Quantitative estimates of labile and semi-labile dissolved organic carbon in the western Arctic Ocean: A molecular approach

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Limnol. Oceanogr., 52(6), 2007, 2434-2444 | DOI: 10.4319/lo.2007.52.6.2434

ABSTRACT: A novel molecular approach based on carbon-normalized yields of combined amino acids was developed to quantify concentrations of labile (L), semi-labile (S), and refractory (R) dissolved organic carbon (DOC) in shelf and basin waters of the Western Arctic Ocean. Concentrations of L-DOC were seasonally and spatially variable (0.1-14.2 μmol L^{-1}). In contrast, concentrations of S-DOC were much less variable (20.2 $\pm$ 0.68 μmol L^{-1} SE). Average concentrations of L-DOC in shelf waters increased from 0.7 μmol L^{-1} to 2.4 μmol L^{-1} between the spring and summer of 2002 and from 1.4 μmol L^{-1} to 3.9 μmol L^{-1} between the spring and summer of 2004. Primary productivity increased 2-3-fold between spring and summer, indicating a strong linkage between plankton and L-DOC production. Patterns of L-DOC abundance in surface waters are suggestive of multiple mechanisms of L-DOC production, including direct release from phytoplankton and release during grazing. Concentrations of L-DOC were not correlated with those of total DOC. Elevated concentrations of L-DOC in halocline waters (40-200-m depth) of the Canada Basin indicated rapid transport of shelf-produced DOC into the basin. Chemical and physical properties of basin waters with elevated L-DOC concentrations indicated a sediment-derived source of basin L-DOC. The approach presented here for quantifying the labile and semilabile fractions of DOC is a potentially powerful tool for understanding processes controlling the distribution, production, and utilization of dissolved organic matter.