The characteristics of dissolved organic matter (DOM) and chromophoric dissolved organic matter (CDOM) in Antarctic sea ice - DTU Orbit (30/12/2018)

An investigation of coloured dissolved organic matter (CDOM) and its relationships to physical and biogeochemical parameters in Antarctic sea ice and oceanic water have indicated that ice melt may both alter the spectral characteristics of CDOM in Antarctic surface waters and serve as a likely source of fresh autochthonous CDOM and labile DOC. Samples were collected from melted bulk sea ice, sea ice brines, surface gap layer waters, and seawater during three expeditions: one during the spring to summer and two during the winter to spring transition period. Variability in both physical (temperature and salinity) and biogeochemical parameters (dissolved and particulate organic carbon and nitrogen, as well as chlorophyll a) was observed during and between studies, but CDOM absorption coefficients measured at 375nm (a375) did not differ significantly. Distinct peaked absorption spectra were consistently observed for bulk ice, brine, and gap water, but were absent in the seawater samples. Correlation with the measured physical and biogeochemical parameters could not resolve the source of these peaks, but the shoulders and peaks observed between 260 and 280nm and between 320 to 330nm respectively, particularly in the samples taken from high light-exposed gap layer environment, suggest a possible link to aromatic and mycosporine-like amino acids. Sea ice CDOM susceptibility to photo-bleaching was demonstrated in an in situ 120 hour exposure, during which we observed a loss in CDOM absorption of 53% at 280nm, 58% at 330nm, and 30% at 375nm. No overall coincidental loss of DOC or DON was measured during the experimental period. A relationship between the spectral slope (S) and carbon-specific absorption (a375) indicated that the characteristics of CDOM can be described by the mixing of two broad end-members; and aged material, present in brine and seawater samples characterised by high S values and low a375; and a fresh material, due to elevated in situ production, present in the bulk ice samples characterised by low S and high a375. The DOC data reported here have been used to estimate that approximately 8TgCy−1 (~11% of annual sea ice algae primary production) may be exported to the surface ocean during seasonal sea ice melt in the form of DOC.

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