Organic Carbon Composition and Transport linked to Wind Forcing in the Nearshore Zone of Herschel Island, Qikiqtaruk (NW-Canada)

Pia Petzold[1,2], Hugues Lantuit[1,2] & Michael Fritz[1]

[1]Section Permafrost at the Alfred-Wegener Institute Helmholtz Centre for Polar- and Marine Research, Potsdam, Germany

[2]Institute for Geosciences at the University of Potsdam, Potsdam, Germany

Arctic coastal areas underlain by permafrost are significantly affected by the effects of global climate change. Rising permafrost temperatures, reduced sea ice cover and warmer seawater temperatures are all contributing to increased coastal erosion. This process releases carbon stored in permafrost into the adjacent coastal zone, where it is degraded, with the potential risk of releasing greenhouse gases (GHGs) into the atmosphere. However, the transport pathways and degradation processes of organic carbon (OC) in the nearshore zone are not well understood. To address this knowledge gap, we repeatedly sampled the nearshore zone of Herschel Island, Qikiqtaruk, Canada, for dissolved and particulate OC (DOC, POC) in order to capture the temporal intraseasonal variability of coastal biogeochemistry. The sampling was conducted along two transects in two consecutive weeks in July 2022. One transect was situated directly offshore of a retrogressive thaw slump, while the other was located in front of a permafrost cliff coast. Each transect comprised six sampling stations spanning from 10 to 1000 m offshore (Figure 1). Water temperature, water depth, electrical conductivity and salinity were determined using a CTD CastAway. For water depths less than 5 m, two water samples were collected at the surface and near the seafloor using a UWITEC water sampler. For depths exceeding 5 m, a third sample was obtained at the thermocline depth. Turbidity was recorded once per sample with a HACH 2100Q turbidity meter. Subsequently, the collected seawater was filtered through 0.7 µm GF/F filters. The filtrate was analyzed for DOC and total dissolved nitrogen (TDN) using a Shimadzu TOC-L with TNM-L module. Inorganic carbon was removed from the filter residues, which were then analyzed for POC and total particulate nitrogen (TPN) content, δ13C and δ15N using an elemental analyzer isotope mass spectrometer (EA-IRMS) at the University of California Stable Isotope Facility (Davis, USA). When feasible, the permafrost cliff transect was sampled for marine surface sediment. Those samples were analyzed for grain size, mercury, carbon and nitrogen content. The data shows a clear gradient in temperature, turbidity and organic carbon content (dissolved and particulate) in the water column, especially in the beginning of the sampling period. The influence of the Mackenzie River plume and the discharge from the slump is evident, with turbidity values between 3.8 and 205 FNU and salinities from 3.0 up to 31.9 PSU. Field parameters will be correlated with ERA5 wind data to indicate the variability in how geochemical properties are affected by wind direction and speed. Multivariate statistics will determine and quantify the relation between water/sediment properties and environmental forcing factors.

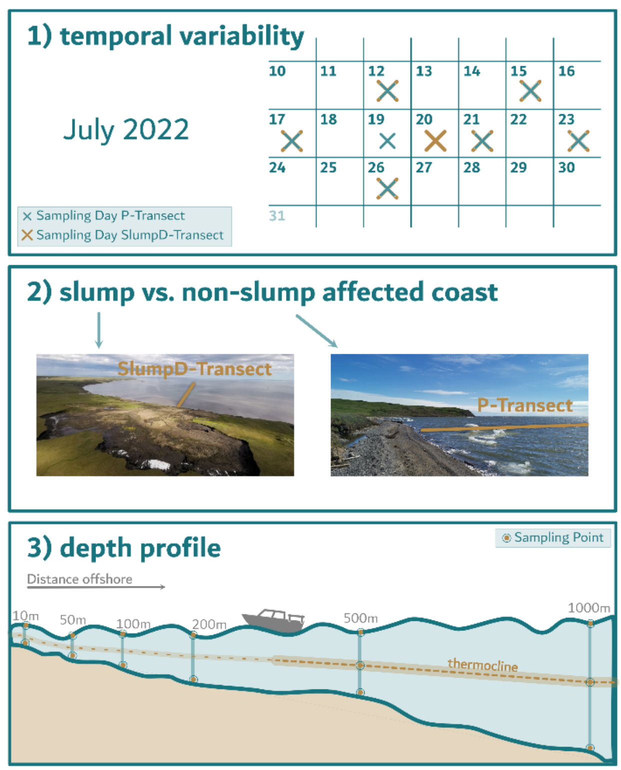

Figure 1. Variability captured in the data set of nearshore biogeochemical parameters.