Effects of SO_2-NO_2 impurities in the CO_2 stream on mineral solubility

S. FISCHER[1,2*] AND A. LIEBSCHER[1]

[1]GFZ German Research Centre for Geosciences, Centre for Geological Storage CGS, Telegrafenberg, 14473 Potsdam, Germany (*fischer@gfz-potsdam.de)
[2]Berlin Institute of Technology, Chair of Mineralogy-Petrology, Ackerstraße 76, 13355 Berlin, Germany

Two sets of laboratory fluid-mineral experiments have been performed in order to analyze the effect of SO_2-NO_2 impurities in the CO_2 stream on the chemical reactivity of (A) siderite and (B) illite. For the siderite and illite separates, baseline XRD data with Rietveld refinements revealed a composition of (A) 69.6±1.3 wt% siderite, 26.7±1.2 wt% ankerite and 3.8±0.8 wt% quartz, and (B) 73.5±1.3 wt% illite, 10.8±1.3 wt% Ca-smectite, 11.9±0.4 wt% orthoclase, and 3.9±0.2 wt% quartz, respectively. SEM-EDS analyses yield initial structural formulae of $(Fe_{0.8}Mg_{0.1}Mn_{0.1})CO_3$ for siderite, $(Ca_{1.0}Fe_{0.9\text{-}0.1}Mg_{<0.4}Mn_{0.1})(CO_3)_2$ for ankerite, and $K_{0.5\text{-}0.7}(Mg_{0.1\text{-}0.2}Al_{1.8\text{-}1.9})[Al_{0.4\text{-}0.6}Si_{3.4\text{-}3.6}O_{10}(OH)_2]$ for illite. Baseline experiments were conducted using pure CO_2 and 2 M NaCl brine at 80 °C and 20 MPa. Brine to mineral weight-ratios were 20 to 1. Run durations were one week for siderite and two weeks for illite, respectively. To study the influence of impurities, repeat experiments using identical starting conditions and analogous materials but impure CO_2 are performed. Siderite is reacted with CO_2 containing 5vol% SO_2, while illite is exposed to CO_2 containing 5vol% NO_2.

Based on XRD, SEM and ICP-AES analysis the baseline experiments using pure CO_2 yield (A) stable siderite and dissolving ankerite, and (B) unaffected illite but dissolution of the Ca-smectite component. Foci of the repeat experiments are on the potential formation of sulphates, e.g., anhydrite, during the CO_2-SO_2 runs, and the incorporation of NO_2 into the illite-smectite structure during the CO_2-NO_2 runs.

DEep CArbon DEgassing: The Deep Carbon Observatory DECADE initiative

TOBIAS P. FISCHER,[1]

[1]Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM USA (fischer@unm.edu)

The question whether the net flux of carbon is into the mantle via subduction or out of the mantle via mantle degassing is fundamental because it provides an important framework for understanding the distribution and isotope composition of C in the mantle, the occurrence of abiotically synthesized carbon species in the mantle and crust, the presence or absence of carbon in the Earth's core, the formation of carbonated peridotite as starting material for ocean crust as well as the effect of mantle carbon release to modulate global climate through time. The Deep Carbon Observatory (DCO) Reservoirs and Fluxes Directorate is centered around the flux of carbon between different Earth reservoirs (https://dco.gl.ciw.edu/science/deep-carbon-reservoirs-and-fluxes) to help address some of these issues.

Volcanoes are *the* main pathway of volatiles, including carbon, from the Earth's interior to the atmosphere and hydrosphere, yet the current estimates of global C flux from volcanic regions range from 65 [1, 2] to 540 [3] Mt/yr. This order of magnitude difference in estimates is the difference between massive subduction of surface C into the mantle versus a balance between mantle input and output, with all the implications stated above. The DECADE initiative within the DCO R&F Directorate is bringing together the scientific expertise of geochemists, petrologists and volcanologists to provide constraints on the global volcanic C flux by a) establishing a data-base of volcanic and hydrothermal gas compositions and fluxes linked to PetDB and the Smithsonian Global Volcanism Program, b) building a global monitorig network to continuously measure the volcanic C flux of 10-12 yet to be selected active volcanoes, c) measure the C flux of remote volcanoes, for which no or only sparse data are currently available, d) develop new field and analytical instrumentation for C measurements and flux monitoring, and e) establish formal collaborations with volcano observatories around the world to support volcanic gas measurement and monitoring activities.

The current governance structure of DECADE includes a board of directors, a program coordination committee and several committees responsible for the key areas of the initiative (data base, network, instrumentation, and field campaigns).

[1] Allard *et al*, GRL 19, 1479-1481; [2] Williams *et al* GCA 56, 1765-1770; [3] Burton *et al* RiMG 75, 323-354

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