The distribution of dissolved iron and aluminum in the Beaufort Sea

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One potential consequence of regional warming in the Arctic is reduced seasonal ice cover with likely, but poorly constrained consequences for marine primary productivity and ecosystem structure. Iron (Fe) plays a predominant role in high-latitude oceans as a potentially bio-limiting nutrient and previous work in the Arctic suggests that sea-ice may be an important vector delivering coastally sourced terrigenous matter to surface waters of the deep basins. Improved understanding of the predominant sources and sinks of Fe in the Arctic Ocean is required to improve our ability to predict the consequences of climate change for the productivity and community structure of the marine environment. To characterize Fe cycling in seawater, geochemical tracers such as aluminum (Al) and manganese (Mn) can be employed with the former indicative of lithogenic sources such as aeolian deposition and ice-rafted particulates and the latter suggesting a source through diagenetic remobilization of the sediments.

Here we report dissolved (<0.2 μm) Al and Fe profiles for six stations along an onshore-offshore transect from the Mackenzie Shelf to the Canada Basin of the Beaufort Sea. Concentrations of Al and Fe in the upper water column generally decreased with distance offshore and both displayed surface maxima (Al = 5-8 nM, Fe = 0.8-1.3 nM) which are consistent with input from summer melting of sea-ice. Maximum dissolved Al concentrations (> 10 nmol L^{-1}) were detected in shelf waters proximate to riverine and sedimentary metal sources or subsurface waters likely influenced by cross-shelf transport.

Quantifying the precipitation and dissolution of CO_2 within geological carbon storage analogues

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Natural CO_2 reservoirs that have contained CO_2 for millennia hold the key to assessing the safety and viability of engineered CO_2 storage. These CO_2 reservoirs are critical in determining the long-term consequences of increasing the gross volume of CO_2 in the subsurface over geological timescales. This study builds on published noble gas data from five natural CO_2 reservoirs of the Colorado Plateau and Rocky Mountain provinces [1] by utilising published noble gas and $\delta^{13}C(CO_2)$ data from a further four CO_2 reservoirs. This forms an extensive global dataset as two of the additional reservoirs are located in China and one each from Europe and the USA.

Within the majority of these CO_2 reservoirs there is a clear lowering of the CO_2 component relative to the tracer ^3He. This reduction of the $CO_2/^3He$ correlates directly with an increase in groundwater-derived noble gases. This can only be explained if processes associated with groundwater interaction are responsible for reducing the magmatic CO_2 component relative to ^3He. We use a combination of the noble gas and $\delta^{13}C(CO_2)$ measurements to distinguish between and quantify the amount of CO_2 drawdown within the individual reservoirs caused by dissolution of CO_2 into the groundwater from that caused by precipitation processes. Our results illustrate that precipitation of CO_2 gas as carbonates is a volumetrically a less significant mechanism of CO_2 drawdown than CO_2 dilution into the groundwater within these natural reservoirs. Additionally, evidence for $\delta^{13}C(CO_2)$ isotopic fractionation caused by precipitation processes is not readily apparent within the reservoirs that have a significant carbonate lithology.

[1] Gilfillan *et al.* (2008) *GCA* **72**, 1174-1198.