Carbon cycling in hypersaline lake of Acıgöl as inferred from C isotopes of carbonates

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The formation of carbonate in aerobic culture experiments by using two different mix aerobic halophilic cultures isolated from hypersaline lake Acıgöl , SW Turkey were studied under various aqueous Mg/Ca ratios (0.05 to 5) in addition to salinity (4.5-15 %). These two different mix halophilic cultures were able to promote the precipitation of similar mineral phases (aragonite, monohydrocalcite, huntite, dypingite, struvite and hydromagnesite) that were undersaturated in the media or kinetically inhibited. Aragonite, monohydrocalcite, huntite, dypingite and struvite were only precipitated in liquid culture experiments in different proportions and at different times whereas dypingite and hydromagnesite precipitated in solid media and hydromagnesite even become single mineral with time and increasing Mg ratios. $\delta^{13}C$ composition of the carbonates showed differences between liquid and solid culture experiments. Carbonates rich in Mg enriched in ^{13}C 7 ‰ relative to carbonates rich in Ca. Furthermore, carbonates precipitated in solid media enriched in ^{13}C compared to those from liquid cultures that reflected $\delta^{13}C$ value of atmosphere. The ^{13}C isotope values of the recent sediment at (0-10 cm) and 20 cm are -10.2 ‰ and -12.6 ‰ at 20 cm, respectively and correlated well with $\delta^{13}C$ values of Ca rich carbonates from liquid culture experiments. Carbonates mineral assemblages identified in the experiments seem to be independent of type of microorganisms whether is controlled by the chemical composition and physical conditions of the media. The relative amounts of monohydrocalcite, hydromagnesite, and dypingite, are controlled by varying the media sulfate concentration from 0 to 56 mM. This demonstrates a kinetic effect that could similarly affect the mineral assemblage in the lake. Also the spherical morphology of hydromagnesite points to growth of these minerals under partial inhibition in the brine under high concentrations of ions and organic polymers produced by the microbial communities. As reproduced by the culture experiments, the authigenic carbonate mineral assemblage of Lake Acıgöl most likely results from interplay of ionic composition of the brine and microbial effects.