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

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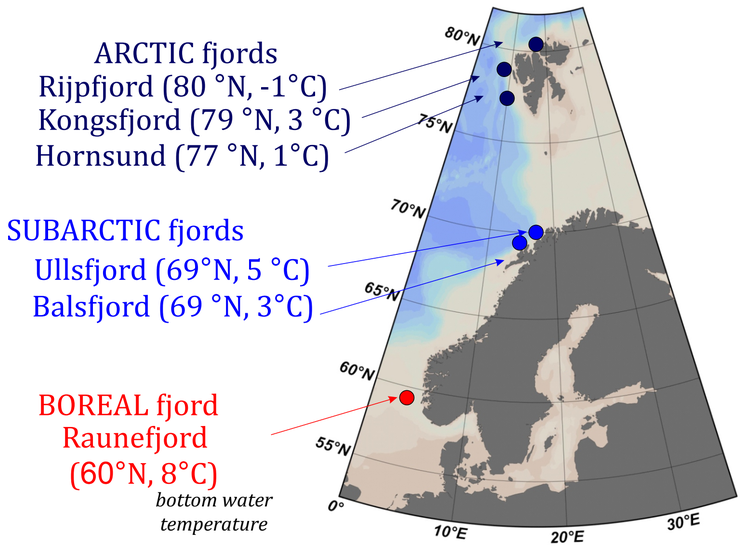
Introduction

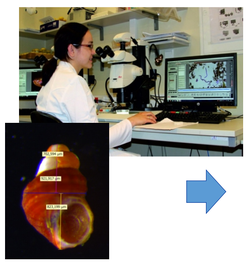
Fjords have been recently recognized as hotspots of organic carbon burial, with organic carbon burial rates one hundred times larger than the global ocean average, accounting for 11% of annual marine carbon burial globally [Smith RW et al. (2015) Nature Geoscience]. The organic carbon production and 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. In the present study we compare organic carbon stocks, accumulation and burial in six North Atlantic fjords located along the latitudinal thermal gradients from the southern Norway (60 °N) to North of Svalbard (80 °N).

Sampling

Sampling in summer 2004 and 2015 from board r/v „Oceania" and r/v „Helmer Hansen" at 3-5 stations (depths 150-300 m) in 6 fjords - Arctic (Spitsbergen), subArctic (northern Norway), boreal (southern Norway).



