



Authigenic carbonate precipitation in Lake Acigöl, a hypersaline lake in southwestern Turkey

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Lake Acigöl (Bitter Lake) is a hypersaline lake in southwestern Turkey at an elevation of 836 m above sea level showing authigenic precipitation of several different carbonate mineral phases. It is a perennial lake and closed drainage basin where a semiarid continental climate dominates. Due to the extreme water chemistry (salinity 8-200 mg/l; SO₄ 112-15232 mg/l; Cl 290-35320 mg/l; Mg, 82-3425 mg/l; Ca 102-745 mg/l) unique microorganisms flourish in the lake. We studied microbial diversity from enrichment cultures and performed precipitation experiments using similar water chemistry and adding bacterial enrichment cultures from lake sediments in order to elucidate whether the mineral assemblages found in the lake can be reproduced. Experiments using moderately halophilic bacteria obtained from the lake sediments demonstrate the formation of various calcium-/magnesium-carbonates: hydromagnesite, dypingite, huntite, monohydrocalcite and aragonite. The relative amounts of different mineral phases, particularly monohydrocalcite, hydromagnesite and dypingite, could be controlled by varying the sulphate concentration in the media from 0 to 56 mM. The similar mineral assemblages identified in the sediments of Lake Acigöl and in the experiments point to similar thermodynamic conditions and kinetics of crystal growth. In particular, the similar spherical morphology points to a rapid crystal growth under strong kinetic inhibition, possibly by organic polymers that are commonly produced by microbial communities. Our results demonstrate that the authigenic carbonate paragenesis of hypersaline lakes as Lake Acigöl can be reproduced in halophilic bacterial cultures. The exact thermodynamic conditions and precipitation kinetics under seasonally changing water chemistry or in batch experiment, however, still have to be constrained in order to establish a microbial model for carbonate precipitation in such environments.