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Ikaite as a possible alkalizer for ocean alkalinity enhancement

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Carbonate minerals like limestone offer preferential alkalization pathways for OAE in terms of partly equilibrated carbonate additions together with a mild pH rise. However, they are practically insoluble in seawater and therefore not directly suitable for OAE. Here we suggest Ikaite from the group of hydrated calcium carbonates as an alternative potential alkalizer. Ikaite could be produced by dissolving abundant limestone and re-precipitating Ikaite in a CO2-recycle reactor at low total cost (< \$90 tCO_2). Current lab scale experiments have shown that Ikaite powder addition to seawater offer fast dissolution kinetics (10^{-6} mol m^{-2} s^{-1}) ranging between slaked lime (10^{-4} mol m^{-2} s^{-1}) and brucite (10^{-8} mol m^{-2} s^{-1}) at temperatures between 10 °C and 25 °C. Meanwhile, the total alkalinity remained stable over a period of 28 days for total alkalinity additions up 1000 µmol kg^{-1}. Beside promising dissolution kinetics, we also observed a reduced alkalinity release efficiency at same seawater temperatures ranging between 50 % and 80 %, which could be explained by partial transformation to insoluble carbonates before addition or during dissolution. In earlier experiments at lower seawater temperature (3°C), however, such decrease have not been observed.

Based on these results we will discuss particle sinking through a surface ocean layer where CO_2 uptake meant to be equally effective (mixed layer depth) using an integrative particle sinking model. The results illustrate which thresholds in particle sizes and dissolution rates should be considered for meaningful solid alkalizer applications.