Tracing hypoxia in the Baltic Sea using trace elemental geochemistry and foraminiferal faunal assemblages

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The modern Baltic Sea suffers from effects of eutrophication, resulting in increased hypoxia ([O_2]<1.4 ml/l) over large areas of this enclosed sea. Our goal is to study how the extent and severity of hypoxia in the region have varied over the Holocene. We focus particularly on the environmental conditions during periods with warmer climate, such as the Holocene Thermal Maximal (8-4 ka BP) and the Medieval Climate Anomaly (2-0.8 ka BP). We apply foraminiferal trace elemental geochemistry and faunal assemblage data to reconstruct past marine conditions (e.g. oxygenation, temperature, salinity). High accumulation rate sediment cores were retrieved for the Holocene (0-8 ka BP) during IODP Exp. 347: Baltic Sea Paleoenvironment; these cores are the basis for this study of Holocene Baltic warm periods. We analyse the trace elemental concentration (Mg/Ca, Mn/Ca Ba/Ca, Sr/Ca) in calcite tests of low-oxygen tolerant foraminifera species from two Baltic Sea sites: the Little Belt, Danish Straits (Site M0059) and the Landsort Deep, the deepest basin of the Baltic Sea (Site M0063). Laser ablation (LA-)ICP-MS allows in situ measurements to avoid the influence of surface diagenetic coatings on these foraminifera. In particular, we use Mn/Ca in calcite as a potential proxy for low oxygen conditions in the Baltic Sea, as Mn is a redox-sensitive element, and its concentration in bottom - and pore waters increases in hypoxic conditions. By combining these trace element data with additional available proxy datasets (foraminiferal assemblages and stable isotope ratios), we quantify and discuss the hypoxia and ecosystem changes during the past warm periods in the Holocene.