Radium isotopes as a tracer of micronutrient input from shelf seas to the North Atlantic

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Shelf seas, such as the Celtic Sea, are shallow, highly productive and rich in macro- and micro-nutrients. Further, shelf sea sediments can act as a source of trace metals to the overlying water column and, via advection, to the open ocean. This is an important mechanism delivering essential micronutrients such as iron (Fe) to low-Fe open ocean waters. However, the magnitude of this Fe source remains poorly constrained.

Along with micronutrients, sediments also release radium (Ra), produced from the radioactive decay of thorium. Radium occurs naturally as four isotopes with half-lives spanning a range of scales from days to years, and can be used to evaluate the extent and rate of advection of waters influenced by interaction with sediments. We present short-lived Ra isotope activities measured in waters above the Celtic Sea shelf and in off-shelf transects to deep (2500 m) water to investigate the fate of this sedimentary Ra signal.

Both short-lived isotopes display higher activities toward the sediment-water interface at multiple shelf locations. In addition, excess ^{224}Ra revealed three distinct plumes of Ra enrichment extending into the Atlantic at depths of ~400, 800 and 1600 m. The shallowest of these plumes extends over 40 km away from the shelf, and suggests a time scale of 1-2 weeks since contact with the sediment at the shelf break. The data show a clear signal of shelf sediment input advected towards the open ocean, tracing a pathway for Fe and other trace metals into intermediate Atlantic waters.