Dolomite Formation in Anoxygenic Photosynthetic Microbial Biofilms

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Presently, dolomite precipitates either in hypersaline environments or in the presence of methanogens or sulphate reducing bacteria. However, these modern processes fail to explain the fine microbial textures found in microcrystalline dolomite from Archean and Proterozoic microbialites. We explored alternative conditions that could have promoted dolomite precipitation during this time period, and managed to reproduce this process in anoxygenic photosynthetic biofilms. The presence of dolomite and calcite was confirmed by both Synchrotron micro-focused X-ray diffraction (μXRD) and X-ray Adsorption Near Edge structure (μXANES) spectroscopy. XRD results demonstrated a heterogenous multiphase dolomite. Nanocrystalline dolomite and calcite precipitated immediately around microbial cells, indicating a high preservation potential of fine microbial textures and structures. The presence of light, 0.1-1 mM manganese and 0.02-0.25 mM sulphide concentrations promote the formation of dolomite, calcite is more abundant at 1 mM concentration of sulphide. Illumina sequencing of enrichment cultures showed the presence of the strictly anaerobic phototrophs from the phylum *Chlorobi* and other anaerobic organisms. These findings demonstrate that primary dolomite can form under conditions that may have preserved primary textures of photosynthetic biofilms on Early Earth.