

Phosphate Sorption Onto CaCO₃ from Seawater

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Phosphate sorption by biogenic materials is a very important mechanism controlling phosphorus concentration in the ocean. Analytical data about phosphorus content in the biogenic CaCO₃ (shells, calcareous muds and other) give no opportunity of estimating a role of the sorption removal of dissolved phosphate, because CaCO₃ carries organic and inorganic impurities containing phosphorus too. To investigate the problem experiments were performed, which model phosphate sorption onto calcite and aragonite from seawater.

Artificial 35 ‰ seawater having 2-5 μM of phosphate was used in the experiments. Specific surface area of calcite and aragonite was equal to 0.023 and 0.82 m²/g, respectively. Mass ratio solid/solution ranged 1: 100 to 1: 1000, and equilibrium pH values ranged 7.66 to 7.92. Temperature maintained 20±1°C for all experiments. Experiments lasted for about three months. Preliminary kinetic experiments showed, that sorption attained equilibrium in 12 days. After exposure samples were filtered through dense paper filter. Values of pH and residual concentration of phosphate were determined in filtrate applying potentiometry and colorimetry with molybdate and ascorbic acid, correspondingly.

The specific sorption of phosphate onto CaCO₃ is described by the common relationship: $\lg G = A + 0.5 \lg [P] + \text{pH}$,

where G is specific sorption, μmole P / g CaCO₃; [P] is equilibrium phosphate concentration, μM; A is a constant equal to -11.5 and -11.4 for calcite and aragonite, respectively.

According to experimental data, concentration of sorbed phosphate onto CaCO₃ in the seawater is about 5-10 ppm. This value is similar to phosphorus concentration in pure biogenic carbonates (Sherwood et al., 1987). However, the value is smaller, than in calcareous sediments (300 ppm by Froelich et al., 1982), which contain phosphorus bounded mainly into organic and inorganic impurities. Bulk concentration of dissolved phosphate in euphotic layer is lower, than in deep sea waters. Nevertheless higher pH values in euphotic layer provide for increase in sorption, thus resulting in insignificant differences of amounts of sorbed phosphorus from depth.

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