Analyses

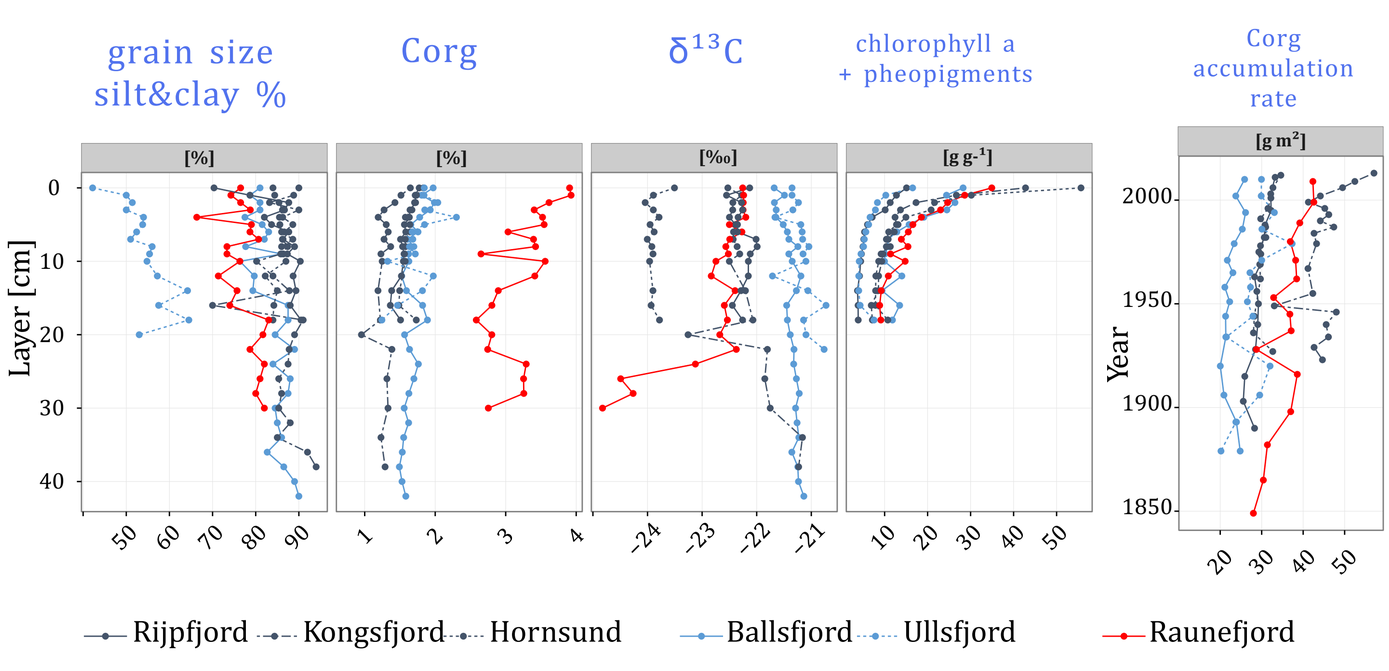


composition	species in macrofauna, higher taxa in meiofauna
individual biomass	estimated based on individual dimensions measurements
production respiration	estimated using the Artificial Neural Network models by Brey (2010)
carbon demand	estimated based on production and respiration (according to Klages et al. 2004)

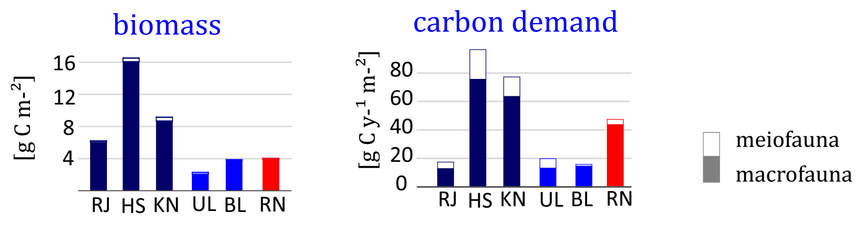
grain size	Malvern Mastersizer 2000 laser particle analyzer
Corg, $\delta^{13}C$	mass spectrometry (CF-EA-IRMS) *at the University of Liège*
photosynthethic pigments	spectrofluometer (Perkin Elmer LS55.)
sediment accumulation rate	^{210}Pb dating (indirect measurment by alpha spectrometry) to obtain MAR (mass accumulation rate)
carbon burial	estimated by multiplying MAR by the deepest measured Corg

Results

SEDIMENTS



BENTHOS



fjord	MAR [g m^{-2}y^{-2}]	average Corg (0-20cm) [%]	Corg benthic demand [g m^{-2}y^{-2}]	Corg burial rate [g m^{-2}y^{-2}]
Rijpfjord	1875	1.6	18	26
Hornsund	1887	1.6	96	28
Kongsfjord	3468	1.3	77	42
Ullsfjord	1623	1.7	19	20
Ballsfjord	1313	1.7	17	20
Raunefjord	1084	3.3	47	30

No clear latitudinal patterns in carbon burial were documented. The highest organic carbon burial rates were noted in Kongsfjord which hosts the most active tidal glaciers in Spitsbergen that implies very high sediment accumulation rates. The second highest burial rates were recorded in Raunefjord, the southernmost fjord with organic carbon content in sediments much exceeding that of all the other localities.

While the Arctic fjords seem to be hot-spots of carbon burial at present, their burial potential may weaken in the course of climate change along with the glaciers retreat (decreasing sediment input and accumulation rates).