Linking Diagenesis and Porosity Preservation to Sequence Stratigraphy of Reservoir Sandstones in the Jauf Formation (Lower Devonian), Eastern Saudi Arabia

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Porosity preservation in deeply buried (present depth 13630'-16830') Jauf Reservoir (Lower Devonian) sandstones is controlled by diagenetic alterations. The spatial and temporal distribution of these diagenetic alterations is linked to the depositional facies and sequence stratigraphic framework. The best quality reservoir sandstones are typically encountered in the tidally influenced channel and estuarine sandstones interpreted as a transgressive systems tract (TST). Poor quality reservoir sandstones are concentrated in the shoreface of a highstand systems tract (HST).

Diagenetic alterations played a critical role in porosity preservation and destruction. Eogenetic alterations include cementation by pyrite, siderite and dolomite, infiltration of grain coating clay, and dissolution and kaolinitization of mica, mud intraclasts and feldspars. The occurrence of kaolinite, mainly in the HST, is attributed to efficient meteoric water flux into sandstones during fall in the relative sea level. Mesogenetic alterations include the formation of illite, chlorite, quartz overgrowths and outgrowths, and ankerite cements; as well as pressure dissolution of quartz grains and transformation of kaolinite into dickite. Illite was formed mainly by the transformation of infiltrated smectite, mud intraclasts and kaolinite, whereas dickite was more resistant towards illitization.

Porosity destruction in the HST sandstones is common due to the prevalence of quartz overgrowths and outgrowths containing small amounts of infiltrated, grain-coating illite. Porosity preservation in the TST sandstones is due to significant amounts of grain coating illite, preventing extensive cementation by quartz overgrowths. This illite coating resulted from the transformation of the ubiquitous infiltrated clays, which are closely linked to the TST and formed by tidal pumping.