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A comparative study of dolomite formation at low temperatures induced by natural exopolymers from sabkhas and clays

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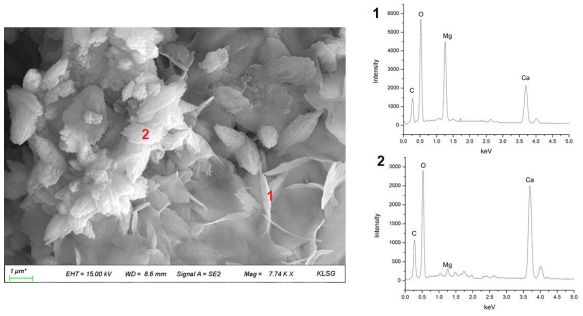

Figure 1: Dolomite like phases and representative EDS spectra from a solution seeded with EPS.

Fluctuations in the abundance of low-temperature (low-T) dolomite have occurred throughout geologic time and have been linked to changes in hydrothermal activity, sea-level, and burial of organic matter representing an important reservoir in the global biogeochemical cycle of carbon. However, low-T dolomite remains an enigmatic mineral since its formation is still not fully understood. To date few experiments have investigated the details of the nucleation mechanisms nor determined how naturally occurring substances influence crystallization of low-T dolomite. Yet, there is an extensive evidence that naturally occurring nucleation surfaces play an integral role in mineralization (Kenward et al., 2013, Deng et al., 2019). Recent studies have found that the characteristics of nucleation surfaces may play a more important role than previously considered (Diloreto et al., 2021). Thus, the aim of this work was to examine the how biotic and abiotic surfaces with variable functional group composition impact low-T dolomite mineralization and morphology. To examine these aspects of low-T dolomite mineralization experiments were carried out in batch reactors using solutions supersaturated with respect to dolomite seeded with exopolymeric substances (EPS) and clays. Our results showed that over a five-month period the rate of low-t dolomite formation in samples seeded with EPS had more extensive mineralization when compared to those seeded with clay. The observed rates in both settings were higher than those found in previously published experiments using bacterial cultures and clays (e.g., Kenward et al., 2013, Deng et al., 2019). Precipitates from samples seeded with EPS show crystallization of dolomite pre-cursors after several days and assemblages of dolomite crystals from 10-days forward **[Figure 1]**. Raman spectroscopic analysis confirmed the presence of a mixtures of carbonaceous phases, including dolomite, calcite, and aragonite, in samples seeded with EPS. Samples seeded with clay and control samples without seed materials showed little and no dolomite crystallization, respectively, during the same timeframe. Overall, the results of this work demonstrate that EPS are preferential nucleation surfaces for carbonate precipitation when compared to clays. Additionally, the findings reveal that the properties of nucleation surfaces such as functional group type and concentration are key factors driving low-T dolomite precipitation.