The dynamics of pore water in subsurface sediments at the site of controlled CO_2 release experiment

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Carbon capture and storage (CCS) in sub-seabed geological formations is a mitigation strategy that can aid the reduction of anthropogenic CO_2 emissions. In 2012, the QICS (Quantifying and Monitoring Potential Ecosystem Impacts of Geological Carbon Storage) project was undertaken by researchers from the UK and Japan. The project conducted a field-scale controlled CO_2 release experiment in order to examine the impacts on the marine ecosystem and evaluate the methods for detection and impact monitoring, should CO_2 leakage occur. Changes in the chemical composition of water and seabed sediment were detected, in particular, pH and dissolved inorganic carbon (DIC) of the sediment pore water during the CO_2 release. After the gas release was stopped, concentrations of all pore water constituents rapidly returned to pre-release values. The QICS team concluded that the environmental impacts from small-scale leakage is not ecologically significant.
We address two unsettled issues from QICS: (1) the mechanism behind the rapid recovery of pore water parameters to pre-release levels, and (2) the fate of the released CO_2 potentially remaining in the subsurface sediments. To settle these issues, we conducted field observation measurements at the QICS site, Ardmucknish Bay, in 2016, four years after the CO_2 release. Time series in situ monitoring of pore water chemistry in the subsurface sediments was conducted in order to investigate pore water dynamics. To characterize pore water behaviour more precisely, we conducted a tracer test using the custom-made pore water extractors. To trace the injected CO_2, carbonate content and stable carbon isotope ratio of the sediment and pore water were compared between the area close to the CO_2 release point and the unaffected reference site. In this presentation we focus on the pore water dynamics at the QICS site and show the results of field observation that influence benthic recovery from a CO_2 leak.

Keywords: CCS, global warming, sediment, pore water

