Geophysical Research Abstracts
Vol. 14, EGU2012-12248, 2012
EGU General Assembly 2012

Terrestrial organic matter sources and distribution along a land-ocean transect in Siberia derived from lignin phenol composition

M. Winterfeld (1,2), M. Goni (3), G. Mollenhauer (1,2)

(1) Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany (maria.winterfeld@awi.de), (2) University of Bremen, Department of Geosciences, Bremen, Germany, (3) College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, USA

Rapid warming of the Arctic is very likely to result in increased permafrost thaw depth and accelerated coastal erosion both associated with enhanced organic matter (OM) export to the Arctic Ocean. Not only higher fluxes of terrestrial OM from land to ocean can be expected, but also a change in composition as previously freeze-locked OM pools become available for erosion, transport, and microbial degradation. To assess the present state of different terrestrial OM sources (e.g. tundra vs. taiga vegetation) contributing to OM fluxes along a Siberian land-ocean transect we analyzed the lignin phenol composition of different sample types.
Holocene permafrost soil samples at several depths, surface water suspended matter (SPM) and surface sediments in the Lena Delta and adjacent Buor Khaya Bay, NE Siberia were collected during field work in July/August 2009 and 2010. Additionally, samples representing the major vegetation constituents of NE Siberian taiga and tundra were collected in summer 2010 and 2011. The samples were analyzed using alkaline cuprous oxide oxidation (CuO) with a microwave digestion system, and different lignin phenols were identified and quantified with a GC-MS. Using the relative proportions of the main lignin phenol groups, i.e. Cinnamyl/Vanillyl ratio (C/V) vs. Syringyl/Vanillyl ratio (S/V), woody and non-woody tissues as well as between angiosperms and gymnosperms can be distinguished. Further, the acid to aldehyde ratio of Syringyl (Ad/AlS) and Vanillyl (Ad/AlV) serve as indicators for lignin degradation (higher ratios mean more advanced degradation).
Along the sampled transect the Ad/Al ratios for Vanillyl and Syringyl varied from an average of 0.89 and 0.74 (different grain size fractions of permafrost soils, n=48) to 1.33 and 0.91 (SPM, n=15) to 1.24 and 1.09 respectively (Buor Khaya sediments, n=6) indicating that probably the main lignin degradation occurs within the soils and during transport to the marine sediments. The C/V and S/V ratios of surface water particulate OM and surface sediments strongly suggest that the lignin phenol composition is a mixture of two dominant sources, i.e. angiosperm leaves and grasses (arctic tundra) as well as gymnosperm woods (southern taiga forests). It further implies that OM from the southern catchment despite the long fluvial transport reaches the coastal area of the Laptev Sea. This in contrast to findings by Goñi et al. 2000 from the Mackenzie Delta and shallow Beaufort shelf. They concluded that most of the lignin exported by the Mackenzie River is derived from tundra vegetation rather than southern taiga forest. Possible implications of our findings regarding degradation of permafrost in the different Siberian biomes and its potential effect on carbon cycling in the Siberian shelf seas will be discussed.

References:
Goñi et al. (2000). Distribution and sources of organic biomarkers in arctic sediments from the Mackenzie River and Beaufort shelf. Marine Chemistry 71, 23-51.