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Mineralogy, Isotopic Characterization, and Age of Authigenic High-Mg Lake Carbonate

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Authigenic high-Mg calcite and poorly crystallized dolomite is found in the sediments at Lake Neusiedl, Austria. The lake is a shallow lake with a maximum depth of 1.8 m. Sediment reworking is strongly influence by wind where waves may at times reach the sediment-water interface. The sediments are fine grained (mainly silt and clay) that rest upon Neogene (Pannonian) strata. The source area today consists of metamorphic rocks and Neogene carbonates but has changed over time. To separate detrital from authigenic phases we first determine the mineralogy of size fractions <4 μm, <3 μm, <2 μm, <1 μm, <0.5 μm and <0.2 μm. The "coarser" fractions (4 μm and 3 μm) contain detrital minerals such as chlorite, muscovite, quartz, feldspar, stiochiometric calcite, and stoichiometric dolomite. In contrast, the smaller size fractions (1 and 0.5 μm) lack stoichiometric carbonate - only carbonate phases with varying Mg content and smectite are present.

To characterize the composition of those authigenic carbonate phases we use X-Ray Diffractometry, Simultaneous Thermo Analysis, Fourier Transform Infra Red Spectroscopy, stable C and O isotopes and 14C activities in carbonate. The content of Mg in the carbonate lattice determines the solubility of carbonate where phases with lower Mg are more soluble. We investigate the stable carbon and oxygen isotope data with varying reaction time during H3PO4 dissolution. Stable C and O ratios were measured at 3 min, 5 min, 15 min, and 20 min reaction times. Radiogenic carbon was measured in CO_2 produced sample dissolution.

Different size fractions of one sample show mixing lines for stable carbon isotopes (vs. VBDB) and stable oxygen isotopes. The d13C values range between -3.8 permil in the finest fraction and -2.9 permil in the coarsest fraction. Stable oxygen isotopes also show a mixing line between -3.8 permil in the finest fraction and coarser samples (-0.85 permil). The stable oxygen content in the lake water lies at -3.8 permil.
Time dependent dissolution of several samples does not indicate a pattern that is coherent for all samples but each sample has to be interpreted independently. In particular one sample showed an increase of 1 permil in both C and O isotopes, the others remain fairly constant with increasing reaction time.

Radiogenic carbon ages lie at 89 % modern cabon (0.2 and 0.5 μm fraction) and 72 % modern cabon (4μm fraction). This corresponds to an age of 850 yBP for the fine fractions and 2 300 yBP for the coarsest fraction. The increase in age with increasing grain size proves that the carbonate was formed by precipitation.