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Incomplete Ostwald ripening in Triassic primary dolomites

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The primary formation of dolomite in ancient evaporative environments is difficult to trace, as often dolomitization is a result of later diagenetic overprint. Recently Preto et al. (2015) found evidence of primary dolomite in dolomites of the Carnian Travenanzes Fm. in the Venetian Alps. This geological unit experienced very little tectonic overprint, which increases the chance to preserve pristine sedimentary structures, petrographic textures and crystallographic microstructures as well as mineralogy. The studied section contains homogeneous, nodular and laminated dolomite beds, intercalated in a 100-m-thick sequence of alluvial clay. A "primary" origin of these dolomites is suggested by the presence of nano-crystalline structure of some crystal aggregates, identified by transmission electron microscopy (TEM). Hence, primary dolomites of the Travenanzes Fm. provide a unique window to interrogate past processes and environmental conditions conducive to dolomite formation.

Our new studies by electron microscopy showed a fine-grained dolomicrite matrix consisting of micrometre sized subhedral to euhedral crystals, which are commonly surrounded by an outer rim entirely filling the interstices. Further analysis by electron backscatter diffraction (EBSD) mapping on polished thin sections revealed that the outer rims represent syntaxial cement that formed during dolomite mud lithification.
EBSD mapping revealed a bimodal size distribution of dolomite grains. Larger grains commonly have a round or irregular shape. To further examine the crystallographic features by high-resolution TEM, a 50 nm thick foil was extracted from one of the larger grains using focused ion beam milling (FIB). Based on the EBSD data the FIB section was oriented so that the c-axis of the dolomite crystal is perpendicular to the foil plane. TEM analysis revealed structures of nanoparticles, which are however embedded in larger domains with more or less unique crystallographic orientation.

Based on our observations, we suggest that nanocrystal aggregation is one of the nucleation and growth pathways for dolomite formation, and that this mechanism operated in the Travenanzes depositional environment. Primary porosity was then filled by syntaxial dolomite. The Travenanzes dolomite has not been pervasively affected by Ostwald ripening, which supports the notion that they are truly primary precipitates preserved within a Triassic clay-rich sequence.

Preto, N. et al. (2015) Sedimentology 62, 697-716.