Implications of Conceptual and Numerical Modeling of Dolomitization for Reservoir Characterization

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This contribution provides new insights into numerical modeling of dolomitization following two approaches (geostatistical and geochemical transport reactive), and attempts to express conceptual models of diagenesis, such as dolomitization, in more quantitative terms. Classical diagenesis studies make use of a wide range of analytical techniques in order to suggest conceptual models that explain specific, relatively time-framed, diagenetic processes and their impacts on reservoirs. Still, these models are qualitative and do not yield "real" data for direct use by reservoir engineers for rock-typing and geo-modeling.

A 3D geostatistical model representing the Ranero dolomitized Cretaceous platform carbonates was constructed, covering an area of 8x2km and a depth of 6km (Cantabrian mountain chain, northern Spain). It is based on interpretation of aerial photographs, geological and topographic maps, as well as field observations. The resulting 3D block included the stratigraphical units, fractures and the dolomite bodies. Geostatistical simulations succeeded in reproducing the dolomitized pattern. A relationship was set to restrict the presence of dolostones to the fractures at depth. A 2D geochemical transport reactive model was built to represent a dolomite front (~350m long; cells: 5x1m) in the Marjaba Jurassic platform carbonates (Lebanon, Middle East). Two aquifer analogues for the end-members of the mixed dolomitized fluids were chosen according to their similar sedimentological character, mineralogical compositions and ambient temperatures to the expected sources of evaporative marine-related waters and hydrothermal fluids.

The geostatistical model helped in illustrating the relationships between the hydrothermal dolomite distribution and the fracture pattern. Numerical reactive transport simulations are valuable not only for predicting dolomite texture (porosity/permeability) distribution but also for validating the prescribed dolomitization model. This study provides means to predict fracture-related HTD distribution and related evolved reservoir properties, achieving, hence, better reservoir characterization.