

# Experiments examining CO<sub>2</sub> Sequestration via Reactions between Oceanic Crust and Hydrous Silicic Liquid

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As atmospheric carbon dioxide (CO<sub>2</sub>) concentrations rise, there is increasing attention on mitigation strategies involving CO<sub>2</sub> sequestration. CO<sub>2</sub> sequestration in mid-ocean ridge environments is increasingly recognized as a strategy to mitigate climate change by removing and storing excess CO<sub>2</sub>. Since the oceanic crust is the largest concentrated reservoir of CaO, it has enormous potential as a source for removal as CaCO<sub>3</sub> (calcite veins). One proposed strategy involves drilling into the sides of oceanic magmatic systems to establish an artificial circulation system that triggers natural seawater-rock reactions that form hydrous alkali silicate liquids and sequester CO<sub>2</sub> [1]. To evaluate the efficiency of this process, it is essential to understand the phase equilibria of hydrous sodium silicate liquids containing carbonate at shallow pressures and variable temperatures, with altered oceanic crust minerals.

This study aims to determine compositions of co-existing minerals and liquid under fixed pressure (1 kb) and variable temperature (300-600°C) conditions. Gold capsules are loaded with oceanic crust minerals (chlorite, epidote, quartz, albite, and actinolite) typically found in altered ocean crust, along with a hydrated Na<sub>2</sub>Si<sub>2</sub>O<sub>5</sub> powder (33 wt% H<sub>2</sub>O) +/- Na<sub>2</sub>CO<sub>3</sub>. A preliminary experiment at 417°C and 1 kb for 23 days with carbonate resulted in epidote, albite and dolomite coexisting with quenched liquid. However, like earlier studies reacting seawater with basalt [2], chlorite saturation did not occur nor was residual quartz found. Our goal is to determine liquid compositions in equilibrium with Chl-Ep-Act-Ab-Qt along with carbonate minerals as a function of temperature. Thus, down flow path reactions and potential critical permeability issues like precipitation clogging can be predicted, shedding light on key issues related to CO<sub>2</sub> sequestration in the submarine setting. Ultimately, these investigations are intended to inform the development of improved strategies for long-term carbon storage, and to address the growing challenge of global CO<sub>2</sub> emissions.

[1] Continuously changing quartz-albite saturated melt compositions to 330 °C with application to heat flow and geochemistry of the ocean crust, *Lundstrom (2020), Journal of Geophysical Research: Solid Earth* 125.

[2] Metabasalts, axial hot springs, and the structure of hydrothermal systems at mid-ocean ridges, *Mottl (1983), GSA Bulletin* 94 (2), 161–180.