Carbonate mineralization in shallow Lake Balaton

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Calcite precipitates in hardwater lakes as a result of CO_2 consumption by algae through photosynthesis. Lake Balaton has a large surface area (~600 km^2) but an average depth of only ~3.5 m. Its sediment is dominated by carbonate minerals, including Mg-calcite that precipitates from lakewater, aragonite from shells, diagenetic 'protodolomite' and allochtonous calcite and dolomite [1]. We studied various aspects of carbonate formation relevant for the biogeochemical cycles in the lake: the relationships between Mg-content, crystal structure, particle size and morphology, the potential autochtonous formation of dolomite, the roles of organisms in nucleating and reprocessing mineral matter, and the association of P with the carbonate minerals.

Both sediment cores and freshly precipitated material were collected, either by placing sediment traps under the ice (in order to avoid the resuspension of sediments by wind-driven turbulence) or by filtering lakewater. Mg incorporation into calcite was studied by X-ray powder diffraction analysis of d(104) spacings. Particle morphologies, microstructures and compositions were observed using scanning and transmission electron microscopies. The Mg content of calcite increases from west to east in the lake, reflecting a gradient in water composition. Mg-calcite particles are elongated, few μm-large aggregates in which the crystallites occur in a consensus crystallographic orientation. Smaller, euhedral dolomite crystals also occur in the sediment traps; in places their cell parameters slightly differ from those of stoichiometric dolomite. Concerning the roles of organisms in mineral precipitation, no evidence has been found for the microorganism-assisted nucleation of Mg-calcite; however, the reprocessing of mineral matter by filtering organisms (zooplankton and mussels) typically produces pellets of several hundred μm in size that are major constituents of the sediment. Studies are in progress to map the distribution of P in the various carbonate minerals, and to explore the origin of the dolomite that has anomalous lattice prameters [2].

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