Effect of Rare Earth Elements on the Production of Calcium Carbonate Crystal.

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Rare Earth elements form hardly soluble carbonates. It is not reasonable to consider that rare earth elements affect the formation of calcium carbonate in the ocean. In this study the effect of rare earth elements on the production of calcium carbonate has been investigated.

The super-saturated solution of calcium carbonate was prepared by mixing calcium chloride and sodium bicarbonate solutions. The water used should be free from carbonate species and trace metals, and degassed water was prepared by boiling deionised/distilled water. The water was kept in the bath at 25°C before use. The combined solution was also kept in a water bath soon after the mixing and in a closed environment the crystallization reaction was monitored by a pH meter and Ca ion electrode. La is exclusively used among rare earth elements because of the lowest solubility of its carbonate and the highest abundance in nature. Chemical forms of La added were La_2O_3, $La(NO_3)_3$, and $LaCl_3$.

Progress of crystallization was successfully monitored by a pH meter, the greater amount of crystal resulting in the lower pH. It was obvious that less amount of crystal was produced when La reagents were added. The effect of La addition was the most prominently seen when $La(NO_3)_3$ and $LaCl_3$ were used. The closed system reduces the uncertainty (or variables) of the experiment. Only with a simple assumption and with the dicussion based on chemical thermo-dynamics, the amount of crystal formed and solubility product of the calcium carbonate could be expressed as the function of pH of the solution. The solubility product of the calcium carbonate, when La reagents were added, was found to be about 10 times of the reported value. The change of crystal structure is the most responsible to explain the increase of the solubility product, but the mechanism increasing the solubility of calcium carbonate is still to be studied.

The result of the present research has an important implication of REE influence on the earth environment. Soil particles containing rare earth elements are carried into the mid-ocean by meteoric activities. This study indicates that rare earth elements may change the solubility of CO_2 in the ocean.