

SUBMARINE GROUNDWATER DISCHARGE IN THE SOUTHWESTERN BALTIC SEA

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ABSTRACT

The protection of the coastal environment in the Baltic Sea relies on the correct identification of the sources and fluxes of pollutants. Although the main transport routes of pollutants (atmosphere, rivers) are well monitored, several studies indicate that a considerable part of unmonitored waters flow to the Baltic Sea. One of these, to date, unmonitored water flows to the sea is submarine groundwater discharge (SGD). SGD is defined here as the flow of meteoric water from the seabed to the coastal ocean and is a ubiquitous phenomenon at ocean margins. SGD occurs whenever the hydraulic gradient on land is above mean sea-level and permeable paths connect continental aquifers to the seafloor. So far very few SGD locations have been described in the Baltic Sea. Here we report from a systematic survey for SGD in the Southwestern Baltic Sea (Mecklenburg Bay, Lübeck Bay, Kiel Bay, Eckernförde Bay). Based on geochemical tracer measurements (radon, radium isotopes, salinity) in seawater, and measurements of pore water salinity in marine surface sediments, we could identify SGD locations related to coastal aquifers discharging directly at the beachfront. More frequently, diffuse discharge from near shore sediments was observed. Such SGD was characterized by significantly lower pore water salinities compared to ambient sea water. Pore water salinity was monitored using an in situ CTD. Interstitial water salinity was marked by strong variation, with generally lower values during periods of low sea level. This relationship indicates that diffusive SGD is largely controlled by the sea level, which, in turn, controls the hydraulic gradient between land and sea. In the Southwestern Baltic Sea the sea level is mainly determined by the wind regime. Within this study, several locations were identified in which SGD is associated with high nitrate concentrations indicating the importance of SGD for the nutrient balance of the Southwestern Baltic Sea.