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Fault and Fracture-Related Dolomitization: A Case Study of Upper Jurassic Formations, Northeastern Saudi Arabia

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ABSTRACT

A massive subsurface dolomitization system has been mapped out and characterized from the Upper Jurassic intervals in northeastern Saudi Arabia using data from core, drill cuttings, petrography, fluid inclusion, geochemistry, borehole image logs, seismic interpretations, and drilling attributes. The dolomitization system is characterized by: 1) its stratigraphically discordant geometries, 2) massive dolomite bodies with textures varying from very fine to macro-crystalline, 3) 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; 4) chaotic seismic reflection characters and high density of fractures in contrast with adjacent non-dolomitized limestones, and 5) variations in reservoir qualities within dolomite bodies and across dolomitization fronts. Fluid inclusion and isotopic data, plus the evident fractured nature of the dolomite, indicate that these subsurface dolomite bodies may have been generated/altered from hot hypersaline fluids that were driven by tectonic events through faults and fracture conduits. An integration of common practice of petrographic and geochemistry with seismic attributes, drilling and imaging logs provides a powerful tool for characterizing subsurface dolomitization system, which in turn assists: 1) better understanding of dolomitization mechanisms and associated diagenetic processes; 2) better prediction of reservoir qualities within the dolomitization system and surrounding areas; and therefore 3) exploration of subtle traps that are likely controlled by stratigraphic and diagenetic variations.