

A geobiological model for the formation of dolomite in sabkha-environments

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Research conducted in the coastal sabkhas of the Arabian Gulf lead to the formulation of a well-known model for dolomite formation: the “sabkha model”. Simplifying, sabkhas form in coastal embayments that are progressively filled with evaporitic precipitates including major proportions of authigenic aragonite. Toward the supratidal zone, supersaturation with respect to gypsum and anhydrite is reached due to extreme evaporation. Precipitation of such Ca-sulfate minerals increases the Mg/Ca ratio of pore-waters, which is traditionally considered as the key factor triggering a diagenetic replacement of aragonite by dolomite. However, there is still a lack of textural evidence supporting such a replacement process. We challenge this view and propose that sabkha-type dolomite forms through a microbially-influenced mineralization mechanism. Accordingly, the ecological stress conditions linked to hypersalinity stimulate high production rates of extracellular polymeric substances (EPS). The physiochemical properties of decaying EPS allow microbes to overcome the kinetic barriers that normally prevent the incorporation of Mg into the carbonate mineral at low temperatures. We support our hypothesis by presenting and reviewing results of studies conducted in the Dohat Faishak sabkha (Qatar), the sabkha of Abu Dhabi (U.A.E.), and in the lab, using halophilic microbes isolated from sabkha-type settings.