Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11376

Designing experiments and models to predict carbon dioxide mineralization in basalts at the field scale

BEN TUTOLO[1], JUAN CARLOS DE OBESO[2], DAPO NOAH AWOLAYO[1], QIN ZHANG[1], CALISTA BROWN[1], TAYLOR KIRSCHNER[1], JOHN BYNG[2], ADAM MITTON[3], CHRISTIAAN LAUREIJS[1], PROF. DREW D SYVERSON, PHD[4], MICHAEL NIGHTINGALE[1], ANDREW LUHMANN[5] AND RACHEL LAUER[1]

[1]University of Calgary
[2]University of Calgary, Department of Geoscience
[3]Simon Fraser University
[4]UNC-Charlotte
[5]Wheaton College

Presenting Author: benjamin.tutolo@ucalgary.ca

Due to their abundance at Earth's surface; high concentrations of cation-rich silicate minerals; and generally favorable porosity, permeability, and injectivity, basaltic rocks have become ideal target lithologies for the rapid injection and mineralization of large volumes of CO_2. CO_2 mineralization in basalts is an intimately coupled process of silicate mineral dissolution and carbonate mineral precipitation, wherein the silicates donate the vital Ca, Mg, and Fe ions required to precipitate Ca-, Mg-, and/or Fe-carbonate minerals. Traditionally, geochemical kinetic experiments have been designed to exclusively measure either far-from-equilibrium silicate mineral dissolution or carbonate mineral growth, and, due to inherent analytical challenges, only rarely are fully coupled dissolution-precipitation reactions parameterized in a kinetic sense. Here, we employ a combination of both far-from-equilibrium mineral dissolution experiments and fully coupled mineral dissolution-precipitation experiments to enable field-scale predictions of CO_2 mineralization in basalts. The latter, dissolution-precipitation experiments are facilitated by nontraditional stable isotope doping techniques (particularly ^{29}Si) that permit simultaneous parameterization of basalt dissolution and carbonate mineral precipitation rates. By comparing these results to predictions made by coupling far-from-equilibrium basalt dissolution and secondary mineral precipitation rate laws, we can advocate for best practices for reactive transport model predictions of field-scale carbonate mineralization. This presentation will include a summary of published and new experimental data as well as direct comparison with equilibrium, kinetic, and reactive transport model predictions of coupled basalt dissolution and secondary mineral precipitation.