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Shallow-burial hydrothermal dolomitization: lessons from the Western and Central Alps

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Several examples of shallow burial hydrothermal dolomitization have been recently documented in Mesozoic successions cropping out in different sectors of the Western and Central Alps and belonging to both the European and the Adriatic palaeo rifted margin of the Alpine Tethys. We will discuss three different case studies where dolomitization was due to a deep, fault-related hydrothermal circulation developed in different geodynamic settings:
- the Middle Triassic–Berriasian Provençal succession of the French–Italian Maritime Alps (European paleo rifted margin), which was intensely dolomitized during the earliest Cretaceous by hot fluids (T $\sim$ 200°C) circulating through regional strike-slip fault systems;
- the Middle Triassic–Pliensbachian Southalpine successions of NE Piemonte (Sostegno, Monte Fenera), affected by dolomitization phenomena related to circulation of hot fluids (T > 80°C), probably along normal faults developed during Early Jurassic rifting in the distal Adriatic paleomargin;
- the Upper Triassic pre-rift carbonates of the distal Adriatic paleomargin preserved in the Lower Austroalpine Err Nappe (Switzerland), affected by hydrothermal dolomitization related to circulation of hot fluids (T $\sim$ 130°C) in the first, Late Triassic-Early Jurassic, rifting phases (e.g. prior the exhumation of the crystalline basement along low-angle detachment faults).
Solid arguments based on stratigraphy and cross-cutting relationships allow to chronologically constrain the dolomitizing events. It will be also shown that these processes are not related to migration of brines during deep burial but took place at a very shallow depth (from a few tens to a maximum of some hundred metres) where fluid temperatures were relatively high (>100°C). They are therefore examples of a true hydrothermal dolomitization which caused both the replacement of the host rock and the cementation of veins and hydraulic breccias by very coarsely crystalline saddle dolomite cement. In spite of some differences due to the timing of the dolomitizing events and the geodynamic settings, these case studies invariably show peculiar geochemical signature pointing to a deep fluid circulation developed along major tectonic structures, commonly rooted in the crystalline basement, which had to be coupled with anomalously high geothermal gradients. Recognition of hydrothermal dolomitization phenomena in fossil continental margins, which possibly have been greatly overlooked in the past, can represent an important evidence of episodes of tectonic activity associated with increased heat fluxes in the shallowest parts of the rock column which is in turn related to perturbations of the thermal regimes.