

## Formation and transformation of amorphous magnesium carbonate in aqueous solution

\*Jun-ya Tanaka<sup>1</sup>, Jun Kawano<sup>2</sup>, Takaya Nagai<sup>2</sup>, Henry Teng<sup>3</sup>

1. Graduate School of Science, Hokkaido University, 2. Faculty of Science, Hokkaido University, 3. The George Washington University

Magnesium carbonation is the desirable approach to carbon dioxide storage. Although magnesite ( $\text{MgCO}_3$ ) is the most stable phase at ambient pressure and temperature in the system  $\text{MgCO}_3\text{-H}_2\text{O}$ , it does not precipitate from aqueous solution under ambient conditions in the laboratory. To solve the difficulty in synthesizing magnesite (so-called “the magnesite problem”), numerous researches have been conducted. Instead of magnesite, various metastable hydrated magnesium carbonates are formed from solution in this system. Recently, amorphous magnesium carbonate (AMC) was reported to precipitate as a precursor of hydrated magnesium carbonate, which should play an important role in formation of magnesium carbonate. In this study, precipitation experiments were conducted to reveal the formation and transformation of AMC from aqueous solution.

Precipitation experiments were performed by mixing 0.2 M  $\text{Na}_2\text{CO}_3$  and 0.2 M  $\text{MgCl}_2$  aqueous solutions. Immediately after mixing, white precipitates were formed. TEM observation showed these were fine particles of AMC of several tens of nanometers. TG-DTA revealed that its approximate chemical formula was  $\text{MgCO}_3\cdot 2\text{H}_2\text{O}$ . With the slurry stirred, this AMC transformed into needle crystals of nesquehonite ( $\text{MgCO}_3\cdot 3\text{H}_2\text{O}$ ), one of the hydrated magnesium carbonates, via a solvent-mediated process. After that, dypingite ( $\text{Mg}_5(\text{CO}_3)_4(\text{OH})_2\cdot 5\text{H}_2\text{O}$ ) particles of several micrometers were formed, while nesquehonite crystals dissolved. These results indicate that AMC forms as the precursor of nesquehonite and influences these transformation process into hydrated magnesium carbonates. The comparative consideration of the short-range structure between AMC and hydrated magnesium carbonates may lead to further understanding the formation process in the system of  $\text{MgCO}_3\text{-H}_2\text{O}$ .

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