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Historic surface water productivity changes in the Barents Sea

I. Maier (1), M. Felix (2), J. Knies (1), and U. Mann (2)
(1) Geological Survey of Norway, Trondheim, Norway, (2) SINTEF Petroleum Research, Trondheim, Norway

In this study we investigate organic carbon sedimentation patterns and surface water productivity changes in response to Holocene climate variability in northern high latitudes. We studied 197 surface sediment samples and 10 short (ca. 10-30 cm long) cores representing the last 300-500 years in the western sector of the Barents Sea between Spitsbergen and the Norwegian mainland.

The Barents Sea (BS) is a shallow (mean depth ca. 200 m) Arctic Ocean shelf sea which is partially covered by sea ice in the northeast in the winter. Warm, saline Atlantic water (AW) enters the BS in the southwest and flows east- and northward until it is subducted under cold, fresh Arctic water (ArW) which enters the BS from the northeast and flows southwestward. The region where the AW is subducted under the ArW is called the Polar Front (PF). Its position is mainly topographically controlled but also depends on the relative strengths of the two water masses. This is also the region of the winter ice margin. Previous research has shown that the BS is one of the most productive shelf seas in the world.

Through a multi-proxy geochemical and organic sedimentological approach we aim to address the following objectives:
1. Reproduce modern changes in primary productivity (PP) by comparing reconstructed PP derived from seabed data to observational PP data. This will help to identify PP hotspots and accumulation of organic matter in the presence/absence of sea ice.
2. Show the spatial distribution of PP over the whole region by using organic facies modeling.
3. Estimate PP variability over the last 500 years comparing results from the sediment cores to our regional modeling results.
4. Reconstruct the position of the PF in the BS throughout the last 500 years.

We use OF-Mod 3D, an organic facies modeling software developed by SINTEF Petroleum Research, to reconstruct PP changes and organic carbon accumulation across the western Barents Sea throughout the past 500 years. OF-Mod 3D is a predictive, process-based, forward-modeling tool used to calculate organic matter preservation in a 3D grid throughout the modeled domain. The surface sample data set is used to calibrate the model to the present-day situation and we will show the spatial distribution of modeled PP throughout the BS region.

The results from the surface data show a difference between the ice-covered and ice-free regions. The preliminary results from the short cores show a north vs. south difference in the distribution of surface δ^{15}N and δ^{13}C and down-core gradients that we interpret as shifts from ice-covered to ice-free, thus giving an indication of the position of the PF over time.