Radium isotopes to distinguish sedimentary and glacial sources of (micro)nutrients

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In many polar locations glacial retreat and mass loss are accelerating. Glacial meltwater contains high concentrations of iron (Fe), much of which is likely to be bioavailable. This implies that discharge from ice sheets, either directly to the ocean via iceberg melt or indirectly via meltwater streams and subglacial discharge, will increase supply of this essential micronutrient to the surrounding ocean. In some cases, offshore productivity shows a strong correlation with presence of meltwater and supply of Fe has been hypothesised to be the causal link.

However, Fe is relatively insoluble in saltwater, and any Fe remaining in solution upon entry to the ocean is subject to intense biological drawdown in productive polar fjords. Supply of Fe and macronutrients from below, via entrainment of deeper shelf waters enriched by benthic sources, is also a key mechanism contributing Fe to surface waters. In polar locations adjacent to Fe-limited regions of the ocean, quantifying the delivery of essential trace metals and macronutrients from shallow sediment versus glacial sources is one key to predicting how the ocean may respond to ongoing climate change. Our study uses short- and long-lived isotopes of radium (Ra), which are released naturally from lithogenic material, as tracers of glacial meltwater and sedimentary inputs to the water column. We compare sedimentary and glacial fluxes from continental shelves in the nothern and southern hemispheres (southwestern Greenland, and the western Antarctic Peninsula, respectively) to investigate the balance of these two inputs in different geographic settings, in terms of both Fe and macronutrients. Radium activities within the water column are used to characterise pathways and time scales of dispersion within the surface mixed layer as well as at depth.