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Evidence of Reservoir Compartmentalization from a Coupled Study on Brine Chemistry and Stratigraphy in and Around the South Liberty Salt Dome, Texas

Detailed brine chemistry of the Oligocene Frio, Eocene Cockfield/Yegua and Cook Mountain Formations around the South Liberty Salt Dome (SLSD) have been used in conjunction with well-logs, biostratigraphic data, and 2-D seismic data to evaluate fluid flow and reservoir compartmentalization. Structural cross-sections and 2-D seismic data demonstrate significant structural dip and faulted intervals on the NW and SW flanks of the SLSD. Furthermore, total Yegua thickness indicates that the SLSD acted as a barrier to shelf margin collapse. Brine chemistry of the Miocene and Frio Formations of the High Island Salt Dome (HISD) was also determined for comparison with the SLSD.

Chemical and isotopic tracers indicate that Na-Cl brines in these fields (TDS 68-250 g/L) are a mixture of local meteoric water and deeper geopressured brines, and that these brines have signature of extensive halite dissolution. In addition, several samples from the NW and SW flanks of SLSD show the effects of extensive gypsum cap-rock dissolution (sulfate up to 1940 mg/L).

Several closely spaced wells (within 35 m) in the faulted flanks of the SLSD, perforated at similar depths, produce waters of strikingly different composition. This is attributed to a greater influx of meteoric water and reaction with the cap-rock suggesting that the faults might act as conduits for vertical fluid flow. This unusual water chemistry was not noted in areas where fault densities were lower. In addition, the preservation of waters of discrete compositions in closely spaced reservoirs supports the presence of lateral compartmentalization along NW and SW flanks of SLSD.
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