

Holocene history of environmental change in a high latitude coastal basin

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Climatic change, eutrophication and sea level rise are impacting coastal systems worldwide. Our understanding of how high latitude regions respond to such environmental change is incomplete. The Bothnian Sea is a high latitude coastal basin that has undergone major changes over the Holocene. Starting as a freshwater glacial lake, 7 ka before present, the basin initially became a marine coastal system before evolving into the present day semi-enclosed brackish coastal system. In this study, we assess temporal trends in bottom water redox conditions, salinity and organic matter supply throughout the Bothnian Sea over the Holocene, using a suite of geochemical proxies, including trace metals, obtained through discrete sample analysis and X-ray-fluorescence scanning of sediment cores retrieved from five sites spatially distributed over the basin. Our sediment records show that the whole basin responded to environmental change in a similar manner. We observe an abrupt shift from a well-oxygenated, oligotrophic, freshwater glacial lake to an anoxic, eutrophic, brackish-marine system. The intensity of anoxia and degree of eutrophication, as recorded by trace metals (e.g. Mo and U) and organic carbon, respectively, varied across the basin. Sediment sulfur records indicate that the basin freshened over time. Recent sediments show evidence for increased human impact (e.g. Pb and As pollution) and an increased rate of organic matter deposition. Our work provides insight in the response of high latitude coastal seas to both abrupt and gradual environmental change, which is relevant in view of future scenarios.