Radium isotopes resolved across an ocean-sediment interface

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Marine sediments are a major source and sink for many (e.g. bio-essential) trace elements in the ocean, but quantifying their rates of seafloor exchange can be problematic. Short-lived radium isotopes (^{224}Ra, ^{223}Ra) are useful tracers of ocean-sediment exchange that may be used to quantify fluxes of other trace elements to and from marine sediments. However, scavenging and turbulent mixing processes that might modify the magnitude of trace-element release or uptake may also occur intensely in an ocean bottom boundary layer – a region that is difficult to sample accurately using wire-hung Niskin bottle rosettes [1]. We present results of ^{224}Ra in a vertical profile from sediment pore-waters, through an ocean bottom boundary layer, to surface waters of the Celtic Sea.

Radium samples were obtained by the trial of a new Miniature Autonomous Pump (MAP) designed to sample radium from 1 m above the seafloor, in combination with pore waters extracted by Rhizon samplers, and water column samples collected by Niskin bottles. We observed a strong gradient between pore waters and the overlying ocean, consistent with the diffusive release of excess ^{224}Ra from sediments to the water column. Elevated ^{224}Ra in the lower 70m of the 110m water column was consistent with efficient vertical diffusion in the central Celtic Sea. We propose MAPs can provide essential improvements to the depth resolution of radium sampling in support of future estimates of trace element fluxes at the seafloor.

[1] Homoky *et al.* (2016) Quantifying trace element and isotope fluxes at the ocean–sediment boundary: a review. *Phil. Trans. R. Soc. A* **374**: 20160246