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The Baltic Sea: Geophysical and geochemical properties of Holocene sediment sequences as indicators of past environmental variability

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The Baltic Sea has undergone large environmental changes since the retreat of the Weischselian Ice-sheet. In the Late Glacial Period and the early Holocene these changes were most likely caused by natural environmental changes (i.e. changes in the morphology and depths of the Baltic basin and the sills). In more recent time anthropogenic impacts have become more important as a possible and likely cause for changes. During the whole Holocene period climate variability played an important role. However, the relative importance between humans and nature is largely unknown.

Here we present the results of a combined geophysical and geochemical study on selected sediment sequences from the Baltic Sea within the two BONUS (Baltic Organisations Network For Funding Science) funded projects HYPER (HYPoxia mitigation for Baltic Sea Ecosystem Restoration) and Baltic GAS (GAS storage and effects of climate change and eutrophication). The over-all aim of these projects is to understand large-scale Baltic Sea ecosystem responses to environmental, climate and anthropogenic forcing.

During two Baltic Sea research cruises in 2009 long sediment cores from 8 different locations were recovered. We present preliminary results from one site (LL19) located in the north central Baltic Proper at 169 m water depth. The Littorina Sea sediment record (i.e. the last c. 8000 years) is characterised by alternating periods of homogenised sediments (indicative of oxic conditions) and laminated sediments (indicative of hypoxic/anoxic conditions).

Mineral magnetic properties illustrate clear changes between laminated and non-laminated sections of the core. The concentration of ferrimagnetic minerals, as revealed by initial magnetic susceptibility () and saturation isothermal remanent magnetization (SIRM) is variable. The laminated sections in particular show high concentrations and to reveal the origin of the ferrimagnetic signal additional magnetic properties were measured, specifically the acquisition of rotational remanent magnetization (RRM), frequency dependency of susceptibility (fd) and magnetic loops. These data show that magnetic assemblage of the laminated sections is dominated by a single-domain magnetic grain size.

The elemental composition was measured with a high resolution Itrax XRF-scanner throughout the core. In addition, biogenic silica (BSi) and total organic carbon (TOC) were determined. Distinct changes of elemental contents between the laminated and homogenous sections in the Littorina Sea sediments were identified. A combination of the physical and geochemical properties of the sediment sequences and the construction of geochronologies will provide information about past environmental variability to identify casual relationships to climate and human impact in the Baltic Sea.