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Potential for CO_2 mineral storage in altered basalts

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The original CarbFix project demonstrated the rapid mineralization of CO_2 injected into fresh basalts in less than 2 years [1]. This study was initiated to assess the degree to which the same approach can be applied to altered basalts. The motivation for this study is that few places provide access to such fresh basalts as in Iceland; the ability to carbonate non-fresh basalts will open the CarbFix CO_2 mineralization approach to many other sites around the world.

Two series of altered basalt samples have been collected. One consisted of a suite of samples collected from the Icelandic surface outcrops and river sediments as a function of basalt age, from 0.5 to 13 million years old. The second set was collected from the core retrieved during the IRDP project near Reyðarfjörður, Iceland [2]. This core has been extensively studied and includes basalts having experienced alteration from 100°C to 350°C. That second series was completed with cores retrieved from the CarbFix2 injection site in Hellisheiði. What is unique to these rock samples is that they all originate from the same initial primary rock, MORB, and have nearly identical chemical compositions. As such the dissolution rates of these rocks will provide direct information on how alteration processes affect their reactivity.

The mineralogy and texture of all rock samples were characterized using XRD, XRF and SEM. A series of whole rock dissolution experiments were performed at temperatures from 25°C to 150°C at pH3 and pH8. Preliminary results indicate that element release rates of basalt altered at ~200°C are slower by 0.5 to 2 orders of magnitude than that of fresh basaltic glass at the same conditions. Interestingly, calcium release rates appear to be the least affected by the alteration process. Results of all experiments are to be presented, and applied to 1) estimating the relative carbonation potential of various altered basalts, and 2) to assess the effect of the age of basalts on the weathering rates.

[1] Matter, Stute, Snæbjörnsdóttir, et al., Science 352 (2016) 1312 LP – 1314.

[2] Fridleifsson, Gibson, Hall, et al., Journal of Geophysical Research. 87 (1982) 6359–6361.