AAPG Datapages/Search and Discovery Article #91206 © Rocky Mountain Section Meeting, Bismarck, North Dakota, June 4-6, 2023

The Presence of Microcrystalline Quartz and Chlorite as Driving Factors for Porosity Preservation and Reservoir Quality in the Lewis Shale, Great Divide Basin and Wamsutter Arch, Wyoming

Ligia Carolina Mayorga[1] and Stephen Sonnenberg[1]

[1]Colorado School of Mines

Abstract

The Lewis Shale is a turbidite system encompassing sandstones, siltstones, and organic-rich shales, deposited during the last Cretaceous seaway transgression that can reach up to 2600 ft in thickness. Its lithological characteristics vary depending upon its location within the Lewis Shale depositional basin (eastern Greater Green River Basin). The present study is in Sweetwater and Carbon counties in Wyoming. Data includes three cores in the Great Divide Basin and one on the Wamsutter Arch. Core’s lithologies represent Lewis Shale's lithologic heterogeneity and complexity. Different lithologies affect the reservoir quality in different ways, such as cement reducing porosity and permeability, clay content increasing the inbound water, etc. Thus, an intrinsic understanding of their internal characteristics to identify the variability is crucial to understand what to expect when planning new well locations in any of these intervals and being prepared for these changes when geosteering horizontal wells. This understanding can be attained by combining high-resolution analyses such as XRF, thin sections, XRD, FE-SEM, and core description. Illite/smectite swelling clays can increase water saturation and cause trouble when drilling this formation, but most samples showed low smectite content. In addition, calcite and dolomite are present as cement and detrital grains, which can decrease the permeability of the rock. Porosity data showed some positive correlation with the percentage of authigenic quartz, calcite, and chlorite in the system. Excess silica was identified using XRF elemental data and ratios with the main detrital proxies and plots. However, all the silica present is not correlated with the main detrital proxies. There is authigenic, biogenic quartz and chert coming from Paleozoic carbonates present. It was later identified as mainly authigenic quartz using FE-SEM and EDS analysis. It was concluded that the presence of microcrystalline quartz and chlorite coatings is preserving porosity and permeability. 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, generally, very low porosity and permeability characteristics of these reservoirs. Chlorite and clay content have a significant impact on the reservoir properties. Thus, it is always recommended to calibrate every model with core data. In all the cores, samples with higher porosity values usually correlate with lower water saturation. Samples classified as finely laminated silty sandstones and bioturbated silty sandstones displayed better reservoir properties than the other facies, even the clean, massive sandstones. It is recommended to perform a petrophysical model in sandstone intervals with fewer intercalations to avoid bed boundary effects and unreliable water saturation values.