Iron isotopes track the uptake and exchange of iron across an oxic shelf sea

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The supply of iron (Fe) to the surface ocean dictates levels of primary productivity where macronutrients are replete. Continental shelves and shelf seas are a source of Fe to ocean basins however, mechanisms that control its supply are poorly understood. Fe isotopes can trace the transfer of Fe from shelf sediments to the water column and the cycling of Fe within the water column. Previous studies focussed on ocean margins where oxygen deficient waters facilitate the benthic supply of dissolved Fe in its reduced form, Fe(II). Conversely, oxic shelf seas represent a significantly larger fraction of ocean continental shelves but the importance of its benthic Fe supply is poorly constrained. Understanding the Fe cycle in shelf seas is critical to determine the extent of Fe supply mechanisms and export of Fe to the adjacent ocean.

Water column profiles of dissolved iron (dFe) and iron isotopes (δ^{56}dFe) in the Celtic Sea are presented for on shelf, shelf edge and N. Atlantic stations. The on-shelf site was sampled repeatedly during pre-bloom, bloom and post bloom conditions. As the bloom develops δ^{56}dFe is fractionated in the surface mixed layer due to biological uptake of Fe. Bottom waters on shelf showed little variation between bloom (-0.22 ± 0.04 ‰) and post bloom (-0.26 ± 0.03 ‰). These isotopically light values are indicative of benthic Fe supply to the water column.

The isotopic composition of dFe in the water column allows the processes of dFe-particle exchange, biological uptake, sedimentary sources and off shelf transport to be disentangled. This improves our understanding of dFe supply to shelf seas and dFe shelf export to the open ocean.