# Why are sedimentary dolomites disordered and metastable?

ANDRE BALDERMANN[1], ARTUR P. DEDITIUS[2],
MARTIN DIETZEL[1], VANESSA FICHTNER[3],
CORNELIUS FISCHER[4], DOROTHEE HIPPLER[1],
ALBRECHT LEIS[5], CLAUDIA NICKEL[6],
VASILEIOS MAVROMATIS[1] AND HARALD STRAUSS[3]

[1]Institute for Applied Geosciences, Graz University of Technology, Graz, Austria; baldermann@tugraz.at
[2]School of Engineering and Information Technology, Murdoch University, Murdoch, Australia
[3]Institut für Geologie und Paläontologie, Westfälische Wilhelms-Universität, Münster, Germany
[4]MARUM/FB Geowissenschaften, Universität Bremen, Bremen, Germany
[5] RESOURCES - Institute of Water, Energy and Sustainability, Joanneum Research, Graz, Austria
[6]Institute of Technology and Testing of Building Materials, Graz University of Technology, Graz, Austria

The formation of modern non-stoichiometric and highly disordered (proto)dolomite occurs mainly in evaporitic and marine-anoxic, organic-rich sediments dominated by bacterial sulfate reduction (BSR). The dissolution and subsequent recrystallization of the metastable (proto)dolomite into more stoichiometric and well-ordered dolomite during burial diagenesis results in the reset of their orginal (micro)textural and (isotope) geochemical signatures. Here, we investigated a succession of Upper Jurassic partly dolomitized limestone and dolostone deposited on a stable carbonate platform at Oker (Central Germany) in order to elucidate the role of trace elements (S, Sr, Fe, Mn, Na) and BSR during the formation, maturation and burial of dolomite in ancient marine settings.

The $\delta^{18}O$, $\delta^{13}C$ and $\delta^{34}S_{CAS}$ isotope data set (+1.4 to +2.9‰ for $\delta^{18}O$, V-PDB, -0.1 to +2.0‰ for $\delta^{13}C$, V-PDB and +17.9 to +19.7‰ for $\delta^{34}S_{CAS}$, V-CDT) and the trace element distribution (300-400 ppm of Na, ~200 ppm of Sr and 100-900 ppm of Fe+Mn) of the Oker dolomite suggest that dolomitization progressed by the early diagenetic replacement of pre-existing magnesian calcite at moderate temperatures between 28°C and 39°C. The dolomitization fluid was a pristine-marine to slightly evaporitic and reducing seawater. The anti-correlation between decreasing carbonate-associated sulfate (CAS) contents in dolomite, from 1950 to 1050 ppm, and increasing ordering ratio, from 0.34 to 0.50, of the dolomite lattice structure indicates the important role of BSR during the formation and maturation of the dolomite. Thus, it is suggested that the CAS content of modern (proto)dolomites predefines its (meta)stability during burial diagenesis.