Mixing of radiocarbon from high latitude oceans through the atmosphere and ocean during the last deglaciation: Results from Iceland and the Drake Passage

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Radiocarbon is a sensitive tracer of carbon cycle processes over the last ~40 kyr. We present new radiocarbon reconstructions from U-Th dated deep-sea corals from the Reykjanes Ridge off Iceland. These results are compared to radiocarbon reconstructions from deep-sea corals in the Southern Ocean and published radiocarbon records from benthic foraminifera to further our understanding of the transfer of carbon between different reservoirs during the last glacial period and deglaciation.

Our dataset from Iceland comes from solitary and colonial corals collected by dredge from water depths ranging between 770 to 1680 m. U-Th ages of these corals range from modern to 40 ka. During the last glacial period at ~35 ka, radiocarbon reconstructed at 1680 m water depth was ~100‰ more depleted from the contemporaneous atmosphere than it is today. However at the Bolling-Allerod and throughout the Holocene these sites were better ventilated, with radiocarbon offsets from the contemporaneous atmosphere similar to those observed in this region today (~70‰).

Radiocarbon reconstructions from Iceland and the Southern Ocean do not show extreme radiocarbon depletions of the magnitude oberved in some intermediate-depth deglacial records (e.g. [1]). A comparison of $\Delta^{14}C$ records to other proxy data suggests that these large depletions cannot be explained by a common water mass (e.g. Antarctic Intermediate Water), since mixing of this water mass would dissipate any extremely depleted radiocarbon signature. However, the radiocarbon depletions that we do observe throughout the glacial ocean are large enough to explain the atmospheric drop in $\Delta^{14}C$ over the 'Mystery Interval' if we allow some direct transfer of carbon from the deep ocean to the atmosphere, such as through the Southern Ocean.

[1] Marchitto *et al*. (2007) *Science* **316**, 1456-1459.

Speciation of contaminant metals in red mud from Ajka, Hungary

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The catastrophic failure of the sludge dam at the Ajkai Timfoldgyar Zrt alumina plant in Hungary on the 4th October 2010 resulted in the release of 700000 m^3 of caustic metalliferous red mud. Red mud leachate is hyperalkaline (pH 13) and has elevated concentrations of metals and metalloids such as Al (1000 ppm) As, V, and Mo (4 - 6 ppm). The red mud itself has elevated concentrations of As, V, Cr, Co, Ni and U (100-1000 ppm). These contaminants persist in water and sediment samples for up to 100 km downstream of the source. The long term effects of the red mud spill on the environment remain largely unknown, especially with respect to the behaviour of the toxic elements present. Here we describe the results of experiments using sequential extraction, electron microscopy and X-ray absorption spectroscopy techniques to characterise the occurrence of metal(loids) within the red mud.

SEM and TEM analysis of red mud material sampled from the dyke breach at Ajka was composed primarily of 10-100 nm haematite particles occurring as 100-700 nm aggregates and 1-4 μm sodium aluminosilicate particles. Transported samples also contain 10-40 μm silt particles, presumably entrained from local soils and sediments. In EDS analysis Cr, Ti, Al, Si, and Mn were associated with aggregates of nano-crystalline (~ 5 nm) haematite. Discrete 2-10 nm Ce-rich particles were also present. At Ajka, acid dosing and gypsum addition were extensively used to lower pH and precipitate soluble Al, As, V and Mo. Sequential extractions performed on transported red mud deposits determined that 70-90 % As and V are present in residual hard-to-leach phases. The remaining 10-30 %, however, occurred in weak acid / hydroxylamine HCl leached phases, which may represent the presence of freshly precipitated metal(loid) containing phases. XAS analysis of red mud samples and leachate precipitates focused on determining As and V speciation in both the labile and refractory phases present. This baseline information will help in predicting the likely environmental mobility, fate and the long term hazards from metal(loid) contamination associated with the spill.