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Experimental insights on dissolution and transport of CO2 in marine sediments at hydrate forming conditions.

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Various strategies are presently being discussed to reduce greenhouse gas emissions into the atmosphere. The idea to inject and store liquefied carbon dioxide in(to) marine sediments is particularly attractive for various reasons. Most convincing is the fact that carbon dioxide can be immobilized within the sediments if it reacts with the pore water to form a solid gas hydrate. However, current understanding of the large-scale technical feasibility of this prospect is still poor and requires accurate knowledge of the physicochemical processes following injection of the liquefied gas.

High-pressure experiments designed to simulate the deep marine environment open the possibility to fill this knowledge gap.

In this study, laboratory experiments were targeted at quantifying (a) the rate of carbon dioxide transfer across the two-phase interface (dissolution), (b) transport kinetics of dissolved carbon dioxide in a seawater-sediment mixture, and (c) formation of carbon dioxide hydrates within the sediment. Selecting experimental temperatures and pressures to conditions within and outside the carbon dioxide hydrate stability field (HSF) allowed highlighting the effect of hydrate presence on both, dissolution and transport kinetics. Concentration increase and hydrate presence were monitored by Raman spectroscopy.

The experiments revealed anomalously fast transport rates of dissolved carbon dioxide at conditions both inside and outside the HSF. These first results could have major significance for safety-related issues in the discussion of carbon storage in the marine environment.