Why Does Calcium Carbonate Precipitate in the Ocean Crust?

Details

Meeting	2012 Fall Meeting
Section	Biogeosciences
Session	Potential Capacities to Sequester Carbon at a Regional Scale II Posters
Identifier	B33D-0545
Authors	Coggon, R*, Earth Science and Engineering, Imperial College London, London, United Kingdom Teagle, D A, National Oceanography Centre Southampton, University of Southampton, Southampton, United Kingdom Harris, M, National Oceanography Centre Southampton, University of Southampton, Southampton, United Kingdom John, C M, Earth Science and Engineering, Imperial College London, London, United Kingdom Smith-Duque, C E, National Oceanography Centre Southampton, University of Southampton, Southampton, United Kingdom Alt, J C, Earth and Environmental Sciences, University of Michigan, Ann Arbor, MI, USA
Index Terms	Composition of the oceanic crust [1021] Hydrothermal systems [1034] Biogeochemical cycles, processes, and modeling [1615] Carbon cycling [4806]

Abstract

Calcium carbonate (CaCO3) precipitation in extant ocean crust may provide lessons for industrial carbon dioxide (CO2) sequestration to mitigate against future climate change. The formation and alteration of the ocean crust during mid-ocean ridge spreading plays an integral role in the geological carbon (C) cycle. Magma-degassing during mid-ocean ridge volcanism releases large volumes of CO2 to the oceans and atmosphere, whereas the precipitation of CaCO3 minerals in rocks and veins during hydrothermal alteration of the ocean crust is a major mechanism of natural CO2 sequestration. However, the physical and chemical conditions that control the nature, extent and rate of calcium carbonate precipitation in the ocean crust are not well known, and the magnitudes of the carbon fluxes associated with the formation and alteration of the ocean crust remain poorly quantified. Mesozoic ocean crust contains significantly more hydrothermal CaCO3 than young ocean crust, but the past ocean conditions responsible for this enhanced C-uptake by the ocean crust are yet to be determined. The thermal, hydrogeologic, and chemical characteristics of active, low temperature seawater-basalt interaction have been investigated by a series of integrated studies in young ocean crust (<3.6 Ma) on the eastern flank of the Juan de Fuca ridge (JdFR). This has included sampling by scientific ocean drilling of CaCO3 veins, their parent fluids, and the basalts that host the veins. This area provides a unique opportunity to investigate the conditions of in

situ hydrothermal CaCO3 precipitation on short geologic timescales. Fluid and vein analyses provide boundary conditions for geochemical modeling using ‘Phreeqc’ to determine why basement fluids are saturated with respect to CaCO3. We evaluate the controlling effects of key parameters including fluid dissolved inorganic carbon (DIC), Mg and Ca concentrations, alkalinity, temperature, and pH on CaCO3 precipitation. Our results provide insights into how differing past conditions (e.g. ocean temperature and pCO2) affected the ocean crustal C-reservoir, and enable better quantification of the magnitude of this reservoir and how it has varied over geological time. This information is directly applicable to the development of industrial scale CO2 sequestration using methods that mimic but accelerate natural CO2-drawdown processes.

Cite as: Author(s) (2012), Title, Abstract B33D-0545 presented at 2012 Fall Meeting, AGU, San Francisco, Calif., 3-7 Dec.