Reservoir Quality on the Lewis Shale for Horizontal Drilling

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Abstract

The Lewis Shale is a turbidite system encompassing sandstones, siltstones, and organic-rich shales deposited during the last Western Cretaceous Seaway transgression. It is informally subdivided into three members; a lower member (characterized by high clay and organic matter content), a middle member or Dad sandstone member (a mixture of siltstones, shales, and sandstones), and an upper member (with decreasing amounts of sandstone and greenish-grey shales. Its lithological characteristics vary depending upon its location within the depositional basin (eastern Greater Green River Basin).

The present study is in Sweetwater and Carbon counties in Wyoming. Investigated data include three cores in the Great Divide Basin and one on the Wamsutter Arch provided by MorningStar Partners/Southland Royalty. These cores contain various lithologies, including shales, siltstones, and sandstones, representing the Lewis Shale's lithologic heterogeneity and complexity. This formation is considered an unconventional reservoir due to its low porosity and permeability and the need to use hydraulic fracturing to obtain hydrocarbons at commercial rates. In addition, the area around the cores is relatively undeveloped for horizontal wells.

The objective of this work is to develop a high-resolution reservoir characterization. Reservoir quality and diagenesis are intrinsically related. For this purpose, some of the analyses performed include X-ray Fluorescence (XRF), X-ray Diffraction (XRD), Field Emission-Scanning Electron Microscopy (FE-SEM), and routine core analyses (RCA).

Well-log data obtained from the Wyoming Oil and Gas Conservation Commission (WOGCC) were used to perform correlations, build maps of the different cored intervals, and evaluate its internal characteristics and reservoir quality. Core description, XRF analyses, thin sections and XRD were taken in areas of interest.

Several authors have described some of the petrophysical properties of the Lewis Shale. However, there are no petrophysical models in the sandstone intervals tying together log and core data to the author's knowledge. The petrophysical characteristics of these four cores displayed the same level of heterogeneity as the facies described. Samples have high variation in water saturation values and, in general, very low porosity and permeability. Samples classified as finely laminated silty sandstones displayed better reservoir properties than the other facies, even the clean, massive sandstones. This proves that the cleanest sandstones are not always the best reservoirs.

Chlorite and clay content have a meaningful impact on reservoir properties. Thus, affecting the porosity calculation. Chlorite also helped preserve porosity and permeability in some of these facies by coating quartz grains, which may explain why the finely laminated silty sandstone facies have better reservoir characteristics than the clean sandstones.

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