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In-situ investigation of alkalinity - denitrification coupling in the sediment - water column interface

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As a shallow shelf sea, the North Sea is very vulnerable to anthropogenic impacts like rising CO_2 concentrations, increasing nutrient inflows and coincident oxygen loss.

Two important processes that determine the role of the coastal ocean as a net sink for anthropogenic CO_2 are alkalinity and denitrification. Alkalinity, the acid binding capacity of the ocean, buffers natural and anthropogenic changes in the oceans' CO_2 and pH system. Denitrification, an anaerobic microbial process in which organic matter is respired, uses NO_3^- instead of O_2 as a terminal electron acceptor. Denitrification reduces NO_3^- to N_2 and in turn produces alkalinity.

Eutrophication, caused by leaching of excess fertilizer nutrients into coastal seas, leads to enhanced denitrification and therefore to enhanced alkalinity as well as an increased uptake of CO_2. However, the quantitative relationship between denitrification and alkalinity production and its control under changing environmental conditions is yet to be determined.

In the German Bight, denitrification is usually restricted to anoxic sediments. In this study, we therefore focus on in-situ experiments in the sediment - water column interface. Batch core

incubations in combination with the isotope pairing technique (IPT) and labelled nitrate additions were used to detect denitrification and gauge its effect on alkalinity production during a cruise on RV Heincke (HE541) in September 2019 in the German Bight. To quantify denitrification, the production of all three N_2 isotope species ($^{28}N_2$, $^{29}N_2$ and $^{30}N_2$) is measured using a membrane inlet mass spectrometer (MIMS). We expect an increase of denitrification rates with nitrate concentrations and incubation times, and we will quantify benthic denitrification. We will further evaluate the assumption of concurrent increases in alkalinity production and will investigate the benthic-pelagic coupling of these processes. Investigating the in-situ interaction of metabolic alkalinity and denitrification will give an estimation of the alkalinity impact on the reduction of anthropogenic CO_2 in the atmosphere.

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