can determine the percentage of carbonate versus siliciclastic detritus with carbonates (wackestones/packstones) more prevalent near basin margins. Extreme vertical changes (TOC, K, Phi, clay, carbonate, other) within a single flow-event can be gradational over several tens of feet to several inches with each end member facies exhibiting its own mineral composition, TOC, porosity, and permeability.

Sampling for reservoir characterization is problematic within such successions as a shift of a few inches up or down can result in carbonate compositions swinging from 70 percent or more to less than 2 percent and TOC changing from less than 1 percent to more than 6 percent. Knowing the percentage of each endmember within a single stratigraphic interval or area, suggests percentages of potential reservoir rock that might contribute to produc tion. Recognizing that a single flow event likely emanated from specific source areas influences the approach for log correlation and mapping.