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Subsurface Jurassic-Cretaceous Dolomitization Front Mapping and Characterization, Onshore-Offshore Northeastern Saudi Arabia

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Massive dolomite has long been documented in the Upper Jurassic and Lower Cretaceous carbonates in the northern regions (onshore and offshore) of Saudi Arabia. These dolomite bodies are characterized by their stratigraphically discordant geometries. Recently more geologic and seismic data have been acquired. Accordingly, a study with the following aims have been undertaken: (1) re-map the dolomite bodies and refine their spatial-temporal geometries; (2) document diagenesis and reservoir qualities within dolomite bodies and across dolomitization front; (3) define a dolomitization system that helps understand the mechanisms of dolomitization and associated diagenetic processes; and (4) predict reservoir qualities within the dolomitization system. This study benefited from the integration of a variety of data such as core/cutting sedimentology, thin-section petrography, drilling attributes, well logs and seismic attributes. This integrated approach helped not only identify the geometries of dolomite bodies but also to depict their fractured nature.

Preliminary results revealed that the dolomitization system contains: (1) massive dolomite bodies with a spectrum of dolomite textures, varying from very fine to macro-crystalline; (2) a wide range of associated diagenetic processes, including precipitations of ferroan-nonferroan calcite, anhydrite, gypsum, fluorite, kaolinite, silicification (quartz/chert), dedolomitization, emplacement of pyrobitumen-hydrocarbon, and fracturing-leaching; (3) dolomite bodies, which show chaotic seismic reflection characters, and exhibit “*tornado*” geometries when capped with anhydrite seals; and (4) variations in reservoir qualities within dolomite bodies and across dolomitization fronts, which results in reservoir heterogeneities and the potential diagenetic-stratigraphic traps. Two mechanisms have been proposed for onshore and offshore massive dolomitization in terms of their depositional and structural characteristics. This presentation offers our current understanding of the Upper Jurassic–Lower Cretaceous regional dolomitization system and diagenetic processes, and provides great insights for reservoir prediction and potential stratigraphic trap exploration opportunities.