Preliminary Interpretations of Produced Water Geochemistry from the San Miguel Formation: Implications for the Origin of Taylor Group Brines in Maverick Basin, Texas

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Abstract

Understanding the characteristics and origin of formation brines is critical to realize reservoir connectivity, history of fluid flow, and geochemical history, which can directly impact exploration and developmental success. To date, little is known about the geochemistry of formation brines within the Taylor Group reservoirs in the Maverick Basin of south Texas. To better inform our state of knowledge, 23 produced water samples were collected from oil wells actively producing from tight sandstone reservoirs of the Taylor Group San Miguel Formation in Maverick Basin, for which information regarding produced water characteristics and reservoir connectivity is scarce. Samples were initially analyzed for elemental and ionic geochemistry including Br, Ca, Cl, Na, and SO_4, and for stable isotopes including δ^2H and δ^{18}O.Molar Na/Cl ratios are close to one while Ca/SO_4 molar ratios start at one and increase substantially suggesting that San Miguel brines are products of evaporite dissolution with sulfate reduction. In contrast, Na-Cl-Br systematics produce a composition similar to seawater or evaporated seawater. Values of δ^{18}O and δ^2H for the San Miguel samples are slightly heavier with respect to O-isotopes compared to local meteoric water, suggesting that the San Miguel brines might be derived from a mixture of meteoric water and evaporated seawater. San Miguel Formation water total dissolved solids (TDS) concentrations range from 36,600 to 69,100 mg L-1. The TDS concentrations are likely too low to

be derived solely from evaporated seawater. Therefore, one possible origin for the San Miguel brines is meteoric water mixed with evaporated seawater as an isometric log-ratio (ilr) plot of Na-Cl-Br suggests. However, Br addition can occur from both halite recycling and kerogen release pushing data points toward the seawater evaporation curve on the Na-Cl-Br ilr plot. Mixing of meteoric water and evaporated seawater can account for the $\delta^{2}H$ and $\delta^{18}O$ values, although there could also be a component of isotopic exchange between meteoric water and clay and carbonate minerals. Although it is difficult to determine with certainty whether San Miguel brines are products of mixed meteoric and evaporated seawater, meteoric water mixed with halite dissolution, or a combination of both, these results are used to illustrate different source scenarios as they relate to reservoir connectivity and historical fluid flow movement in Maverick Basin.

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