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Effect of Mg/Ca ratios on microbially induced carbonate precipitation

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Influence of Mg/Ca ratios on microbially induced carbonate mineralogy were investigated by series of experiments carried out under various environmental conditions (Mg/Ca ratio, temperature and salinity). Halophilic bacterial cultures used for biomineralization experiments were isolated from hypersaline Lake Acıgöl (Denizli, SW Turkey), displaying extreme water chemistry with an average pH around 8.6 (Balci eta l.,2015). Enriched bacterial culture used in the experiments consisted of Halomonas saccharevitans strain AJ275, Halomonas alimentaria strain L7B; Idiomarina sp. TBZ29, 98% Idiomarina seosensis strain CL-SP19. Biomineralization experiments were set up using above enriched culture with Mg/Ca ratios of 0.05, 1, 4 and 15 and salinity of 8% and 15% experiments at 30oC and 10oC. Additionally, long-term biomineralization experiments were set up to last for a year, for Mg/Ca=4 and Mg/Ca=15 experiments at 30oC. For each experimental condition abiotic experiments were also conducted. Solution chemistry throughout incubation was monitored for Na, K, Mg, Ca, bicarbonate, carbonate, ammonium and phosphate for a month. At the end of the experiments, precipitates were collected and morphology and mineralogy of the biominerals were investigated and results were evaluated using the software DIFFRAC.SUITE EVA. Overall the preliminary results showed chemical precipitation of calcite, halite, hydromagnesite and sylvite. Results obtained from biological experiments indicate that, low Mg/Ca ratios (0.05 and 1) favor chlorapatite precipitation, whereas higher Mg/Ca ratios favor struvite precipitation. Biomineralization of dolomite, huntite and magnesite is favorable at high Mg/Ca ratios (4 and 15), in the presence of halophilic bacteria. Moreover, results indicate that supersaturation with respect to Mg (Mg/Ca=15) combined with NaCl (15%) inhibits biomineralization and forms chemical precipitates. 15% salinity is shown to favor chemical precipitation of mineral phases more than 8% salinity. At 10oC, struvite dominates the Mg/Ca=4 system, contrary to same conditions at 30oC. Long-term experiments (Mg/Ca=4, 15% NaCl) showed that, dolomite precipitation is favored over time with elevated pH values (pH: 8-9).

Key words: Lake Acıgöl, enrichment cultures, halophilic bacteria, autogenic carbonate, biomineralization, Mg/Ca ratio.

References

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