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Reconstructing conditions during dolomite formation on a Carnian coastal sabkha/alluvial plain using 87Sr/86Sr isotopes - Travenanzes Formation, northern Italy

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The study of large amounts of dolomite that formed in the Triassic Tethyan realm is hampered by late diagenetic or hydrothermal overprint. These dolomites are difficult to link to past environmental and early diagenetic conditions, and their correlation to models for dolomite formation in modern environments is problematic. Preto et al. (2015) suggested, based on evidence from nano-scale structure analysis by transmission electron microscopy and petrographic observations, that dolomites in the Carnian Travenanzes Formation of the Southern Alps (Dolomites area) represent a preserved primary phase. The Travenanzes Formation was deposited in an extended alluvial plain or coastal sabkha environment subject to a semi-arid climate. Beds and nodules of nearly stoichiometric dolomite are embedded in large amounts of clay, which shielded early formed dolomite from diagenetic fluids.
This finding of penecontemporaneous dolomite provides an ideal model case for reconstructing past environmental conditions at the time of dolomite precipitation. While Preto et al. (2015) argued that dolomite formation was mediated by extracellular polymeric substances produced by sulphate-reducing bacteria, it remains unclear whether precipitation occurred from evaporating seawater or mainly from brine derived from evaporating continental groundwater. Both cases exist in modern environments of dolomite formation. In the coastal sabkhas of Abu Dhabi and Qatar, dolomite precipitates from concentrated brine derived from seawater, either through seepage and reflux or through evaporative pumping (the sabkha model). In the coastal ephemeral lakes of the Coorong Lagoon system (South Australia) dolomite precipitation occurs from evaporating groundwater.
The goal of this study is to distinguish marine from continental influence during formation of Carnian dolomite using 87Sr/86Sr isotope ratios. Sr isotopes could reveal different origins of ionic solutions for dolomite precipitation, which is not indicated by oxygen isotopes. The marine 87Sr/86Sr values have been reconstructed for most of the Phanerozoic and are nearly constant in the Carnian (McArthur et al., 2012), while the age of the dolomite beds of the Travenanzes Formation is constrained by their stratigraphic position in the measured section (Dibona Section; Preto et al., 2015). The continental Sr isotope signal is governed by weathering rates, especially during silicate weathering of the source rock in the catchment area (McArthur et al., 2012). Through 87Sr/86Sr isotope investigation of primary dolomite in beds and nodules of the coastal sabkha or alluvial plain environment, the influence of marine or continental conditions can be determined. The finding of celestine SrSO4 and Sr-rich barite BaSO4 within the cemented dolomite by SEM indicates enrichment of Sr, possibly during strong evaporative conditions. Hence, the generation of phase-specific Sr-isotope data will allow for a more precise reconstruction of the conditions that led to dolomite formation in the Triassic shallow coastal sabkha/alluvial plain environment.
McArthur et al. (2012) Strontium isotope stratigraphy. In: “The geologic time scale” (F.M Gradstein et al., eds.), Elsevier, p. 127-144.
Preto et al. (2015) Primary dolomite in the Late Triassic Travenanzes Formation Dolomites, Northern Italy: Facies control and possible bacterial influence. Sedimentology 62, p. 697-716.