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Rock Physics Characterization of a Source Rock in NW Saudi Arabia

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ABSTRACT

Unconventional reservoirs are gaining interest in Saudi Arabia due to the recent successes in North America, where it has proven economical to produce gas from source rocks. There are many challenges in unconventional exploration due to the heterogeneity of the source rocks. Whether it's mechanical heterogeneity in terms of brittleness and frackability, geochemical variations in Total Organic Carbon (TOC), or kerogen type and maturity, it is important to map these heterogeneities to know where to place our wells to maximize exploration success. To better characterize our source rocks, we need a multidisciplinary approach that combines geosciences and engineering data to better understand our source rocks potentials and limitations. Rock physics can be the bridge between science and engineering as it combines geoscience and engineering data to better understand reservoir properties. We present a workflow that combines geochemistry, image processing, and rock physics modeling to understand some of these heterogeneities in potential shale gas reservoirs in the northwest of Saudi Arabia. Geochemical and mineralogical analysis of a source rock in the northwest of Saudi Arabia shows that maturity, kerogen quality, TOC, and mineralogy varies across the basin. This is accompanied by variability in well performance. To understand variability in the basin and what governs the rock response, an effective medium rock physics model was created, which takes into account kerogen properties (aspect ratio and elastic properties). This model clusters facies based on mineralogy, kerogen properties, and acoustic response. The model inputs were verified by scanning electron microscopy (SEM) images and lab measurements. As a result, the proposed model provides a good fit to the log data and shows how the rock bulk moduli decrease with a decreasing kerogen aspect ratio for the three facies.