ROCK–TYPE DISCRIMINATION OF COMPOSITION AND FABRIC IN THE HAYNESVILLE SHALE

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ABSTRACT
The best recovery of hydrocarbons from unconventional reservoirs occurs in zones optimal for horizontal drilling and hydraulic fracturing and in locations with high gas concentration. Characterization of the relationship between important rock properties, such as mineralogy, rock fabric, and fluid saturation with elastic properties of the Haynesville shale will improve our ability to identify these optimal locations. This study investigates the effectiveness of rock typing as a technique for improving rock physics modeling of elastic properties of the Haynesville Shale in Panola County, Texas. Rock typing is the division of regions with varying mineralogy and rock fabric in the Haynesville into distinct intervals to be modeled separately. In this work, the Haynesville is modeled using the differential effective medium (DEM) model, which allows for parameterization of pore and grain aspect ratio, mineral composition, and load bearing matrix. A similar procedure is also used to model the whole Haynesville unit as a single interval with the DEM. The effectiveness of the rock-type models versus the full-interval model is evaluated in terms of their abilities to replicate sonic logs. Calibration of the Haynesville as a whole and of each rock type using the DEM at well A, predicts a mean pore aspect ratio of .3. Using this calibrated pore aspect ratio with a single mineral assemblage is a poor predictor of the variation of C33 and C44 throughout the Haynesville. However, by incorporating rock typing, the Haynesville is divided into two rock types, and described with separate models. The first rock type is calcite rich and clay poor, and the second is clay rich and calcite poor. By dividing the Haynesville in to just two simple rock types in this study, C33 and C44 of individual rock types were better fit, than when described using one mineral assemblage. The greater sensitivity of the rock type models to mineral content allows for better description of a distinct porosity - stiffness trend for each rock type.
Model lines based on 5 idealized mineral assemblages each with a pore aspect ratio of .3. In all four panels, solid points represent measured data, C33 or C44, and colored lines represent each of the 5 mineral combinations. a) and b) contain measured points for rock type 1 (calcite rich and clay poor), while c) and d) contain measured points for rock type 2 (clay rich and calcite poor).