Dissolved organic matter composition in Arctic drift ice and surface waters.

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In this study we investigated spectral properties of dissolved organic matter (DOM) in the ice cores and open waters within the polygon located north off Svalbard (figure 1) – the region where warm Atlantic Water (AW) carrying heat and salt into the Arctic Ocean, interfaces the Polar Water and meets the ice transported by the Transpolar Drift. The open lead water column (OW), under ice water column (UIW) and sea ice cores (ICE) samples were collected during the "TRANSSIZ" expedition (Transitions in the Arctic Seasonal Sea Ice Zone) conducted in May and June 2015 on board of the icebreaker FS Polarstern (cruise code PS92 - ARK XXIX/1).
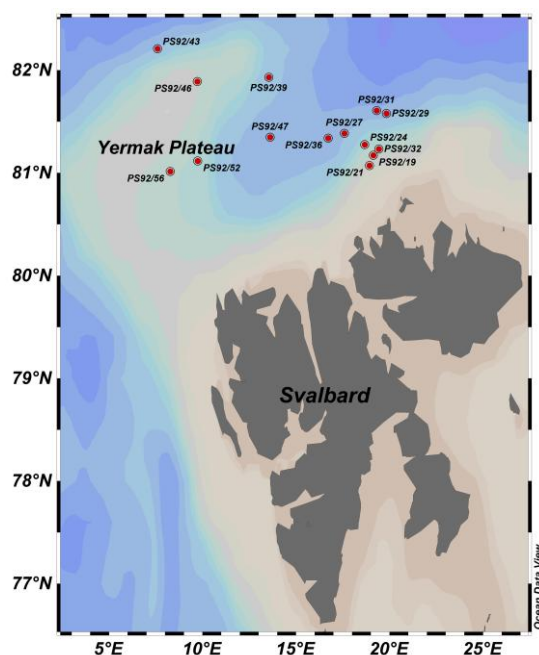

Figure 1 Location of sampling stations during TRANSSIZ (PS92) expedition presented in this study.

The PARAFAC model was derived to assess the DOM composition based on measured Excitation Emission Matrix spectra (EEM). The four-component PARAFAC model has been successfully validated. The PAPRAFAC model identified one protein-like component (C1) ($\lambda_{Ex}/\lambda_{Em}$ 282(270)/335) and three humic-like components (C2-C4). The C2 component ($\lambda_{Ex}/\lambda_{Em}$ 315(252)/395) has spectral characteristics similar to the maximum M described by Coble (1996) considered to be a precursor of organic matter of marine origin. The C3 component ($\lambda_{Ex}/\lambda_{Em}$ 357(258)/446) has spectral characteristics similar to terrestrial

humic-like material described as maximum C by Coble, (1996). We have assigned spectral characteristic of the last component, C4 ($\lambda_{Ex}/\lambda_{Em}$ 261(399)/492), to a mixture of humic-like material of terrestrial origin described earlier as maximum A (Coble, 1996) and soil fulvic acids - maximum D (Coble, 1996).

We have observed a change in DOM fluorescence intensity between two sampled water masses (OW and UIW) and drift sea ice (ICE). The DOM fluorescence intensity in open waters was lowest (I_{Tot} = 0.044 R.U.) and the DOM composition was dominated by the humic-like components (C1-C3). The total fluorescence I_{Tot}. increased in under ice water by 33.3 % compared to open waters but not significant changes in DOM composition were observed.

The sea ice cores were divided into three layers: surface, middle and bottom. The DOM fluoresces intensity in the ice bottom layer was 26.6 and 68.9 % higher compared to UIW and OW, respectively. The fluorescence DOM intensity in the ice cores was lowest in its middle layer. We have observed a significant change in DOM composition in the sea ice. The fluorescence intensity of protein-like component C1 was 1.5 times higher than a sum of fluorescence intensity of remaining humic-like components C2-C4. The C1 contributed 30 % to I_{Tot}. The spectral indices: ratio between fluorescence intensity of identified protein-like components to humic-like components, I_p/I_h and SUVA(254) were highest in the sea ice bottom layer (I_p/I_h = 2.164, SUVA(254) = 1.380 m^2 g^{-1} C), while humification index, HIX, values were found lowest there (0.486).

References:

Coble P. G.,1996. *Characterization of marine and terrestrial DOM in seawater using excitation – emission matrix spectroscopy*. Mar. Chem., 51, 325-346.