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# Isotope biogeochemistry of exchange of water and substances across a Baltic Sea-peatland interface

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Land-ocean interactions in the coastal zone (LOICZ) are of particular interest regarding the exchange of elements, like nutrients, carbon and sulfur. An important pathway is submarine groundwater discharge (SGD) for this element exchange from the terrestrial to the marine environment and vice versa. On the pathway biogeochemical transformations may take place, that may lead to the accumulation of higher concentrations of nutrients, metals, carbon dioxide and methane.
Beside fresh groundwater, SGD also consist of a considerable proportion of recirculated often brackish seawater.
In the present study we followed the water and element exchange and associated biogeochemical transformation processes along a 2.5 km long coastal stretch in front of a rewetted peatland, the Hütelmoor area at the southern Baltic Sea.
Drone-based thermal infrared images conducted during winter time allowed for the identification of several possible SGD sites. Highest temperature difference of about 1°C has been measured in the northern part of the study area created by a local plume near the coastline. Several vertical pore water profiles were retrieved via mobile push-pull and up to 5 m long permanent pore water samplers in the shallow water area on a seasonal base. Furthermore, Baltic Sea surface water samples were obtained during several ship cruises. A focus was set on the investigation of concentration gradients of major and redox-sensitive trace elements, nutrients and the stable isotope composition (H, C, S, O) of water, dissolved inorganic carbon (DIC) and sulfate to understand the mixing processes and superimposing biogeochemical transformation reactions. Ra isotope investigations in the water column and in the pore water complemented these measurements and are used for the detection of benthic-pelagic coupling via exchange of solutions on a local to regional scale.
During different sampling campaigns, Rn, several Ra, and Ra isotopes were measured along transects with different lengths perpendicular to the coastline. Rn was found to be low in the water column. Both sampling campaigns reveal differences in dissolved Ra isotope concentrations indicating exchange between sediment and water column with higher contributions from SGD in the northern part of the study area. Nearshore water show higher Ra signals compared to the offshore stations and are positioned on a mixing line with the pore water end member.
We found evidence for a strong control of the bottom-pore water exchange induced by exposed lithology and a high activity of dissimilatory sulfate-reducing microorganisms in the coastal sediments. Sedimentary sulfur fractions and their stable isotope signatures are controlled by the availability of dissolved organic matter or methane, reactive iron, and in the wetland particular dissolved sulfate. Following a recent flooding event with brackish Baltic Sea water, the sulfur isotope composition of sulfate in surface waters draining the peatland indicate the impact of solutions that were modified by net microbial sulfate reduction.

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