The Effect of Wet Clay on Elastic Properties in Paleozoic Siliciclastic Reservoirs

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ABSTRACT

The formation under study is a promising siliciclastic reservoir of Paleozoic age, located in central Saudi Arabia. Numerous wells have been drilled in this sandy to silty sand Paleozoic fairway. The depositional environment of these Paleozoic clastics are dominated by semiarid to arid terrestrial settings, such as playa lakes, streams and eolian deposits. The amount of clay with bound water, otherwise known as wetclay, in this formation is low, ranging from 0 to 40% of wetclay. The depositional environment of this formation is consistent throughout the region, however, the thicknesses of these deposits as well as their depths vary extensively throughout the area. This forwards a likely variation of diagenesis in the region, which might lead to heterogeneity in the formation. A comprehensive rock physics analysis is conducted for fluid mapping. The amount of wetclay in the formation is low. Therefore, the elastic properties of wetclay, namely, the compressional, the shear, and the bulk density cannot be accurately depicted. The objective of modelling different wetclay elastic properties is to figure out if they affect our fluid substitution, thus affecting the hydrocarbon saturation modeling. In order to adequately model compressional and shear velocities, we used 6 wells in our region to find out the relationship between compressional and shear velocities. Moreover, different illite-based wetclay densities were selected to evaluate the effect on the density. Based on the results of the modelled elastic properties, when the wetclay volumes are low, averaging about 15%, the effect of different elastic properties on fluid substitution and consequently fluid projection is minimal. This is true for the modelled compressional wave and its respective shear wave with the established relationship in the region as well as the modelled density ranges. However, as expected, the changes in the fluid are more prominent in variations of compressional and shear velocities than differences in the bulk density. Nonetheless, the changes are measurable and are expected to rise with increasing wetclay volumes.