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Environmental drivers and benthic controls of organic carbon storage in sediments of northern fjords - a latitudinal study (60–80°N)

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Fjords have been recently recognized as hotspots of organic carbon storage, with organic carbon burial rates one hundred times larger than the global ocean average, accounting for 11% of global annual marine carbon burial [1]. The organic carbon production and processing in coastal waters and sediments are controlled by environmental settings that are likely to be reshaped in the course of the global warming. The fastest and strongest changes are to occur in polar regions [2]. In the present study we compare organic carbon stocks, accumulation and burial in temperate (Raunefjorden, Ullsfjorden, Balsfjorden) and Arctic (Hornsund, Kongsfjorden, Rijpfjorden) northern fjords located along the latitudinal/thermal gradient from the southern Norway (60 °N) to North of Svalbard (80 °N).

The sediment cores were collected at 3 to 5 stations within the central basin at 150-300 m in each fjord during r/v Helmer Hansen and r/v Oceania cruises in 2014 and 2015. Vertical patterns of grain size and organic matter content characteristics (particulate organic carbon, stable isotope ¹³C signature, photosynthetic pigments concentration) have been analyzed. Two-end members method was used to determine the organic carbon sources. Sediment accumulation rates have been estimated with use of ²¹⁰Pb dating method. Fresh carbon accumulation rate was estimated based on organic carbon concentration in surface sediments and mass sediment accumulation rate. The variability in benthic carbon demand (calculated based on the macro- and meiobenthic species biomasses in samples collected at the same stations) was also assessed to explore the patterns of biological controls of carbon storage in sediments. Carbon burial was estimated by multiplying organic carbon concentration in deepest sampled sediments and mass sediment accumulation rate.

The effects of contrasting hydrological regimes and biological activity on the carbon storage in the studied fjords are discussed from the perspective of possible effects of climate warming driven changes on the Arctic fjordic sedimentary systems.

References:

[1] Smith R.W. et al. (2015) Nature Geoscience 8: 450-453

[2] ACIA (2006) Arctic Climate Impact Assessment – Scientific Report. Cambridge University Press, Cambridge

