CO_2 mineral sequestration using Magnesium originated from weathering

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The atmosphere is not only a major natural carbon reservoir, but also controls the global climate and vital to human survival. However, due to anthropogenic CO_2 emissions, the carbon flux entering the atmosphere increases rapidly in a short time scale causing climate anomalies. Although naturally occurring silicate - carbonate cycle can adjust atmospheric CO_2 concentration over the geologic time scale through precipitating carbonates (calcite, aragonite and dolomite *etc*.), it is invalid to regulate CO_2 concentration and inhibit global warming efficiently. Aimed at artificial acceleration of natural silicate - carbonate transformation process, we studied the thermodynamics and kinetics of CO_2 absorption and magnesium carbonate precipitation using ready-to-use Mg ion in sea water and saline lakes. Based on the research results, a simplified process for mineral sequestration of CO_2 using bischofite was also developed. Bischofite is a kind of product formed by millions of years of crustal movement and solar-driven weathering.

The gas-liquid-solid three-phase reaction process involved in CO_2 magnesium carbonation transformation was studied. The feasibility of CO_2 mineral sequestration by free magnesium ion in solution is proved by thermodynamics analysis. Also, the kinetic processes on gas-liquid and liquid-solid interface are studied in detail. Figure 1 illustrates the reaction path of CO_2 - Mg carbonate transformation process accelerated using NH_3. The 1st order zwitter-ion reaction mechanism was found appropriate to describe the reaction between CO_2 and NH_3, in which the zwitter-ion formation was the rate limiting step. With the solution chemistry carefully chosen, impurities (mainly brucite) could be avoided and pure nesquehonite was acquired.

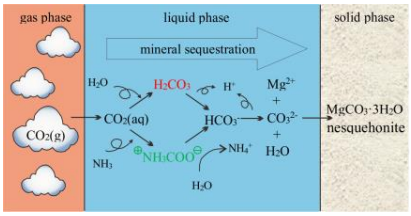

Figure 1: Reaction path of transformation process