**Supplemental**

Chart, scatter chart

Description automatically generated

**Figure S1.** Calibration of the CTD mounted Haardt fluorometer on GN01 to water samples taken and measured onboard (following Stedmon et al., 2021). Fl. = V \* 0.7143 – 0.0321; R2 = 0.91.

A picture containing text, screen, display

Description automatically generated  
**Figure S2.** The fluorescence properties of fluorescent components identified by PARAFAC modeling in the Canada Basin (a) and the Nansen, Makarov, and Amundsen Basins (b). Dotted line- excitation, solid line- emission.

Graphical user interface

Description automatically generated

**Figure S3.** Sectional plots of temperature and salinity in the upper 400 m for sections A (a, c) and B (b, d); vertical distribution of *in situ* CDOM fluorescence (CDOM), silicate concentration ([Si]max corresponds to the upper halocline core (Anderson et al., 2013)), the Pacific water fraction (fPac) estimated from the δ18O/salinity method (e) at GN01 station 52 (central Canada Basin).

Graphical user interface

Description automatically generated  
**Figure S4.** Relationship (Pearson correlation) of lignin phenol (TDLP9) concentrations, fSIM and fMet in the Chukchi Sea, Canada, Makarov, Amundsen and Nansen Basins. Only significant (p < 0.001) correlations are shown.

**Graphical user interface, application

Description automatically generated**  
**Figure S5.** Sectional plots of dFe, dMn, dNi, dCu, dZn, dCd in the upper 400 m (section A). The white line represents the isohaline of S=31, which is the border of the PML in the Canada Basin. Black dashed isohaline of σ = 27 kg/m3 represents the LHC/UHC border. The LHC is bordered at the bottom by the isopycnal of σ = 27.6 kg/m3.

**Graphical user interface

Description automatically generated with low confidence**  
**Figure S6.** Sectional plots of dFe, dMn, dNi, dCu, dZn, dCd in the upper 400 m (section B). The white line represents the isohaline of S=31, which is the border of the PML in the Canada Basin. Black dashed isohaline of σ = 27 kg/m3 represents the LHC/UHC border. The LHC is bordered at the bottom by the isopycnal of σ = 27.6 kg/m3.

Chart, scatter chart

Description automatically generated

**Figure S7.** Scatterplots between the dNi (top panels), dCu (bottom panels) and C1 PARAFAC components and *in situ* CDOM fluorescence (CDOMF; a, b), lignin phenols (TDLP9) and dissolved organic carbon (DOC; b, d), in the top 300 meters of the Arctic Ocean. Only significant correlations (p<0.001 are shown).

Chart, scatter chart

Description automatically generated

**Figure S8.** Scatterplots between the trace metals and *in situ* CDOM fluorescence (a), DIC (b), DOC (c), terrigenous humic-like C1482 (d), marine humic-like C1434 (e), marine humic-like with sediment signature C1402 (f), in the top 300 meters of the Canada Basin. Only significant correlations (p<0.001 are shown).

**Table S1.** Spectral characteristics of the six fluorescence components identified by PARAFAC in the Eurasian Basin and the TPD region and comparisons to previously identified components.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| PS94 | Description | Excitation max/ | Similar components | References |
| **Emission max, nm** |
| C2411 | Humic-like | 260,300/411 | Florida Keys C1 | Yamashita et al., 2013 |
| C2456 | Humic-like  terrigenous | 260,340/456 | Florida Keys C2,  Lena 2013 C2 | Yamashita et al., 2013,  Gonçalves-Araujo et al., 2015 |
| C2404 | Humic-like | <260,309/404 | Omdrev C2,  Arctic Seawater C2 | Kothawala et al., 2014,  Chen et al., 2018 |
|  |  |  | C3 | Williford et al., 2021 |
| C2492 | Humic-like  terrigenous | 285/492 | Omdrev C3 | Kothawala et al., 2014 |
| C2338 | Protein-like (Tryptophan) | 280/338 | Antarctic Ice C3 | Stedmon et al., 2011 |
| C2302 | Protein-like (Tyrosine) | 273/302 | Arctic Seawater C3 | Chen et al., 2018 |
|  |  |  | C5 | Williford et al., 2021 |

**Table S2.** Spectral characteristics of the four components identified by PARAFAC in the Canada Basin and the Chukchi Sea and their comparison to previously identified components.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **GN01** | **Description** | **Excitation max/** | **Similar components** | **References** |
| **Emission max, nm** |
| C1482 | Humic-like, terrigenous | 285,380/482 | Omdrev C3,  Beringia C3 | Kothawala et al., 2014,  Walker et al., 2009 |
|  |  |  | C1 | Williford et al., 2021 |
| C1434 | Humic-like | 260,340/434 | Omdrev C4, | Kothawala et al., 2014, |
| C1402 | Humic-like | 295,395/402 | Arctic Seawater C2,  Beringia C6 | Chen et al., 2018,  Walker et al., 2009 |
| C1348 | Protein-like | 275/348 | ArcticFjords\_PPL C4 | Wünsch et al., 2018 |