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Dolomitization and over-dolomitization in the Vajont limestone (Dolomiti Bellunesi, Italy) controlled by Mesozoic normal faults: a microstructural and diagenesis study

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The Vajont Gorge (Dolomiti Bellunesi, Italy) provides spectacular outcrops of Jurassic limestones (Vajont Limestone Formation) in which Mesozoic faults and fracture corridors are continuously exposed. Some of these faults acted as conduits for Mg-enriched hydrothermal fluids resulting in structurally-controlled dolomitization of the limestone. The dolomitization resulted in several dolomite bodies (100-200 m thick and several hundreds of meters along fault strike) that are particularly interesting as reservoir analogues for hydrocarbon, CO_2, or water-bearing systems.

The dolomitization process occurred after deposition and compaction of the oolitic limestone (dolomitization post-dates a dissolution event that affected the internal parts of the oolites), but before the Alpine contractional deformation. In fact, the meso-structural data collected in the Vajont Gorge allowed the reconstruction of a 3D model showing that the circulation of the dolomitizing fluids into the limestone host rock, but also the late stage of porosity reduction (strong pore filling due to over-dolomitization) were controlled by normal faults and fracture corridors interpreted as Pre-Alpine (Jurassic or Cretaceous).

Later on, the influence of Alpine (Tertiary) deformation have been very limited in the studied volume. For instance dolomite veins are sometimes overprinted by bed-inclined stylolites consistent with Alpine shortening axes, but no large Alpine fault is present in the studied outcrops.

Cathodoluminescence microscopy allowed recognizing different growth stages saddle dolomite crystals, which point to varying precipitation conditions during three main stages of dolomitization.

Dolomite and calcite crystal twinning suggests deformation under increasing temperature conditions, consistent with intracrystalline plasticity deformation mechanisms.

The presence of cataclasites composed of hydrothermal dolostone clasts, in turn cemented by dolomite, or of dolomite veins and compaction/deformation bands in high porosity dolomite bodies, is an additional argument pointing to the close interaction between tectonic deformation and fluid circulation. Particularly, it shows how tectonics controlled fluid circulation both in the first stages of dolomitization, when porosity was created, and in later stages, when porosity was strongly reduced due to over-dolomitization.

The microstructure of fault breccia suggests a high-pressure of injected fluids and is useful to reconstruct the chronology of events involved in the formation and evolution of dolostone bodies.

A study of quasi-steady-state (e.g. crack and seal) vs. episodic/seismic (mass precipitation, cavitation) deformation processes is under way to investigate the possible correlation between fluid injection events and the progressive slip on faults.