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Fault-related dolomitization in the Orpesa Ranges (Iberian Chain, E Spain): reactive transport simulations and field data constraints

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The relationships between hydrothermal fluid circulation and fracturing that lead to mineral dissolution and/or precipitation in carbonate rocks have direct impacts on the evolution and final distribution of hydrocarbon reservoir permeability. Understanding the coupling between these processes is important for predicting permeability and improving hydrocarbon recovery. We present a case study of dolomitization processes in Cretaceous limestone from the Orpesa Ranges (Iberian Chain, E Spain).

Extending over part of the Maestrat Cretaceous Basin, the Orpesa area is deformed by extensional faults. These faults accommodated thick sequences of shallow marine limestone, mainly during Aptian times. The syn-rift carbonates are partially dolomitized due to the circulation and mixing of hydrothermal fluids along normal faults and bedding. Both Aptian and later Neogene extensional faults must have served as conduits for the circulation of fluids. MVT deposits of Paleocene age are well documented in the Maestrat basin and may also be related to dolomitization. Samples of host rocks and vein fillings have been collected along strike and analyzed in different fault sections to characterize fluid and rock composition, track flow pathways and map the relationships of fluid flow with respect to the main normal faults in the area.

Using field and geochemical data from the Orpesa Ranges carbonates, we have developed reactive-transport models to study the influence of different parameters in the dolomitization of carbonates related to the circulation and mixing of hydrothermal fluids at the outcrop scale. We present results from models that were run with constant and non-constant permeability. The main parameters analyzed include: initial porosity and permeability of layers and fractures, composition of fluids, groundwater and brines flux, composition of layers, reactive surface of minerals, differences in vertical and horizontal permeability, and presence or absence of stratigraphic barriers.