# Abiotic synthesis of disordered dolomite at ambient temperature

YI-FEI MA[1], QI-ZHI YAO[2]* AND GEN-TAO ZHOU[1]*

[1]School of Earth and Space Sciences, University of Science and Technology of China, Hefei 230026, P. R. China (gtzhou @ustc .edu .cn)

[2]School of Chemstry and Materials Science, University of Science and Technology of China, Hefei 230026, P. R. China (qzyao@ustc.edu.cn)

The dolomite problem has been a matter of debate for decades. The argument centers mainly on the rare presence of Holocene dolomite and generally unsuccessful precipitation under low temperatue experimental conditions. Similarly, incorporation of high Mg content into calcite is also hard to achieve abiotically under ambient conditions although biological high magnesian calcite (HMC) is wide spread. There is a broad consensus on these issues that the obstacle to synthesis of anhydrous Mg-bearing carbonates virtually lies in the dehydration barrier of $Mg^{2+}$ in solution before it is incorporated into the lattice. Recently, considerable progress has been made on synthesis of HMC at low temperatures. Among these studies, amorphous calcium carbonate (ACC) is believed to be a vital precursor to preserve magnesium. Herein we report the formation of high magnesian calcite and disordered dolomite under mild conditions. Our experiment results suggest that the preliminarily formed Mg-rich amorphous phase might have undergone a nonclassical crystallization process leading to formation of disordered dolomite (with $MgCO_3$ content up to 49.9 mol %), which could substantially enhance Mg occlusion by preventing its release into solution due to dissolution. We propose that this transformation process is predominantly solid-state mediated, and $pCO_2$ as well as pH were believed to be critical factors to maintain such transformation. This particular transformation process from ACC to calcite structure enhances effective reservation of magnesium in the crystalline phase so that dehydration of magnesium no longer acts as a prerequisite for the formation of HMC or dolomite. Therefore, the finding may be indicative of biological regulation of phase transformation in the formation of high magnesian carbonate minerals. Furthermore, now that the synthesis of dolomite through disordered analogues has been proved feasible in many hydrothermal experiments, our work may help pave the way towards a full insight into the dolomite problem.