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Migration Direction and Compartmentation Deduced from Reservoir Brine Geochemistry, South Eugene Island Block 330 Field, Offshore Louisiana

Reservoir compartmentation and filling direction are usually inferred from hydrocarbon chemistry. However, brines associated with the reservoired hydrocarbons can also contribute useful information. In the offshore Louisiana Plio-Pleistocene reservoirs of South Eugene Island Block 330, the brines co-produced with oil in some ways resemble seawaters that have dissolved halite. However, as documented by Losh, Walter, et al. (2002, AAPG Bull.), sodium is deficient relative to chloride on a molar basis in all but one of the 22 samples, and the extent of sodium deficiency correlates positively with the concentrations of other cations (such as K, Mg, Ca), suggesting that ion exchange between brine and sediment has substantially modified the brine's chemistry. Sodium deficiency in the brines increases from south to north in the GA and HB reservoirs. Iodine concentrations in brines from these reservoirs are nearly three orders of magnitude greater than seawater, and decrease somewhat from south to north, suggesting the presence of residual connate waters in the northern parts of these reservoirs. The iodine concentrations, as well as 129I and Sr isotope data (Moran et al., 1995, Geochim et Cosmochim Acta), indicate the brines ascended from Oligocene or older sediments at least 7 km deeper in the section. Thus, both the Na and I data suggest the brines entered the GA and HB sands from a coastward-dipping fault bounding the southern edge of the SEI330 minibasin. Oil V/Ni and sulfur content show variations that are compatible with northward flow from the same fault. Salinity in the GA reservoir is about twice that of brines in the HB sand only 400 feet deeper, indicating the two sands were charged separately and that their fluids have not mixed. At least in this case, brine chemistry, corroborated by oil geochemistry, provides good evidence for filling direction in, and lack of commingling between, the two sands.