Rusty river hypothesis: Understanding iron-carbon-climate feedback utilizing iron stable isotopes

S. M. HAWLEY*[1], H. M. WILLIAMS[1], P. A. E. POGGE VON STRANDMANN[2] AND K. W. BURTON[1]

[1]Dept. Earth Sciences, Durham University, Durham
*s.m.hawley@durham.ac.uk
[2]Dept. Earth Sciences, University College London, London

Rivers are the dominant source of iron (hydr)oxides to near coastal sedimentary environments. Sediment iron (hydr)oxide concentrations have been linked to carbon burial[1], weathering regimes have been linked to changes in riverine (hydr)oxide prodution[2], and weathering regimes are linked to climate change creating a potential global climate feedback cycle. We have analyzed river waters and sediments from Iceland for iron stable isotopes to better understand the controls on (hydr)oxide formation in glacial and non-glacial river systems.

Riverine sediments transported via glacial rivers have an isoptic composition within error of fresh basalt implying the material will have a similar reactive iron composition to fresh basalt. Sediments transported via precipiation fed rivers have isotopic composition close to Icelandic soils suggesting they are enriched in reactive iron realtive to fresh basalt. Even with the realtive difference in reactive iron concentration between glacial and precipiation fed rivers the higher absolute sediment loads in glacial rivers suggest glacial systems transport more reactive iron to the ocean than precipitation fed catchements.

The relative balance of glacial versus precipitation dominated weathering in sub-artic terrains depend on Earth's climate. Evidence strongly suggests that (hydr)oxides protect organic matter from microbial degradation creating a global 'rusty sink[1]' for organic carbon in marine sediments. Carbon burial moderates atmospheric carbon dioxide levels and Earth's climate, potentially creating a weathering driven iron-carbon burial-climate feedback cycle. This 'rusty river hypothesis' significantly expands upon Martin (1990)'s Iron Hypothesis[2] by eliminating the geographic constraints and the need to link primary production to carbon burial inherant in Martin's original hypothesis.

[1] Lalonde, K., et al (2012). *Nature*. **483**, 198-200 [2] Martin J.H (1990) *Paleocean*. **5**(1), 1-13 [3] Raiswell, R et al (2006). GCA. **70**, 2765-2781.