

Variability and Estimation of Formation Water Density in the Alberta Basin

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The salinity of formation waters in the Alberta basin ranges from meteoric to over 350 g/L TDS in the vicinity of evaporitic beds. Temperature and pressure conditions reach 200°C and 60 MPa. Knowledge of the density of formation water at in-situ conditions is crucial for the evaluation of the fate of injected fluids and in the identification of hydrocarbon migration paths and accumulations. Errors in water density estimates may lead to incorrect estimates of the magnitude and direction of the flow of formation waters, both on geological and human time scales, thus affecting exploration strategies and environmental assessments.

A high-quality set of over 4800 water density analyses was selected out of more than 150,000 formation water analyses collected by the energy industry in the Alberta basin. This set was used in the analysis, which revealed a linear relationship between TDS and water density for each of 23 major aquifer systems in the basin. The distribution of water density in the basin shows a stratigraphic and a geographic dependence that is controlled by origin, hydrostratigraphy and the flow systems active in the basin. For low salinity (< ~60,000 mg/l), the STP-measured Alberta basin brine density values are well predicted by existing algorithms; however, for higher salinity these algorithms increasingly underestimate brine density. The cause of this deviation is the proportion of heavy ions in these brines, particularly Ca. The density of formation waters in the basin can be well described empirically by linear regressions of density as a function of salinity fitted individually to each major unit.