



Bacterial sulfate reduction is the driving force for dolomite precipitation: New insights from CAS contents and $\delta^{34}\text{S}_{\text{CAS}}$ signatures of sedimentary dolomites

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Recent advances in the understanding of the underlying reaction pathways and environmental controls inducing the precipitation of dolomite in mostly marine and early diagenetic sedimentary environments suggest that bacterial activity and bacterial sulfate reduction are key processes during the dolomitization of magnesian CaCO_3 precursors at ambient temperatures [1]. However, in evaporitic and marine-anoxic, organic-rich sediments the precipitating dolomite is usually non-stoichiometric, highly disordered and metastable and is thus often referred to as (proto)dolomite. Subsequent multiple recrystallization of the (proto)dolomite during burial diagenesis is currently suggested to result in a more stable (stoichiometric and ordered) type of dolomite. On the basis of (micro)textural and (isotope)geochemical signatures of pure dolostone and partly dolomitized platform carbonates exposed in the Upper Jurassic rock succession at Oker (Northern German Basin), we highlight here the important role of bacterial sulfate reduction on the formation of sedimentary dolomite. Our results indicate that the Oker dolomite has been formed by the early diagenetic replacement of pre-existing magnesian calcite and aragonite precursors through reaction with pristine-marine to slightly evaporitic and reducing seawater at temperatures between 26 °C and 37 °C. The elevated $\delta^{34}\text{S}_{\text{CAS}}$ values, from +17.9 to +19.7 ‰ (V-CDT), of the Oker dolomite, relative to the ambient Upper Jurassic seawater, indicate that bacterial sulfate reduction was active during dolomite precipitation. Moreover, the linear anti-correlation ($R^2 = 0.98$) between decreasing CAS content (~ 1000 - 2000 ppm) in dolomite and increasing degree of cation order (~ 0.35 to 0.50) of the dolomite lattice structure suggests that, besides temperature and diagenetically driven recrystallization events, incorporation of CAS during co-precipitation of dolomite significantly affects the composition, structure and stability of modern and ancient sedimentary dolomites [2]. This observation might explain why modern (proto)dolomites enriched in CAS are characterized by a pronounced low ordering degree and metastability and therefore tend to recrystallize during burial diagenesis, thereby resetting their pristine (isotope)geochemical and petrographic signatures of formation.

[1] Bontognali et al. (2010). *Sedimentology*, 57, 824-844.

[2] Baldermann et al. (2015). *Chemical Geology*, 412, 1-14.