Evaluating Salt Weld Permeability and Migration Risk

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Viscous flow and dissolution may remove halite and other evaporites from between competent wall rocks. The resulting salt weld may act as either a barrier or pathway for migration of hydrocarbons or fluids containing precious metals. Hydrocarbon exploration success may depend on weld properties that vary widely from one target to the next. Sealing salt welds are desirable to trap sub-salt reservoirs, whereas leaking welds can charge supra-salt reservoirs. The ability to predict fluid conductivity of salt welds would be invaluable to exploration in basins affected by salt tectonics. Traditionally, rock salt has been regarded as a nearly perfect seal. However, experimental and field data indicate that under specific pressure, temperature, and stress conditions, halite behaves as a Darcy-type porous medium having small but non-trivial permeability. Empirical data from hydrocarbon-producing fields and wells in offshore Brazil and the Gulf of Mexico suggest that the most important factors controlling permeability are salt thickness, weld area, and timing. Regional seismic mapping and seismic attribute characterization can be used to predict weld thickness and area. Weld timing can be estimated by analyzing synkinematic thickness variations above salt. Other factors, such as lithology, can also control permeability, but their effects are more variable. If a weld composed of brittle rocks accommodates strain, fractures may form and increase permeability. Conversely, the permeability of a weld containing ductile rocks may be unaffected by strain. Weld geometry can also affect migration; fluid flow is focused toward the crest of an antiformal weld but deflected away from a synformal weld. Understanding these factors prior to drilling can be used to evaluate migration risks associated with salt welds.