

The impact of climate and dam construction on silicon fluxes to the oceans

S.R. GISLASON^{1*}, E.S. EIRIKSDOTTIR¹, E.H. OELKERS²
AND K. BURTON³

¹Institute of Earth Sciences, University of Iceland, Sturlugata 7, 101 Reykjavik, Iceland

(*correspondence: sigrg@raunvis.hi.is)

²LMTG-Université de Toulouse-CNRS-IRD-OMP, 14 Avenue Edouard Belin, 31400 Toulouse, France

³Earth Sciences, Oxford University, Oxford UK

Silicate weathering rates are affected by lithology, climate and biota creating a dynamic link between weathering, climate and biology. Silica is transported to the oceans by rivers either as dissolved species or as suspended particles. Estimates suggest that some 26% of the global suspended material delivered to the oceans is trapped behind dams. Data from rivers in NE Iceland show clear evidence of increases in chemical and physical weathering accompanying increases in temperature and runoff over the past 40 years, and that the suspended material flux is much more dependent on discharge and therefore climate than the dissolved species [1, 2]. Recent dam construction on some of these rivers likely filters out the larger suspended load fraction changing the nature and chemistry of the metals transported to the ocean. Furthermore it can be predicted that, regulating the flow of the river systems with dams will alter the delivery of dissolved nutrients like silica to the coastal waters. The main flux of silica occurs during the spring and summer in pristine direct runoff rivers but late in the summer and early fall in glacial fed rivers. Spring fed rivers are more like regulated rivers, with even flux of silica throughout the year. The much needed flux of nutrients for algal blooms that normally occur during the spring and summer time at high latitudes, will most likely be partly shifted to the winter, and some of the silica can be sequestered by diatoms within the man made reservoirs. This project will document the natural elemental and isotopic variations in weathering fluxes accompanying seasonal changes in runoff prior to dam construction, and compare these with the present-day (post-dam) variations. These data will allow assessment of the impact of dam construction on chemical weathering in these rivers catchments and on the elemental and isotope composition of material delivered to the oceans.

[1] Gislason, Oelkers & Snorrason (2006) *Geology* **34**, 49–52.

[2] Gislason *et al.* (2009) *EPSL* **277**, 213–222.

Mineral sequestration of CO₂ in basalt – The CarbFix project

S.R. GISLASON^{1*}, D. WOLFF-BOENISCH¹,
A. STEFANSSON¹, H. ALFREDSSON¹, E.H. OELKERS²,
E. GUNNLAUGSSON³, H. SIGURDARDOTTIR³,
B. SIGFUSSON³, E.S.P. ARADOTTIR³, W.S. BROECKER⁴,
J.M. MATTER⁴, M. STUTE⁴ AND G. AXELSSON⁵

¹Institute of Earth Sciences, University of Iceland, Askja, Sturlugata 7, 101 Reykjavik, Iceland

(*correspondence: sigrg@raunvis.hi.is)

²LMTG-Université de Toulouse-CNRS-IRD-OMP, 14 Avenue Edouard Belin, 31400 Toulouse, France

³Reykjavik Energy, Baejarhalsi 1, 110 Reykjavik, Iceland

⁴Lamont-Doherty Earth Observatory, 61 Route 9W, Palisades, NY 10964, USA

⁵ISOR, Iceland GeoSurvey, Grensasvegur 9, 108 Reykjavik, Iceland

Carbonate minerals provide a long-lasting, thermodynamically stable, and environmentally benign carbon storage host. Mineral storage is in most cases the end product of geological storage of CO₂. The relative amount of mineral storage and the rate of mineralization depend on the rock type and injection methods. Rates could be enhanced by injecting CO₂ fully dissolved in water and/or by injection into silicate rocks rich in divalent metal cations such as basalts and ultramafic rocks. The CarbFix project [1] aims at mineral sequestration of carbon in southwest Iceland and will start injection in early 2010. Carbon dioxide will be fully dissolved in meteoric water and injected into basaltic rocks. The initial test injection will contain 0.07 kg/s of CO₂ dissolved in 2 kg/s of water. The CO₂ gas-water mixture will be pumped into the injection well, at 25 bar total pressure and 350 m depth. The pH of the water after dissolution at 25 bar *in situ* partial pressure of CO₂ is estimated to be 3.7 and the dissolved inorganic carbon concentration (DIC) to be ~1 mol/kg. As the CO₂ charged waters percolate through the rock the dissolution of mafic minerals and glass will consume the protons provided by the carbonic acid. As a result of these dissolution reactions, combined with dilution and dispersion the pH of the injected water will rise and alkalinity will increase. Concomitantly, the concentration of dissolved elements will increase and alteration minerals will form, resulting in mineral fixation of carbon. Conservative tracers and ¹⁴C labelled CO₂ will be mixed into the injected gas and water stream to monitor the subsurface transport and to constrain the carbonate mass balance. If successful, the experiment will be up-scaled.

[1] Gislason *et al.* (2010) *Int. J. Greenhouse Gas Control*.