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Radioisotope constraints of benthic iron flux on the East Antarctic Peninsula

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Short-lived radioisotope tracers emanating from the seafloor can provide unique constraints of the rates of water mixing and vertical diffusivity (K_v) overlying marine sediments. When combined with vertical concentration gradients of comparatively well-conserved chemical properties in seawater, K_v may be used to quantify an apparent vertical flux of these chemical properties as they are exchanged between the sediments and the water column [1]. During a UK-led GEOTRACES processes study (PICCOLO), to the East Antarctic Peninsula (EAP) in January-March 2024, we collected >16,000L of seawater to produce a novel picture of the short-lived radioisotope tracer, radium (Ra-224, half-life = 3.6 days), in vertical profiles through bottom waters at multiple sites along the shelf, including an outflow of the Larsen Ice Shelf, and at sites across the shelf-slope transition of the EAP, from 64 to 67 degrees South.

Using near-bottom depth-gradients in measured excess Ra-224 activity, in combination with radium-paired measurements of dissolved iron (dFe) concentration-depth gradients, we quantify an effective vertical diffusivity (K_v) and benthic dFe flux across the ocean's bottom boundary layer from our study sites in this region of the East Antarctic Peninsula. Despite the low nanomolar concentrations of dFe we observed in the water-column, which are characteristic of these well-oxygenated shelf waters, our approach yields benthic dFe fluxes of 10s-100s of $\mu mol\ m^{-2}\ d^{-1}$ in this region. Sea-ice cover challenges ship access and sampling along EAP, and we appear to lack any previous direct observations of benthic dFe flux from the study area for comparison. Our flux estimates are comparable in magnitude, however, to those observed by *in situ* benthic chambers and reported from lower oxygen and reducing continental margin settings elsewhere the world [1]. Thus, it appears these shelf sediments of the EAP also provide an important inventory of dFe, which could be used to sustain primary production, food webs and carbon-cycling in this lower limb region of the Antarctic Overturning Circulation.

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