Assessing ocean alkalinity for carbon storage

Supervisors

Main supervisor: Doctor Phil Renforth (Cardiff University)
Co-supervisor: Professor Steve Barker (Cardiff University)
Co-supervisor: Professor Andy Ridgwell (University of Bristol)

Project enquiries - Email: RenforthP@Cardiff.ac.uk **Contact number:** +44 (0) 02920879672

Host Institution: Cardiff University

Project description

The recent IPCC assessment report emphasizes that any human intervention capable of stabilizing atmospheric carbon dioxide concentrations at a safe level is likely to require enhanced carbon dioxide removal (CDR) from the atmosphere in addition to drastic CO_2 emissions reductions. The ability to remove would help slow down or even reverse the increase in CO_2 and help mitigate the attending climate and ocean acidification impacts (Rau and Lackner 2013). Carbon storage as ocean alkalinity has received very little attention compared to other forms of carbon sequestration. Yet, recent work suggests it has sufficient capacity to sequester all future anthropogenic CO_2 emissions for hundreds of years with, notionally, minimal impact on global ocean bulk chemistry, and the technologies to deliver this are at least cost comparable to alternative carbon sequestration proposals (e.g. \$20 - 100 tCO_2^{-1}). There are still many unanswered technical, environmental, social, and ethical questions, but the scale of the carbon sequestration challenge warrants further research. Underpinning all of these is uncertainty in the longevity of carbon storage as ocean alkalinity. The aim of this project is to investigate this by 1) reviewing evidence from paleo-climate research that investigates the impact of elevated alkalinity on the carbon cycle, 2) conduct laboratory studies to develop a relationship between carbonate formation in seawater and alkalinity concentration, 3) integrate this information into an Earth system model to investigate the change in ocean chemistry and atmospheric CO2 concentration under a range of alkalinity addition scenarios. This project could provide a step-change in our understanding of an important carbon storage reservoir.

The student will benefit from recent investment in laboratory facilities in Cardiff that provide us with the ability to conduct geochemical experiments with a high degree of environmental control. These new laboratory facilities will be used to investigate carbonate precipitation from real and artificial seawater under a range of temperatures, gas pressures, and carbonate system conditions. Cardiff University's boat, *RV Guiding Light*, will be used for coastal seawater collection and collaboration with future research cruises will be used to source open-ocean seawater.

Rau, G.H. and Lackner, K.S. (2013). Reversing Excess Atmospheric CO2. *Science* 340 1522-1523