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Using radium and carbon isotopes to evaluate the biogeochemical impact of boundary exchanges in the North Sea

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The North Sea is one of the most studied coastal regions on the planet, yet inputs of carbon and nutrients from the boundaries of the system remain an area of uncertainty in for both the observational and numerical modeling communities alike. Diagenetic reactions within sediments and subsequent sediment-water column exchange provide inputs of dissolved inorganic carbon (DIC), alkalinity (AT) and nutrients (NO_3-, PO43-) to the water column throughout the North Sea. In the shallow parts of the North Sea, additional sedimentary inputs from mudflats combined with freshwater inputs from the adjacent European landmass provide a substantial input of dissolved constituents into the Southern North Sea.

This study aims to explore the biogeochemical impacts of such boundary exchanges in the North Sea using an extensive suite of water column samples collected in September, 2011. The dominant controls of the stable carbon isotope signature of DIC (δ13CDIC) are determined and isolated. These include in-situ biological activity, and land-based signals, which can affect the paleo records found in shelf sediment cores. These investigations can guide modelling studies to assess the impacts of changing river loads on the biogeochemistry of coastal waters. The sediments and the coastline are also a well-defined source of Radium isotopes (224Ra, 223Ra, 228Ra). The dispersion of longer-lived 228Ra into the North Sea from the coastline can be used to calculate the offshore transport of numerous carbon, nutrient and metal species. Meanwhile the seafloor provides the dominant source of 224Ra, thus a strong relationship between Ra and Alkalinity provides a signature of sedimentary AT release.