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Hypoxia in the Baltic Sea as revealed by lipid biomarkers

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Anthropogenic nutrient loading is a main cause of decreasing oxygen concentrations in the Baltic Sea leading to an increase of so-called hypoxia (oxygen concentrations less than 2 mg/L oxygen) during the last century. In addition, natural, climate change-driven hypoxia appeared during the last 8000 years. The increased flux of organic material to the bottom water and sediments due to nutrient enrichment has disrupted the balance between oxygen supply through physical processes and oxygen consumption from decomposition of organic material. Apart from effects of oxygen concentrations on biogeochemical dynamics in the sediment (e.g., N, P, S and Fe cycling) microbial and benthic faunal communities are affected as well. The history of the various (micro)organisms is recorded in sediment cores, in particular in the form of lipid biomarkers that are unique for a certain group of organisms.

In this study, we assess whether the sedimentary record carries evidence for low-oxygen conditions in the Bothnian Sea. This part of the Baltic Sea is currently well-oxygenated, but may have experienced periods of low-oxygen conditions in the past. A preliminary study of cores SR5 spanning the last 8000 years (recovered from the southern part of the Bothnian Sea) and LL19 (from the Baltic Proper) revealed that the organic carbon is mainly terrestrial-derived as evidenced by the high concentrations of higher plant lipids (n-alkanes, n-alcohols, n-fatty acids). Common biomarkers typical of oxygen depleted conditions, such as isorenieratene (from green sulfur-reducing bacteria) and lycopane (marine photoautotrophs) were absent from the sediments. By contrast, 2,23- (C_{24}) and 2,25- (C_{26}) alkanediols were highly abundant, and although their source organisms is yet unknown, these compounds have been observed in several other oxygen depleted sediments. Although cores SR5 and LL19 are from different locations with the Baltic proper nowadays much more oxygen depleted than the Bothnian Sea, the relative abundances of lipid biomarkers was rather similar albeit in a somewhat different distribution.