Templated nucleation and growth of calcite in a freshwater environment

ROSTÁSI, Á.[1], MOLNÁR, ZS.[2], FODOR, M.[1], BERECZK-TOMPA, É.[1], VÁCZI, T.[2], PÓSFAI, M.[1]

[1] Department of Earth and Environmental Sciences, University of Pannonia, Veszprém, Hungary; mihaly.posfai@gmail.com

[2]Department of Mineralogy, Eötvös Loránd University, Budapest, Hungary

Both inorganic and microbial processes play important roles in carbonate mineral precipitation in freshwater lakes. Identifying the individual factors that determine particle size and shape, composition, and the spatial relationships of carbonates with other constituents of the sediment can be challenging but important for both understanding nutrient cycling and providing input for lake management planning. We studied the formation of Mg-bearing calcite in Lake Balaton, a large, shallow, Mg-rich calcareous lake in Hungary [1], by collecting particles from the water and by performing laboratory precipitation experiments.

Mg-calcite particles from Lake Balaton have distinct and remarkably consistent morphologies, independent of seasonal and annual variations in water temperature and composition. They are typically elongated parallel to [001], are about 4 to 8 μm long, and even though appear to be composed of many smaller crystals, electron diffraction patterns indicate they are perfect single crystals. The calcite crystals are invariably attached to nm-scale flakes of smectite, suggesting that the clay mineral serves as a nucleation site. The templated nucleation may also direct the further growth of calcite parallel to the clay flakes, resulting in its elongated shape. We confirmed the templated nucleation of calcite by lab experiments in which diatoms were added to filtered lakewater (to reach supersaturation through photosynthesis), and calcite precipitation was successfully induced by adding smectite. While in deep, oligotrophic lakes calcite typically nucleates on picoplankton cells [2], we rarely observed this phenomenon in Lake Balaton. Because of the shallowness of the lake, sediments are stirred up by even gentle winds and the movement of organisms, making nm-scale smectite flakes readily available for Mg-calcite nucleation. Thus, while Mg-calcite precipitation is an indirect consequence of biological activity (photosynthesis), the physical properties of the particles are primarily determined by inorganic factors. [3]

[1] Tompa et al. (2014) *Central Eur. Geol*. 57, 113-136. [2] Dittrich et al. (2004) *Geomicrobiol. J*. 21, 45-53. [3] This research was supported by NKFIH grants K116732 and PD121088.