MITT.ÖSTERR.MINER.GES. 161 (2015)

HIGH-RESOLUTION SEM STUDY OF AUTHIGENIC HIGH-MG CALCITE AND (PROTO-) DOLOMITE OF LAKE NEUSIEDL (AUSTRIA)

Zünterl, A.[1], Neuhuber, S.[2], Kogelbauer, I.[2], Ottner, F.[2], Dietzel, M.[1] & Hippler, D.[1]

[1]Technische Universität Graz, Inst. Applied Geosciences, Rechbauerstraße 12, 8010 Graz, Austria
[2]Universität der Bodenkultur, Inst. Applied Geosciences, Peter-Jordan-Straße 70, 1190 Wien, Austria
e-mail: dorothee.hippler@tugraz.at

Lacustrine environments provide an ideal setting to study the formation of authigenic high-Mg calcite/(proto-) dolomites. Within these settings carbonate mineral formation is highly controlled by the saturation state and reaction kinetics depending on e.g. (1) alkalinity, due to physico-chemical conditions or microbial activity, (2) degree of evaporation, and/or (3) mixing of different water bodies. Here, we present new results on the formation of authigenic carbonate precipitates of Lake Neusiedl (Austria) that were first noted in the early 70's. We performed high-resolution imaging and mapping on different size fractions of five sediment samples of Lake Neusiedl applying field emission SEM, equipped with SE and BSE detectors and an EDX system. The aim of our study is to better understand the mechanisms controlling the formation of Mg-rich carbonates in Lake Neusiedl, as a case study for low temperature (proto-) dolomite formation environment by investigating mineralogical and chemical composition, as well as their microstructure.

We found clear evidence for the authigenic origin of the investigated high-Mg calcite/(proto-) dolomites, which form spherical aggregates ranging in size from 0.4 μm to 3 μm. These aggregates are made of (i) cauliflower-arranged amorphous or cryptocrystalline precipitates or (ii) nano-sized rhombs ($\leq$ 0.2 μm). BSE imaging reveals no zoning, but homogenous distribution of Ca and Mg ions in the carbonate phases. The evaluation of the Mg to Ca ratio yields two types of high-Mg carbonate phases: Type 1 represents (proto-) dolomites with excess Mg over Ca (Mg:Ca = 1.1 to 1.5), and type 2 consists of the high-Mg carbonate solid phase calcite with a Mg:Ca ratio of 0.7. Interestingly, the sediment also contains framboidal pyrite besides quartz, feldspar, mica (smectite), and low-Mg calcite.

According to our findings, we propose that an amorphous precursor phase initiates precipitation of the Mg rich carbonate phase, which subsequently form (proto-) dolomite by suggesting dissolution-reprecipitation reactions. The occurrence of framboidal pyrite points to bacterial sulfate reduction, which likely stimulates high-Mg carbonate/(proto-) dolomite precipitation in particular in respect to the high alkalinity and elevated Mg/Ca ratio (> 5) of the solution of Lake Neusield.

D.H., M.D. and A.Z. kindly acknowledge financial support through the TU Graz Anschub-finanzierung. We also thank S. Simic (FELMI) and G. Auer (Universität Graz) for assistance during SEM analyses. This is a contribution to NAWI Graz.