

Using carbon and radium 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 form the boundaries of the system remain an area of uncertainty for both observational and numerical communities alike. Diagenetic reactions within sediments and subsequent sediment-water column exchange provide inputs of dissolved inorganic carbon (DIC), alkalinity (A_T) and nutrients (NO_3^- , PO_4^{3-}) to the water column throughout the North Sea. In the shallow waters of the Wadden Sea, similar sedimentary inputs from the 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 ($\delta^{13}C_{DIC}$) are determined and isolated. This includes the land-based signal, which can affect the paleo records found in shelf sediment cores, and can be further modeled 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 (^{224}Ra , ^{223}Ra , ^{228}Ra). The dispersion of longer-lived ^{228}Ra 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 ^{224}Ra , thus a strong relationship between Ra and Alkalinity provides a signature of sedimentary A_T release.