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Controls on modern microbialite calcium and magnesium stable isotopic compositions from Storr's Lake, San Salvador Island, The Bahamas with implications for the rock record

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Modern microbialites grow within the hypersaline, turbid, low alkalinity, high magnesium (Mg) and calcium (Ca) concentration (and Mg/Ca ~4.5), shallow (less than 2 meters deep) Storr's Lake on San Salvador Island, The Bahamas. Rather than growing via the trapping and binding of sediments, these largely micritic microbialites form via microbial processes, both photosynthetic and heterotrophic, creating crusts and mounds with laminated to clotted structures that could be preserved in the rock record. Previous carbon (C) isotopic measurements of the microbialite $CaCO_3$ suggest both photosynthesis (evidenced by higher $d^{13}C$ values) and extracellular polymeric substance degradation (evidenced by lower $d^{13}C$ values) control organo-mineralization, but this C isotopic signature may not be preserved in the rock record. Processes controlling organo-mineralization may also be recorded by other stable isotopic systems, like Mg and Ca isotopes investigated here along with trace element composition and X-ray diffraction data to identify mineralogy of the carbonate. In the irregular upper surfaces of the microbialite mounds, high-Mg calcite (~14 mol% Mg) dominates while aragonite occurs in the interior of the mound. Aragonite is found in all eleven sampled microbialites from around the lake except one of the shallowest mounds (40 cm water depth to the top of the mound). The Ca and Mg isotopic compositions of two mounds collected from deeper parts of the lake (60 cm and 110 cm water depth to the top of the mound) are controlled by mineralogy, unlike $d^{13}C$. None of the isotopic systems analyzed simply reflect the lake water (or seawater), which has implications for the use of microbialites as proxy archives. We utilize numerical simulations of carbonate authigenesis and recrystallization to investigate the basic controls on the preservation of isotopic compositions during early diagenesis.