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Noble Gases to Track Groundwater in Marine Sediments

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Offshore-freshened groundwater (OFG), i.e., freshwater found in marine sediments and aquifers underlying the ocean, has been documented at many continental margins and is commonly found within 55 km from the coastline and down to water depths of 100 m [1]. Different geochemical tracer techniques and analytical methods have been employed in the past to identify OFG and to study its various possible emplacement mechanisms into the marine sediments [1]. In the Baltic Sea, the presence of OFG and submarine groundwater discharge have been reported at various locations (see e.g. [1], [2], [3]).

Here we report results from noble gas analysis and excess air (EA) patterns in pore water of marine sediments from the Mecklenburg Bay (Baltic Sea). The presence of large amounts of EA (a typical and omnipresent surplus of atmospheric air in terrestrial groundwater) indicates that the pore water in the sediments is not of marine but instead of terrestrial origin and is derived from (continental) groundwater. Noble gas concentrations and reconstructed recharge conditions suggest that the groundwater infiltrated mainly during the (early) Holocene, preferentially during periods of sea level low stands, when the sediments were located close to former shorelines or might even have been exposed to the atmosphere. During these phases, hydraulic gradients between land and sea were increased, which lead to an enhanced emplacement of OFG into the sediments. Such varying hydraulic conditions of the Baltic Sea are in turn reflected in different EA amounts found throughout the investigated core. Based on the results of this study, noble gas analysis may present a useful a tool that could complement other tracer methods to identify OFG and study its emplacement mechanisms in the future.

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