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Enhancing Carbon Sequestration in Aquatic Systems Using Mineral Amendments

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Reducing carbon dioxide (CO_2) and methane (CH_4) emissions from freshwater environments is an important route to mitigate climate warming. Mineral amendments, including $Ca(OH)_2$-rich cement materials and gypsum ($CaSO_4 \cdot 2H_2O$), can help prevent CO_2 and CH_4, respectively, from escaping to the atmosphere, but their carbon sequestration efficiencies in aquatic environments remain incompletely characterized. Here, we present results from controlled experiments with suspensions of these mineral amendments under conditions relevant to natural and engineered water bodies, tracking gas consumption or production dynamics, solution chemistry, and secondary mineral formation. In the experiments with cement materials, rapid consumption of inflowing gaseous CO_2 was accompanied by $CaCO_3$ precipitation, with up to 70% of the cement converted within days. Reaction kinetics were influenced by particle size, with finer materials sustaining CO_2 uptake over longer periods. The results provide preliminary estimates of CO_2 sequestration efficiencies and imply that calcium-based amendments could be used at the field scale. Time permitting, preliminary results on the reduction of net production of CH_4 by gypsum amendments will also be presented.