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Formation pathway of norsethite dominated by solution chemistry under ambient conditions

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ABSTRACT

Recently dolomite analogs, including norsethite, kutnahorite, and $PbMg(CO_3)_2$, etc., have attracted much attention due to their dolomite-like crystallographic structure and the resulting potential in solving “dolomite problem.” Previous studies indicate that mechanisms that underlie the formation of norsethite exhibit some similarities to pathways of dolomite crystallization. However, the crystallization behavior of norsethite is still poorly understood, and the physicochemical factors regulating the process are not yet fully established. Herein, to determine the relationships between solution chemistry and formation pathway of norsethite, a series of experiments for the synthesis of norsethite from the solutions with different concentrations of Mg^{2+} and Ba^{2+} by a CO_2 gas-diffusion method was carried out under ambient conditions. The morphology and phase composition of the products were investigated by a range of techniques, including XRD, FESEM, micro-Raman, and FTIR techniques. ICP-AES was used to monitor the evolution of the concentrations of Mg^{2+} and Ba^{2+} in the mineralization solutions. Our observations suggest that the formation pathway of norsethite strongly depends on Mg/Ba ratio in solution, and pure norsethite can directly crystallize from the solutions with Mg/Ba ratio ranging in 20–40. This is the first time to report the direct precipitation of dolomite analogs at ambient temperatures. It suggests that direct precipitation is a feasible pathway for cation ordering structure formation under ambient conditions.

Keywords: Norsethite, dolomite analog, formation pathway, dolomite